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Wildlife Institute of India

स्पीड पोस्ट

No. WII/RTI/CPIO/2020-21 (Qtr-I)

दिनांक: 22.10.2020

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महोदय,

कृपया आरटीआई अधिनियम, 2005 के तहत उल्लिखित अपने आवेदन को देखें। इस संदर्भ में, आपको यह सूचना दी जा रही है कि इस कार्यालय में हाथी गलियारों के बारे में जानकारी नहीं है जिन्हें उत्तराखंड सरकार द्वारा अनुमोदित किया गया है। फिर भी, उत्तराखंड राज्य में हाथी गलियारों के बारे में एक सामान्य समझ हासिल करने के लिए, हम आपको निम्नलिखित रिपोर्टों और प्रकाशनों का अवलोकन करने की सलाह देते हैं:

1. Johnsingh, A.J.T. , Qureshi, Q. , Mohan, D. & Williams, C.A. (2006) Conservation of the Asian elephont in North-West India. *Gajah* .
2. Johnsingh, A.J.T., Ramesh, K., Qureshi, Q., David, A., Goyal, S.P., Rawat, G.S., et al.(2004) Conservation Status of Tiger and Associated Species in the Terai Arc Landscape , India Conservation Status of Tiger and Associated Species in the Terai Arc Landscape , India.
3. Menon, V., Tiwari, S.K., Ramkumar, K., Kyarong, S., Ganguly, U.& Sukumar, R.(eds) (2017) Right of passage: Elephant corridors of India. Wildlife Trust of India, New Delhi.

चूकी उपरोक्त डाक्यूमेंट्स रिपोर्ट 557 पन्नो में है जिसे हम कॉम्पैक्ट डिस्क (Compact Disk) में कॉपी कर आपको उपलब्ध करा रहे है जो कि इस पत्र के साथ संग्लंगन है |

आपको यह भी अवगत करना है कि भारत सरकार के निर्देश के अनुसार, COVID-19 (कोरोना की बीमारी) के कारण संस्थान में बहुत सीमित स्टाफ के साथ कार्य कर रहा है, अतः आरटीआई की सूचना देने में विलम्ब हुआ है |

अगर आप उक्त जानकारी से संतुष्ट नहीं हैं तो **सूचना का अधिकार अधिनियम 2005,** के तहत अधोलिखित अपीलीय प्राधिकारी को एक माह के भीतर – **निदेशक एवं अपीलीय प्राधिकारी, भारतीय वन्यजीव संस्थान, पोस्ट बॉक्स 18, चन्द्रबनी, देहरादून – 248001, दूरभाष न० 0135-2640910, 2646102** को अपील कर सकते हैं |

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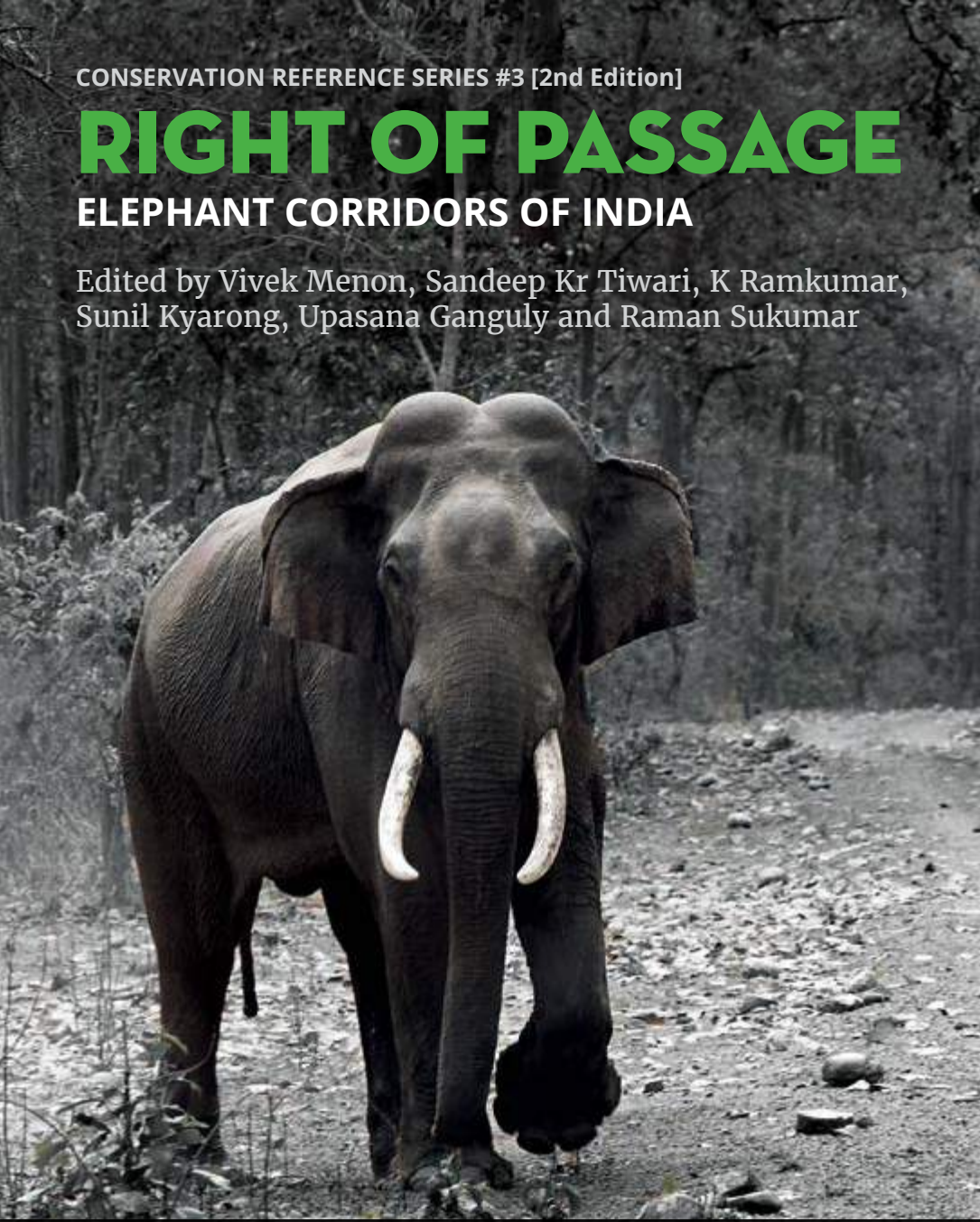
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CONSERVATION REFERENCE SERIES #3 [2nd Edition]

RIGHT OF PASSAGE

ELEPHANT CORRIDORS OF INDIA

Edited by Vivek Menon, Sandeep Kr Tiwari, K Ramkumar, Sunil Kyarong, Upasana Ganguly and Raman Sukumar



हाथी परियोजना
भारत सरकार
PROJECT ELEPHANT
GOVT. OF INDIA

ELEPHANT FAMILY
Protecting Asian elephants and their habitat

Wildlife Trust of India

In loving memory of

Ashok Kumar

Founder and Chairman Emeritus, Wildlife Trust of India

The legendary conservationist whose legacy lives on

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Protecting Asian elephants and their habitat

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RIGHT OF PASSAGE

ELEPHANT CORRIDORS OF INDIA



Edited by

Vivek Menon, Sandeep Kr Tiwari, K Ramkumar, Sunil Kyarong, Upasana Ganguly and Raman Sukumar

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Wildlife Trust of India (WTI) is a non-profit conservation organisation committed to initate and catalyse actions that prevent the destruction of India's wildlife and its habitat. In the long run, it aims to achieve, through proactive reforms in policy and management, an atmosphere conductive to conservation. WTI works through building partnerships and alliances and its strengths lie in its willingness to work with innovative conservation techniques like acquiring land for wildlife and rescue and rehabilitation.

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FOREWORD

THE CONSERVATION OF GLOBAL BIODIVERSITY IS TODAY THREATENED mainly due to loss, destruction and fragmentation of natural ecosystem to cater to the need of growing economy and increasing human population. Larger mammals like elephants that require extensive habitats for survival are one of the most affected ones due to the land use change. The spread of human settlements, commercial plantations, industry, farming, mining, linear infrastructures etc are restricting movements of these long ranging animals. This has been enhancing human-elephant conflict in many parts of the country. Thus, the harmonious relationship between elephants and people is gradually getting strained resulting in causalities on both the ends in extreme conditions.

Maintenance of wildlife corridors is an essential element of managing landscape and an important tool to overcome the adverse effects of habitat fragmentation and loss for ensuring larger habitat availability, genetic exchange within and between the populations and minimising human-elephant conflict. The Wildlife Trust of India and Asian Nature Conservation Foundation in collaboration with State Forest Departments, Project Elephant and researchers had identified 88 elephant corridors and published a report, 'Right of Passage: Elephant Corridors of India' in 2005.

Over the years, the Ministry of Environment, Forest and Climate Change (Government of India) State Forest Departments and conservation organisations have been working for securing these corridors. In the meantime, a survey was initiated by Wildlife Trust India in collaboration with Project Elephant to review the status of the existing corridors and new ones that may have emerged in the last one decade and prepare conservation plan for securing those.

The second edition of the publication is an outcome of concerted efforts by the Wildlife Trust of India and a number of elephant experts and conservationists who have come forward to resolve the critical issues of habitat fragmentation and loss. The corridors have been discussed in State Consultative meetings involving officials from State Forest Departments, elephant experts, conservation organisations and researchers before finalising.

The authors have put forward a conservation plan for each corridor and have also prioritised the corridors based on ecological importance and conservation feasibility. This will definitely be of immense help to wildlife managers.

The publication is truly a commendable effort towards providing a roadmap for securing of elephant corridors in India. It could be used by various agencies, including the Ministry of Environment, Forest and Climate Change (Government of India) and State Forest Departments, conservation organisations, researchers, developmental agencies, donors as well as policy makers to help protect and secure the corridors for the long-term conservation of our National Heritage Animal.

New Delhi
August 10, 2017

(Siddhanta Das)

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CLIMATE CHANGE

MESSAGE

INDIAN ELEPHANTS REPRESENT THE INDIAN ETHOS and are closely associated with the people of India in their religious, cultural, literary and traditional heritage. However, throughout its range of distribution in country, the conservation of the endangered Asian elephant (*Elephas maximus*) is threatened, due to the loss and fragmentation of habitats – owing to rising elephant populations, pressures from fast-increasing human populations, their changing lifestyles and consequential agricultural and developmental activities – and poaching for ivory. India hosts about 27,312 elephants (*Elephant Census, 2017*), a majority of them spread across 29 Elephant Reserves, covering 11 Elephant Landscapes in 14 states. However, the fragmentation and shrinkage of elephant habitat has increased human-elephant conflict in many parts of the country. To prevent this situation from escalating, it is important that the corridors that elephants have traditionally used are saved, before it is too late.

Wildlife Trust of India and Asian Nature Conservation Foundation, in collaboration with state forest departments, Project Elephant Division of the Ministry, had identified 88 elephant corridors and published a report titled 'Right of Passage: Elephant Corridors of India' in 2005. This was a significant contribution to elephant conservation and habitat protection in India. The Elephant Task Force formed by Project Elephant, Ministry of Environment, Forest and Climate Change in 2010 also recognised these corridors. Over the years, the Ministry, state forest departments and conservation organisations have been working in tandem to secure and protect elephant corridors.

I am sure the 2nd Edition of this publication will provide a good reference to wildlife managers for protecting and securing the corridors. This publication will also be of great assistance to developmental agencies in proper planning and creation of linear infrastructures in order to avoid or minimise the negative impacts on elephant habitat and natural areas, as well as to the policy makers in framing an ecologically sound policy for the conservation of our National Heritage Animal.

New Delhi
August 5, 2017

(R K Srivastava)

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PREFACE

TWELVE YEARS IS MORE THAN HALF A HUMAN OR AN ELEPHANT GENERATION, and in a country such as India there are inevitable changes that happen on the ground in this time span. New roads come up, new and faster trains are scheduled on old rail tracks requiring realignment of these routes, and human incursions into nature continue at a daily rate. The first edition of *Right of Passage*, detailing 88 corridors for elephants in India, has gone out of date. I am therefore exceedingly happy that the second edition of this publication has now come out.

In this edition you will notice that the number of corridors has gone up to 101, which is not good news at all. More corridors are formed only when more fragmentation of habitat has occurred. Given that a few corridors that were listed earlier have now been put in the 'impaired' category (since elephant movement through them has ceased altogether because of anthropogenic issues), this increase assumes greater significance.

As in the first edition, there are maps detailing the boundaries and topography of the corridors, also showing human constructions in corridor areas. What is more important, though, is the small section titled 'Conservation Plan' at the end of each narration.

Nature and infrastructure need not always be at loggerheads. There are enough technological solutions that can be put in place to ensure safe passage to our National Heritage Animal while not compromising development goals. Such goals should however be in consonance with overall sustainable development goals, which include nature conservation as an important construct of social and environmental preservation. I am sure managers of elephant habitats and infrastructure projects will both benefit from this publication and that policy dialogue as well as direct action will ensure that elephants get the right of way in our crowded nation. This is also the long-term solution to conflict, although in shorter time scales this may not be visible.

I congratulate the team that undertook this gargantuan (or should I say elephantine) task within the Wildlife Trust of India, as well as the many individual elephant experts who are listed as authors and contributors, and the state and union government officials who have helped to make this publication so much more error free. Side by side of such publications, which are status documents, conservation action continues apace to secure on ground these pathways for the elephant, a cultural and heritage icon for India and the world.



New Delhi
August 5, 2017

(Vivek Menon)
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EXECUTIVE SUMMARY

THE FRAGMENTATION AND LOSS OF NATURAL HABITATS are major drivers of ecosystem degradation and biodiversity loss globally. Mega-herbivores such as elephants, with large home range and food requirements, have been among the species most affected by habitat alteration and loss of habitat connectivity. The fragmented nature of the Indian landscape, with people all around, has increased human-elephant conflict in most parts of the country. On an average about 400-450 people lose their lives annually due to such conflict in India, and around 100 elephants are killed in retaliation for the damage they cause to human life and property.

Various strategies are being discussed and debated to manage and overcome the adverse effects of habitat fragmentation and loss. Wildlife corridors are an important means of ensuring larger habitat availability to species, genetic exchange within and between populations, and the minimising of human-elephant conflict in altered habitats. These corridors have to be restored and secured on a priority basis.

Wildlife Trust of India (WTI) and the Asian Nature Conservation Foundation (ANCF), in collaboration with state forest departments, Project Elephant and several researchers, had identified 88 elephant corridors and published a report titled *Right of Passage: Elephant Corridors of India* in 2005. This publication systematically assessed the status of the 88 identified corridors, and prioritised them for conservation interventions and securing. The report was endorsed by Project Elephant, Ministry of Environment and Forests*, and all state forest departments. In the last decade, the Ministry of Environment, Forest & Climate Change (MoEF&CC), state forest departments and conservation organisations have been working at the policy and ground level to protect and secure these corridors. The elephant task force formed in 2010 also recognised these corridors and strongly recommended that they be legally protected and secured through various approaches.

* as the Ministry of Environment, Forest and Climate Change (MoEF&CC) was known at the time.

Over the years, the MoEF&CC, state forest departments, WTI, ANCF and other conservation organisations have been working to secure these corridors through land securement, voluntary relocation of people and conservation easement by working with local communities. However, due to a lack of legal protection to corridors and Elephant Reserves, and land use changes that have occurred in the last decade, elephant habitats and corridors have been further negatively impacted. A field survey was consequently initiated by Wildlife Trust of India in collaboration with Project Elephant from July 2013 to December 2015, to update the status of existing corridors and identify new ones that may have emerged in the intervening decade, and prepare conservation plans for securing them. The information collected from corridors in all states was compiled into a draft report that was reviewed through state-level consultative meetings with officials of state forest departments, conservation organisations working on elephants, elephant experts and others. The final list of corridors and the conservation plan for each corridor incorporated the suggestions and comments of those present at the consultative meetings. Whenever a new corridor was suggested, the team surveyed the area and if convinced, formally incorporated it into the final list as an elephant corridor.

STATUS OF CORRIDORS

A minimum of 101 elephant corridors were identified as currently in use in India, and seven corridors that were previously identified were found to have been impaired in the last decade. Of the corridors currently in use, 28 are in Southern India, 25 in Central India, 23 in North-eastern India, 14 in Northern West Bengal and 11 in North-western India. An estimated 69.3% of these corridors are being regularly used by elephants, either around the year or in a particular season, and 24.7% are being used occasionally. Some 57.5% of the corridors are of high priority ecologically, and 41.5% are of medium priority, indicating that most of the corridors are important for elephant movement and to maintain a healthy population.

Only 22.8% of the corridors are one kilometre or less in length compared to 28.5% in 2005, and 17.8% of corridors are between one and three kilometres compared to 19.3% in 2005, suggesting the further fragmentation of habitats. However, on a regional basis, about 39.1% of the corridors in North-eastern India and 32.14% of the corridors in Southern India are of one kilometre or less, pointing to what the overall findings indicate: that the fragmentation of elephant habitats is less severe in these regions (and most severe in Northern West Bengal followed by North-western and Central India).

Human settlements and the resulting biotic pressure, linear infrastructure elements (roads, railway lines, canals), and encroachments onto corridor areas are major issues impacting connectivities. Only 21.8% of corridors are free of human settlements compared to 22.8% in 2005, and 45.5% have one to three settlements compared to 42% in 2005. A large extent of corridor area and habitat is also being lost due to encroachment, with 28.7% of corridors now encroached upon. Some 66.3% of corridors also have highways (national and/or state) passing through them. Twenty corridors already have railway lines passing through them and in four, a railway line has been proposed or construction work is in progress. An estimated 36.4% of corridors in Uttarakhand, 32% in Central India, 35.7% in Northern West Bengal and 13% in North-eastern India have railway lines passing through them. (Between 1987 and June 2017, approximately 265 elephants have been killed by train accidents in different part of the country.) About 40% of the corridors in Central India and 27% in North-western India are affected by irrigation canals. Overall, 11% of the corridors are affected by canals. Further, 11.9% of corridors are affected by mining and/or boulder extraction. Corridors also pass through agriculture lands and/or are encroached upon for cultivation: about 2/3rd of them are affected by agriculture activities. All these developmental activities and biotic pressures have severely impacted elephant movement.

In terms of land use, only 12.9% of the corridors are totally under forest cover compared to 24% in 2005; 44.5% are jointly under forest, agriculture and settlements compared to 40% in 2005; and 15.85% are under forest, tea gardens and settlements as compared to 16% in 2005. In Central India, almost 88% of corridors are jointly under forest, agriculture and settlements and only 4% are totally under forest cover, compared to about 35.7% of

corridors in Southern India that are totally under forest cover. Almost 47.5% of the corridors have a Protected Area at one or both ends, or lie within a Protected Area.

To ensure that corridors are protected and secured, it is important that they are legally protected to prevent further fragmentation of habitat and increased human-elephant conflict. To achieve this, state governments should first demarcate and notify these corridors as State Elephant Corridors, which could then be legally protected under appropriate sections of the Wild Life (Protection) Act, 1972, the Environment Protection Act, and other laws. Wildlife Trust of India also recommends that wherever possible, the state forest department, Project Elephant and conservation organisations should make efforts to protect and secure corridor lands through purchase and voluntary relocation of inhabitants. Corridors could also be secured by working with the local communities and governments (Autonomous District Councils) to reduce local dependency on corridor land, and getting the corridors notified as Village Reserve Forests by the Council or Community Reserves by the state forest department.

Development policies in elephant habitats should be thoroughly discussed, involving various stakeholders to prevent further fragmentation and degradation and a consequent rise in human-elephant conflict. While planning infrastructure development in such regions, appropriate mitigation measures should be finalised during the planning stages to minimise impact. The overall policy in these areas should aim towards the long-term conservation of wildlife by ensuring the protection of larger forest areas.

Seven corridors have been impaired in the past decade and many more are on the verge of being impaired. This has been due to the lack of any agency keeping a close eye on these corridors so that land use changes could be detected in time and mitigation measures initiated. Hence, it is important to engage local community-based organisations in corridor areas as 'Green Corridor Champions' (GCCs), who will work as the eyes, ears and voice of corridors. GCCs will be charged with sensitising, motivating and mobilising local communities, and creating a sense of pride and ownership among them towards elephant corridors. They will work to secure and monitor the status of corridors by coordinating the actions of local self-governments, state and central governments, and other stakeholders.

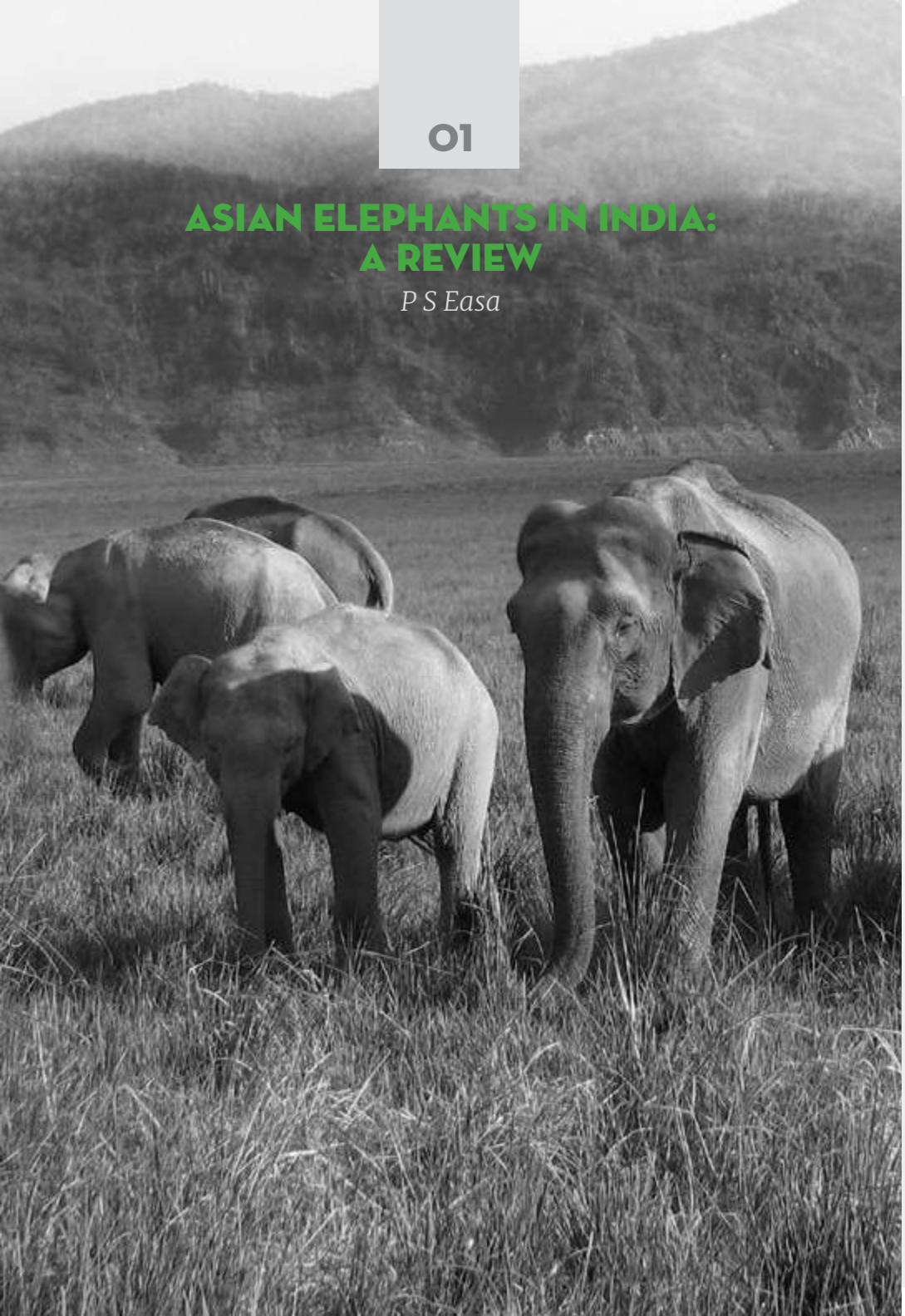


Fig. 1.01: A herd of wild elephants in Dalma Wildlife Sanctuary, Jharkhand

01

ASIAN ELEPHANTS IN INDIA: A REVIEW

P S Easa



THE ELEPHANT HAS ALWAYS BEEN CONSIDERED as an embodiment of strength, size and intelligence. It has been looked upon with mixed feelings of love, worship and fear. The human culture in elephant range countries is so closely associated with the elephant that it was the subject of a number of classical works of literature. Elephants were also a part of human society and were maintained in captivity for use in war, festivals, timber logging and religious processions.

Asian elephants (*Elephas maximus*) once ranged over a vast area from the Tigris and Euphrates in West Asia to South East Asia (*Olivier, 1978*). However, their present distribution is confined to Bangladesh, Bhutan, Myanmar, China, India, Indonesia, Cambodia, Laos, Malaysia, Nepal, Sri Lanka, Thailand and Vietnam (*Santiapillai, 1987*; *Sukumar 2011*). Though the number of Asian elephants in the wild is estimated to be 45,826-53,306 (*IUCN AsESG 2016, unpublished*), they are threatened because of the loss, shrinkage and degradation of their habitat. Fragmentation of available habitats has confined most of the populations to small islands. In addition, the threat from poaching for ivory has considerably depleted the number of tuskers, most often leading to a highly skewed sex ratio. Developmental programmes and encroachment within and around elephant habitats has also led to the loss of the elephants' traditional movement paths. All these factors have contributed to increased human–elephant conflict, which has often led to the loss of both human and elephant lives. On an average about 400 to 450 humans lose their lives due to human-elephant conflict in India and around 100 elephants are killed in retaliation for the damage they cause to human life and property.

The historical range of the elephant in India has shrunk, confining elephants into distinct geographical zones (*Jerdon, 1874; Ali, 1927; Daniel, 1980*). Elephants in the Andaman and Nicobar islands are considered to be feral and are the descendants of a captive stock. The Indian subcontinent has an estimated population of about 27,312 elephants (*MoEFCC, 2017*), which is

<< Elephant herd, Corbett Tiger Reserve, Uttarakhand

about 55% of the world population. These range in 29 Elephant Reserves spread over 10 elephant landscapes in 14 states, covering about 65,814 sq km of forests in northeast, central, north-west and south India.

THE NORTH-EASTERN POPULATION

Elephants in north-eastern India range in the states of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura (between 21° 58′–29° 27′ N and 89° 42′–97° 24′ E). The elephant population in the north-east was contiguous with that of Bhutan, Bangladesh, Nepal and Myanmar. The 9650-odd elephants (*MoEFCC, 2017*) in the region are now discontinuously distributed and exist as 15 populations in an area of about 8900 sq km (*Choudhury, 1999*). The range extends from near northern West Bengal (near the Indo-Nepal international border), along the Himalayan foothills up to the Mishmi Hills and the eastern Brahmaputra plains of Assam and Arunachal Pradesh (*Choudhury and Menon, unpublished draft Action Plan*). Then it takes a 'U' turn and covers eastern Arunachal Pradesh, the plains of upper Assam and the foothills of the Naga Hills, the Garo Hills of Meghalaya through the Khasi Hills, parts of the Brahmaputra plains and the Karbi plateau. Elsewhere in the south, scattered populations survive. Choudhury (1991, 1992, 1995, 1999 and 2001), Williams and Johnsingh (1996 a and b), Gurung and Lahiri Choudhury (2000), Marak (2002) and Tiwari *et al.* (2008) give details of elephant conservation issues in the area.

The elephant population on the north bank of Brahmaputra extends from northern West Bengal through the Himalayan foothills and the bhabar-terai tract (called the Duars in this part of the country) touching southern Bhutan, northern Assam and Arunachal Pradesh. In eastern Assam, the range also covers part of the floodplains of the Brahmaputra and Lohit Rivers. An area of about 7900 sq km is available to an estimated population of 2700–3000.

Elephants on the south bank of the Brahmaputra are divided into eastern, central and western populations. The eastern population is spread over lower Dibang Valley, Lohit, Changlang and Tirap in Arunachal Pradesh, Tinsukia, Dibrugarh, Sibsagar, Jorhat and Golaghat in Assam, and Mon, Tuensang, Mokokchung and Wokha in Nagaland. The population lost its contiguity with the north bank in the 1970s and the central area of South Bank in the 1980s (*Choudhury, 1995 and 1999*). An estimated 1200 elephants occupy about 4500 sq km of forests in the area, though they also use tea plantations and agricultural lands as they move.

The population in the central area extends from Kaziranga National Park across the Karbi Plateau, parts of the central Brahmaputra plains and the basin of the Diyung river, to the foot of Meghalaya plateau in Assam and Meghalaya. These elephants are separated from the south bank and western population due to the expansion of Guwahati city, clearing of forests for *jhumming* and human habitation along National Highway 40 which connects Guwahati to Shillong. The extent of elephant habitat is about 5050 sq km with an estimated population of 2900-3000.

Asian elephants are threatened because of poaching as well as the loss, shrinkage and degradation of their habitats. Fragmentation of available habitats has also confined most elephant populations to small islands.

The elephant population in the western areas is seen in parts of Assam and Meghalaya along the foot of the Meghalaya plateau covering the Garo and Khasi Hills. It also covers the Kamrup and Goalpara districts in Assam, and Ri-Bhoi, the West Khasi Hills, East Garo Hills, West Garo Hills and South Garo Hills in Meghalaya. The seasonal range of this population also extends to areas of Bangladesh, though that has been now hindered due to fencing along the international boundary. The habitat available to an estimated 2500 elephants is about 6850 sq km.

There are also a few isolated populations in Dhansiri-Intanki covering part of the Karbi Anglong district of Assam and the Kohima district of Nagaland. This

includes the Dhansiri and Daldali Reserve Forests in Karbi Anglong and Intanki Sanctuary in Kohima. About 300–350 elephants are estimated in about 1050 sq km of territory. Elephants regularly move between Dhansiri and Intanki across the inter-state boundary. Inside Assam, they move between Dhansiri and Daldali and adjacent forests affected by human pressure. A population of elephants numbering about 35-40 is distributed in the Barail-Jaintia Hills along the southern face of the Barail Range of Assam and the Jaintia Hills of Meghalaya. The population is small, scattered and considered non-viable.

A small population of elephants also occurs in the forests of Tripura, especially in the southern areas of Dholai district. A few elephants exist in an area of about 2100 sq km in Dampa Tiger Reserve of Mizoram and Gumti Wildlife Sanctuary in Tripura. This tiny population is in contiguity with the population of the Chittagong Hill Tracts in Bangladesh. Two herds of about eight elephants were also reported from Ngengpui sanctuary and two or three are reported in Palak Dil area of Saiha district. A small herd is distributed in an area of about 140 sq km in the Tilbhum, Longai and Patharia Hill forests of southern Assam. The Laokhowa and Burhachapori Wildlife Sanctuaries have a population of about five to 10 elephants. The four to five elephants in Orang National Park, 40-45 in Amcheng Hills Reserve Forests and 30-35 in Gibbon Wildlife Sanctuary are the other small populations in Assam.

THE NORTHERN WEST BENGAL POPULATION

The elephants in northern West Bengal form the western-most extension of the north-east Indian elephant population. There are about 488 elephants in this region (*MoEFCC, 2017*) spread over the Darjeeling and Jalpaiguri districts, covering nine forest divisions. Although the elephant population in this region is only about 1% of the total elephant population of India, the human-elephant conflict is among the highest in the country. Northern West Bengal has a forest area of 3051 sq km covering about 25.7% of the total geographical area of the region (*Das, undated*). However, the elephant holding area is mostly confined to an elevation of 900 m and the elephant habitat is about 2000 sq km, which lies in the terai, western Duars and eastern Duars. The terai and the western Duars region of North Bengal has patchy forest with human habitation and tea gardens through which regular movement of elephants occurs.

THE NORTH-WESTERN POPULATION

The north-western elephant population in India was once distributed over parts of Uttar Pradesh from Katerniaghat Wildlife Sanctuary to the Yamuna River (*Singh, 1978*). Currently elephants range across about 9000 sq km of forests in the outer Himalaya and the Shivalik Hills and parts of the terai and bhabar tracts. About 2040 elephants (*MoEFCC, 2017*) are distributed in six isolated populations: from west to east, these populations include those between the Yamuna and the Ganga River, the Ganga and Khoh river, the Khoh and Haldwani, the Haldwani and Sharda river, in and around Dudhwa Tiger Reserve, and those of the Katerniaghat Wildlife Sanctuary. The major breaks in this elephant range are along the Ganga River, along the Gola River, along the Sharda canal, and between Dudhwa National Park and Katerniaghat Wildlife Sanctuary thus severely hindering elephant movement. In several other places, the habitat connectivity is under severe threat of breaking up.

The growing human population in Uttar Pradesh has encroached on elephant habitats; people living on forest fringes depend on the forest for fuel, fodder and small timber.

The elephant habitat in the north-west includes seven Protected Areas, viz. Corbett National Park, Rajaji National Park, Sonanadi Wildlife Sanctuary, Nandhaur Wildlife Sanctuary, Dudhwa National Park, Kishanpur Wildlife Sanctuary and Katerniaghat Wildlife Division. The altitude varies from 200–1000 m. The vegetation in this tract comprises mostly moist and dry sal forests interspersed with northern tropical dry deciduous forests, northern tropical moist deciduous forests, and bamboo thickets. Himalayan sub-

tropical forests, cane brakes, seasonal swamp forests, and plantations of teak, eucalyptus, poplar and Ailanthus are also present.

The elephants in the range form six populations, with the 250-300 elephants west of the Ganga River occupying about 1500 sq km; about 1200 elephants between the Ganga and Gola Rivers occupying 4000 sq km; and just 100 elephants occupying the 1800 sq km stretch between the Gola and Sharda Rivers. About 50-75 elephants are distributed over 2500 sq km between Khatima Range and Katerniaghat.

A rise in the human population and consequent increase in developmental activities has led to the fragmentation and degradation of the remaining elephant habitat. A number of breaks have been identified in this elephant range and about 11 crucial corridors have also been identified. Humans have encroached on elephant habitat as they depend on the forest for fuel, fodder and timber. The dependence on forest land to graze livestock, the and conversion of natural forests into monoculture plantations of tea, eucalyptus etc, have degraded the habitat and exotics like Lantana and Parthenium have taken root. The impact of Gujjar settlements on the habitat is multifarious: lopping of trees, overgrazing and the use of waterholes by buffaloes are a few of the problems to be addressed (*Dabadghao and Shankarnarayan, 1973; Johnsingh et al., 1990; Johnsingh and Joshua, 1994*). The railway tracks passing through Rajaji National Park and Dudhwa Tiger Reserve also cause a major direct impact on elephants. Twenty-three elephants were killed by train-hits in Rajaji National Park between 1987 and May 2017. Though the collective efforts of WTI, the Northern Railways and the Uttarakhand Forest Department have succeeded in averting accidents since 2003 in all but two cases (*Menon et al., 2003; Singh et al., 2011, WII 2016*), the problem is perennial and needs to be addressed for a permanent solution.

Sunderraj *et al*. (1995), Javed (1996), Williams (2002), Johnsingh *et al.* (2004) , Joshi, *et al.* (2010), and Menon *et al.* (2003) have dealt with the conservation problems of the area. Conservation measures requiring immediate attention



Fig. 1.02: An elephant in Corbett Tiger Reserve, Uttarakhand

are the maintenance of identified elephant corridors, especially the Gola corridor, to ensure elephant movement, and the rehabilitation of *Gujjars* and other human settlements outside the national park. A large number of workers are engaged in sand and boulder mining in the river beds within the Gola Reserve Forest, adding more pressure on the surrounding habitat. Encroachment upon corridor forest and habitat, and biotic pressures caused by an increasing human population, are other threats to the landscape. Habitat improvement programmes have to be carried out to make this a better elephant habitat.

THE CENTRAL POPULATION

The elephant habitats in central India extend over 21,000 sq km in the states of Odisha, Jharkhand, Chhattisgarh and southern West Bengal, at times extending to Madhya Pradesh and Bihar, and hold a population of about 3128 elephants (*MoEFCC, 2017*). Biogeographically, this region falls in the Chhota Nagpur plateau in the north of the Eastern Ghats (*Rodgers and Panwar, 1988*). A major portion of the forests of Jharkhand, southern West Bengal and north-western portions of Odisha is deciduous. The elephant habitats in Chhota Nagpur are in the Palamau, Singhbhum and Dalbhum forests. To the north of the Mahanadi River, elephants are distributed in Baripada, Karanjia, Keonjhar, Bamra, Rairakhol, Angul, Dhenkenal, Athamalik and Athgarh Forest Divisions in Odisha. The Eastern Ghats extending from the south of the Mahanadi River upto Mahendragiri, Boudh, Nayagarh, Phulbani, Baliguda, Kalahandi, Raygada, Parilakhmundi and Ghumsur North Forest Divisions in Odisha form the elephant habitat in the area. Singh (1989), Datye (1995), Tiwari (2000), Nigam (2002), Swain and Patnaik (2002), Sar and Lahiri Choudhury (2002), Singh *et al.* (2002), Sar *et al.* (2004), Biswal *et al.* (2010), Pradhan *et al.* (2013), Palei *et al.* (2013) Palei (2014), Mishra and Bisht (2016) etc have dealt with elephants of the area.

Odisha has about 57% of the elephant habitat in central India with 1900 elephants spread over about 11,000 sq km (*Swain and Patnaik, 2002*). The state has elephants in 44 out of 50 Forest Divisions.

About 50% of the elephant population is found in 11 (viz. Similipal National Park, Similipal Wildlife Sanctuary, Hadgarh, Kuldiha, Satkosia Gorge, Baisipali, Chandaka-Dampara, Kotgarh, Lakhari, Khalasuni and Badarma) of the 19 sanctuaries in the state. The remaining 50% of the population is found outside the Protected Area network, making it the primary concern for human-elephant conflict in the state. Three Elephant Reserves, viz. Mayurbhanj, Mahanadi and Sambalpur have also been declared. Chowdhury (*unpublished draft Action Plan*) identifies four zones of larger elephant habitats in Odisha and two in Jharkhand. The first, including Similipal Tiger Reserve and the Kuldiha and Hadgarh Wildlife Sanctuaries, has an area of 3200 sq km with an estimated population of about 500 elephants. This zone along with the adjacent forests of Noto and Garsahi could be an ideal habitat for the long-term conservation of elephants. The Satkosia-Baisipalli zone, situated in central Odisha, has the Satkosia Gorge and Baisipalli Wildlife Sanctuaries. This, with the adjacent 800 sq km of reserve forests, could form a larger landscape of about 1760 sq km (*Chowdhury, unpublished draft Action Plan*).

The central Indian elephant habitat is one of the most fragmented and degraded because of encroachment, shifting cultivation and mining activities.

The south Keonjhar plateau, with about 2600 sq km of elephant habitat is spread over the Deogan, Ghatgan and Telkoi Ranges of Keonjhar Forest Division, and the Kamkhya and West Ranges of Dhenkanal Division. The area is believed to have about 200–250 elephants. Madanpur-Rampur-Kotgarh-Chandrapur zone in the Eastern Ghats has about 800 sq km of habitat, of which about 80% is fragmented due to shifting cultivation. About 300–400 elephants are estimated to be present in this area.

Jharkhand has two distinct elephant populations, viz. Palamau and Singhbhum, and about 678 elephants (*MoEFCC, 2017*). The Palamau population occupies about 1200 sq km of Betla National Park, Palamau Tiger Reserve and adjoining

areas. In recent years, elephants have started moving into new areas of Hazaribagh, Ranchi, Ramgarh, Bokaro, Dhanbad, Giridih, Deogarh, Dumka, Pakur, Godda and Sahibganj, passing through fragmented forest patches, agricultural land and human settlements. Elephants have also started moving to Bihar and West Bengal from these areas. This has increased human-elephant conflict, especially crop depredation, and has become a major challenge for the division managers to with respect to minimising conflict. This zone harbours approximately 100-125 elephants. The second zone of Dingbhum-Dalbhum-Bonai comprises 2900 sq km of forests and includes the Saranda, Kolhan and Porahat Forest Divisions. This is contiguous with the Joda and Koira Ranges of the Bonai Division of Odisha and Dalma Wildlife Sanctuary of Jharkhand. Only 350–450 elephants are found in this zone.

Chhattisgarh was known to have elephants several centuries ago, with Surguja and Korba having a history of elephant capture for the Mughal army. The area did not have elephants for a long period subsequently. The forests in northern Chhattisgarh, comprising Surguja, Korba, Raigarh, Jashpur, Surajpur, Mungeli and Korea districts, presently harbour some 247 elephants (*MoEFCC, 2017*). About 14 elephants have died due to electrocution from 2005 to 2014. Between 2009 and 2015, 164 human lives have been lost due to human-elephant conflict.

In addition, there are five isolated populations in Odisha and three in Jharkhand. The Bamra Hills has two Protected Areas, viz. Khalasuni and Badarma. This constitutes an Elephant Reserve with a population of 257 elephants in an area of 427 sq km. The Kapilas and Chandaka-Dampara Wildlife Sanctuaries also hold about 40-50 and 20-30 elephants respectively. The Lakhari Valley Wildlife Sanctuary has about 50–60 elephants in an area of 185 sq km. About 10–15 elephants are spread over an area of 130 sq km in Mahendragiri. The three isolated populations in Jharkhand are:

a) Hazaribagh, Chatra and Gaya
b) Ranchi and Gumla
c) Rom-Musabani forests.

The elephant habitat in Midnapore, Bankura and Purulia districts in the southern part of West Bengal are considered as range extensions of the adjoining Dalma Wildlife Sanctuary of Jharkhand. The area comprises tropical moist deciduous forests interspersed with dry deciduous forests. About 100-125 elephants move annually to West Bengal during the paddy season from September to February. There is also a resident population of about 50-60 elephants in the region. The area is mostly under agricultural cultivation with no Protected Areas. The Mayurjharna Elephant Reserve with an area of 414 sq km has been declared to conserve about 100-plus elephants.

There have been recent reports of elephants straying into Madhya Pradesh's eastern districts of Singrauli and Anuppur from bordering northern Chhattisgarh, causing concern among the locals and forest officials. Elephants in recent years have also been reported in Bhagalpur, Banka and Jamui Districts (from Jharkhand) and Supaul, Araria, Kishanganj and west Champaran (from Nepal).

The central Indian elephant habitats are one of the most fragmented and degraded because of encroachment, shifting cultivation and mining activities. The northern part of Odisha has the highest number of iron ore, manganese and chromate mines. The southern part has about 9% of the total forest area under shifting cultivation. There have been 398 human deaths in Odisha, 354 deaths in Jharkhand and 164 deaths in Chhattisgarh from 2009 to 2015. According to a report (*Palei et al., 2014)*, 119 elephants died in Odisha due to intentional or accidental electrocution between 2001 and 2012.

THE SOUTHERN POPULATION

The south Indian population is distributed over the Western Ghats and parts of the Eastern Ghats in Kerala, Tamil Nadu, Karnataka and Andhra Pradesh (*Sukumar, 1989*). About 11,935 elephants (*MoEFCC, 2017*) are reported from the region. Most of the elephant ranges in this region are hilly with tropical wet evergreen, semi-evergreen, moist deciduous, dry deciduous and dry

thorn forests in addition to high altitude shola grasslands and plantations. Elephants in the south could be considered to consist of eight populations based on habitat contiguity (*Sukumar and Easa, unpublished draft Action Plan*). Easa (1989, 1994), Sivaganesan (1991), Sukumar (1989), Syam Prasad and Reddy (2002), Baskaran (2013) and Madhusudan *et al.* (2015) describe various aspects of elephant conservation in the region.

About seven elephants appeared in Andhra Pradesh in 1984 and established themselves in the dry deciduous forests of Koundinya Wildlife Sanctuary. A second herd of 22 joined the first in 1986 (*Syam Prasad and Reddy, 2002*). The population is reported to be on the increase and occupies an area of about 356 sq km.

In 2002, a herd moved to the Sindhudurg district of Maharashtra from Karnataka and established itself. Elephants also entered the Kolhapur district in 2004. The elephants have been using certain routes regularly in Sindhudurg and Sawantwadi. In the initial one or two years they mainly resided in the Tilari catchment area and around the villages of Shirange and Konal, which are downstream of the Tilari Dam. In Kolhapur district the elephants were distributed mainly in the Chandgad and Gadhinglaj talukas, moving from Chandgad to Gadhinglaj via Kamewadi, Nesri, Batkanangle, Teginhal, Masewadi, Naukud, Channekuppi to the Hukkeri district of the Karnataka boundary. Though very small in number, this population has created a lots of problems by way of crop raiding and human deaths.

Northern Karnataka is considered the northern-most limit of elephant distribution in south India and elephants are distributed in the Uttara Kannada and Belgaum districts. About 60-70 elephants occur in the moist and dry deciduous forests mainly of the Dandeli Wildlife Sanctuary.

The crestline of the Karnataka portion of the Western Ghats has an elephant population that occurs in small scattered groups in the forests of South Kanara, Mangalore, Shimoga and Chikmagalur. The total number of elephants is believed to be about 60.

The Bhadra-Malnad area also holds a small population. The Malnad plateau on the east of the Western Ghats is separated from the rest of the tract by coffee plantations and other cultivations. The elephant habitat of about 827 sq km is mostly in the Bhadra Wildlife Sanctuary and is considered to have tenuous links with the Pushpagiri and Brahmagiri Range.

The Brahmagiri-Nilgiris-Eastern Ghats population extends from the Brahmagiri Hills to the south through the Eastern Ghats in the states of Karnataka, Tamil Nadu and Kerala, with a splinter group in Andhra Pradesh. About 6300-6500 elephants are distributed over 12,000 sq km of habitat. A number of the Protected Areas including Bandipur, Nagarahole, Mudumalai, Wayanad, Biligirirangan Swamy Temple, Kaveri and Brahmagiri fall within the area. The diversity in vegetation, ranging from dry thorn forest to the montane shola grasslands, make this one of the best Elephant Reserves in the country with a demographically and genetically viable population. This is the largest population of elephants in the country and possibly in Asia as well.

With diverse vegetation types, a number of cash crop cultivated areas, and human settlements, the Brahmagiri–Nilgiris–Eastern Ghats landscape is one of the most complex in terms of conservation challenges.

The diverse vegetation types and a number of cash crop cultivated areas and human settlements make this one of the most complex landscapes in terms of conservation challenges. Maintenance of habitat contiguity through existing corridors or through the consolidation of habitat, mitigating the ill effects of human–elephant conflict, and controlling poaching, fire and other degradation factors would help in maintaining the integrity of the habitat. There has been a relocation of four settlements (enclosures), out of 110 from within the Wayanad Wildlife Sanctuary, thereby providing additional undisturbed areas for wildlife. The Wildlife Trust of India, ANCF, Elephant Family, IUCN Netherlands and World

Land Trust initiative of securing land in the Thirunelli-Kudrakote Corridor in North Wayanad has also helped the free movement of elephants.

The Nilambur-Silent Valley-Coimbatore elephant population is connected to the Nilgiris through the high altitude mountainous portions of Silent Valley and Mukurthi National Parks. It is also distributed within the forests of Nilambur South and North Divisions, Mannarkad Division and Silent Valley National Park. The vegetation types include tropical wet evergreen, semi evergreen, moist deciduous, dry deciduous, dry thorn scrub and shola forests and grasslands. Though a large stretch of virgin forest is found in the area, a portion is subjected to forestry operations, cash crop cultivation and pressures from human habitations. There are a few constrictions through which the elephants move either throughout the year or in certain seasons. Maintenance of these corridors through appropriate measures, relocation of selected private holdings and stringent protection measures can ensure the long-term survival of this otherwise viable population.

The Anamalais-Parambikulam elephant population is one of the best conserved with about 4500 sq km of diverse habitat and about 1600 elephants (*Easa et al., 1990*). The elephants in this population range across Tamil Nadu and Kerala. The Indira Gandhi Wildlife Sanctuary and the Palani Hills form the Tamil Nadu part of the habitat. Parambikulam, Chinnar, Thattekad, Peechi and Chimmoni Wildlife Sanctuaries, Eravikulam National Park and the forests of Chalakudy, Nemmara, Vazhachal, Malayattur, Munnar and Mankulam Forest Divisions form the Kerala part of the habitat. Vegetation types range from dry thorn scrub forest to high altitude shola grasslands with evergreen and moist deciduous forests dominating equally.

Though vast and varied in habitat, the area also has probably the largest number of reservoirs for irrigation and electricity generation, tea and cardamom estates, and forest plantations, and the rampant extraction of forest produce (especially reeds). The population is also under pressure because of poaching. Encroachments, especially in the Mathikettan shola



Fig. 1.03: A wild tusker in Similipal Tiger Reserve, Odisha

areas, have reduced the effective habitat, depriving the elephants of some of their traditional movement paths.

Human-elephant conflict in this region is largely concentrated around the Valparai areas. The maintenance of the traditional paths through the elephant corridors, resettlement of some of the human habitations for consolidation of elephant habitat, improvement of degraded habitat, and effective monitoring to prevent poaching are the most crucial measures for the long-term conservation of this population.

The Periyar-Srivilliputhur population is spread over Kerala and a small portion of Tamil Nadu. Periyar Tiger Reserve with the adjoining Ranni, Konni, Achankovil, Punalur and parts of Thenmala Forest Divisions, form the elephant habitats in Kerala whereas Srivilliputhur and parts of Theni Divisions of Tamil Nadu form the habitat in Tamil Nadu. The uniqueness of this area is in its vast stretch of evergreen forests. The dry deciduous forest along the foothills of the Varashunad Hills is also prominent. There are extensive plantations of tea and eucalyptus especially in the southern part. There are about 1500 elephants in the area.

This is probably one of the compact elephant habitats in the south, without many human habitations. Though large-scale poaching of elephants has resulted in the killing of a number of tuskers, one of the major issues in the area is the disturbance caused by the Sabarimala pilgrimage, which attracts millions of people within a short period. Stringent anti-poaching activities, measures to improve the degraded habitats, and a reduction of the pressure exerted on the area by pilgrims are conservation priorities.

The Agasthyamalai elephant population is the southernmost in the country and ranges over the Kalakked-Mundanthurai Tiger Reserve, Kanyakumari Wildlife Sanctuary, the Neyyar, Peppara and Shendurney Wildlife Sanctuaries, and Reserve Forests of Thiruvananthapuram Forest Division. A part of the Agasthyamalai Biosphere Reserve, this habitat supports about 300 elephants.

THE CONSERVATION OF ELEPHANTS IN THE COUNTRY

While elephants in India may seem to be protected in Elephant Reserves, over 40% of Elephant Reserves are not part of Protected Areas or government forests and there are ever-increasing pressures on their habitat. There should be management plans for Elephant Reserves irrespective of state or administrative boundaries. Conservation efforts should be focused mostly on consolidating habitat, especially by reducing or removing biotic pressure through site-specific programmes.

The central Indian elephant population is perhaps the most fragmented one, with the region's habitat further threatened due to mining activities and linear development. However, some of the sub-populations, especially in the north-east, are also highly vulnerable. The skewed sex ratio due to selective removal of tuskers, human-elephant conflict leading to intolerance among the affected people, and policies for economic development in elephant habitats are also of great concern. It is also important that the suggestions put forward by the Government of India appointed Elephant Task Force in their report *Gajah* (*Rangarajan et al., 2010*) be implemented. An integrated approach involving all stakeholders could probably ensure the long-term conservation of this magnificent animal.

02

WHAT IS AN ASIAN ELEPHANT CORRIDOR?

Arun Venkataraman, Sandeep Kr Tiwari and K Ramkumar

THE NEGATIVE EFFECTS OF HABITAT FRAGMENTATION threaten many species today and strategies to reduce their impact have been widely discussed (*Saunders et al., 1991; Huxel and Hastings, 1999*). A proposed method for moderating the negative effects of habitat isolation is the preservation and restoration of linear landscape elements (corridors that structurally link otherwise isolated habitat remnants) (*Saunders and Hobbs, 1991*). These corridors are meant to increase landscape connectivity by facilitating movement of organisms between habitat fragments and thus minimise the risk of inbreeding and extinction, increase local and regional population persistence and facilitate colonisation (*Doak and Mills, 1994; Fahrig and Merriam, 1994; Sjorgen, 1991; Simberloff, 1988*).

In common usage, a corridor has been defined as:

1. A gallery or passageway into which compartments or doors open
2. A gallery or passageway connecting several apartments of a building
3. A narrow passageway or route

(*Merriam Webster and Co, 1961*)

A common attribute of these definitions, and most relevant to their ecological applications, are the terms "passageway" and "connecting". The term "passageway" or "gallery" connotes the concept that the corridor is narrow relative to the habitats being connected.

In ecological literature corridors are one of the three landscape elements, the other two being 'patch' and 'matrix' (*Forman and Godron, 1986*). The principles of landscape ecology have defined corridors as narrow strips of land which differ from the matrix on either side. Corridors may be isolated strips but are usually attached to a patch of somewhat similar vegetation (*Forman and Godron, 1986*). This definition characterises corridors in terms of their shape and spatial context but does not discuss its functional role. Forman and Godron (1986) also emphasise the possible transport function of corridors, arising as a consequence of their shape and context, rather than as a necessary condition to ascribe the term "corridor" to a linear element.

Even with the above definitions the necessary criteria for determining whether a linear landscape element is a corridor or not is ambiguous. One definition emphasises function (passageway from one location to another) while others discuss form and context (narrow and contrasting with the environment on its edges). Thus, when the significance of corridors to maintenance of biological diversity is debated (*Noss,1987; Simberloff and Cox, 1987; Saunders and Hobbs, 1991a*) disagreements arise due to divergent interpretations of the corridor concept.

Corridors have also been described as linear patches of natural vegetation providing habitat for species that are not adapted to the surrounding habitat, as temporary use areas or as a permanent part of their home ranges. Maelfait and De Keer (1990), in a study of invertebrates in Belgium, recognised their use for migration but emphasised the role corridors played as habitat. While summarising the role of corridors, Saunders and Hobbs (1991) included both the habitat (form) and movement (function) role of linear patches. Emphasis was however placed on facilitated movement. Merriam (1991) stated: "Corridors may or may not be involved in achieving connectivity among patches or fragments", thus implying that a definition does not require a functional role of facilitating movement. Laan and Verbbo (1990), were among few to recognise that a strip of vegetation as habitat or as a facilitator of movement are not necessarily

equivalent and are difficult to differentiate. A failure in reconciling these definitions of corridors has led to a controversy over their value.

The most commonly assumed distinguishing characteristic of a corridor is its function as a linear landscape element to facilitate species movement. Soule and Gilpin (1991) provided a clear and concise definition: **"a linear two dimensional landscape element that connects two or more patches of wildlife (animal) habitat that have been connected in historic times; it is meant as a conduit for animals"**. Rosenberg et al. (1995) went many steps further in clearing the confusion over function and mathematically defined corridors. They first defined habitat as **"a patch that provides for survivorship, natality (birthrate) and movement. If average survivorship and natality rates allow for a stable or growing population that produces immigrants it is a source patch; otherwise it is a sink that is dependent on immigrants to sustain its population"** and corridor as **"a linear landscape element that provides for survivorship and movement but not natality (birthrate) between other habitats"**. Thus not all of a species' life-history requirements may be met in a corridor. They further provided a model which provided a decision-making rule for discriminating among possible passages connecting habitat patches so that a dispersing animal could maximise its likelihood of successful dispersal. This model allowed for a definitive definition where **"a corridor is a linear landscape element where the immigration rate to the target patch is increased over what it would be if the linear patch was not present"**.

More recently, landscape resistance maps are increasingly being used to predict population connectivity and to map areas significant in facilitating animal movement. Traditional expert opinion is presently less useful for developing landscape resistance maps now that new and effective approaches using empirical data provide a much more reliable and robust means to map landscape resistance. There are a number of ways to predict or describe connectivity from resistance surfaces. Least-cost paths, least-cost corridors, circuit theory, centrality analyses, and resistant kernels are all powerful approaches suitable for different objectives (*Cushing et al., 2013*).

These approaches reduce the need for some of the subjective comparisons found in the next sections. However all these approaches require competence with the use of GIS algorithms and while invaluable for assessing landscape connectivity within a small set of landscapes, require a major national programme to assess the large numbers of corridors found in this volume. This is certainly possible in the future, especially if these approaches gain popularity within landscapes and landscape level assessments can eventually be complied to provide regional or national level assessments.

RELEVANCE OF THE ABOVE DEFINITIONS TO ELEPHANT CORRIDORS

While considering the relevance of the above definitions for elephant corridors it is obvious that the management implications of such definitions have to be clearly evaluated. These definitions have been strongly influenced by principles of population and community ecology, which while useful when defining a corridor, provide little guidance on the actual consequences of having an elephant corridor and the ensuing management and conservation action required for its management. It is thus essential to incorporate the 'desirability' of an elephant corridor in its definition.

The most commonly assumed distinguishing characteristic of a corridor is its function as a linear landscape element to facilitate species movement.

Asian elephants are long ranging species with extensive habitat and nutritional requirements. Furthermore, the population biology and genetics of the species require fairly unhindered gene flows across populations to ensure long-term viability. In the fragmented, human-transformed landscapes that typify most elephant habitats in Asia today, corridors thus ensure that nutritional, demographic and genetic needs are met. In these kinds of landscapes, corridors are likely to be surrounded by human settlements. The usage of corridors by elephants may thereby lead to human-elephant conflict through a multitude of mechanisms.

The 'desirability' of a corridor is the result of an interplay of the positive and negative social and ecological attributes described above and even though a landscape element could be defined as a corridor using population and community ecology principles, it could be rejected on purely social grounds. These attributes could play a dual role of both defining and prioritising corridors for conservation action.

In addition to 'desirability' it is also useful to define the attributes that characterise corridors. These are:

- Form
- Spatial Context
- Habitat Structure
- Function

THE FORM OF A CORRIDOR

The form of an elephant corridor pertains to its own specific shape and geometry and the context of the habitats it connects.

The definition "linear landscape element" is quite apt. Linear implies a tendency to appear as a straight line in a single dimension. While corridors could have width and thus be two dimensional, it is essential they be much narrower than the habitat patches they connect. Corridors however do not necessarily have to be straight.

How narrow should corridors be with respect to the habitat patches they connect? It is recommended that a subjective criterion is that the corridor should be narrow enough to experience a significant risk of being severed in a relatively short span of time. Risks could include sudden habitat loss caused by land use changes, or denotification and consequent land use changes; the effect of developmental activities, e.g. roads and railway lines, creating obstacles on a corridor and impeding movement; geographical events such as landslides or earthquakes; and increased human activity on

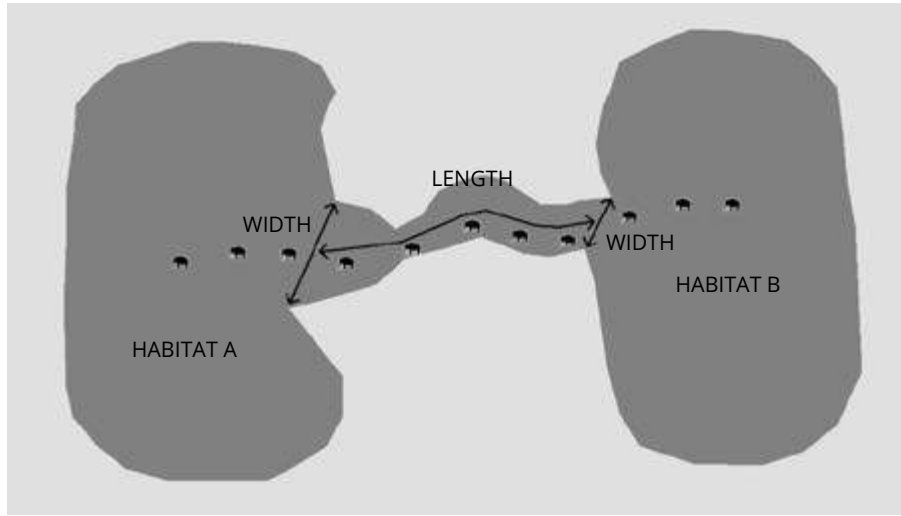


Fig. 2.01: Dimensions of a corridor: length and width

a corridor's periphery. A highly threatened corridor could thus be a narrow strip of private forest or revenue forest where a spread of agriculture could disrupt elephant movement in a short time span. A narrow corridor with Protected Area status could be threatened through denotification and consequent exploitation for agriculture, or by the expansion or increase in the intensity of human activity on its periphery. A narrow strip of habitat connecting two larger habitat patches could even be a portion of flat land at the foothill of mountainous terrain, the latter not conducive for elephant movement. These attributes should thus influence decisions on the definition and prioritisation of corridors for conservation action.

For management purposes it is essential that the length and width of a corridor be carefully defined. It is recommended that the width be measured perpendicular to an axis parallel to the direction required to travel from one habitat patch to another (*Figure 2.01*). The length is the distance between the two patches along this axis. Demarcation of the corridor boundary is also very important for the management of corridors. For demarcation, the corridor boundary typically includes the boundary

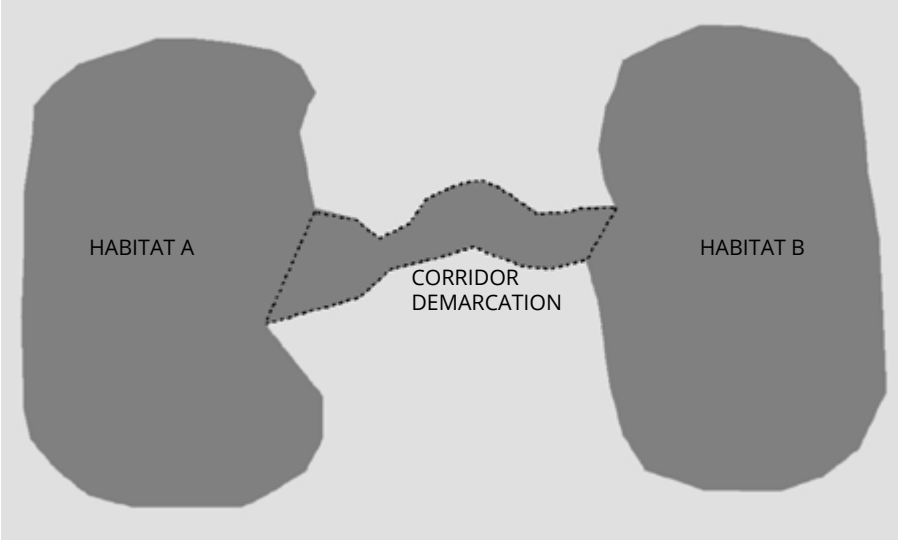


Fig. 2.02: Demarcation of corridor boundary

of a narrow corridor along the movement axis till it terminates in the habitats at both ends (*Figure 2.02*). However, the process of demarcation of corridor boundary may slightly vary to the various forms of corridor. (All lighter grey areas in this figure and subsequent ones are human dominated areas and darker grey areas are elephant habitat.)

SPATIAL CONTEXT OF A CORRIDOR

There are two dominant issues here:

a. Spatial context of a corridor with respect to its connectivity to the habitat patches it connects

b. Spatial context of a corridor with respect to other passages/corridors

Habitat patches connectivity

Assuming that habitat within a corridor comprises vegetation similar to that within the habitat patches it connects, it is desirable though not essential that the habitat in the corridor is physically contiguous with the habitat patches. This is provided the gap between the habitat patches

and the extremities of the corridor are minimal and not obstructed (e.g. by water bodies, terrain), allowing for quick and easy movement.

Passages and corridors

Form 1: Standard corridor: Figure 1 indicates a typical corridor that is easy to identify and design conservation action for. Generally this kind of corridor will have a well-defined structure enabling connectivity, and will facilitate elephant movement between larger habitats. The land use of the corridor will be completely natural habitat or a mosaic of natural habitats and human dominated habitats. Also, the corridor will be mostly surrounded by human habitation and agriculture lands. Generally the corridor and connecting habitats will be part of the same Reserve Forests or Protected Areas. However, if such a corridor is in proximity to other corridors or relatively narrow passages, how does one assess its importance with respect to others?

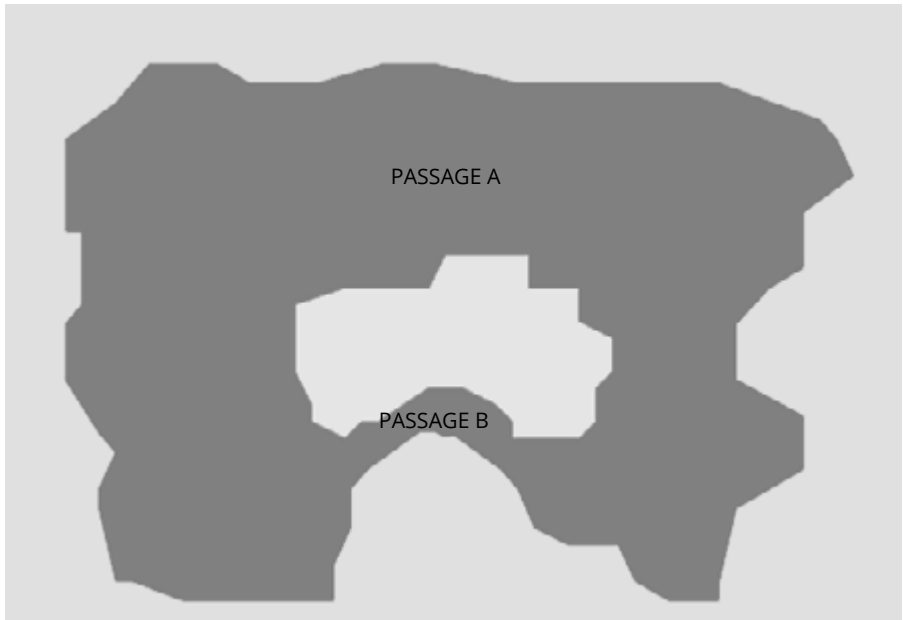


Fig. 2.03: Two adjacent passages between habitats

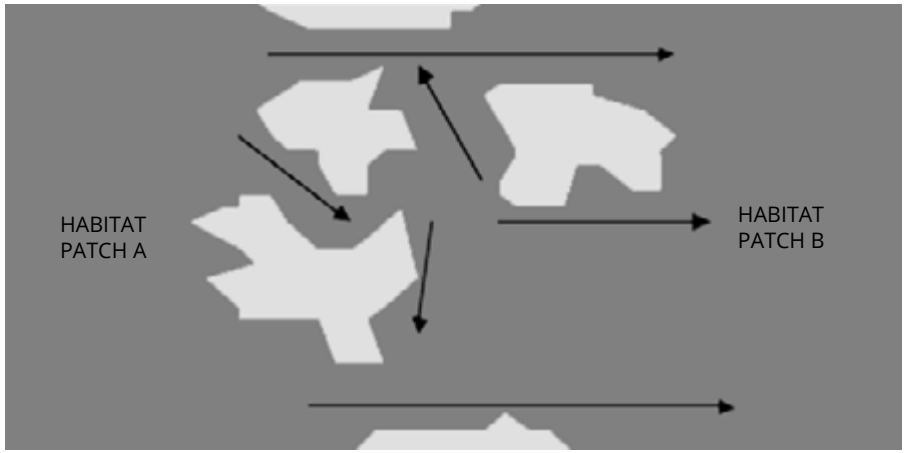


Fig. 2.04: Multiple form passages through a fragmented passage

Form 2: The scenario depicted in *Figure 2.03* indicates a typical corridor, passage B, in close proximity to a wider passage, passage A. To evaluate the relative importance of A over B one could consider the following attributes of each:

1. Probability of severance due to the threats described previously
2. Importance by evaluating elephant usage, considering home range fidelity

In the above scenario, passage A is much wider than passage B and therefore the chance of its severance is much lower. In addition, passage A could comprise a portion of a Protected Area (and hypothetically passage B could be privately owned) and therefore the risk of severance of A through the threats mentioned above could be minimal, though a finite risk would exist if it were denotified or subjected to a developmental activity like a road being built through it. If passage B is not used by elephants (because of terrain or other ecological factors) obviously it is not an elephant corridor.

However, if used by even a few elephants it acquires importance as:

a) Herds or solitary elephants that use the passage traditionally will continue to use it through its existence.
b) If severed, herds could then use passage A, but would spend a fair amount of time adapting to its use and in the interim period could move through settlements causing elephant-human conflict. In summary, when prioritising corridors for conservation action, passage B is assigned greater importance than passage A.

Form 3: Multiple Corridors: In another scenario, a fragmented habitat could result in several passages (*Figure 2.04*). This is a complex situation where defining corridors among these passages (depicted by arrows) requires some thought and is important as in a country like India, a number of elephant habitats resemble this. It may be useful to describe this kind of habitat as a "constrained habitat".

Ideally all such passages can be called corridors and receive conservation action to ensure that movement from habitat patch 1 to habitat 2 is maximised. Obviously this is impractical, as it would then require possible relocation or reduction of settlement areas, which is expensive and requires significant cooperation from inhabitants in terms of accepting a disruption

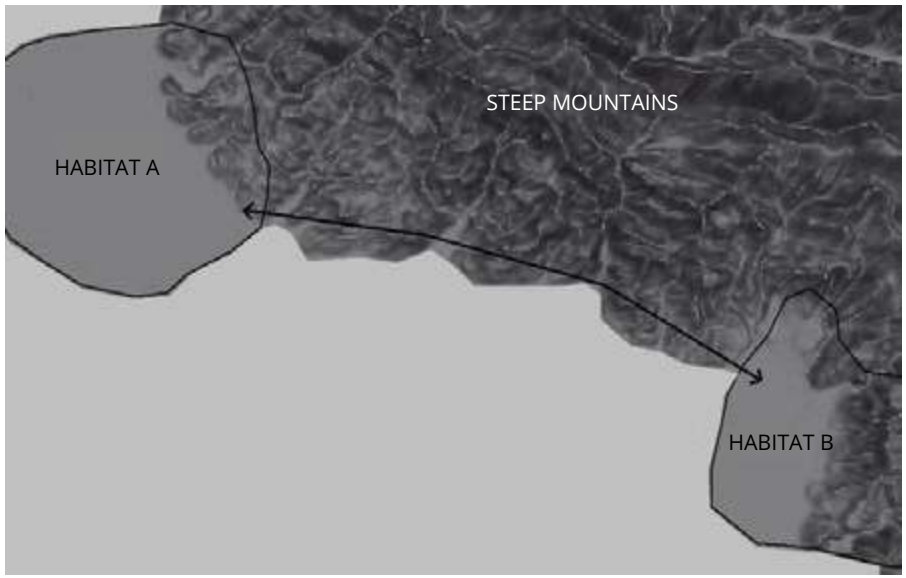


Fig. 2.05: A flat land at the foothills of mountainous terrain serving as passage

of lifestyle and livelihood. It is therefore important to identify the specific passage that facilitates the maximum movement of elephants and thereby connectivity between patch 1 and 2, and define only that as a corridor. This is similar to the model described by Rosenberg *et al.* (1995). Such a corridor may facilitate movement because of preferable terrain or habitat.

Form 4. Foothill Corridor: A narrow strip of habitat along the foothills of a steep mountain that is not conducive for elephant movement and connects two or more viable elephant habitats.

As discussed above, Form 4 corridors (*Figure 2.05*) are those resulting from the topography of the landscape. These could be flat lands or gentle slopes (or both) at the foothills of steep mountains that are not conducive for elephant movement but connect two larger habitats. Management would involve preventing any development (such as roads or settlements) or agricultural activity from interrupting the corridor. Foothills, being close to human settlements/agriculture lands or other land use, are associated with high levels of conflict between elephants and humans. Such corridors are prone to land use changes and fragmentation due to expansion of human settlements or other pressures and at times force elephants to move through higher elevations. Both protection and management strategies to mitigate conflict have to be given high priority to facilitate the movement of elephants.

Form 5. Stepping-stone Corridor: Private lands that connect two or more fragmented patches of elephant habitat, serving as stepping stones between viable elephant habitats.

Private or government-owned forest lands and fragmented forest patches can facilitate movement between two larger habitats (*Figure 2.06*). These small patches act as stepping stones for elephants moving between the two viable habitats. At times, these patches (stepping stone) also functions as habitat and the land between these patches could also be considered as corridors for management purposes if the distance between these patches are long and elephants spend considerable time in these habitats as can be seen in North Bengal. The intervening spaces between the patches are often plantations, tea gardens, or agricultural lands, often left fallow due to their usage by elephants and other wildlife. These habitat patches are frequently found in agricultural plantations such as those for tea cultivation, and elephants use them for shelter in the day and to raid crops at night. Corridors of this form are associated with high levels of human-elephant conflict. Management of these corridors would involve ensuring that the intervening areas (both agricultural lands and plantations) are largely free of human presence and agriculture. Any voluntary cessation of activities within by community members should be compensated through free, prior and informed consent. Mitigation of conflict in the surrounding communities should also be facilitated, by providing subsidies and the organisation of voluntary labour for the adoption of mitigation methods. Principles for facilitating movement through corridors in plantations are similar though companies can also further contribute by restoring natural habitat conditions in the intervening spaces and avoiding any development within or in close proximity (e.g. roads and labour lines).

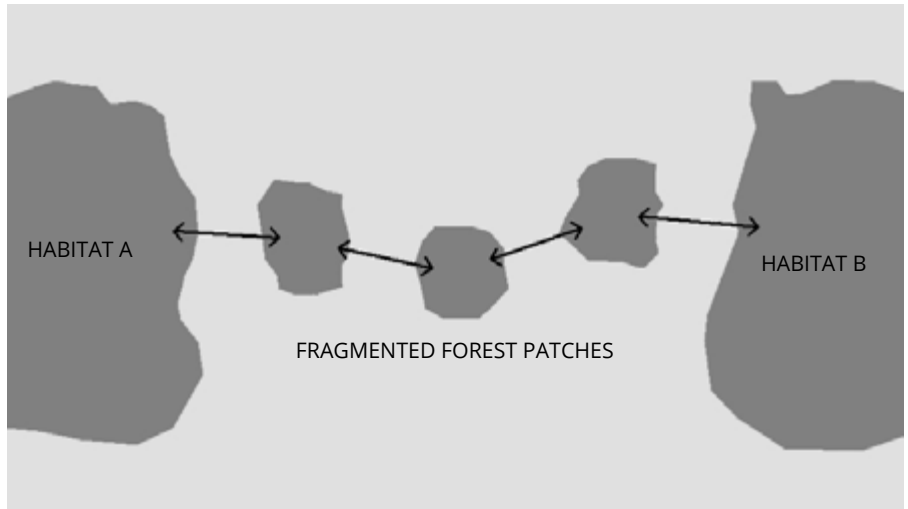


Fig. 2.06: Stepping-stone corridor



Fig. 2.07: Fragmented forest corridor

A similar form where there are no habitat patches between the large habitat patches and the entire corridor comprises agricultural lands needs the same management action; avoiding any agricultural, settlement and development within through voluntary means.

Both these forms (4 and 5) of corridors are today increasingly being intersected by linear infrastructure despite official recognition of their ecological status. While transmission lines may not impede movement in the long-term (with appropriate mitigation of impact during construction), roads and railway lines permanently impede movement along these corridors in the absence of prohibitively expensive mitigation.

The linear length in Form 4 and 5 corridors is the distance travelled by elephants between the two habitats. The width is that of the largest patch measured perpendicular to the direction of movement. These measurements are to determine whether these are corridors in the first place (as discussed for Form 1 corridors) and do not have any other management implications.

Form 6. Fragmented forest corridor: One or more fragments of small forest patches/private lands or both, which connect clusters of degraded or fragmented elephant habitats in human dominated landscapes or viable elephant habitats. *Figure 2.07* shows the most complex corridor in terms of management, comprising a series of degraded or fragmented patches connecting two large clusters of degraded/fragmented forest patches that could be considered habitat. Movement across the larger cluster tends to be relatively less constrained than within the corridor (between these clusters), though in and around both the clusters and the corridors, conflict is very intense. In many cases the clusters are recognised as viable elephant habitats (e.g. elephant habitats in Chhattisgarh, Odisha and Jharkhand), so the series of habitat patches can still be considered a corridor. In this case the length would be the linear distance elephants travel to reach either cluster of patches and the width would be the width of the widest patch measured perpendicular to the general direction of movement.

Form 7 Community Corridor: A contiguous revenue/private/community forest that is prone to fragmentation (even in the short term) and connects two or more patches of viable elephant habitat.

This type of corridor comprises contiguous forests owned by individuals or communities and providing connectivity for elephants between forests owned by the government (Reserve Forests or Protected Areas) (*Figure 2.08*).

The most complex corridor in terms of management are a series of degraded or fragmented patches connecting two large clusters of degraded/ fragmented forest patches that could be considered habitat.

Since *jhumming* (slash and burn cultivation) is one of the major practices in the community forests in North East India, such a corridor is highly prone to fragmentation even within short time periods while the RF/PA could be considered as permanent.

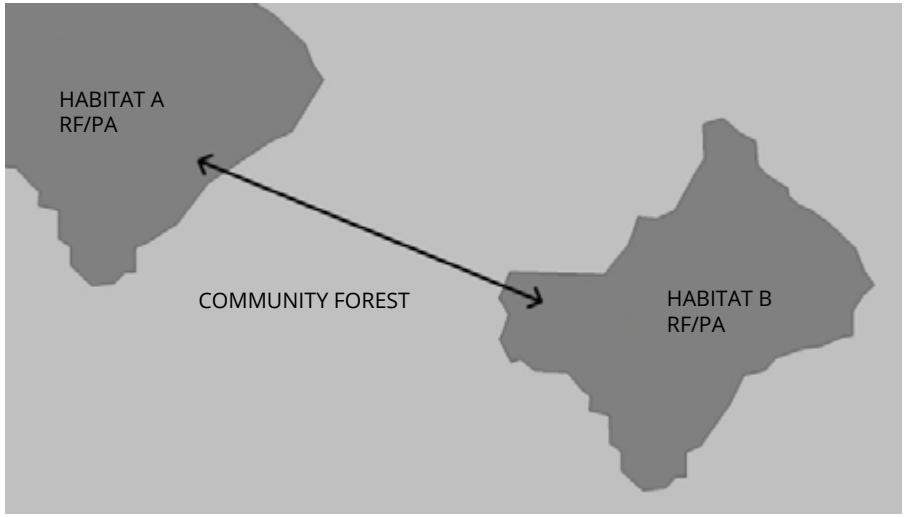


Fig. 2.08: Community corridor

Mining and other development activities are other major threats. Apart from the disparity in the legal status of these corridor forests and connecting habitats, these forests are more or less contiguous but prone to land use changes. In this case the length would be the linear distance elephants travel to reach both habitats and the width would be the width of the widest connecting habitat measured perpendicular to the general direction of movement.

HABITAT STRUCTURE IN CORRIDORS

Forman and Godron (1986) did indicate that corridors are usually connected to patches of somewhat similar vegetation. While this is usually true as most corridors are relics of contiguity existing in historical times and therefore have vegetation of the connected habitat patches, one could conceive deviations. As mentioned above, habitat patches may often have cultivated land separating them. If these lands are sparsely populated, lie fallow, are not obstructed by human artefacts such as houses or other structures, and could ensure a quick passage of elephants with no resulting conflict, there is no reason to not consider these corridors. Corridors could also be sparsely covered with relic vegetation of the connected habitat patches or even be reforested with quick growing trees like eucalyptus or acacia (*D. K. Lahiri Choudhury pers. comm.*). However, this action only provides cover and no food resources and is suitable only for quick movement.

FUNCTION OF CORRIDORS

There is little doubt that the function of corridors is to facilitate the movement of elephants from one habitat patch to the other. One could even add the term 'accelerated' here and therefore define corridors has "linear landscape elements which facilitate accelerated movement across habitat patches".

Corridors should not be thought of as habitat, where increased residency could promote conflict in adjoining settlements (*D.K. Lahiri Choudhury, pers. comm.*). Therefore restoration programmes should not focus on habitat improvement that could encourage elephants to stay within corridors. A similar concept is within Rosenberg *et al.*'s (1995) definition where corridors provide survivorship but not natality.

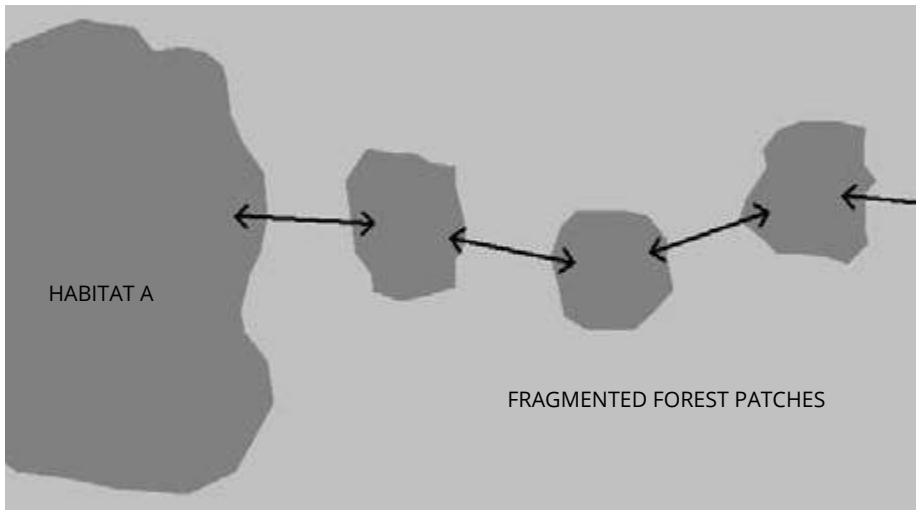


Fig. 2.09: Elephant movement from viable habitat to small patches (sink)

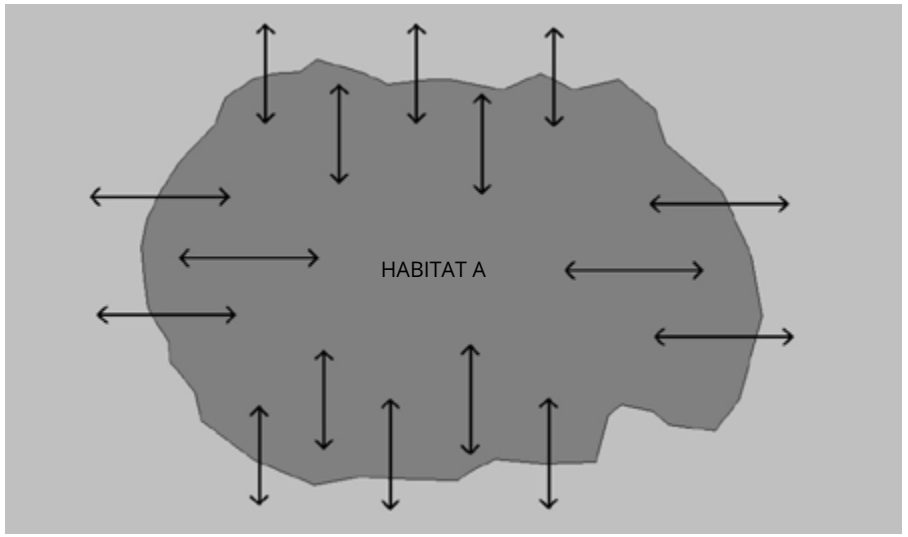


Fig. 2.10: Elephant movement from habitat to adjacent crop land

In terms of sources and sinks, it is essential to iterate that elephant corridors only connect source patches where survivorship and natality (birth rate) for a stable or growing population exist. Connecting sources with sinks (which are entirely dependent upon on immigrants to sustain their populations) are undesirable for elephants, unlike for a number of other species. This is because by definition, sinks do not support viable populations and are usually marginalised because of human settlements. Corridors promoting elephant movement into such sinks could greatly escalate conflict levels. However, there could be sinks that contain habitat of good quality and have little human presence, and which do not have viable populations for historic reasons e.g. past hunting levels. Corridors connecting such sinks with sources could encourage the creation of additional viable populations.

WHAT IS NOT AN ELEPHANT CORRIDOR?

Ambiguity about the definition and shape of elephant corridors persists due to a lack of clarity on the concept among various agencies/individuals. Elephant movement paths, migratory routes, crop raiding routes etc are at times considered elephant corridors or loosely termed elephant corridors, either due to a lack of conceptual understanding or just to draw attention towards any movement path of elephants. For example, elephant movement to Mysore (Karnataka), Jamshedpur (Jharkhand), or almost reaching Howrah (West Bengal) etc in recent years. This section thus discusses what are not elephant corridors from a spatial context.

Example 1. All landscape elements that facilitate elephant movement between larger habitats (source) and small fragmented habitat patches (sink) are not corridors (*Figure 2.09*). Similarly any landscape element facilitating elephant movement between two small fragmented forest patches are not corridors unless they connect viable elephant habitats at both ends. In summary, elephants cannot go from somewhere (viable habitat) to nowhere or nowhere to nowhere.

Example 2. Elephant movement within a contiguous habitat or from a habitat to fringe village/s for crop raiding cannot be considered corridors (*Figure 2.10*). At times, these elephants take refuge in tea gardens/plantations or small patches of forest during the day and raid crops at night. Such movement paths cannot be considered corridors.

Example 3. A small fragmented landscape in otherwise intact habitat. It may be useful to ignore passages created by this fragmentation entirely as elephant movement is unrestricted elsewhere (*Figure 2.11*).

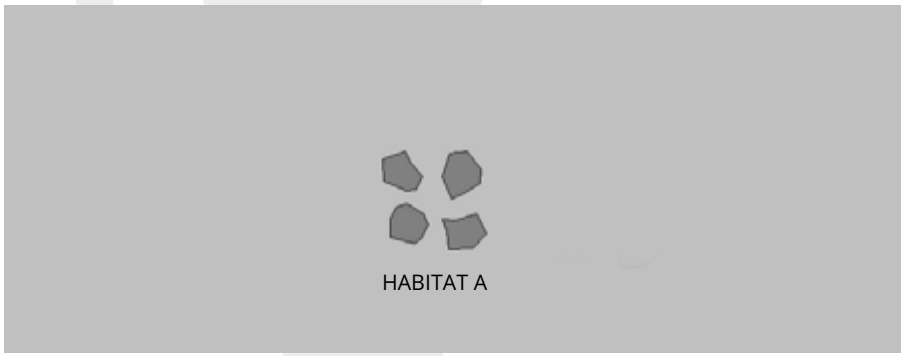


Fig. 2.11: A small fragmented landscape

03

DOCUMENTING AND SECURING CORRIDORS: THE APPROACH AND PROCESS

Sandeep Kr Tiwari

THE DESTRUCTION, FRAGMENTATION AND DEGRADATION of natural ecosystems are the primary causes of the decline in global biodiversity. Habitat destruction leads to fragmentation; the division of habitat into smaller and more isolated fragments separated by a matrix of human-transformed land cover. The loss of area and greater exposure to human land uses along fragment edges initiate long-term changes to the structure and function of the remaining fragments and are detrimental to the maintenance of biodiversity (*Haddard et al., 2015*). These fragmented habitats with human populations on the fringes also increase conflict between humans and wildlife. Understanding the consequences of habitat change and developing effective strategies to maintain biodiversity in disturbed landscapes is a major challenge to both scientists and land managers. For land managers, the challenge is to design and implement land use strategies that will ensure the conservation of natural resources in the face of competing demands for land use. This could be done for example, by enhancing landscape connectivity by means of corridors – the bandages for a wounded natural landscape (*Soule and Gilpin, 1991*). A holistic approach is required across both public and private lands to protect and manage natural ecosystems and ensure connectivity between the remaining wild habitats in fragmented landscape.

Wildlife habitats in India are no exception to the ubiquitous phenomenon of fragmentation and degradation. This has adversely affected the populations of larger herbivores like elephants, which have vast home ranges and require large amounts of food. This has led to increased conflict between humans and elephants, manifesting in crop-raiding, damage to property and loss of human and elephant lives. About 400-450 humans lose their lives due to human elephant conflict in India annually, and around 100 elephants are killed in retaliation for the damage they cause to human life and property.

Realising that the long-term solution to habitat shrinkage, fragmentation and increased human-elephant conflict is land use management, and that

<< A wild elephant passing through an elephant corridor

elephant corridors are an essential element of managing landscapes, Wildlife Trust of India (WTI) took up the challenge of mapping and identifying the status of elephant corridors in 2001 through its Wild Lands programme, which aims at creating a buffer to the existing Protected Area network of India by identifying, prioritising, securing and/or managing privately owned wild lands of critical importance, thereby contributing to the conservation of threatened wild species. In 2005, in collaboration with a team of researchers, forest officials and NGOs, WTI and ANCF identified 88 elephant corridors in India and published a report titled *Right of Passage: Elephant Corridors of India* (*Menon et al., 2005*). This publication systematically assessed the status of 88 identified corridors and prioritised them for conservation interventions and securing. The report was endorsed by Project Elephant, Ministry of Environment and Forests (MoEF)* and all state forest departments. In the last one decade, the Ministry of Environment, Forest and Climate Change (MoEF&CC), state forest departments and conservation organisations have been working at the policy and field level to protect and secure these corridors. The Elephant Task Force formed in 2010 also recognised these corridors and strongly recommended that they should be legally protected and secured through various approaches (*Rangarajan et al., 2010*).

However, with the rising pace of development to cater to the country's increasing human population and expanding economy, there have been further changes in land use in many wildlife areas, including elephant habitats, since the report was published in 2005. It was hence thought pertinent to revisit and survey the existing corridors and delineate new ones that may have emerged in the last decade, so that their current status could be understood and conservation plans prepared for securing them.

Based on the list of 88 corridors identified in 2005, a review of available literature and consultations with people working on elephants in India, the tentative new corridors were once again shortlisted. The forest cover of elephant habitats was reviewed, including terrain/contours (using Google Maps and GIS mapping) to understand the current status of elephant habitat connectivity. In order to verify all the corridors in detail, WTI's field team conducted discussions with the officials of relevant state forest departments, forest field staff, knowledgeable members of NGOs and individuals, before personally visiting the corridors. Details such as GPS locations, the parameters of the corridor, habitations, land use status, human artefacts, threats, and socio-economic details were collected based on which a conservation plan was prepared for each corridor. The newly identified and verified corridors were marked on a 1:50,000 toposheet. Information on the functionality or usage of corridors by elephants was collected from frontline forest department staff, secondary surveys from local villagers (present and past usage of corridors by elephants in the region), direct surveys for usage by elephants, and discussions with local researchers, and published literature. The team also collected information on the extent of habitat being connected, ecological importance of the landscape, alternate routes available to elephants, quality of habitat. Corridor boundaries were delineated based on structural connectivity, functional connectivity of elephants between habitats, artefacts and land use.

Corridor boundaries were delineated based on structural connectivity, functional connectivity of elephants between habitats, artefacts, and land use.

The information collected from the corridors in all states was compiled into a draft report. To finalise the list of corridors, review the corridor draft report prepared for each state, and refine and strengthen corridor-specific conservation plans, WTI, with financial support from Project Elephant, MoEF&CC, undertook state-level consultative meetings with forest department officials, conservation organisations working on elephants, elephant experts and others. The draft report was shared with participants in advance. Every corridor in a state was reviewed in great detail and the final list of corridors, with the conservation plan for each corridor, was prepared incorporating the suggestions and comments proferred. In case a new corridor was suggested,

* as the Ministry of Environment, Forest and Climate Change (MoEF&CC) was known at the time.

the team surveyed the area and if convinced, incorporated them into the report.

The rationale behind the fact sheet:

1. **Name of the Corridor:** Corridors have been named based on the names of forests (wherever possible these are the names of the Reserve Forests) being connected. This was done to both standardise the naming process and logically rationalise the function of the corridor, i.e. its connection of the named forests. Since in many cases the corridor was previously referred to by other names, an 'alternate name' listing is also provided to facilitate easy retrieval of data.

2. **Ecological Priority:** In order to accord some level of priority to the corridors, the editors have categorised them as being of High, Medium and Low ecological priority. This is based on the regularity of elephant movement, the population size of elephants in connecting habitats, the area of the habitats being connected, and the presence of alternate routes nearby. Ecological priority can be differently interpreted by different experts and this rating may only be taken as a thumb rule. A detailed rating is given in **Appendix I.**

3. **Conservation Feasibility:** Completely independent of ecological priority, corridors were also categorised by conservation feasibility. This took into account factors such as the major land use of the corridor, number of human settlements and/or linear infrastructure elements passing through it, encroachment, extent of area to be purchased, presence of institutions/ industries, political and community will, and the on-ground feasibility of securing it. The conservation feasibility of a corridor could be low even if it ranks high in terms of ecological priority. As with ecological priority, conservation priority is a reflection of WTI's views and may be interpreted differently by other agencies. A complete ranking is given in **Appendix II.**

4. **State:** The state or states through which the corridor runs.

5. **Alternate Name:** Other names by which the corridor is referred to.

6. **Forest Division:** The Forest Division in which the corridor is present or the nearest Forest Division to the corridor.

7. **Connectivity:** The two elephant habitats that are being connected by the corridor.

8. **Geographical Coordinates:** The corridor's geographical location was recorded with a Global Positioning System (GPS) reading taken at the two ends of the corridor.

9. **Length and Width:** Length is the distance between two habitats in the direction of elephant movement. Width is the distance of separation at the two closest points. Both are measured in kilometres.

10. **Major Land use:** The land use pattern within the corridor area: forest, agricultural land, settlement, tea garden, plantation, river etc.

11. **Major Habitations/Settlements:** Gives the names of the major settlements located within the corridor area.

12. **Forest Type / Vegetation:** The type of vegetation present within the corridor area using standard vegetation types (*Champion and Seth, 1964*).

13. **Frequency of Usage of the Corridor by Elephants:** This has been broadly divided into regular, occasional and rare. Seasonal animal movement that is seen every year is classified as regular and seasonal.

14. **Human Artefacts:** Lists the man-made structures present in the corridor area that impede elephant movement.

15. **Habitat Quality:** The habitat quality assessment of the corridors was

carried out to determine tree species composition, availability of elephant food plant species, regeneration and recruitment classes of trees and ground cover variables. Random plots of 20m x 20m were laid across the corridor to collect the variables such as tree species, height and girth at the breast height (GBH) for each individual tree (GBH> 20cm). Within the plot, four sub-plots of 5m x 5m were laid to record ground cover variables such as grasses, herbs, shrubs and barren ground. The number of plots varied based on size of corridor.

16. **Elephant Population in and around the Corridor:** The elephant population of the habitats being connected, using data collected from census records of state forest departments and published literature. Elephant dung encounter survey was also carried out in the corridor area to confirm elephant movement.

17. **Forest / Land use:** Provides information on a corridor's legal status and the land use of the corridor area:

a. Legal status of the corridor: Denotes the status of the land in the corridor area, viz. National Park, Wildlife Sanctuary, Reserve Forest, revenue land, community forest, private forest, private land etc
b. Land use of the corridor: Provides the land use pattern within the corridor area in detail

18. **Other Ecological Importance:** this section includes other important ecological aspects like important mountain ranges, tiger/elephant reserves, protected areas, Important Bird Areas (IBA) etc present in the landscape reflecting the importance of the landscape and corridor.

19. **Threats to the Corridor:** Lists all the present and potential threats to the corridor that hinder elephant movement based on direct observations, discussion with forest departments, local NGOs and villagers.

20. **Corridor Villages:** The name of settlements within the corridor, and information especially population size and dependency [fuelwood, Non-timber forest products (NTFP) and other resources] of people on corridor , forest and habitat based on socio-economic survey of people living within the corridor.

21. **Corridor Dependent Villages:** The name of settlements at the corridor's periphery(within 1 km), and information especially population size and dependency (fuelwood, NTFP and other resources) of people on corridor forest and habitat.

22. **Human-Elephant Conflict:** Details of human-elephant conflict, especially death and injury to humans due to elephants, elephant deaths due to human factors, and crop depredation in the corridor or the Forest Division.

23. **Maps:** Two maps have been included for each corridor. The first is a 3D map showing the location of the corridor in the landscape and the topography of the area. The second is a land use map showing the location of the corridor and its demarcation, as well as the area to be secured/protected.

24. **Conservation Plan:** Lists the steps that need to be taken to protect and secure the corridor from current and potential threats both at the policy level and in the form of physical interventions in the corridor.

One of the major issues encountered in almost all the corridors is the large-scale dependence of people from corridor and fringe villages for fuelwood and NTFP sourced from the corridor forest and connecting habitats. Livestock grazing is also reported in many corridors. Hence, it is important to undertake eco-development activities support in corridor and fringe villages to minimise dependence on corridor forests. Energy efficient stoves/*chullahs* could be provided to the villagers to minimise fuelwood extraction from forest areas. This will also help improve their health, which is adversely affected by smoke from traditional *chullahs*. Such measures have been initiated in Valmiki Tiger Reserve

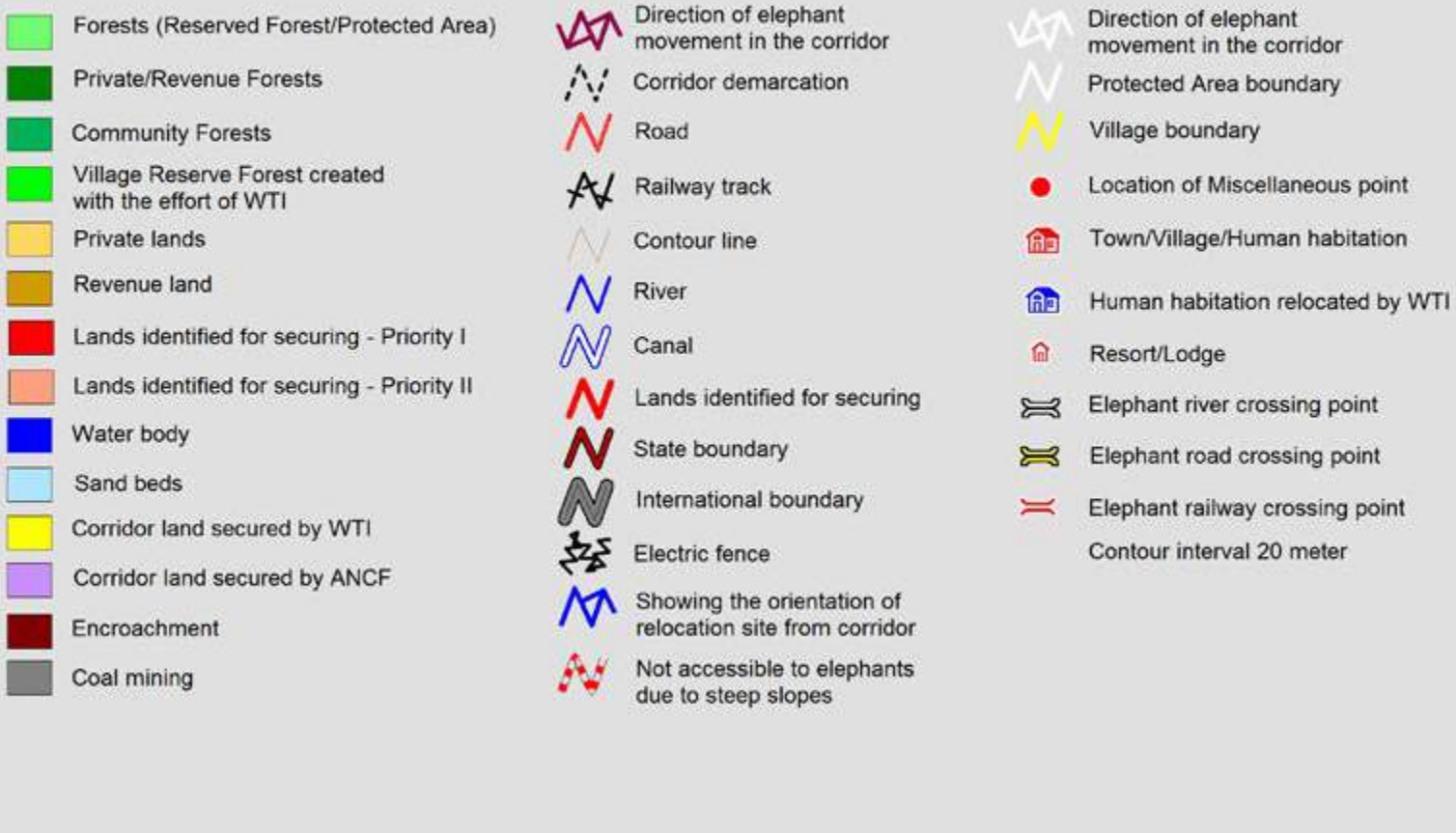


Fig. 3.01 (a): Legend used in the plot and 3D maps for individual corridors

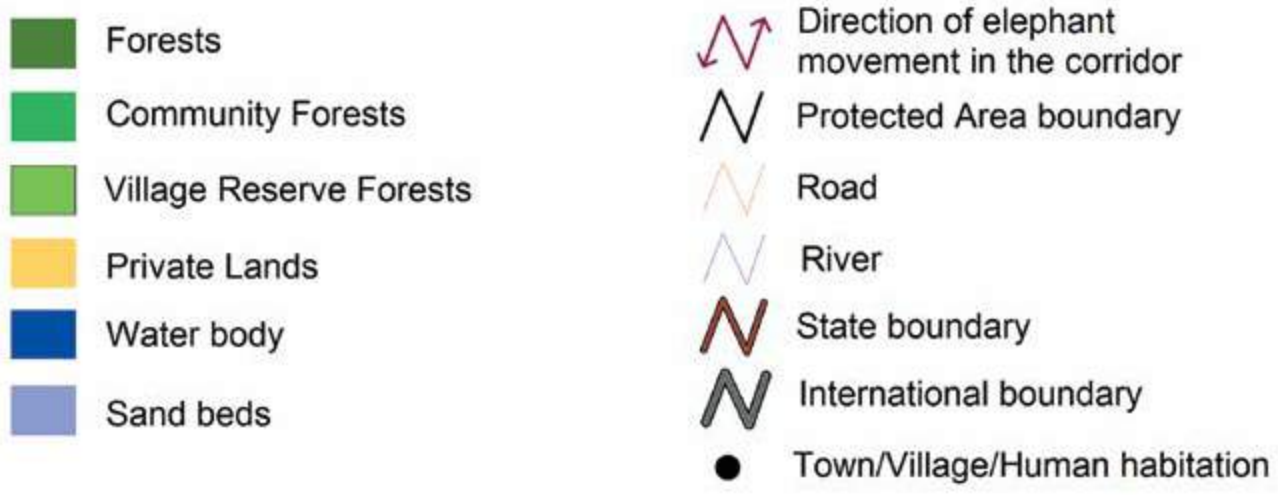


Fig. 3.01 (b): Legend used in the location maps of the region



Fig. 3.02: A tusker in the Chilla-Motichur corridor in Uttarakhand

and Nagzira-Nawegaon corridor villages, with a 30-40% reduction in fuelwood collection reported. Suitable eco-developmental support should also be provided to villagers based on their skills, after providing adequate training. The social schemes of state and central governments and tribal welfare departments could be channelised in these villages to reduce forest resource extraction and win the support of local communities for securing and protecting corridors.

Another hurdle encountered in many corridors is a lack of awareness among people about the importance of the corridor, especially the correlation between the loss of a corridor and increased human-elephant conflict in the area. People are also unaware how they can contribute towards securing and protecting corridors. Awareness and education programmes targeting corridor dependent villages and especially schools located around corridors could be organised to sensitise the locals, and in particular children, people's representatives and development agencies working in the region, about the importance of these linkages, how the impact of development activities can be minimised, and how they can contribute towards protecting corridors. It is important that a sense of pride be created among local communities about corridors in their area through these awareness programmes. Only then can the corridors be secured in the long-term. As a first step, signages have been fixed in most of the corridor identified in 2005.

It is important for a densely populated country like India to give careful thought to the manner in which land is secured for creating wildlife passages. There are limits to the extent to which land can be purchased or acquired by the government or other conservation agencies for strengthening corridors. Ideally, the complete takeover of land should be restricted to small, critical parcels of privately-owned land through a transparent and voluntary process. Conserving large mammals requires a landscape approach, as emphasised by the National Wildlife Action Plan (2017-22) that has been drawn up by the Government of India. Given the complex mosaic of protected areas, forests under government (both forest department and revenue department) control, private forests, and other private lands that may serve as passages for animals within a landscape, we should explore the possibilities of reward-based methods both for community-owned lands and privately-held lands.

The concept of "conservation easements" or payments for ecosystem services has not yet been adequately explored in the country. The idea is to reward land owners for maintaining wildlife friendly values. At the same time, there should be legal provisions that can be applied in and around elephant corridors in order to regulate detrimental development.

Over the years, WTI has found four approaches to be relevant for securing and protecting elephant corridors in the country. These models have been adopted in the conservation plans. The four models include:

1. **The Public Initiative model:** Creating empowered local stakeholders through the Green Corridor Champions initiative to ensure that each and every corridor is monitored in perpetuity; engaging with communities through public campaigns and spot interventions.

2. **The Government Securement Model:** Focussing on policy advocacy and providing central and state government agencies with technical assistance and 'soft hands' for the securing of key corridors through official schemes for purchase and rehabilitation.

3. **The Private Purchase Model:** Directly purchasing land, voluntarily rehabilitating communities, and transferring the purchased land to the state forest department for legal protection (a successfully implemented model is in place).

4. **The Community Securement Model:** Community owned lands are set aside through easements or bilateral benefit-sharing models; working with community based organisations (CBOs), governments and other stakeholders to ensure community-based protection of corridors.

CASE STUDIES OF ELEPHANT CORRIDORS SECURED

A. Private Purchase Model

1. Thirunelli-Kudrakote Elephant Corridor, Kerala

The Thirunelli and Kudrakote Reserve Forests are an important conduit for wildlife movement between the Nilgiri Biosphere Reserve and the Brahmagiri Hills. The corridor connects the Brahmagiri Wildlife Sanctuary in Karnataka with the Wayanad Wildlife Sanctuary and Wayanad North Division in Kerala, further leading on to Nagarhole National Park in Karnataka. The corridor had seven villages inside it, of which four (Thirulakunnu, Valiya Emmady, Kottapady and Pulliyankolly) were strategically located at points that considerably reduced the effective width of the corridor.

WTI, in collaboration with the Kerala Forest Department and the local communities, and with financial support from Elephant Family, IUCN Netherlands and World Land Trust, secured the corridor by purchasing about 25 acres of land and voluntarily relocating 37 families from these four critical villages. The families were provided with land for resettlement and agriculture, new houses, water facilities and other basic amenities. ANCF secured 12 acres of land from Suldarvayal settlement. The secured land was

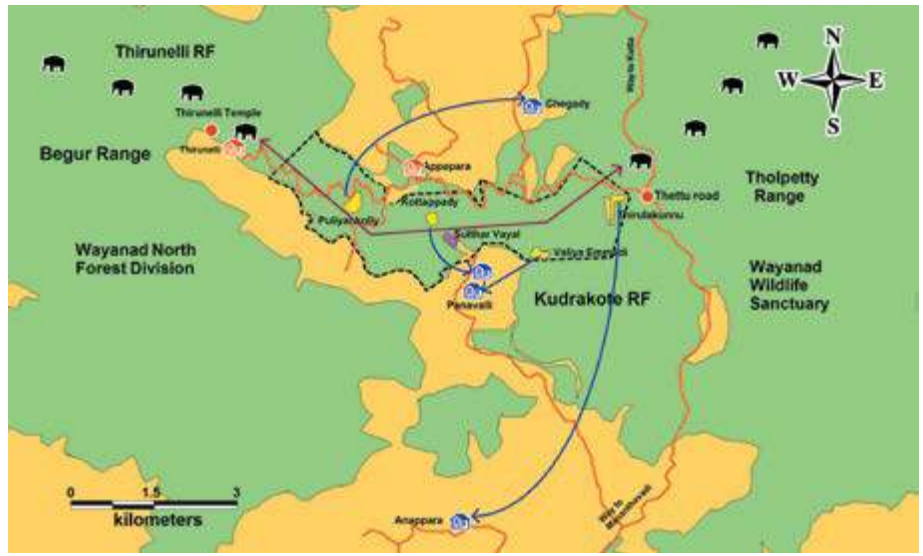


Fig. 3.03: Thirunelli-Kudrakote Elephant Corridor, Kerala

handed over to the Kerala Forest Department and notified as part of Wayanad Wildlife Sanctuary and Wayanad North Forest Division in 2015 (*Sukumar et al., 2016*). With Elephant Family's support, the corridor is being monitored for animal movement and the relocated families are being monitored to assess the change in their socio-economic status.

2. Edayarhalli – Doddasampige Elephant Corridor, Karnataka

This corridor facilitates elephant movement between Kollegal Forest Division and Biligiri Rangaswamy Temple (BRT) Tiger Reserve, through the villages of Arekadavu, Kurubaradoddi and Budipaduga, further leading on to Sathyamangalam Tiger Reserve. The elephant range to the east of the Biligiriranga Hills has been divided by a long strip of cultivated land, extending south from the town of Kollegal for a distance of 50 km to the Tibetan settlement at Byloor. This strip nearly cuts off the Doddasampige Reserve Forest of BRT Tiger Reserve from the Ramapuram Range of Kollegal Forest Division. In collaboration with the Karnataka Forest Department, IFAW-WTI and ANCF secured the corridor by purchasing 25.5 acres of land from 17 villagers

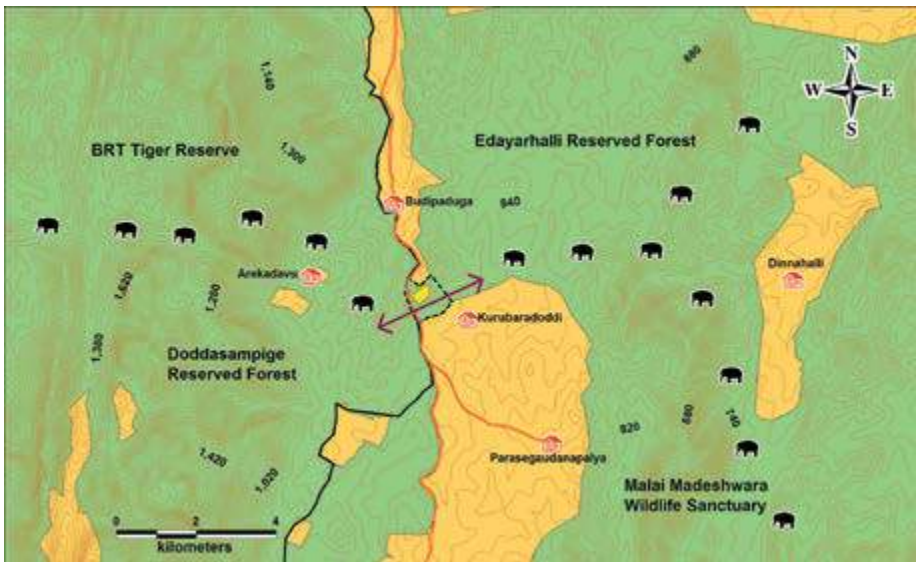


Fig. 3.04: Edayarhalli – Doddasampige Elephant Corridor, Karnataka

of Aandipalya village, which is located between the villages of Kurubaradoddi and Budipaduga along the Kollegal-Satyamangalam Highway. The secured land was transferred to the Karnataka Forest Department through a formal MoU and transfer deed in 2007 to incorporate it as part of the Protected Area for legal protection and maintain it as an elephant corridor. This is the first-ever privately purchased elephant corridor in Asia.

B. The Government Securement Model

3. Kaniyanpura - Moyar Elephant Corridor, Karnataka

This corridor connects the Kaniyanpura Reserve Forest and Moyar Reserve Forest of Bandipur Tiger Reserve. The corridor is located on the inter-state boundary of Karnataka and Tamil Nadu. Elephants from Sathyamangalam Tiger Reserve move to Bandipur Tiger Reserve through a narrow forest located between the villages of Kaniyanpura, Karagundi, Kaniyanpura colony settlements and the deep Moyar gorge. The corridor is 3000m in length and only 50m to 250m wide.

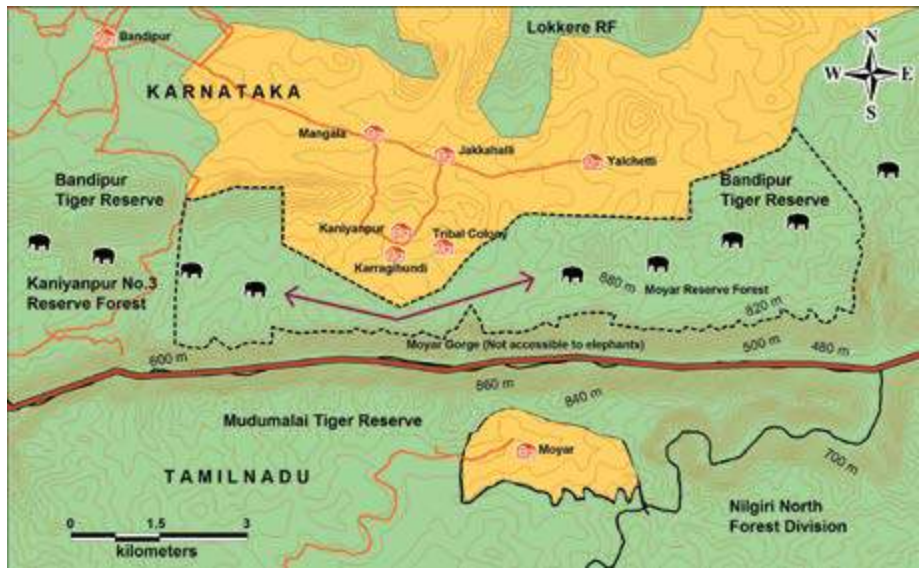


Fig. 3.05: Kaniyanpura - Moyar Elephant Corridor, Karnataka

This corridor was initially very narrow, about 100m at its widest point. The Karnataka Forest Department along with Project Elephant, Government of India (which provided the funds) secured the corridor for the free movement of elephants with active ground support from WTI's regional partner, the Asian Nature Conservation Foundation (ANCF; earlier known as the Asian Elephant Research and Conservation Centre or AERCC), which played a pivotal role in identifying, prioritising and correctly mapping the corridor.

C. Community Securement Model

4. Siju-Rewak Elephant Corridor, Meghalaya

This corridor is situated in Garo Hills Elephant Reserve that supports over 1000 elephants. It connects Siju Wildlife Sanctuary with Rewak Reserve Forest, a very important linkage for elephants that helps in maintaining habitat continuity between Balpakram-Siju-Rewak and Nokrek National park. The corridor is about 3.5 km long and 2 km wide (*Williams & Johnsingh,1997*).

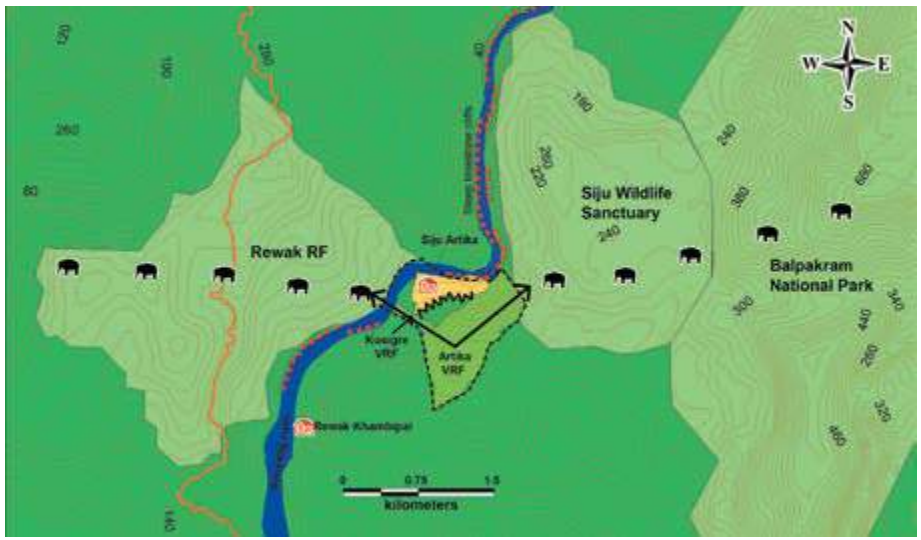


Fig. 3.06: Siju - Rewak Elephant Corridor, Meghalaya

Elephants can cross the Simsang river only at three or four places where there are sandy stretches along the river; elsewhere the river is bounded by steep limestone cliffs and large boulder formations along both banks. Only a part of the corridor forest is controlled by the Forest Department; the rest is under local tribal community management. A major hindrance for elephant movement through the corridor is the village of Aretika (with 27 families), which lies in the corridor area across the eastern side of the Simsang River and the southern end of Siju WLS. The people of this village practice *jhum* or shifting cultivation, which is a traditional practice of tribal people throughout Meghalaya. This has resulted in the rapid depletion of natural forests.

WTI, with financial support from World Land Trust (WLT) and working with the Nokma (Village Head), villagers, Garo Hills Autonomous District Council and Meghalaya Forest Department, secured the corridor by notifying the corridor area as two Village Reserve Forests, namely the Siju-Aretika Village Reserve Forest and the Rewak-Kosigre Village Reserve Forest, spread over about 250 hectares, in 2007-08. The corridor is being monitored to assess animal usage pre and post securement. Due to increased usage of the corridor by elephants, human-elephant conflict has increased in Aretika. An electric fence has therefore been erected around the village to prevent the entry of animals.

GREEN CORRIDOR CHAMPIONS

Wildlife Trust of India is also working towards empowering local stakeholders through the formation and deployment of a cadre of **Green Corridor Champions (GCCs).** These community-based organisations or groups of individuals will work as the eyes, ears and voice of corridors. GCCs will be charged with sensitising, motivating and mobilising local communities, and creating a sense of pride and ownership among them towards elephant corridors. They will work to secure and monitor the status of corridors by coordinating the actions of local self-governments, state and central governments, and other stakeholders. Besides monitoring corridor usage by

elephants, GCCs will monitor and tactfully dissuade any activities resulting in land use change that may immediately or in future create a hindrance to animal movement through a corridor. They will sensitise people and work with local governments to institutionalise the protection of the corridor. To enable community-based organisations to function effectively as GCCs, adequate training will be imparted to GCC members to develop their capabilities and skills to be the real champions of corridor securement.

Strategy: To utilise the services, expertise, reach and connectivity of local community-based organisations that will act as champions of the cause of securing elephant corridors, by creating a sense of pride among the local communities towards corridors in their area, and by gaining the trust of these communities and working with them and local governments to secure identified corridors.

Specific roles and responsibilities

- Monitoring of the corridor for potential threats and land use changes. The objective is to keep an eye on the corridor to ensure that no activity inimical to animal movement takes place in the corridor area. If a threat is perceived or manifests in the corridor, it will immediately be brought to the notice of the forest department and WTI, who in turn would take appropriate action without losing time. The GCC may also use its skills and good offices with the concerned local community to dissuade it from indulging in any change in the land use of the corridor that will adversely impact or impair the functioning of the corridor.
- Monitor the corridor for animal usage to understand how the corridor is being used by elephants and other animals, and if the movement is seasonal or throughout the year.
- Undertake awareness campaigns involving the community in the corridor area and in fringe villages/schools, to build public support for corridor protection.
- Work with local authorities and sensitise local politicians/legislators about the importance of specific corridors. Also persuade governments to include identified corridors under existing Protected Areas or otherwise accord them legal protection. The aim is to generate political goodwill and support for securing and protecting corridors and to ensure that no new developmental projects hindering animal movement are approved and implemented in corridor areas.

WIldlife Trust of India has already deployed two Green Corridor Champions covering four corridors in the Kaziranga-Karbi Anglong landscape with Elephant Family's support. The GCC initiative will be scaled up to cover all the identified corridors in the country.

Wildlife Trust of India has also fixed scientifically designed signboards in all the corridors to inform people about the importance of the corridor area and advise them to minimise their activities in these corridors. These signages will also help local planning authorities to plan developmental activities in an ecologically sensitive manner and prevent land use changes in the corridor area as the stakeholders are aware of the criticality of the area. Drivers of vehicles passing through these corridors can also take due precaution upon seeing the signages.

IMPAIRED CORRIDORS

In the last decade, the land use and land cover of India's elephant landscapes have changed drastically due to developmental activities, infrastructure development, the increasing human population and the need for space for settlements and agriculture. The already fragmented habitats have further fragmented, hindering elephant movement and resulting in increased human-elephant conflict. In the absence of protection of corridors, seven corridors have been impaired and are no longer being used by elephants. A few other corridors are also on the verge of being impaired if urgent measures are not taken to protect and secure them. The impaired corridors include:

a) Gola Rankhu and Gorai-Tanda: This corridor connects the Gola Rankhu and Gorai Reserve Forest of Terai East Forest Division and the Tanda Reserve

Forest of Terai Central Forest Division in Uttarakhand. Several infrastructural and developmental elements such as NH87, an Indian Oil Corporation Limited (IOCL) depot, a railway sleeper factory, an ITBP campus, the Bindukhatta encroached settlement between the Haldwani-Lalkuan Highway (NH87) and the Gola River, and mining near the Gola river in the last one decade has impaired the connectivity between these habitats. Increased human-elephant conflict reported on either side of the corridor villages, *viz.* Kishana Nawadh, Jaipur Bisha, Gangapur Kabadwal, Tejpur Negi, Bachi Neward and Haripur Bachi, indicates that elephants are still coming to both ends of the corridor but are not able to move through it.

b) Lagga Bagga – Kishanpur: Elephants once used this corridor to move from the Royal Sukhlaphanta National Park in Nepal through Lagga Bagga, Gunhan, Tatarganj, Chandpura, Bailha, Faizulganj, Navedia, Dhakka and the Maharajganj beat of Bhira Range to Kishanpur Wildlife Sanctuary. However, this corridor, situated in Pilibhit Forest Division, Kishanpur Wildlife Sanctuary and South Kheri Forest Divisions, has been subjected to fragmentation and extreme biotic pressure due to a large human settlement and agricultural land between the Sharda River and canal (Hazara, Navediya, Maharajpur, Khirkiya, Dhakka etc). Consequently, it is now impaired.

c) Dumriya – Kundaluka and Murakanjiya (Mosabani-Rakhamines): Located in the Mosabani Forest Range of Dhalbhum Forest Division, this corridor used to connect the Dumriya Reserve Forest with Kundaluka Protected Forest and Murakanjiya Reserve Forest, thereby maintaining elephant movement from the Sarali Protected Forest and Kanapat Reserve Forest areas of Gorumahisani (Odisha) to the Mosabani and Rakhamines areas of Jharkhand. The corridor has been impaired due to agriculture and other developmental activities and a total loss of forest cover in the corridor area.

d) Charduar - Singri Hills: This corridor used to pass through tea gardens and human settlements connecting the Sonai Rupai Wildlife Sanctuary and Charduar Reserve Forest with the Singri Hills Reserve Forest. However, due to large-scale loss of forest cover and encroachment in Charduar Reserve Forest (130 sq km under encroachment), Sonai Rupai Wildlife Sanctuary (satellite core of Nameri National Park), and the Singri Hills, and human settlements and developmental activities in between, elephant movement through the corridor is totally impaired.

e) D'Ering – Mebo at Kongkul: This corridor in the Pasighat Forest Division of Arunachal Pradesh connects D'Ering Wildlife Sanctuary with Mebo Reserve forest through the Sissar Riverbed. The corridor then leads to the Dibang Forest Division, criss-crossing several private forests. The corridor was near Kongul village, a new settlement of the Padam community. The corridor has been impaired due to floods and a change in the course of the Siang River, and the formation of stiff embankments in the corridor passage. The elephants now cross the river near the villages of Mer and Gadum.

f) Saipung – Narpuh: This corridor connects the Saipung Reserve Forest with the Narpuh II Reserve Forest and borders the North Cachar Hills of Assam. The Lynju and Sumleng Rivers drain the corridor area. This habitat supports very few elephants. Elephant movement between Narpuh RF I and Narpuh RF II has been totally cut off due to mining, border fencing and other activities in the region. No elephant movement has been reported between Narpuh II and Saipung in the last four to five years.

g) Mahananda – Kolabari: This corridor in North West Bengal connects the elephant population of Mahananda Wildlife sanctuary to Kolabari Reserve Forest, and finally with the forests of Jhapa district of Nepal. The movement to Nepal is currently cut off due to power fencing along the Mechi River by Nepalese authorities. The elephants now go up to the Mechi River and return, which has increased human-elephant conflict on the Indian side. Although a large number of elephants still comes till the Kolabari Reserve Forest and Tukrajhar forest to raid crops, there is no viable habitat available and the movement to Nepal is cut off due to the power fence. The fragmented corridor currently does not connect any habitat towards Mechi and thus cannot be considered a corridor.

04

ELEPHANT CORRIDORS OF NORTH-WESTERN INDIA

Sandeep Kr Tiwari, A K Singh, A J T Johnsingh, A Christy Williams, K Ramkumar and Sumanta Kundu



THE NORTH-WESTERN ELEPHANT HABITATS that once extended from Katerniaghat Wildlife Sanctuary in the east to the Yamuna River in the west are now fragmented at many places. The steep Himalayas and the Shivaliks bound this elephant range to the north and the fertile Terai to the south.

The increase in human populations and associated developmental activities have fragmented and reduced the elephant habitats and impacted the movement of elephants, resulting in increased human-elephant conflict. As a result, the elephant population (numbering approximately 2070; MoEF&CC 2017) distributed along the foothill of the Himalayas in Uttarakhand and Uttar Pradesh is now broken up into six sub-populations. From west to east, the populations include those between the Yamuna and Ganga Rivers, the Ganga and Khoh Rivers, the Khoh and Gola Rivers, the Gola and Sharda Rivers, in and around Dudhwa Tiger Reserve, and that of the Katerniaghat Wildlife Sanctuary. The major breaks in this elephant range are along the Ganga River, along the Gola River, along the Sharda canal, and between Dudhwa National Park and Katerniaghat Wildlife Sanctuary, thus severely hindering elephant movement. In several other places too, the habitat connectivity is under severe threat of breaking up.

Because of human inhabited areas and a lack of clear government policies in dealing with their occupants, migrant communities near forest fringes and hills have slowly but steadily encroached upon forest areas. This has not only fragmented the habitats but has also led to their degradation. The dependence of fringe communities on the forests for fuel, timber and non-timber forest produce (NTFP); livestock grazing and conversion of natural forest into monoculture plantations of teak and eucalyptus; and linear infrastructure elements (highways, railway lines, canals) have severely degraded elephant habitats, with invasive alien species like *Lantana* and *Parthenium* taking root. The impact of Van Gujjar settlements on the habitat is multifarious. Relocation of these communities from certain parts of Rajaji Tiger Reserve and Corbett Tiger Reserve has revived the health of the forests and wildlife in these areas.

TIgers have taken over the Chilla Range after Gujjars were relocated and the area has been notified as part of Rajaji Tiger Reserve.

The elephant habitat in the Yamuna - Ganga section comprises the Shivalik Forest Division, Dehradun Forest Division and a large part of Rajaji National Park, supporting a substantial elephant population of at least 300. However, the elephant habitats in this region are adversely affected by presence of Van Gujjars, development of road and railway networks, increasing human population, agriculture activities, and industrialisation in the region (*Johnsingh, 1992 and 2001; Johnsingh et al., 1990; Joshi et al., 2010*). Four elephant corridors have been identified in this region; the corridor between the Motichur and Gohri Ranges of Rajaji Tiger Reserve across the Ganga is severely threatened due to settlements both on the right and left banks, and the consequent biotic pressure. However, the Chilla-Motichur corridor is being revived with the relocation of human settlements (Khandgaon-III) from the corridor and the construction of an overpass for vehicles on NH 58.

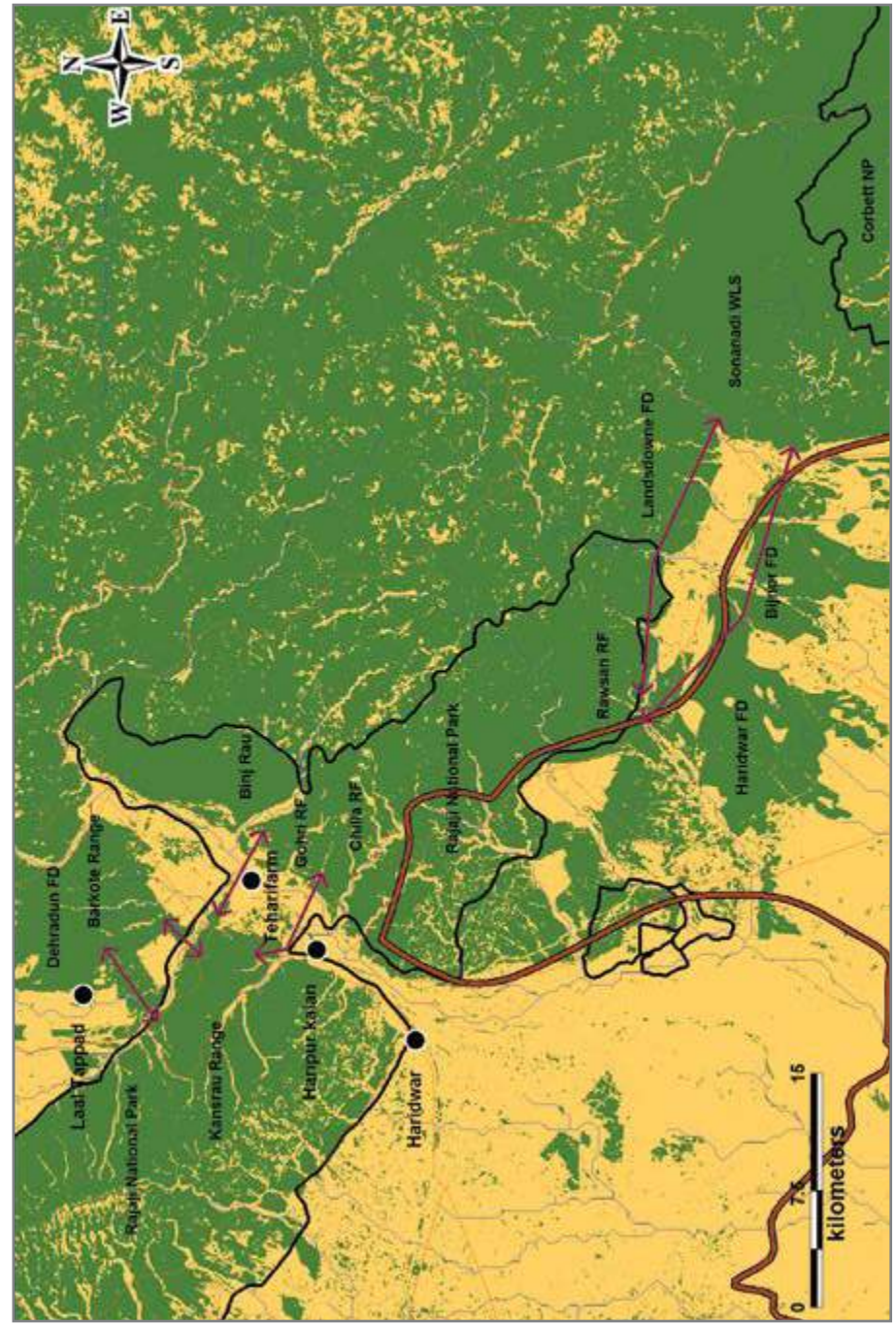
Because of human-inhabited areas and a lack of clear government policies in dealing with the occupants, communities near the forest fringes have steadily encroached upon forest lands.

The elephant habitat in the Ganga - Khoh section comprises the Gohri and Chilla Ranges of Rajaji Tiger Reserve, Haridwar Forest Division and Lansdowne Forest Division of Uttarakhand, and Bijnor Forest Division of Uttar Pradesh, supporting about 250-300 elephants. The last two decades have seen a rapid expansion of human settlements adjacent to the Laldhang-Kotdwar forest route and Kotdwar. Human encroachment into forest areas has also increased, what with the large Van Gujjar population and the expansion of agriculture and industrial activity. These factors have severely affected the elephant distribution in this stretch. Two elephant corridors have been identified in this region.

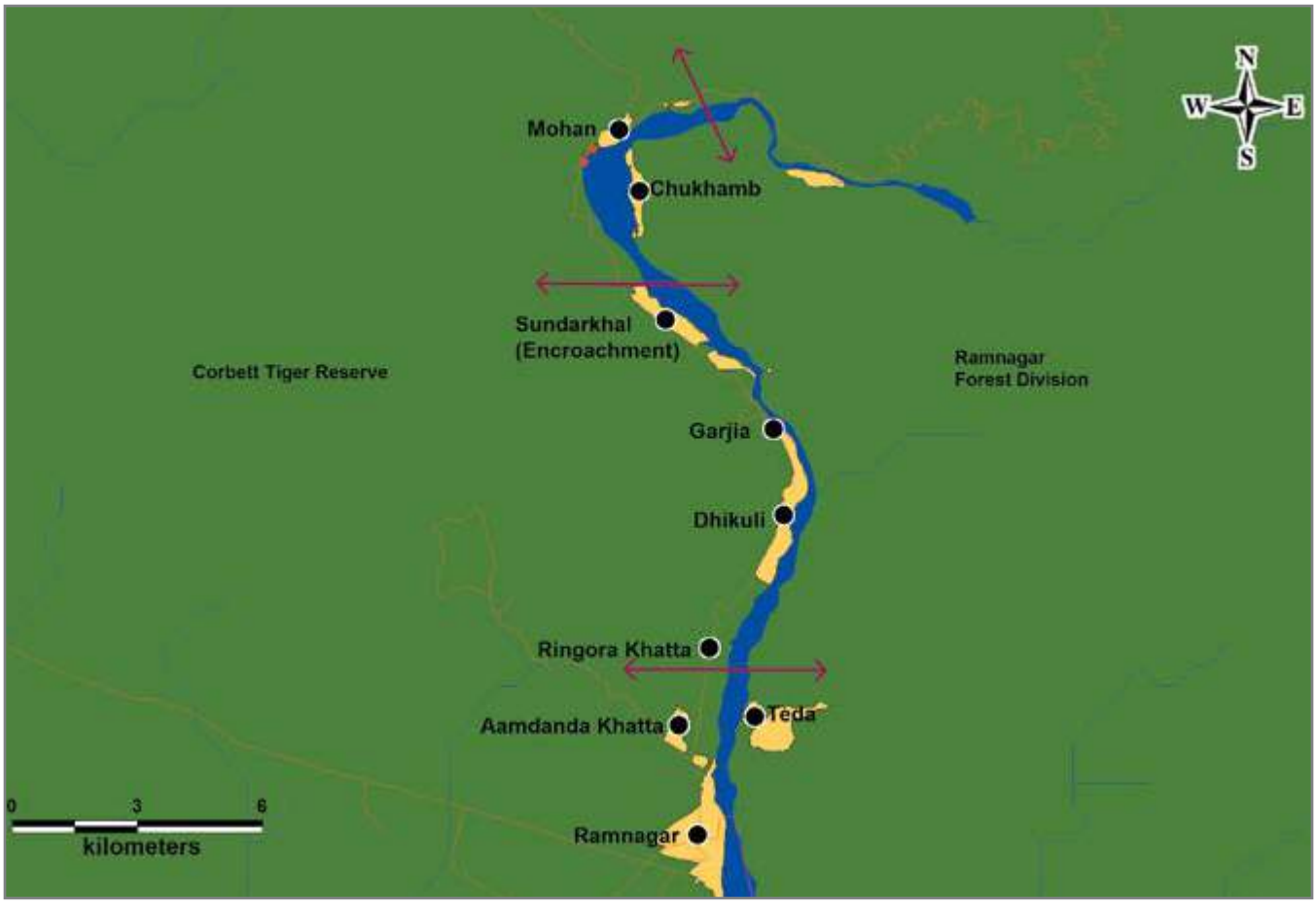
The elephant habitat in the Khoh and Gola River section comprises part of Lansdowne Division, Corbett Tiger Reserve, Ramnagar Forest Division, Terai West and Terai Central Forest Divisions, and supports more than 1000 elephants. A large human population (including Gujjars); a network of highways; the mushrooming of resorts along the Kosi River; sand and boulder mining on the Nihal and Gola riverbeds and sand mining on the Kosi riverbed; NTFP collection, illegal extraction of timber and grazing; and industrialisation (especially in Terai Central and adjacent areas of Terai East) have severely affected elephant habitat and the movement of elephants across the habitat. The elephant movement between Terai Central and Terai East (across the Gola River) is completely impaired due to the presence of an Indian Oil depot, a Railway Sleeper Factory, an ITBP camp and encroachments. The landscape had five corridors of which one, Gola Rankhu and Gorai - Tanda has been impaired in the last few years.

The elephant habitats in the Gola River and Sharda River comprise the Terai East and Haldwani Forest Divisions in Uttarakhand and Pilibhit Tiger Reserve in Uttar Pradesh. The habitat is quite fragmented and the movement of elephants between the Khatima and Surai Ranges across the Sharda canal in Terai East Forest Division is very limited due to the coming up of a four-lane highway between Khatima and Tanakpur and encroachment along the Sharda canal.

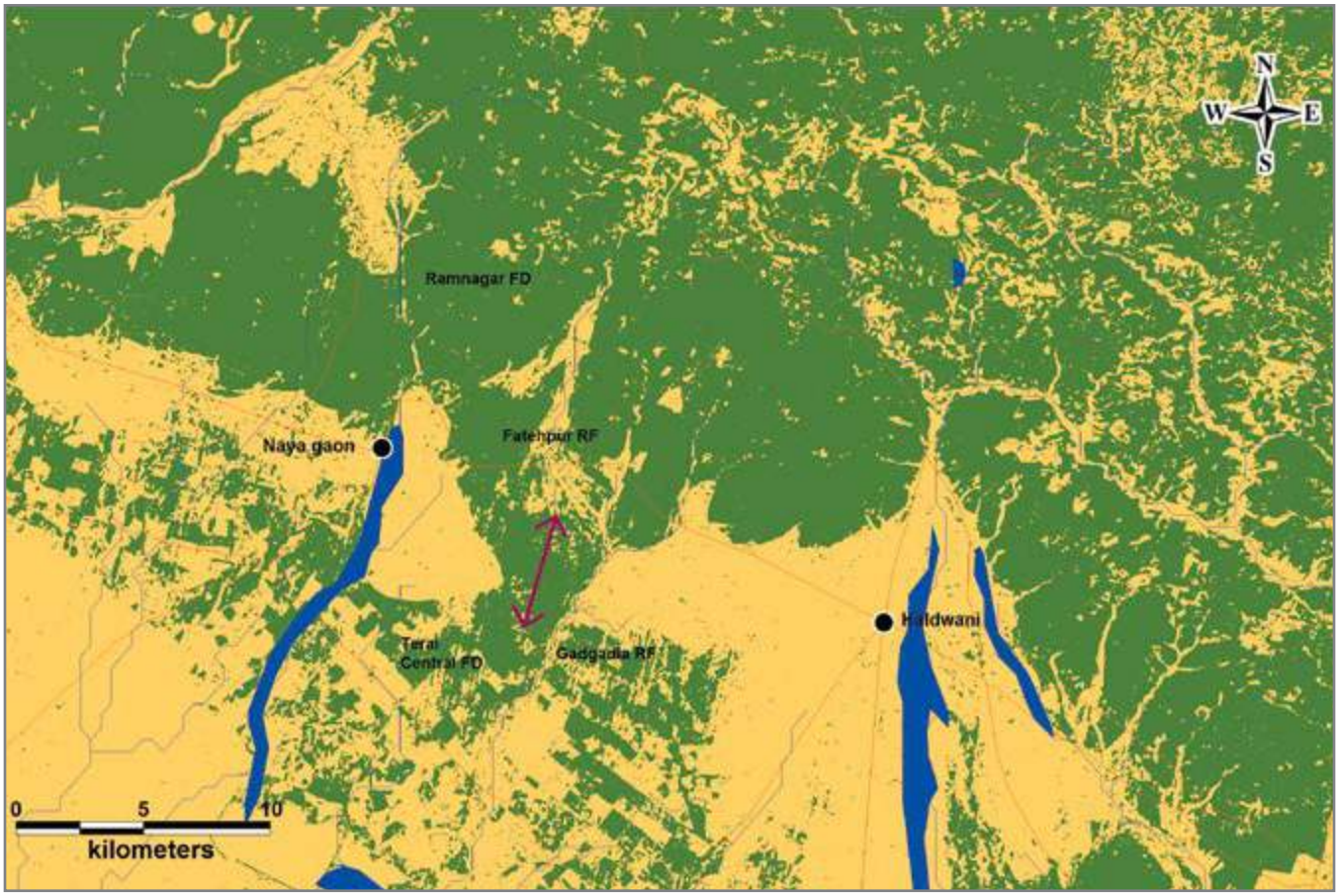
The movement of elephants between Sukhlaphanta National Park through Lagga Bagga to Pilibhit Forest Division and Kishanpur Wildlife Sanctuary has been almost completely impaired due to fragmentation and extreme biotic pressure on the corridor forest from large human settlements and agriculture land between the Sharda River and canal (Hazara, Navediya, Maharajpur, Khirkiya, Dhakka etc). Similarly, the elephant habitat in Dudhwa Tiger Reserve was contiguous with Nepal but is severely threatened due to encroachment. Connectivity with Dudhwa National Park and Katerniaghat Tiger Reserve has been disrupted due to human settlements and continuous biotic pressure. One functional corridor exists in this stretch, through which the elephant population of Katerniaghat Tiger Reserve is connected with Royal Bardia National Park, Nepal, and moves across the Karnali River and agricultural landscape.



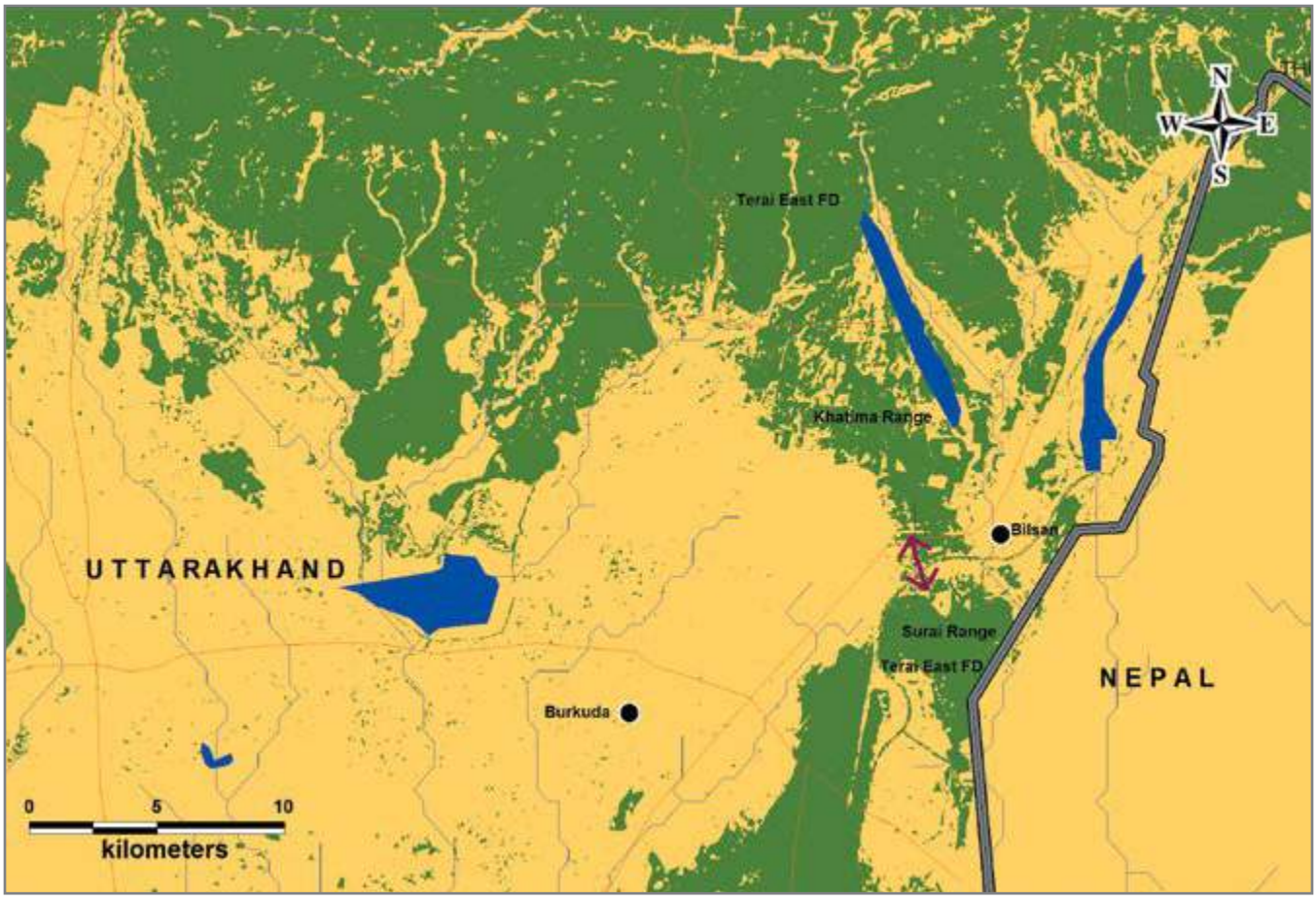
Elephant corridors in North–Western India – Part I



Elephant corridors in North-Western India - Part II



Elephant corridors in North-Western India - Part III



Elephant corridors in North-Western India - Part IV



Fig. 4.01: Elephants in the Chilkiya - Kota corridor

4.01

Kansrau-Barkote

Ecological priority: High

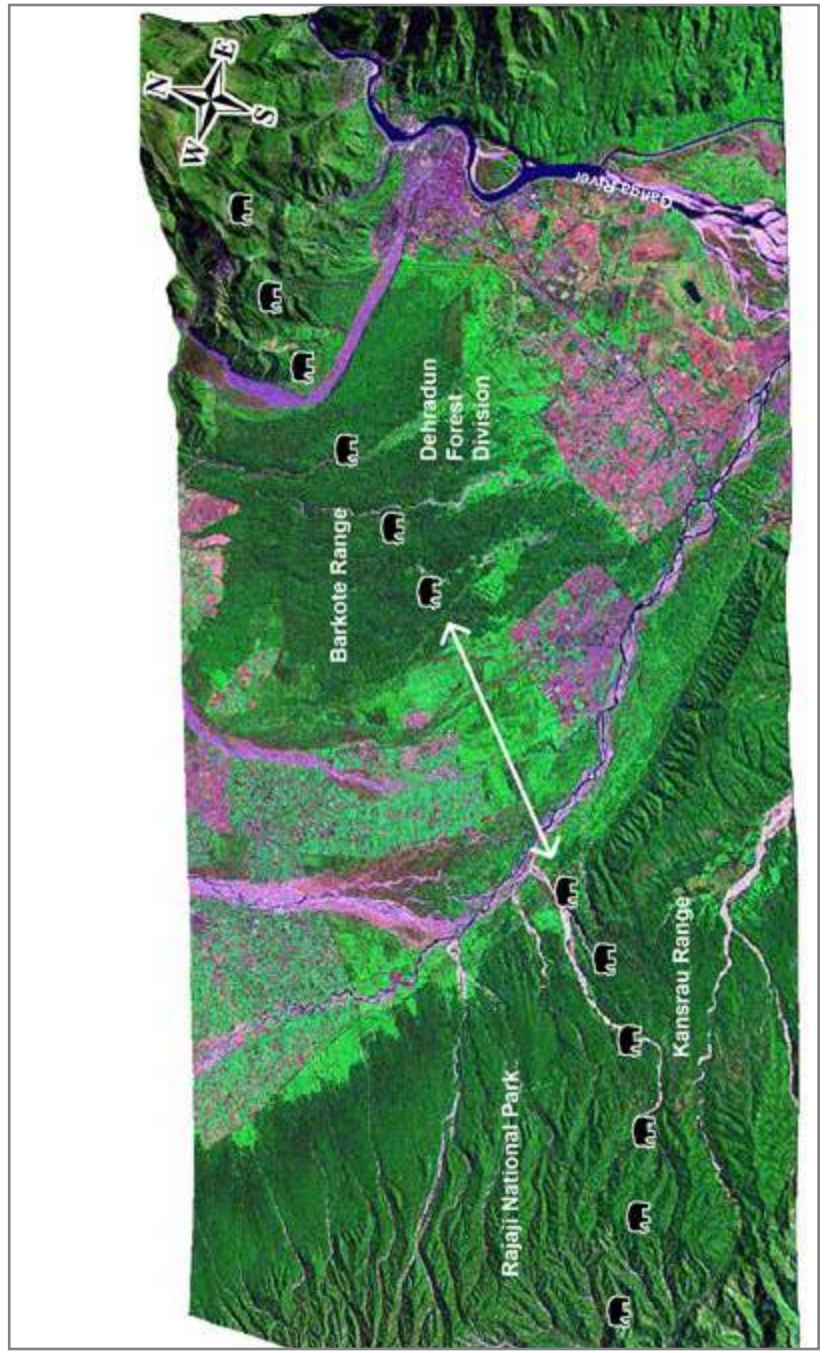
Conservation feasibility: High

The Kansrau-Barkote corridor provides connectivity for elephant movement between the Kansrau Range of Rajaji Tiger Reserve and the Barkote and Rishikesh Ranges of Dehradun Forest Division. The corridor is under severe biotic pressure from the surrounding villages and heavy traffic on the Dehradun-Haridwar highway.

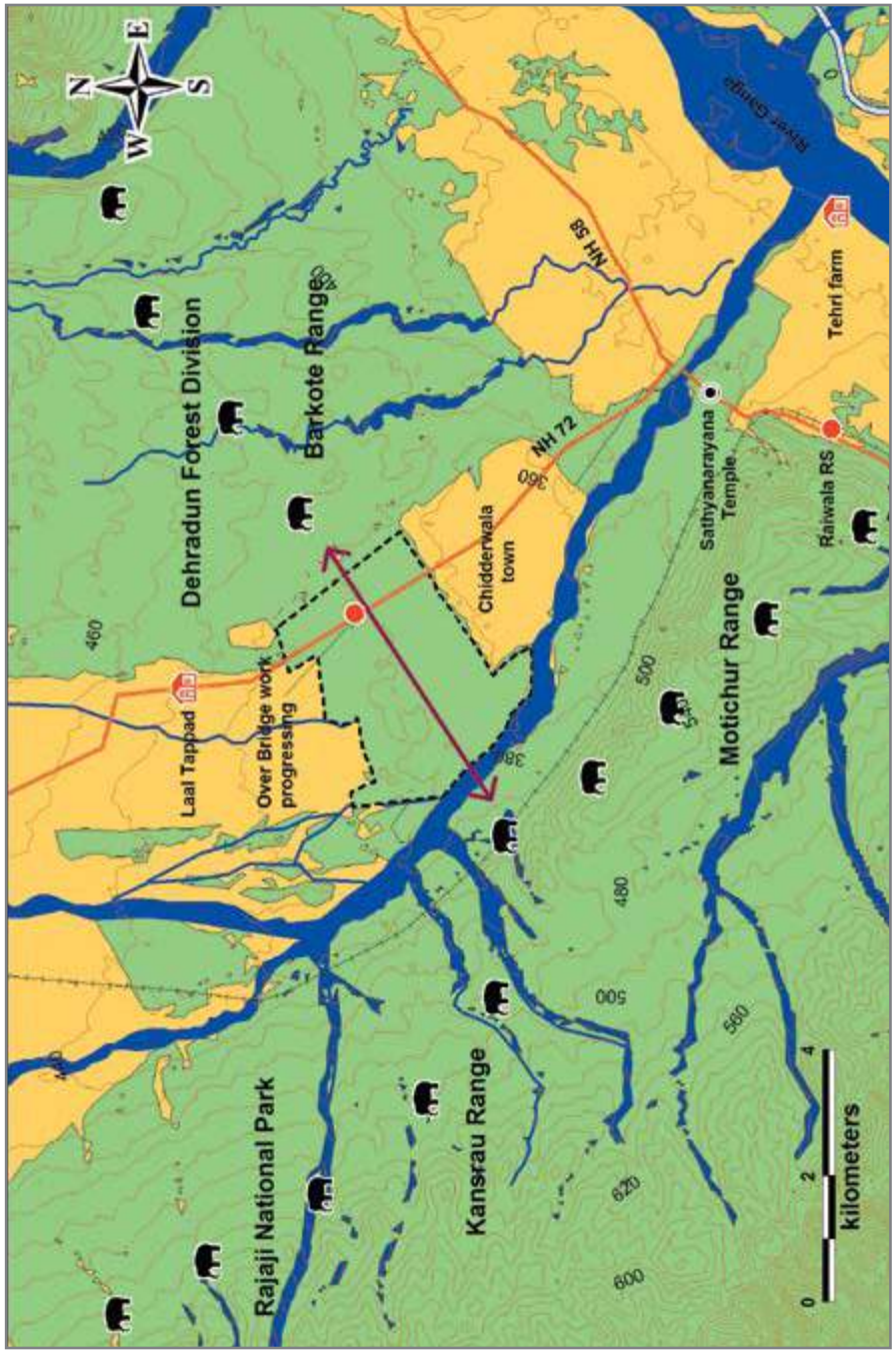
State	Uttarakhand
Connectivity	Kansrau Range of Rajaji Tiger Reserve with Barkote Range of Dehradun Forest Division
Length and Width	4 km and 0.9- 2.2 km
Geographical coordinates	30° 4' 27"- 30° 6' 39" N
	78° 8' 49"- 78° 11' 34" E
Legal status	Reserve Forest
Major land use	Forest
Major habitation/settlements	Nil
Forest type	Tropical dry deciduous forest with plantation of *Acacia catechu*, *Tectona grandis* and *Eucalyptus*
Frequency of usage by elephants	Regular

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 64 tree species were recorded in the sampled area of 0.12 ha. The major species included *Acacia catechu* (13%), *Tectona grandis* (33%), *Trewia nudiflora* (9%), *Ailanthus excelsa* (4%) and *Eucalyptus sp* (2%). Other species included *Mallotus philippensis, Zizyphus mauritiana, shorea robusta* etc. The ground cover was dominated by shrubs (39.3%), grasses (27.8%) and barren ground (23.7%).



3D map showing the landscape of the Kansrau- Barkote Corridor



Map of the Kansrau – Barkote Corridor

Estimated elephant numbers in the landscape

Rajaji National Park: 309

Dehradun Forest Division: 27

(*Elephant Population Estimation, Uttarakhand, 2015*)

The corridor is used by bulls and small groups of 10-12 elephants.

Forest / Land use

Forest Type: Tropical dry deciduous forest with plantation of *Acacia catechu*, *Tectona grandis* and *Eucalyptus*

River: Song

Road: Dehradun – Haridwar Highway (NH 72)

Other ecological importance

Mountain Range: Foothills of the Himalayas

Elephant Range: North-Western Landscape

Elephant Reserve: Shivalik Elephant Reserve

Protected Area: Rajaji National Park and Tiger Reserve

HUMAN DIMENSIONS

Threats

1. *Highway traffic*: High traffic on NH 72 severely impacts elephant movement. On average, 243 vehicles move through the corridor per hour. An average of 344 vehicles ply per hour between 6 am and 6 pm, with a further 142 vehicles per hour between 6 pm and 6 am.

2. *Anthropogenic pressure*: Firewood collection and cattle grazing by the people of Lal Thappar, Chandi, Chiddarwala and Sergarh villages on the fringes of the corridor forest have degraded the quality of vegetation. Illicit felling of trees is also reported from the corridor area.

3. *High-tension power line*: Two high-tension power lines pass through the corridor forest on either side of the Jakhan River.

Corridor dependent villages: There is no village located inside the corridor. Villages such as Lal Thappar (210 households), Chandi (120 households), Shergarh (100 households) and Chhidarwala are located on the fringes of the corridor forest. Villagers depend on the corridor forest mostly for fuelwood and cattle grazing.

Human-Elephant Conflict: Conflict is quite high and a large number of crop depredation cases are reported from fringe villages (Chandi and Chhidarwala).

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent developmental activities affecting elephant movement.

2. Construction of a flyover on NH 72 in the corridor area has to be completed as soon as possible due to heavy vehicular movement throughout the day. Until the flyover is completed, vehicular speeds within the corridor should be regulated by suitable physical barriers.



Fig. 4.02: Groundtruthing of the corridor by the WTI team



Fig. 4.03: Indirect evidence of elephant presence in the corridor

4.02

Motichur-Barkote & Rishikesh

Ecological priority: High

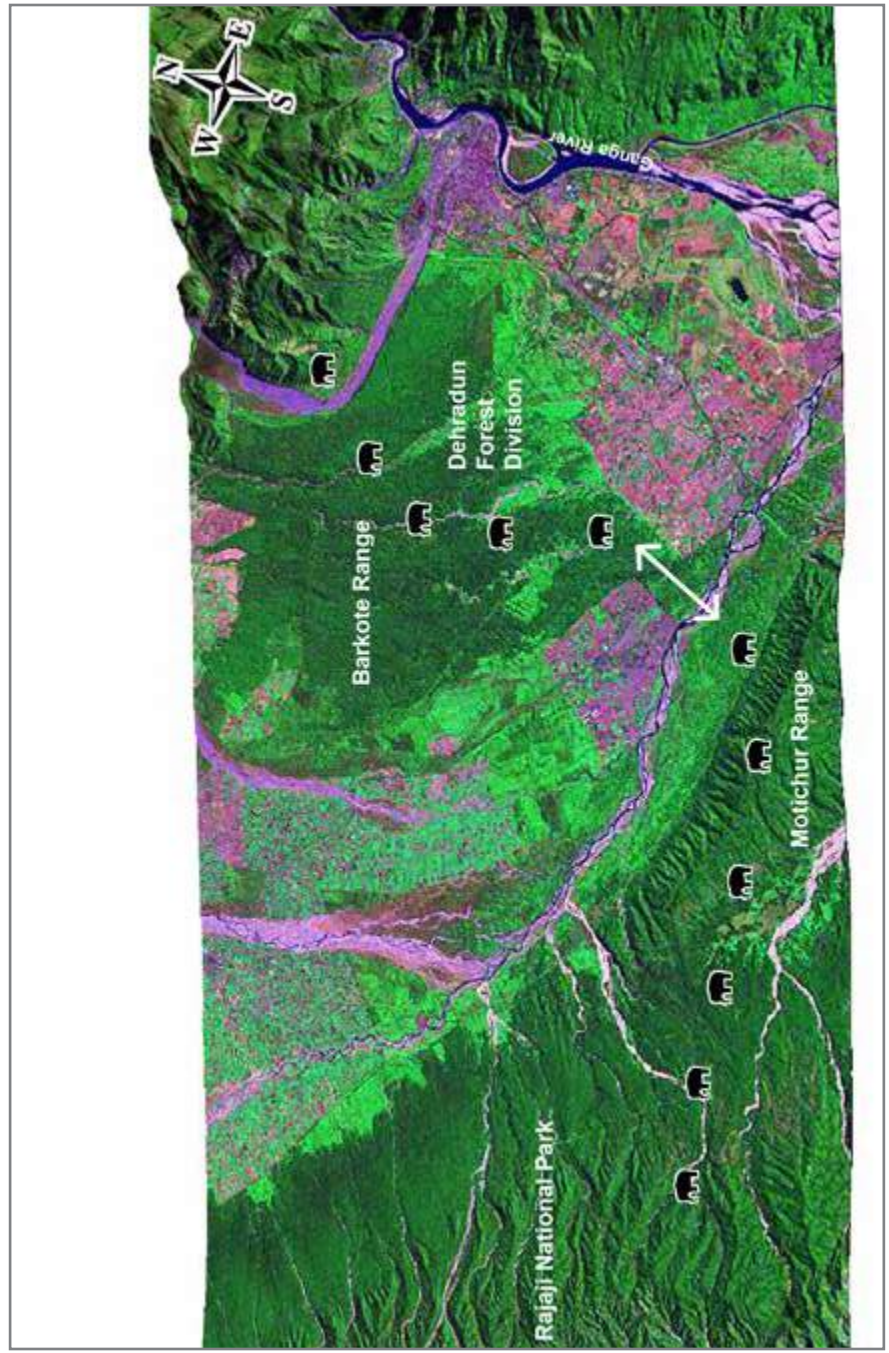
Conservation feasibility: High

Situated between Nepali Farm Junction and Chhiddarwala village along NH 72, this corridor connects the Motichur Range of Rajaji Tiger Reserve with the Barkote and Rishikesh Ranges of Dehradun Forest Division. It comprises the Motichur Range of Rajaji Tiger Reserve (Suswa 5 Block) and the Barkote (Golatappar 7b Block) and Rishikesh Ranges (Gola 6b Block) of Dehradun Forest Division. The corridor is mostly used by bulls and movement intensifies during the cropping season. Elephants generally cross the corridor near Tinpani *nullah* to move between the habitats.

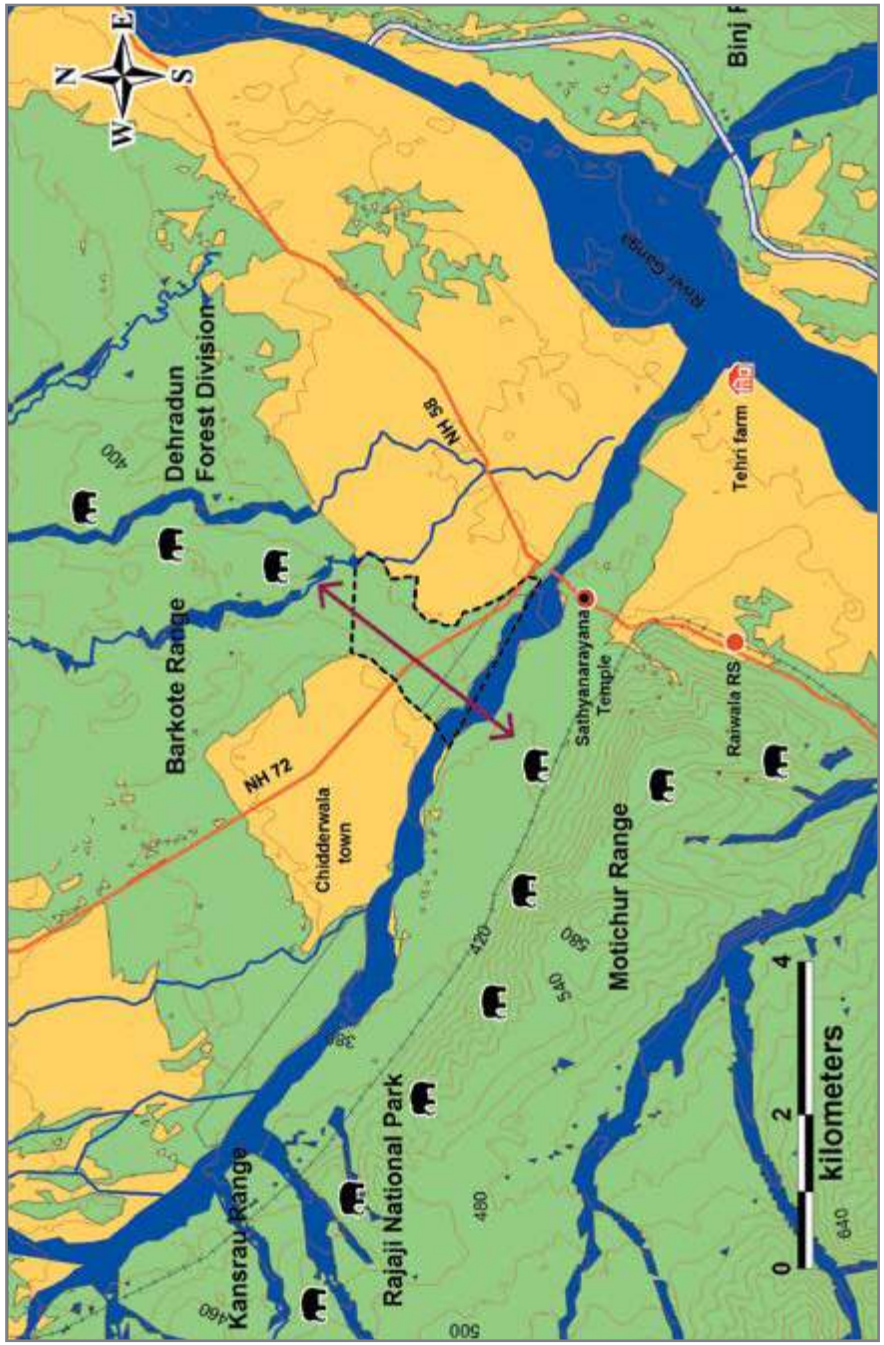
Alternate name	Tinpani Corridor
State	Uttarakhand
Connectivity	Rajaji TR and Dehradun Division
Length and Width	1.5 km and 2 km
Geographical coordinates	30° 3' 14"-30° 4' 34" N 78° 11' 44"-78° 13' 17" E
Legal status	Reserve Forest
Major land use	Forest, Settlement, River and Road
Major habitation/settlements	None
Forest type	Tropical dry deciduous mixed forest and Teak plantation
Frequency of usage by elephants	Occasional

FORESTS AND ELEPHANTS

Corridor habitat status: An average density of 367 trees per ha was observed in the corridor area. *Tectona grandis* (31.8%) and *Syzygium cumini* (20.5%) were dominant species in the sampled area of 0.12 ha. A maximum GBH of 108.6 cm



3D map showing the landscape of the Motichur - Barkote and Rishikesh Corridor



Map of the Motichur - Barkote and Rishikesh Corridor

was measured for *Syzygium cumini.* Thick undergrowth was observed in all the sample plots due to the ongoing monsoon season, with only about 5% of the ground being barren. The ground cover was dominated by curry leaves (*Murraya koenigii*), *Trewia nudiflora*, Kala bansa (*Barleria sp*), *Syzygium cumini, Cassia fistula, Diospyros melanoxylon* etc. Other species included *Mallotus philippensis, Zizyphus mauritiana, Shorea robusta* etc. The ground cover was dominated by shrubs (39.37%) followed by grasses (27.81%) and barren ground (23.75%).

Estimated elephant numbers in the landscape

Rajaji Tiger Reserve: 309

Dehradun Forest Division: 27

(*Elephant Population Estimation, Uttarakhand, 2015*).

Forest/Land use

Forest Type: Tropical dry deciduous mixed forest and teak plantation

River: Song; Tinpani *nullah*

Road: Dehradun – Haridwar Highway (NH 72)

Other ecological importance

Mountain Range: Himalayas

Elephant Range: North-Western Landscape

Elephant Reserve: Shivalik Elephant Reserve

Protected Area: Rajaji Tiger Reserve

HUMAN DIMENSIONS

Threats

1. Settlements and biotic pressure: Though the corridor has no settlements, biotic pressure arises from the large human population of fringe villages. The people of Sahab Nagar, Khairi Kalan and Khairi Khurd collect fuelwood and Non Timber Forest Produce (NTFP) from the corridor forest, which has degraded its habitat.

2. Highway traffic: High traffic and the expansion of NH 72 is severely affecting elephant movement. On average, 243 vehicles move through the corridor per hour, with 344 vehicles per hour moving between 6 am and 6 pm, and a further 142 vehicles per hour between 6 pm and 6 am. The ongoing expansion of NH 72 has further hindered elephant movement due to sound pollution, increased human presence and construction material being dumped along the corridor.

3. *A high-tension electric line* passes through Suswa 5 Block of the Motichur Range and Gola 6b Block of Rishikesh Range. The sagging of this electric line could be fatal for elephants.

4. *Boundary wall and canteen building in Tinpani park:* The boundary wall and canteen building of the abandoned Tinpani Recreational Park (Golatappar 7b Block) are major obstacles to elephant movement.

Corridor dependent villages: Khairikalan, Khairi Khurd and Sahab Nagar.

The fringe villages of Khairikalan (147 households), Khairi Khurd (293 households) and Sahab Nagar (375 households), and the biotic pressure they exert (fuelwood and NTFP collection) has degraded the corridor forest.

Human-Elephant Conflict: Conflict is reported from villages on the corridor periphery. Conflict intensifies during the cropping season, mostly by the bulls. Human-leopard conflict has increased in recent months.

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent developmental activities affecting elephant movement.

2. Electric line pillar posts in the corridor need to be strengthened and the high-tension line should be periodically monitored to prevent sagging.

3. The boundary wall and the abandoned canteen building of Tinpani Recreational Park should be demolished to aid unhindered movement of elephants. Activities deterimental to wildlife movement within the forest should be prevented.

4. As the corridor forest runs along NH 72 for about a kilometre, speed breakers should be installed at both ends of this stretch to reduce vehicular speeds at night, since the majority of elephant movement is reported after dark.

5. Suitable elephant proof barriers could be dug along the forest boundary of Suswa 5 Block of the Motichur Range and Golatappar 7b Block of the Barkote Range to reduce conflict in fringe villages. A 500-metre-long trench is already in place along the forest boundary of the Gola 6b Block of the Rishikesh Range.



Fig. 4.04: Elephant in the Motichur-Barkote Corridor

4.03
Motichur – Gohri

Ecological priority: Medium

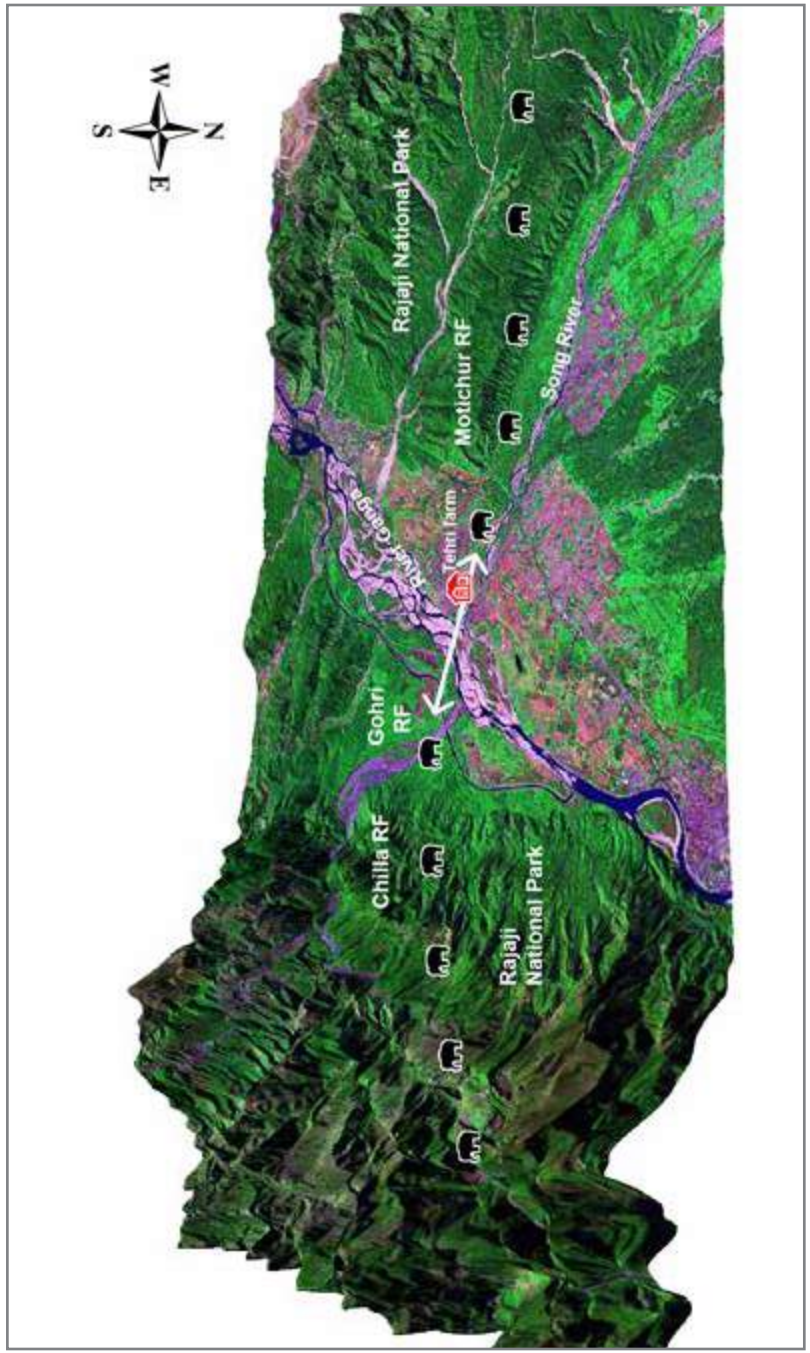
Conservation feasibility: Medium

This corridor connects the Motichur and Gohri Ranges of Rajaji Tiger Reserve across the Ganga River. Elephants move along the Song River and through Raiwala Block 2 and Suswa Block, crossing the road near the Satyanarayan Temple. Due to the tremendous pressure from villages as well as roads and other development activities, elephant movement has greatly reduced through this corridor.

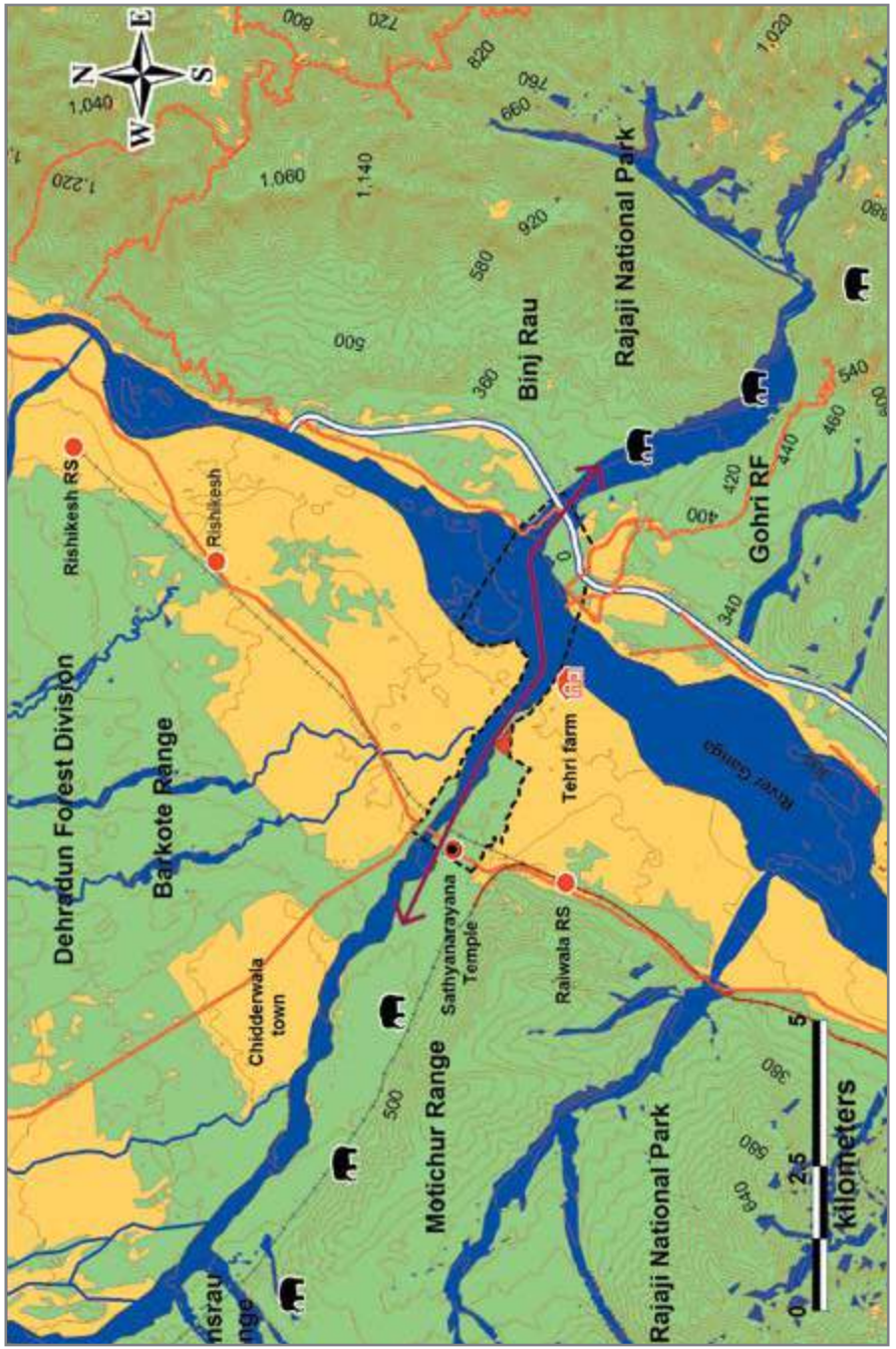
Alternate Name	Binj-Rau
State	Uttarakhand
Connectivity	Motichur and Gohri Ranges of Rajaji Tiger Reserve
Length and Width	5 km & 1-0.3 km
Geographical coordinates	30° 1’ 39”-30° 3’ 19” N 78° 12’ 40”-78° 16’ 45” E
Legal status	Rajaji Tiger Reserve, Revenue Land
Major land use	Forest, human settlements, agriculture land and river
Major habitation/settlements	Tehri Farm, Gohri Maphi (part) and Ganga Bhogpur
Forest type	Tropical dry deciduous forest, sal and teak plantation
Frequency of usage by elephants	Rare; bulls and small herds

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 67 plant species were recorded in the sampled area of 0.2 ha. The average GBH and height recorded were 86.23 cm and



3D map showing the landscape of the Motichur–Gohri Corridor



Map of the Motichur–Gohri Corridor showing the land to be secured

23.5 m respectively. Average tree density was 310 trees per ha. *Tectona grandis* and *Shorea robusta* were dominant species. Other species included *Mallotus phillipinensis, Acacia catechu, Zizyphus mauritiana* etc.

The ground cover was dominated by barren ground (43.1%), shrubs (28.7%) and herbs (24.3%) with the remaining area covered by grasses.

Estimated elephant numbers in the landscape

Rajaji National Park: 309

(Elephant Population Estimation, Uttarakhand, 2015)

Forest/Land use

Forest Type: Tropical dry deciduous forest

Settlements: Gohri Maphi (part) and Tehri Farm. Ganga Bhogpur (on the other side of the Ganga River), Satyanarayan Forest Rest House

Rivers: Ganga and Song

Road: Haridwar-Dehradun (NH 72)

Railway: Rishikesh-Haridwar

Buildings/Artefacts: Chilla power canal, Satyanarayan Temple

Other ecological importance

Mountain Range: Himalayas

Elephant Range: North-Western Landscape

Elephant Reserve: Shivalik Elephant Reserve

Protected Area: Rajaji Tiger Reserve

HUMAN DIMENSIONS

Threats

1. Highway traffic: Heavy traffic on NH 72 severely affects elephant movement. On average, 571 vehicles per hour move through the corridor. Between 6 am and 6 pm, 808 vehicles ply per hour. A further 333 vehicles ply per hour between 6 pm and 6 am. Although an overpass for vehicles was planned and work started

about three years ago, this is currently on hold. The incomplete structure and construction debris has severely affected elephant movement.

2. Railway line: (Haridwar- Rishikesh): Between 14 and 16 trains pass through the corridor every day, of which four trains run between 6 pm and 6 am.

3. Settlements: Tehri Farm, Gohri Maphi and Ganga Bhogpur settlements act as physical barriers and are sources of anthropogenic pressure, hindering the free movement of elephants and other wild animals.

4. Chilla power canal: With its cemented embankments, the Chilla power canal is a major hurdle to elephant movement. The small bridge on the canal is mostly used by solitary bulls and rarely by small herds. Traffic movement between Chilla and Rishikesh hinders elephant movement.

5. Satyanarayan Temple: Biotic pressure from devotees as well as the structure itself hinders animal movement.

6. Satyanarayan Forest Rest House is situated inside the corridor.

Corridor Villages: Tehri Farm (50 families), Ganga Bhogpur (201 families and a population of 1150), and part of Gohri Maphi.

Corridor dependent villages: Gohri Maphi (part).

Human-Elephant Conflict: From 2003 to 2013 there were 2158 cases of human injury/livestock death/crop damage/property loss due to conflict with elephants reported in Rajaji National Park.

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent developmental activities affecting elephant movement.

2. Construction of a flyover on NH 72 in the corridor area has to be completed as soon as possible due to heavy vehicular movement throughout the day. Until the flyover is completed vehicle speeds within the corridor should be regulated by suitable physical barriers.

3. Traffic movement between Chilla and Rishikesh has to be regulated.

4. Train speeds must be regulated and steps taken to prevent the dumping of food waste on the track in the corridor area.

5. Screens should be installed on both sides of the road bridge on the Song River to minimise the effect of vehicle headlights.

6. An animal friendly bridge with sufficient width has to be built on the Chilla power canal to facilitate animal movement.

7. In consultation with villagers, 26 acres of land need to be secured in Tehri Farm along the Song River.

4.04
Chilla- Motichur

Ecological priority: High

Conservation feasibility: High

This corridor extends across the Ganga and connects the western part of Rajaji Tiger Reserve (and thereby Dehradun Forest Division and Shivalik Forest Division) to the eastern part, maintaining the Rajaji-Corbett elephant population as a single entity. Elephants mostly move through Motichur *rau*, the former Khandgaon-III village, and areas adjacent to the army ammunition dump to move between the habitats.

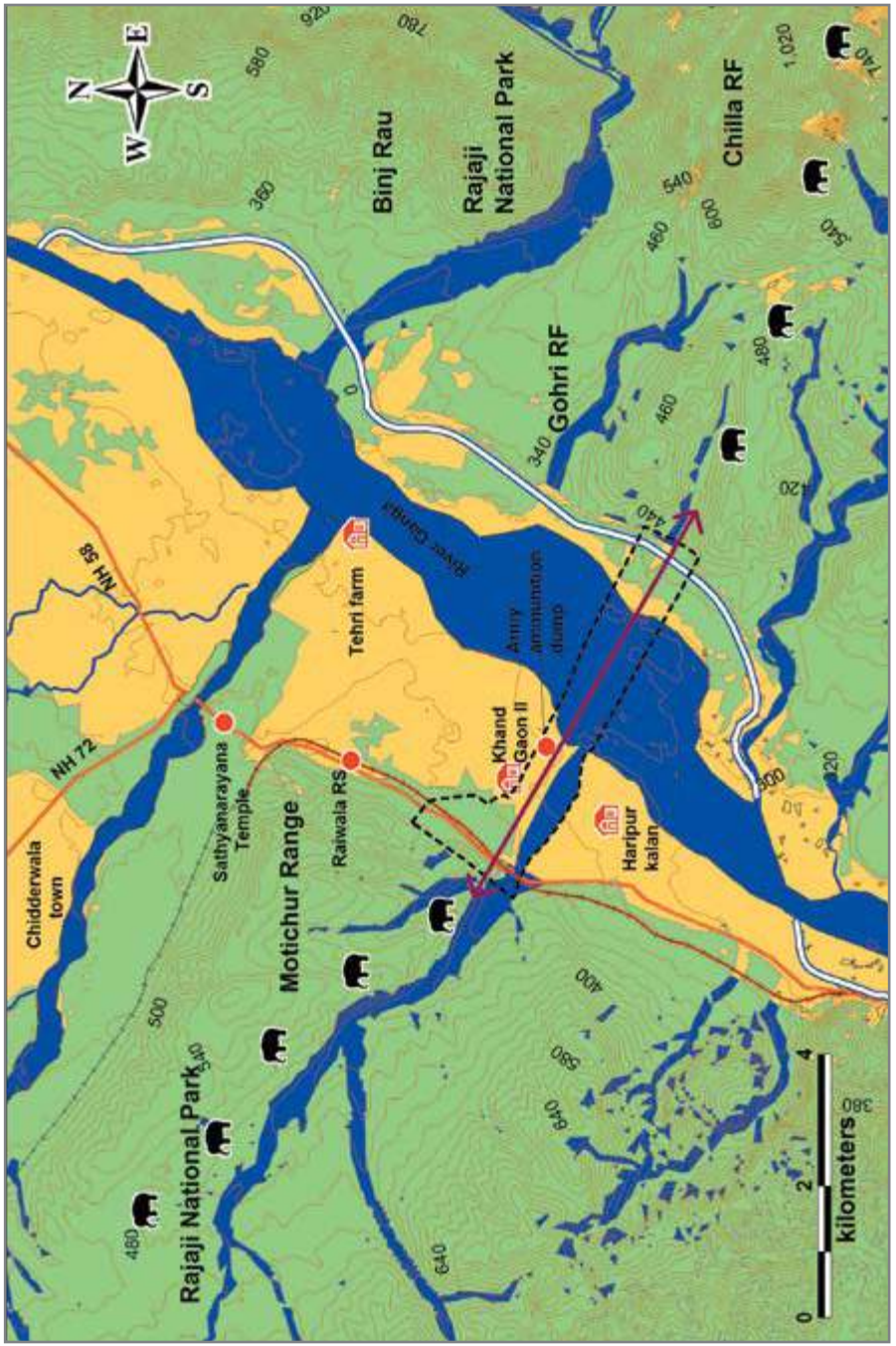
State	Uttarakhand
Connectivity	Motichur Range with Chilla Range of Rajaji Tiger Reserve
Length and Width	4 km and 1 km
Geographical coordinates	29° 59′ 3″-30° 1′ 24″ N 78° 11′ 16″-78° 14′ 46″ E
Legal status	Revenue Land, Reserve Forest and Tiger Reserve
Major land use	Forest, agriculture, human settlements, road, railway line, river and power canal
Major habitation/settlements	Nil; (Khandgaon-III relocated to Lalpani)
Forest type	Tropical dry deciduous sal forest and teak plantation
Frequency of usage by elephants	Regular; throughout the year

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 39 plant species were recorded in the sampled area of 0.4 ha. Average GBH and height were 68.23 cm and 22.5 m respectively.



3D map showing the landscape of the Chilla- Motichur area showing the corridor



Map of the Chilla – Motichur Corridor showing artefacts and Khand Gaon-III village

Average tree density was 210 trees per ha. *Tectona grandis* was dominant and also extensively debarked by elephants in this corridor. Other species included *Mallotus philippensis, Shorea robusta, Adina cordifolia, Ehretia laevis, Aegle marmelos, Holarrhena antidysenterica, Trewia nudiflora, Lagerstroemia parviflora, Mitragyna parviflora, Terminalia tomentosa* etc.

The ground cover was found to be dominated by shrubs (45.6%), herbs (30%) and grasses (11.2%). The remaining area was barren ground.

Estimated elephant numbers in the landscape

Rajaji National Park: 309
(Elephant Population Estimation, Uttarakhand, 2015)

Forest/Land use

Forest Type: Tropical dry deciduous sal forest and teak plantation
Settlements: Khandgaon-III (relocated to Lalpani, Rishikesh)
Rivers: Ganga, Motichur *rau*
Road: Haridwar-Dehradun (NH 72)
Railway: Haridwar-Dehradun
Artefacts: Army ammunition dump, Chilla power Canal

Other ecological importance

Mountain Range: Himalayas
Elephant Range: North-Western Landscape
Elephant Reserve: Shivalik Elephant Reserve
Protected Area: Rajaji Tiger Reserve

HUMAN DIMENSIONS

Threats

1. Settlements: Anthropogenic pressure (fuelwood collection and grazing) from fringe villages (Khandgaon-II and III and Haripurkalan) impacted the corridor forest. Khandgaon-III has now been relocated to Lalpani, Rishikesh.

2. Highway traffic: Heavy traffic on NH 72 severely affects elephant movement. Between 6 am and 6 pm, 808 vehicles move through the corridor per hour on average. A further 333 vehicles ply per hour between 6 pm and 6 am. Although an overpass for vehicles was planned and work started about three years ago, this is currently on hold. The incomplete structure and construction debris has severely affected elephant movement.

3. Railway line (Haridwar- Dehradun): Over 60 trains pass through the corridor every day, with an average of 2.5 trains per hour. Train-hits on this line have resulted in the death of 22 elephants since 1987.

4. Chilla power canal: With its cemented embankments, the Chilla power canal is a major hurdle to elephant movement. The small bridge on the canal is mostly used by solitary bulls and at times by small herds. Traffic movement between Chilla and Rishikesh hinders elephant movement.

5. Army ammunition dump: The concrete boundary of this area hinders elephant movement. Sound pollution from nearby firing range also affects elephant movement.

Corridor villages: The Khandgaon-III settlement was situated inside the corridor and had 31 households with a population of about 130-140. To secure the corridor, the families have been rehabilitated to alternate site at Lalpani, Rishikesh.

Corridor dependent villages: Khandgaon-II (35 families), part of Khandgaon-III (15-16 families) and Haripurkalan (75-80 families)

Human-Elephant Conflict: Three human deaths (one adult female and two children) were reported in the corridor area due to a tusker attack on November 5, 2010.

The incidence of human-elephant conflict in and around Rajaji National Park is quite high. About 12 human deaths, 23 cases of human injury and more than 1900 cases of crop depredation were reported between 2003-04 and 2013-14.

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent developmental activities affecting elephant movement.

2. Rehabilitation of Khandgaon-III: villagers that resided within the corridor have been relocated to Lalpani Block II of the Rishikesh Range.

3. Construction of a flyover on NH 72 in the corridor area has to be completed as soon as possible due to heavy vehicular movement throughout the day.

4. Train speeds need to be regulated and an Animal Detection System installed along the tracks. Dumping of food waste on tracks in the corridor must be prevented. Until the Animal Detection system is in place, night patrolling of critical sections of the track by Wildlife Trust of India, Northern Railways and the Uttarakhand Forest Department should continue.

5. The army ammunition dump should be shifted to alternate site outside the corridor.

6. Animal friendly bridges have to be created on the Chilla power canal, with sufficient width to facilitate animal movement. The movement of vehicles between Chilla and Rishikesh needs to be regulated, especially in the mornings and evenings.

7. Habitat restoration of the degraded corridor forest in the land vacated by Khandgaon-III residents needs to be undertaken.

4.05
Rawasan–Sonanadi (Via Lansdowne FD)

Ecological priority: High

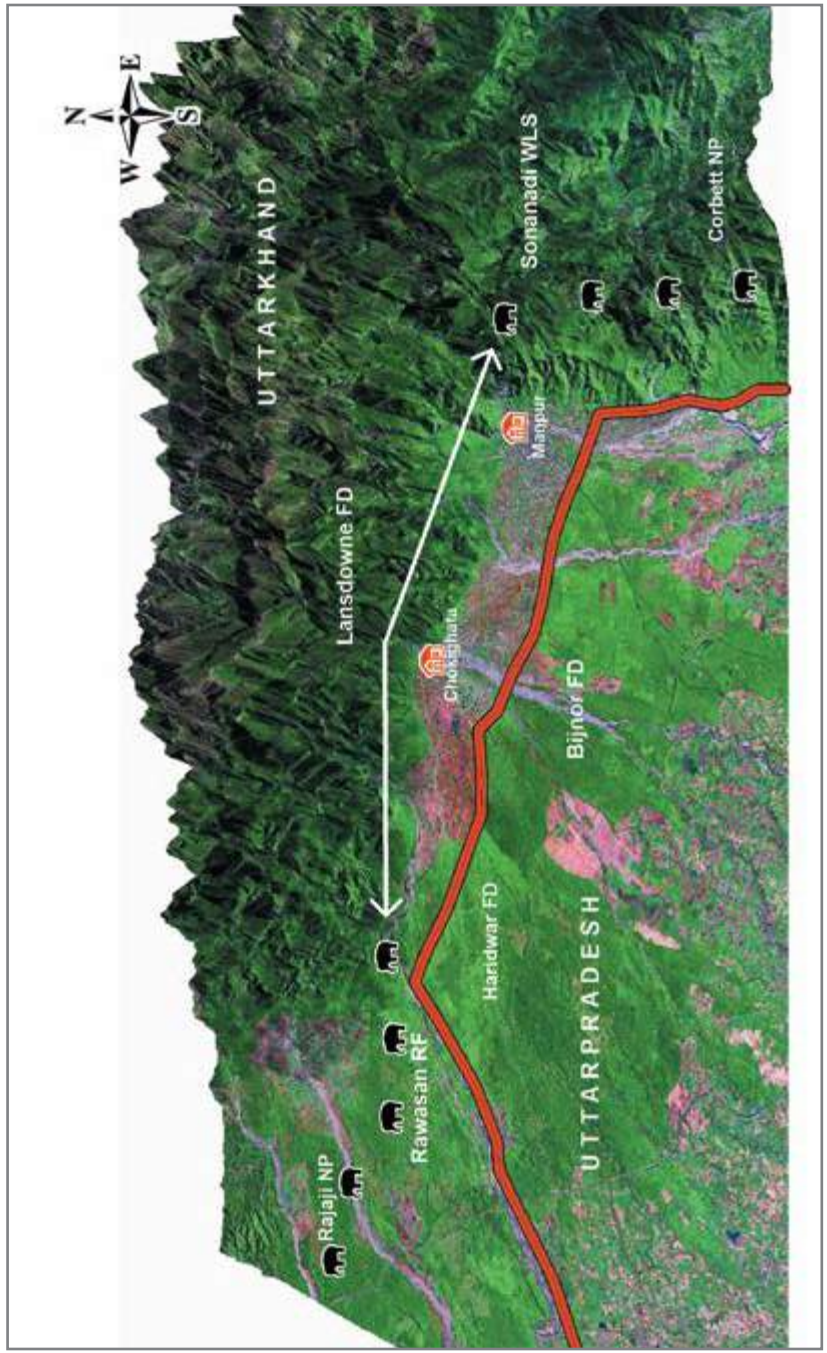
Conservation feasibility: Medium

This corridor connects Rajaji and Corbett Tiger Reserves. Elephants use the foothills between Rawasan (at the eastern end of Rajaji Tiger Reserve) and the Khoh River (western end of Corbett Tiger Reserve) and pass through the Rawasan, Sigaddi, Malan, Gawalgarh, Sukhrao, Giwain and Totgadhera blocks in the hilly terrain of Lansdowne Forest Division.

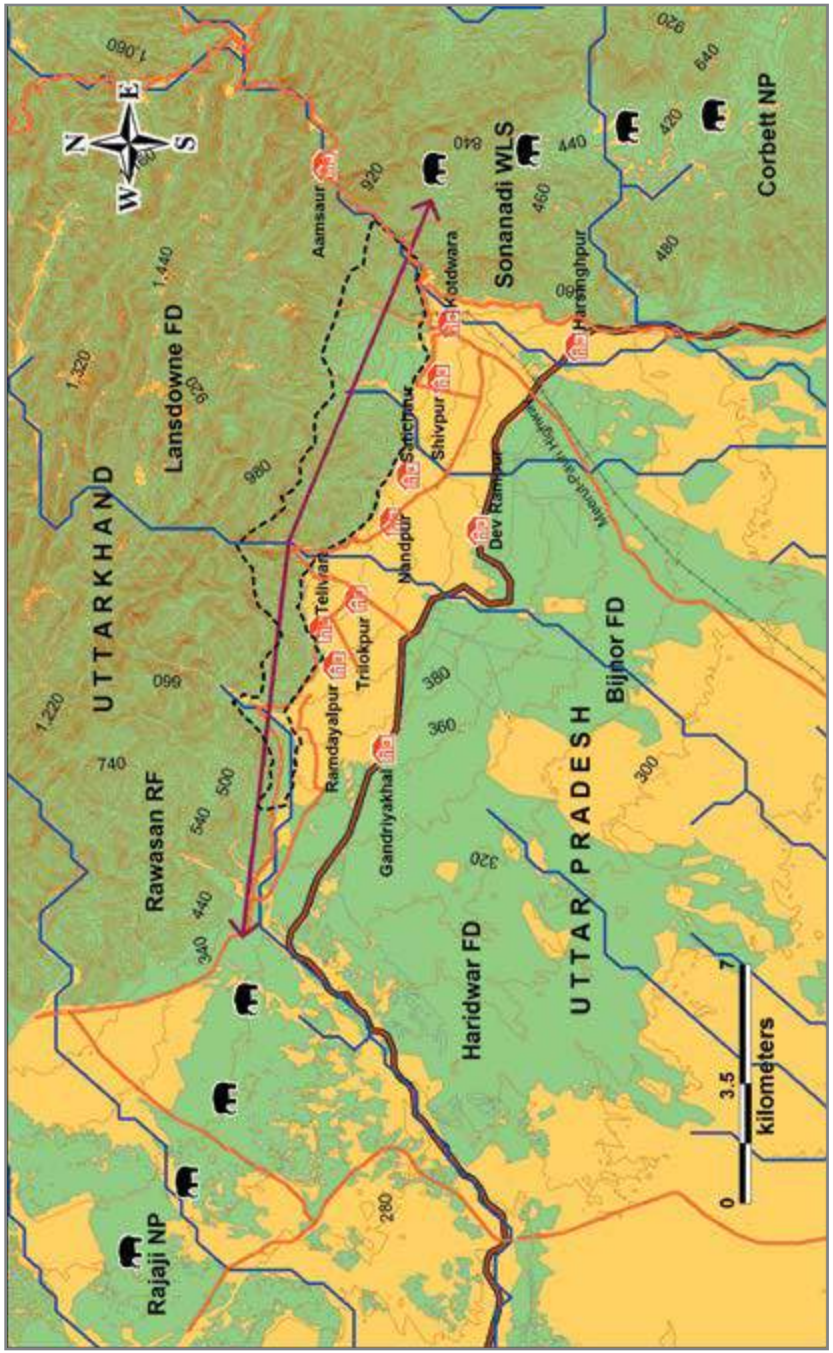
Alternate Name	Rajaji-Corbett
State	Uttarakhand
Connectivity	Rajaji Tiger Reserve and Corbett Tiger Reserve
Length and Width	21 km and 1–2 km
Geographical coordinates	29° 45′ 25″-29° 48′ 32″ N 78° 22′ 46″-78° 33′ 27″ E
Legal status	Reserve Forest & Revenue Land
Major land use	Forest, settlements and agriculture
Major habitation/settlements	Various Gujjar *deras* (settlements)
Forest type	Tropical dry deciduous sal forest
Frequency of usage by elephants	Regular, both bulls and herds use this corridor

FORESTS AND ELEPHANTS

Corridor habitat status: This is a sal (*Shorea robusta*) dominated mixed forest. Other species include *Anogeissus latifolia, Desmodium oojeinense, Bauhina roxburghiana, Syzygium cumini, Terminalia alata, Butea monosperma, Mallotus philippensis, Cassia fistula* etc. The main shrubs found are *Zizyphus mauritiana* and *Helicteres isora*.



3D map showing the landscape of the Rawasan–Sonanadi (via Lansdowne FD) corridor



Map of Rawsan–Sonanadi (via Lansdowne) corridor

Estimated elephant numbers in the landscape

Lansdowne Division: 160
Rajaji National Park: 309
Corbett Tiger Reserve: 1035
(Source: Elephant Population Estimation, Uttarakhand, 2015)

Elephant movement is regular and both bulls and family herds use the corridor, although in small groups of 5-10.

Forest/Land use

Forest: Tropical dry deciduous sal forest
Settlements: A large number of Gujjar settlements (*deras*)
River: Sonanadi
Road: Lansdowne to Pauri (NH 119)

Other ecological importance

Mountain Range: Himalayas
Elephant Range: North-Western Landscape
Elephant Reserve: Shivalik Elephant Reserve
Protected Areas: Sonanadi Wildlife Sanctuary, Rajaji Tiger Reserve and Corbett Tiger Reserve

HUMAN DIMENSIONS

Threats

1. Settlements and anthropogenic pressure: A large number of settlements are located all along the corridor. People in these setllements depend on the corridor forest for fuelwood and grazing their livestock.

The corridor has a large number of settlements towards its southern part and the biotic pressure from these villages (again mainly fuelwood extraction and cattle grazing) is a major threat to the corridor.

2. Heavy traffic on NH 119 (Lansdowne to Pauri) threatens elephant movement

between the habitats. Pauri being the district headquarters, Kotdwar a major business destination and Lansdowne the headquarters of the Garhwal Rifles regiment, traffic volume is a major issue. On average, 243 vehicles move through the corridor per hour, with 344 vehicles per hour between 6 am and 6 pm, and a further 142 vehicles per hour between 6 pm and 6 am.

3. Encroachment in the Malan River area near Karalghati, Laldhang and Kotdwar areas is another problem.

Corridor dependent villages: Jhandi Chaur, Ram Dayalpur, Laldhang, Chamaria, Nayagaon, Bhubdevpur, Mandevpur, Kishandevpur, Shrirampur, Jaidevpur, Dalipur, Ramdayalpur, Lokmanipur, Udairampur, Teliwara, Bhimsinghpur, Kothala, Mawakot, Satichaur, Dhrubpur, Lalpur, Shivpur, Kotdwar, Gewai, Grastanganj, Ratanpur, Khumichaur, Bisanpur, Nathupur, Aamsaur, Jamargaddi, Ramripulinda, Aldawa etc.

Human-Elephant Conflict: Human-elephant conflict is high in this region. From 2007 to 2012, a total of 76 cases of human injury/death were reported in Lansdowne Forest Division. During the same period, 344 cases of crop damage by elephants were reported. High levels of conflict with leopards and tigers are also reported in and around the corridor area. Between 2008 and 2010, 23 cattle were lost to tigers and 241 livestock predated by leopards, with most incidents reported from the Laldhang Range (*Malviya and Ramesh, 2015*).

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent developmental activities affecting elephant movement.

2. Demarcation of the forest boundary on southern side of the corridor could be carried out. Power fences could also be provided in fringe villages in the southern part of the corridor to mitigate conflict.

3. Settlements from the Laldhang and Kotdwar Ranges within the corridor could be relocated near the southern periphery of the Chiriyapur Range of Haridwar Forest Division in consultation with the residents, many of whom have expressed their willingness to relocate.

4. Vehicular traffic needs to be regulated at night through suitable barriers. A flyover could also be constructed between Lal Pul and Aamsaur.



Fig. 4.05: A signage in the corridor for public awareness

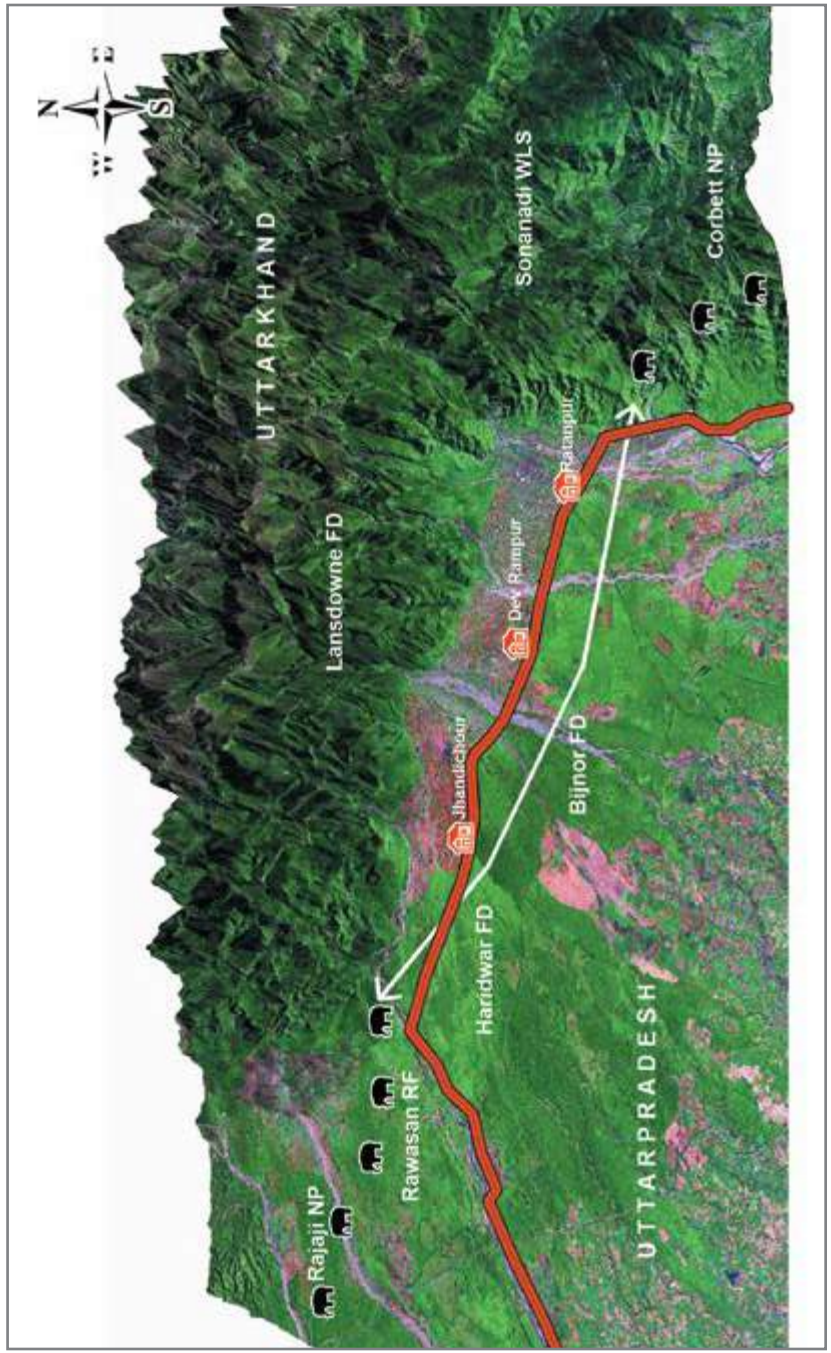
4.06
Rawasan–Sonanadi (Via Bijnor Forest Division)

Ecological priority: High

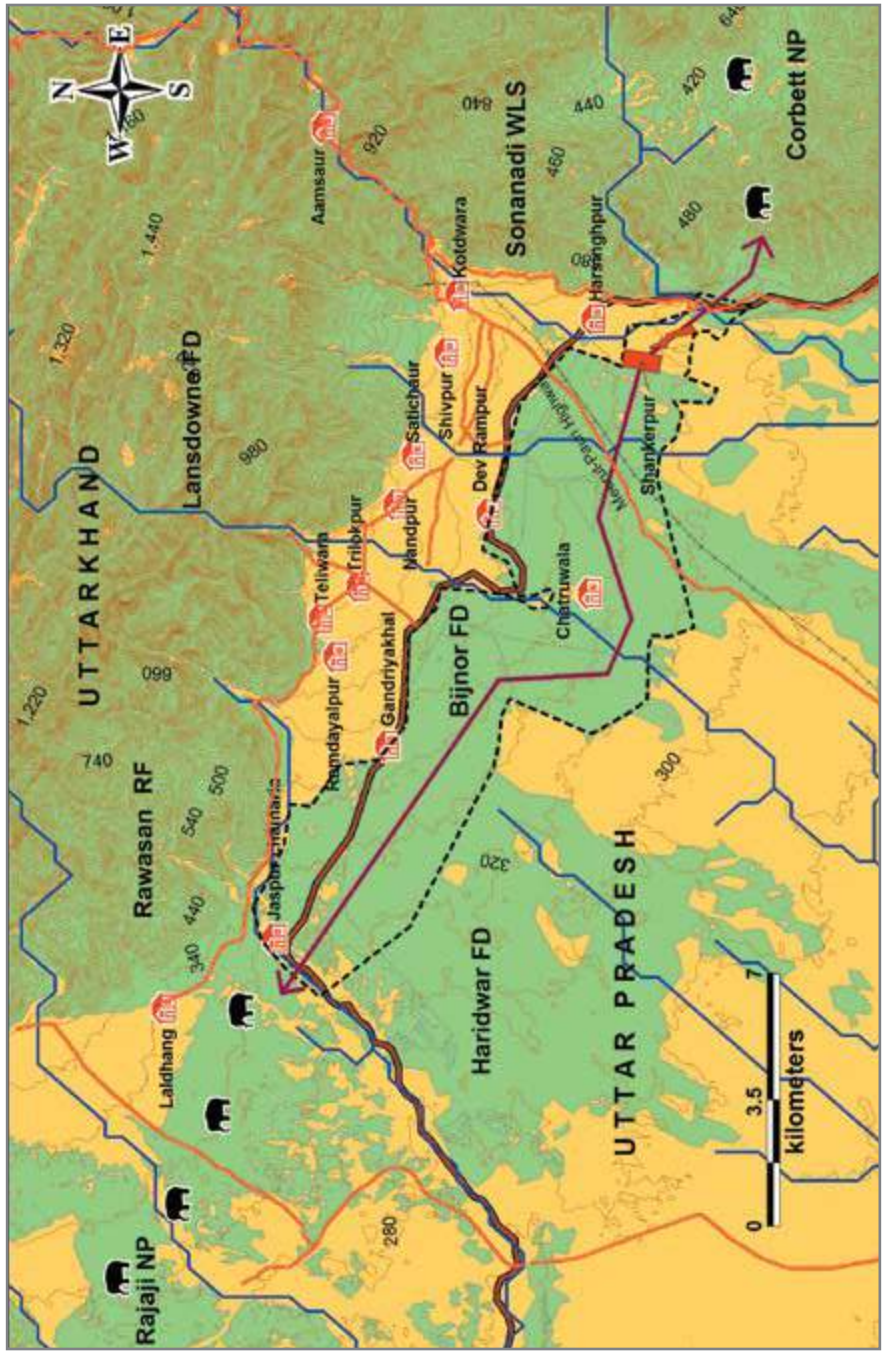
Conservation feasibility: Medium

This corridor, which extends between the Khoh River (Sonanadi Wildlife Sanctuary west of Corbett Tiger Reserve) and the eastern end of Rajaji Tiger Reserve (Rawasan), passes through Bijnor Forest Division in Uttar Pradesh and is extremely degraded due to agriculture and the influx of people from the hill areas. Moving from Corbett Tiger Reserve (Sonanadi Reserve Forest), elephants pass through the Saneh Reserve Forest (Compartment 2) and cross the Khoh River to enter the Kauria Range of Bijnor Forest Division between Deven Nagar and Shankerpur Farm.

Alternate Name	Rajaji-Corbett
State	Uttarakhand
Connectivity	Rajaji National Park and Corbett Tiger Reserve
Length and Width	28 Km and 0.1-11 km
Geographical coordinates	29° 40′ 46″-29° 48′ 9″ N 78° 19′ 31″-78° 31′ 38″ E
Legal status	Reserve Forest, Patta Land
Major land use	Forest, settlements and agricultural land
Major habitation/settlements	Gujjar Basti, Devennagar, Shankerpur, Chatruwala
Forest type	Tropical dry deciduous forest
Frequency of usage by elephants	Occasional (solitary and herds)



3D map showing the landscape of the Rawasan–Sonanadi (Via Bijnor FD) corridor



Map of Rawsan–Sonanadi (via Bijnor FD) corridor

FORESTS AND ELEPHANTS

Corridor habitat status: This is a sal (*Shorea robusta*) dominated mixed forest. Other species include *Anogeissus latifolia, Desmodium oojeinense, Bauhina roxburghiana, Syzygium cumini, Terminalia alata, Butea monosperma, Mallotus philippensis, Cassia fistula* etc. The main shrubs found were *Zizyphus mauritiana* and *Helicteres isora*.

Estimated elephant numbers in the landscape

Lansdowne Division: 160
Rajaji Tiger Reserve: 309
Corbett Tiger Reserve: 1035
(Source: *Elephant Population Estimation, Uttarakhand, 2015*)

Forest/Land use

Forest type: Tropical dry deciduous forest
Settlements: Gujjar *deras*, Deven Nagar, Shankerpur Farm and Chatruwala
Road: Najibabad-Kotdwar (NH 119), Kotdwar-Kalagarh–Kotdwar
Railway: Najibabad-Kotdwar Railway Line

Other ecological importance

Mountain Range: Himalayas
Elephant Range: North-Western Landscape
Elephant Reserve: Shivalik Elephant Reserve
Protected Areas: Sonanadi Wildlife Sanctuary, Corbett Tiger Reserve and Rajaji Tiger Reserve

HUMAN DIMENSIONS

Threats

1. Human settlements and anthropogenic pressure: Gujjar settlements within the corridor as well at its periphery, especially Jaspurchamaria and Laldhang villages, exert biotic pressure (fuelwood extraction, cattle grazing) on the corridor forest. Boulder mining is also an issue in the area.

2. Highway Traffic: High traffic in the Najibabad-Kotdwar stretch of NH 119 severely affects elephant movement. On average, 404 vehicles move through the corridor per hour. Between 6 am and 6 pm, 281 vehicles pass through the corridor per hour. Another 122 vehicles pass through the corridor per hour between 6 pm and 6 am.

3. Proposed conversion of the Kotdwar-Laldhang forest road into a metalled road.

4. Najibabad-Kotdwar Railway Track: This railway track passes through the corridor and is a threat to elephants crossing from Zafrabad (mainly from Compartments 3, 2B, 2A and 9) in the Kauriya Range.

5. Shankerpur Farm: This farm is situated in the corridor near the Khoh River and is a barrier to elephant movement.

Corridor Villages: Gujjar Basti, Devennagar, Shankerpur, Chatruwala.

Corridor dependent villages: Motadhak, Medduwala, Sherawala, Ramnagar, Rahman Nagar, Prem Nagar, Hardaspur, Laldhang, Jashpur Chamaria, Hardaspur, Bhawanipur and Kawriria.

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent developmental activities affecting elephant movement.

2. Traffic on Nazibabad-Kotdwar road (NH 119) passing through the corridor needs to be regulated, especially at night.

3. Train speeds need to be regulated between 6 pm and 6 am.

4. A parcel of 127 acres of land in the Shankurpur Farm area and 61 acres of land in Sulema Shikopur could be secured to facilitate elephant movement.

5. The expansion of Chatruwala village and other fringe settlements within the corridor forest needs to be prevented, as does the spread of agricultural activities.

6. The forest boundary on both sides of the corridor, especially the southern side, should be demarcated.



Fig. 4.06: Elephant sighting in the Rawasan - Sonanadi Corridor

4.07

Malani–Kota

Ecological priority: High

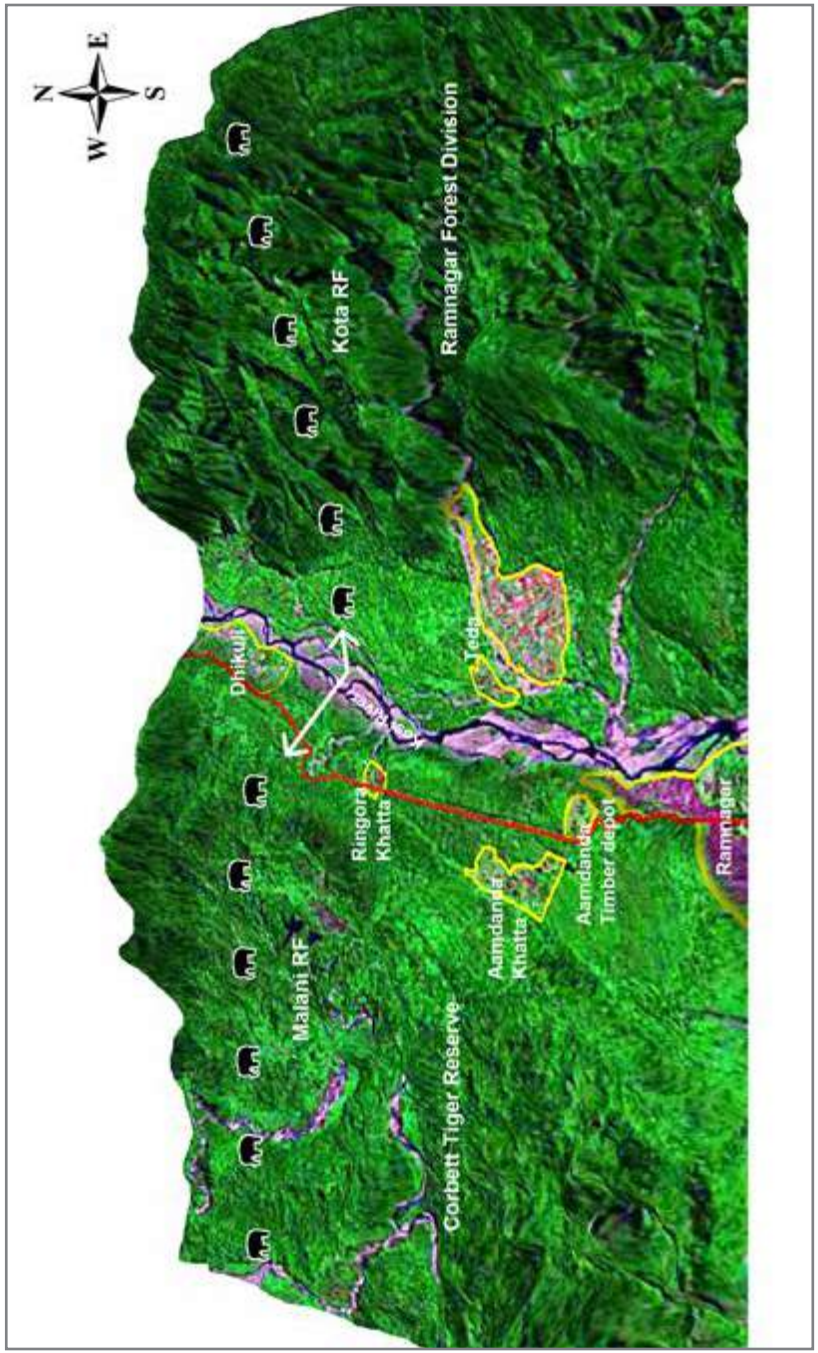
Conservation feasibility: Medium

This is one of the three corridors that connect Corbett Tiger Reserve with Ramnagar Division. The corridor is situated between the Aamdanda gate of Corbett TR and Laduachaur (Dhikuli) village along NH 121. Ringora village is situated in the middle of the corridor. Elephants mainly pass through the Majar and Ringora nullahs to move between the habitats.

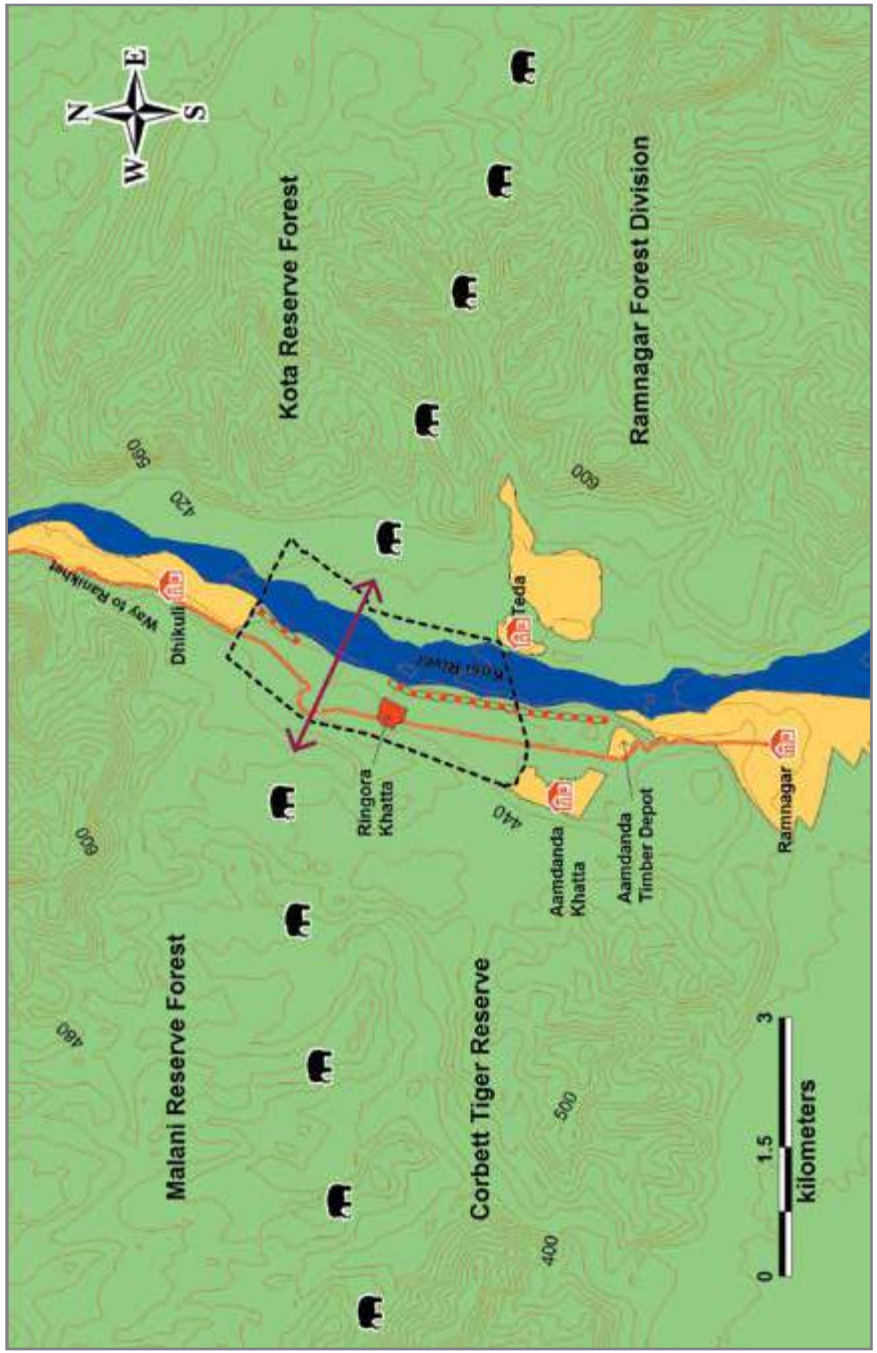
Alternate Name	Ringora- Bijrani
State	Uttarakhand
Connectivity	Corbett Tiger Reserve and Ramnagar Division
Length and Width	1 km and 2.8-3.5 km
Geographical coordinates	29° 25′ 15″-29° 27′ 8″ N 79° 7′ 18″-79° 9′ 4″ E
Legal status	Reserve Forest
Major land use	Forest, Settlement, River and Road
Major habitation/settlements	Ringora
Forest type	Tropical dry deciduous sal forest and teak plantation
Frequency of usage by elephants	Regular; used by bulls and herds

FORESTS AND ELEPHANTS

Corridor Habitat Status: Tree density was estimated at 408 per ha in the corridor area. Dominant tree species in the sampled area of 0.12 ha were teak (*Tectona grandis:* 65.3%) followed by rohini (*Mallotus philippensis:* 24.5 %). The highest GBH was found in *Tectona grandis* (200 cm).



3D map showing the landscape of the Malani– Kota Corridor



Map of the Malani- Kota Corridor

At least 60% barren ground was observed in the sample plots due to the presence of teak plantations. Curry leaves (*Murraya koenigii*), Kala bansa (*Barleria sp*), *Shorea robusta*, *Mallotus philippensis* etc were dominant in the remaining ground cover.

Estimated elephant numbers in the landscape:

Corbett Tiger Reserve: 1035

Ramnagar Forest Division: 84

(Source: Elephant Population Estimation, Uttarakhand, 2015)

Forest/Land use

Forest type: Tropical dry deciduous sal forest and teak plantation

Settlements: Ringora Khatta and roadside shops

River: Kosi

Road: NH 121

Other ecological importance:

Mountain Range: Himalayas

Elephant Range: North-Western Landscape

Elephant Reserve: Shivalik Elephant Reserve

Protected Area: Corbett Tiger Reserve

HUMAN DIMENSIONS

Threats

1. Settlement: Ringora village located within the corridor hinders elephant movement.

2. Fuelwood collection: Extraction of fuelwood from the corridor for personal and commercial use by people in and around Ramnagar town has affected the quality of the habitat.

3. Sand/boulder mining: Illegal boulder and sand mining is persistent in the Kosi riverbed near Ringora village, hindering animal movement.

4. Resorts: A large number of resorts in Dhikuli have increased traffic flow through the corridor, with tourists at times stopping by the road when animals are sighted.

5. Vehicular traffic: There is heavy traffic on NH 121 which runs through the corridor due to the aforementioned resorts and hotels in Dhikuli. On an average 128 vehicles were recorded moving through the corridor per hour. This number went up to 212 vehicles per hour between 6 am and 6 pm, with a further 45 vehicles per hour moving through the corridor between 6 pm and 6 am.

6. Forest fires: Man-made forest fires are another major problem in the corridor, affecting vegetation and the herbivore population.

7. A high-tension electric line passes through Compartment 1 and is a threat to elephants since the wires sag in places. One elephant was electrocuted and died when it came in contact with a sagging line recently.

Corridor villages: Located within the corridor, Ringora village has about 35 to 38 families. Most of the inhabitants are engaged in various professions in Ramnagar and Dhikuli. A few villagers have small shops / *dhabas* in the village area on NH 121. Some families are also dependent on agriculture, which is mostly monsoon based. This village does not have basic facilities like electricity, water supply and healthcare.

Corridor dependent villages: Aamdanda (70-80) families and Teda (200-225 families)

Human–Elephant Conflict: There is hardly any conflict reported to the forest department. However, interactions with villagers reveal that there is occasional crop-raiding by lone bulls and small herds.

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent encroachment and developmental activities affecting elephant movement.

2. Commercial activity inside Ringora village and along the portion of NH 121 within and around the corridor should be strictly prohibited.

3. In consultation with the villagers, Ringora village should be relocated to an alternate site.

4. Sand/boulder mining in the Kosi riverbed, whether for personal or commercial purposes, should be strictly prohibited in the corridor area.

5. Electric posts in the corridor must be strengthened and the high-tension line periodically monitored to prevent sagging.

6. The speed of vehicles passing through the corridor area should be regulated through speed breakers.

Land identified to secure the corridor: Ringora village is located in middle of the corridor and covers an area of about 20 ha. This land was given to these families by the forest department during the colonial period. The land presently falls under the Reserve Forest category. As the corridor is vital for the movement of both elephants and tigers, the village should be relocated preferably close to Ramnagar town, as most of the inhabitants are dependent on Ramnagar for their day-to-day work.

4.08

Chilkiya – Kota

Ecological priority: High

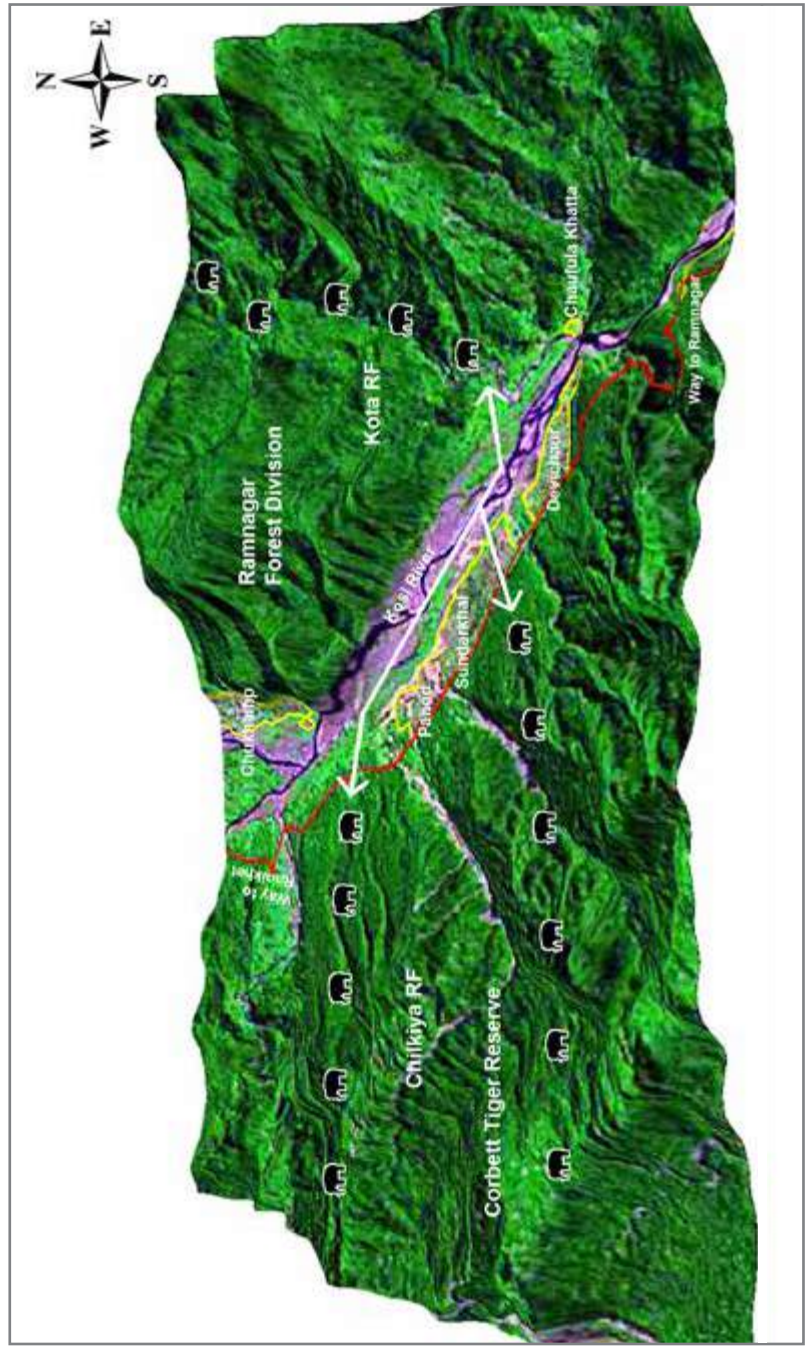
Conservation feasibility: Medium

Among the three corridors connecting Corbett Tiger Reserve with Ramnagar Division, this one is the most crucual. The corridor is situated along the Kosi River and NH 121, between Garjiya Temple and the Dhangarhi gate of Corbett Tiger Reserve. Elephants move through Sunderkhal village (Kosi Range), which is situated in the middle of the corridor on encroached forest land along the main road.

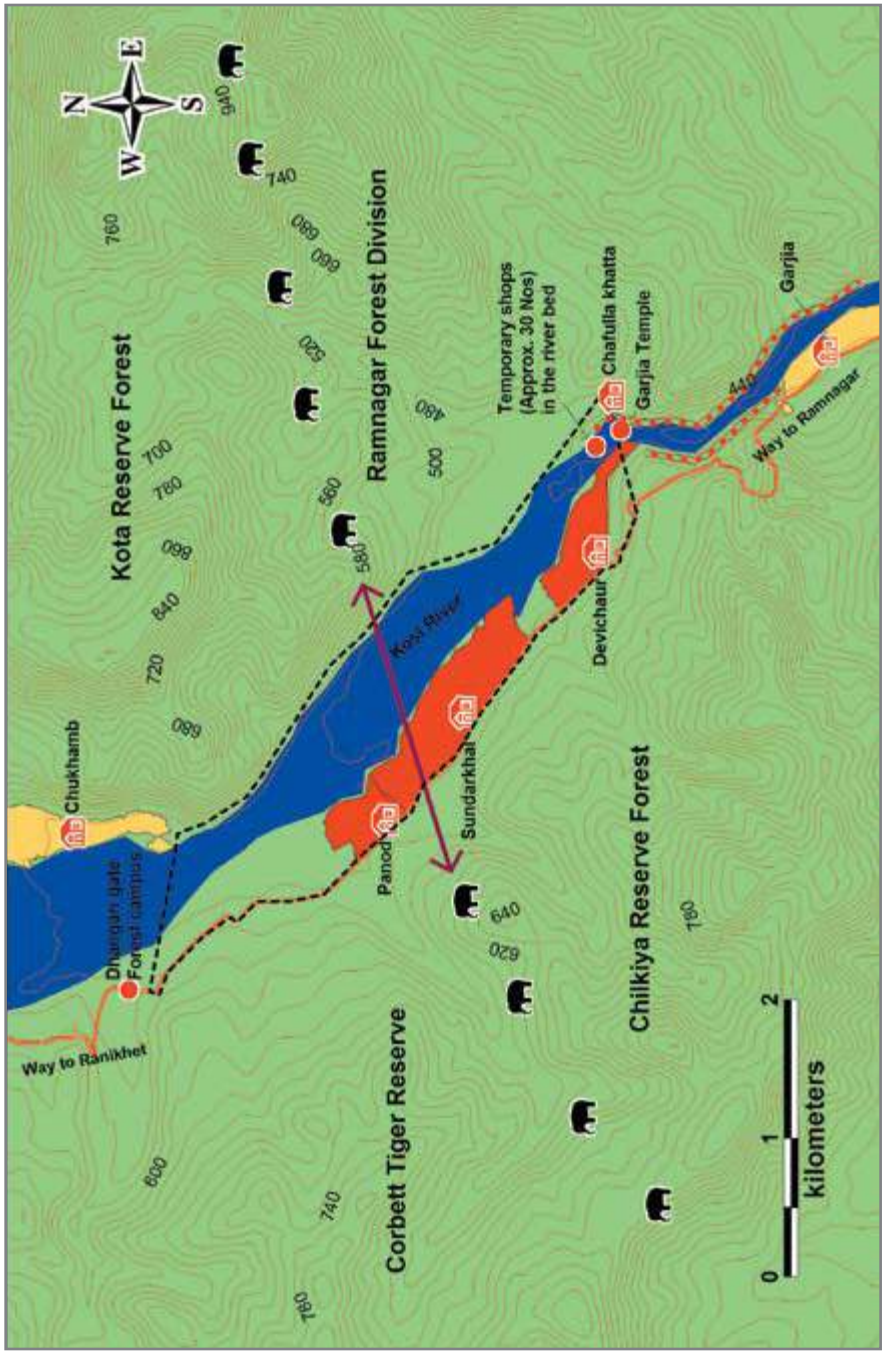
Alternate Name	Dhangari-Sunderkhal
State	Uttarakhand
Connectivity	Chilkiya Reserve Forest of Corbett Tiger Reserve and Kota RF of Ramnagar Division
Length and Width	Length 0.7 km and width 3.9 km
Geographical coordinates	29° 29′ 36″-29° 31′ 30″ N 79° 5′ 58″-79° 8′ 37″ E
Legal status	Reserve Forest
Major land use	Forest, Settlement, River
Major habitation/settlements	Sunderkhal (Panod, Sunderkhal, Devichaur and Garjia)
Forest type	Tropical dry deciduous (sal dominant), teak plantation, riverine
Frequency of usage by elephants	Occasional

FORESTS AND ELEPHANTS

Corridor Habitat Status: An average density of 360 trees per ha was observed in the forested part of the corridor. Sal (*Shorea robusta;* 30.6%), teak (*Tectona grandis;* 40.3%) and khair (*Accacia sp;* 20.8 %) were the dominant species in the sampled



3D Map showing the landscape of the Chilkiya - Kota Corridor



Map of the Chilkiya– Kota corridor showing the village to be relocated

area of 0.2 ha. Maximum GBH was measured for Pilkhan (*Ficus sp;* 280 cm). The bark of *Tectona grandis* and *Shorea robusta,* and the leaves and bark of *Mallotus philippensis* are palatable to elephants.

About 10% of the sampled area was barren. The ground cover was dominated by curry leaves (*Murraya koenigii*), kala bansa (Ver), *Shorea robusta*, *Mallotus philippensis* etc. The area of the corridor between the road and the river is mostly occupied by humans.

Estimated elephant numbers in the landscape

Corbett Tiger Reserve: 1035
Ramnagar Forest Division: 84
(Source: Elephant Population Estimation, Uttarakhand, 2015)

Forest/Land use

Forest type: Tropical dry deciduous (sal dominant), teak plantation, riverine
Settlements: Sunderkhal (encroachment)
River: Kosi River
Buildings/Artefacts: Garjiya Temple, shops on riverbed near the temple
Roadway: NH 121, Ramnagar–Ranikhet road

Other ecological importance

Mountain Ranges: Himalayas
Elephant Range: North-Western landscape
Elephant Reserve: Shivalik Elephant Reserve
Protected Area: Corbett Tiger Reserve

HUMAN DIMENSIONS

Threats

1. Settlement: Sunderkhal village, an encroachment, occupies about 92 ha of the corridor area and has considerably reduced the width of the corridor, affecting animal movement.

2. Biotic pressures: Cattle grazing and fodder and fuelwood collection by villagers has degraded the corridor habitat quality.

3. NTFP collection: Large numbers of people frequent the corridor to collect NTFP, especially curry leaves (*Murraya koenigii*). This has increased conflict between humans and elephants as well as tigers.

4. Garjiya Temple: The mass gathering of pilgrims at this temple, as well as associated developmental activities such as the construction of hotels and shops near the riverbank within the corridor hinders elephant movement throughout this area.

5. High-tension electric Line: A high-tension line passes through the Kosi Range in the corridor, posing a threat to elephants.

6. Traffic: NH 121, which runs through the corridor, is a busy road due to the presence of numerous hotels, resorts and other tourist spots. On an average 117 vehicles were recorded passing through the corridor road per hour, with an average of 72 vehicles per hour between 6am and 6 pm, and 26 vehicles per hour between 6pm and 6 am.

Corridor Villages: Sunderkhal with its 310 families has a population of about 1500 and is an encroached village. Most of these families belong to the Scheduled Caste category. They have migrated from the hilly regions of Nainital, Almora and Garwhal and have been settling in the area since 1974. People here mostly depend on the nearby resorts, hotels and factories for their livelihood, or work as labourers in the unorganised sector. Agricultural activity in Sunderkhal has drastically reduced over the last few years due to crop-raiding by wild animals, especially elephants, and the erosion of land due to floods in the Kosi River.

Corridor dependent village: Chafulla khatta is a small hamlet of six families. The land was allotted to these families by the forest department during the colonial period.

Human–Elephant Conflict: No human causalities have been recorded due to elephants in this area, but there have been cases of human death and injury due to tigers within the corridor area and surrounding habitats over the last six years. A total of eight tiger-related human deaths and three leopard-related deaths were reported between November 2010 and September 2016. Cattle depredation is also a problem in the region.

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent encroachment and developmental activities affecting elephant movement.

2. All 310 families of Sunderkhal village (consisting of Panod, Sunderkhal, Devichaur and Garjia) have to be relocated to an alternate site. A majority of families are agreeable to relocation provided a suitable compensation package is provided.

3. All new developmental activities inside Sunderkhal village and in fringe areas of the corridor should be prohibited. Shops located on the riverbed near Garjiya Temple should be removed.

4. Cattle grazing and collection of fodder and fuelwood should be regulated inside the corridor area. Illicit felling of trees should be completely stopped.

5. Commercial exploitation of NTFP, especially curry leaves, sourced from the corridor area should be banned.

6. Electric posts in the corridor should be strengthened and electric lines periodically monitored to prevent sagging or damage during floods.

Land identified to secure the corridor: About 92 hectares in the Panod, Sunderkhal, Kanojia and Devichaur segments of the corridor should be secured on a priority basis.

4.09
South Patlidun – Chilkiya

Ecological priority: High

Conservation feasibility: Medium

This corridor is located in the Mohan Range of Almora Forest Division, which connects Corbett Tiger Reserve (Mandal Range) with Ramnagar Forest Division (Kosi Range). This is one of the three corridors connecting Corbett Tiger Reserve with Ramnagar Division. Elephants move between the villages of Mohan and Kumeria, mostly along the nullahs on both sides of the Kosi River.

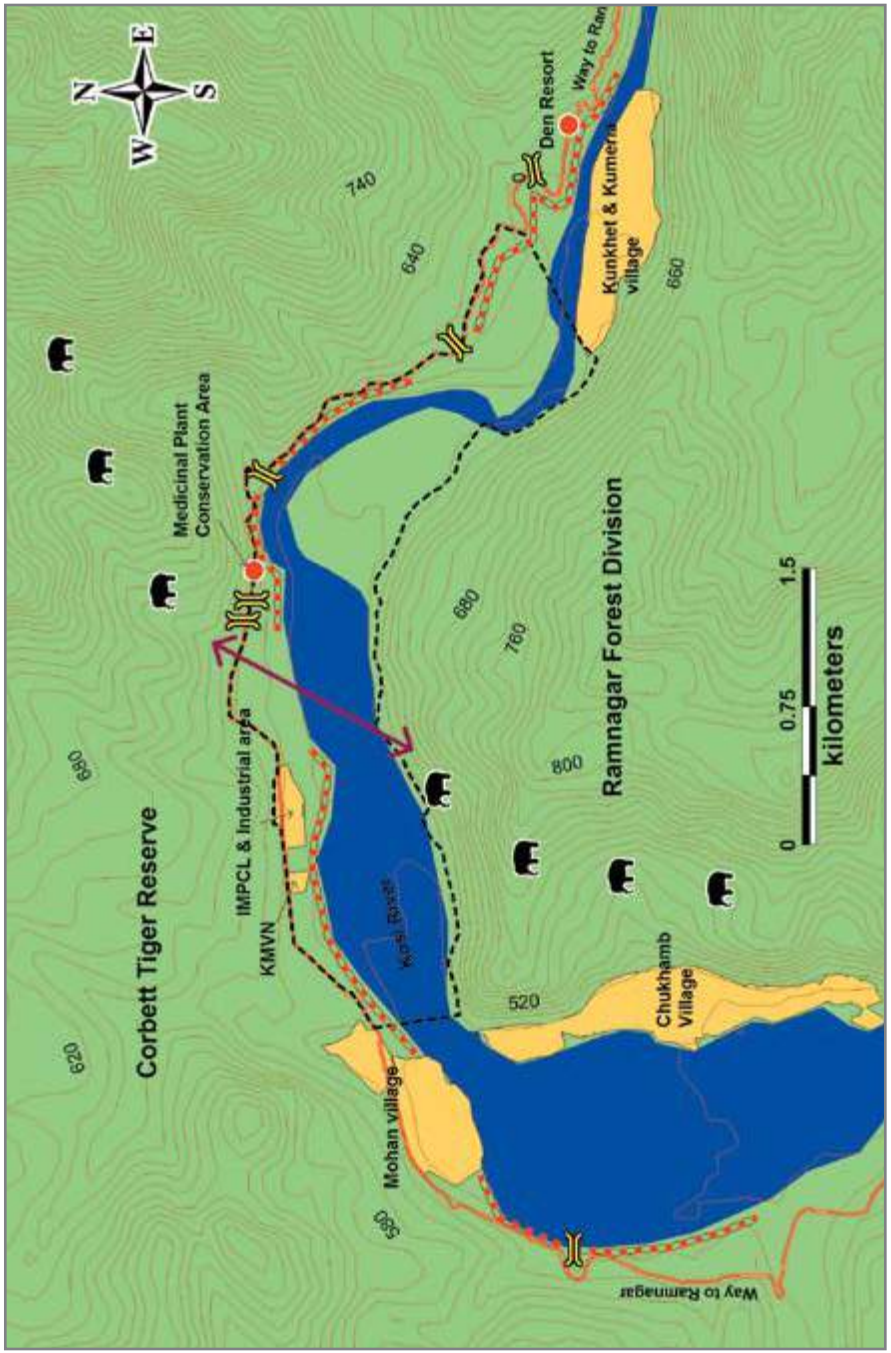
Alternate Name	Mohan - Kumeria
State	Uttarakhand
Connectivity	South Patlidun RF of Corbett Tiger Reserve and Chilkiya RF of Ramnagar Division
Length and Width	Length 3.5-5.0 km and width 0.5-2.0 km
Geographical coordinates	29° 32′ 14″-29° 33′ 19″ N 79° 6′ 35″-79° 9′ 18″ E
Legal status	Reserve Forest
Major land use	Forest, settlement, industry, agriculture, resorts
Major habitation/settlements	Mohan Industrial Area
Forest type	Tropical dry deciduous (sal dominated) and teak plantation
Frequency of usage by elephants	Regular, mostly used by bulls

FORESTS AND ELEPHANTS

Corridor Habitat Status: An average of 500 trees per ha was observed in the corridor area. Sal (*Shorea robusta;* 28.3%), rohini (*Mallotus philippensis*; 38.3%) and teak (*Tectona grandis;* 16.7%) were the dominant species in the sampled area of 0.12 ha. Maximum GBH was measured in Haldu (*Adina cordifolia*; 305 cm). The



3D map showing the landscape of the South Patlidun – Chilkiya Corridor area



Map of South Patlidun – Chilkiya corridor

bark of *Tectona grandis* and *Shorea robusta,* and the leaves and bark of *Mallotus philippensis* are palatable to elephants. The ground cover was found to be dominated by curry leaves (*Murraya koenigii*), kala bansa, *Shorea robusta*, *Mallotus philippensis* etc.

Estimated elephant numbers in the landscape

Corbett Tiger Reserve: 1035
Ramnagar Forest Division: 84
(Source: Elephant Population Estimation, Uttarakhand, 2015)

Forest/Land use

Settlements: Indian Medicine Pharmaceutical Corporation Limited (IMPCL) colony
Buildings & Artefacts: IMPCL, Prakash Industry, Khulbe Industry and Kumaon Mandal Vikas Nigam (KMVN) Resort
River: Kosi
Road: Ramnagar-Ranikhet National Highway (NH 121)

Other ecological importance

Mountain Range: Himalayas
Elephant Range: North-Western India (Rajaji-Corbett Landscape)
Elephant Reserve: Shivalik Elephant Reserve
Protected Area: Corbett Tiger Reserve

HUMAN DIMENSIONS

Threats

1. *Mohan Industrial Area:* 18.4 ha of this industrial park is situated in the middle of the corridor and has blocked the movement of elephants to a significant extent.

2. *Biotic pressure:* Cattle grazing and fodder and firewood collection by the villagers of Kunakhet, Kumeria, Mohan and Chukham have affected the quality of corridor habitat.

3. *High-tension electric line*: A high-tension line passes through the corridor and at certain places has sagged dangerously low.

4. *Development activities in villages:* The construction of the KMVN Resort and subsequent land conversion is a threat to the corridor, especially in the villages of Kunakhet and Kumeria, located two kilometres from the boundary of Corbett Tiger Reserve.

Corridor village: Chukham (86 families)

Corridor dependent villages: Mohan (35 families), Kunakhet (110 families) and Kumeria (20 families)

A majority of the people in the area are dependent on employment at IMPCL or the resorts based in Bohra Kote, Marchula, Dhikuli and Mohan. A small population undertakes agriculture. However, a substantial portion of agricultural land in Chukham village was lost due to erosion in the floods in 2010 and 2011.

There is a proposal under consideration for the rehabilitation of Chukham village by the Government of Uttarakhand.

Human-Elephant Conflict: Elephants frequently visit villages in the area, especially during the cropping season. Reports of cattle lifting by tigers and leopards are also common. A report by WWF-India indicates 102 cases of cattle being predated in Chukham and 38 cases in Mohan between 2006 and 2010.

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent encroachment and developmental activities affecting elephant movement.

2. Land use changes in the corridor's fringe villages, especially Kumeria and Kunakhet, should be prohibited.

3. Expansion of Mohan Industrial Area should be prohibited.

4. Relocation of Chukham forest village should be taken up on a priority basis. This will facilitate elephant and tiger movement in the region.

5. Relocation of the IMPCL factory and the chemical factory at Garjia is required.

Land identified to secure the corridor: The state government is working towards the relocation of Chukham village. Land in Mohan Industrial Area (18.4 ha) also needs to be acquired and its inhabitants relocated to an alternate site.



Fig. 4.07: A tusker in the corridor

4.10
Fatehpur- Gadgadia

Ecological priority: High

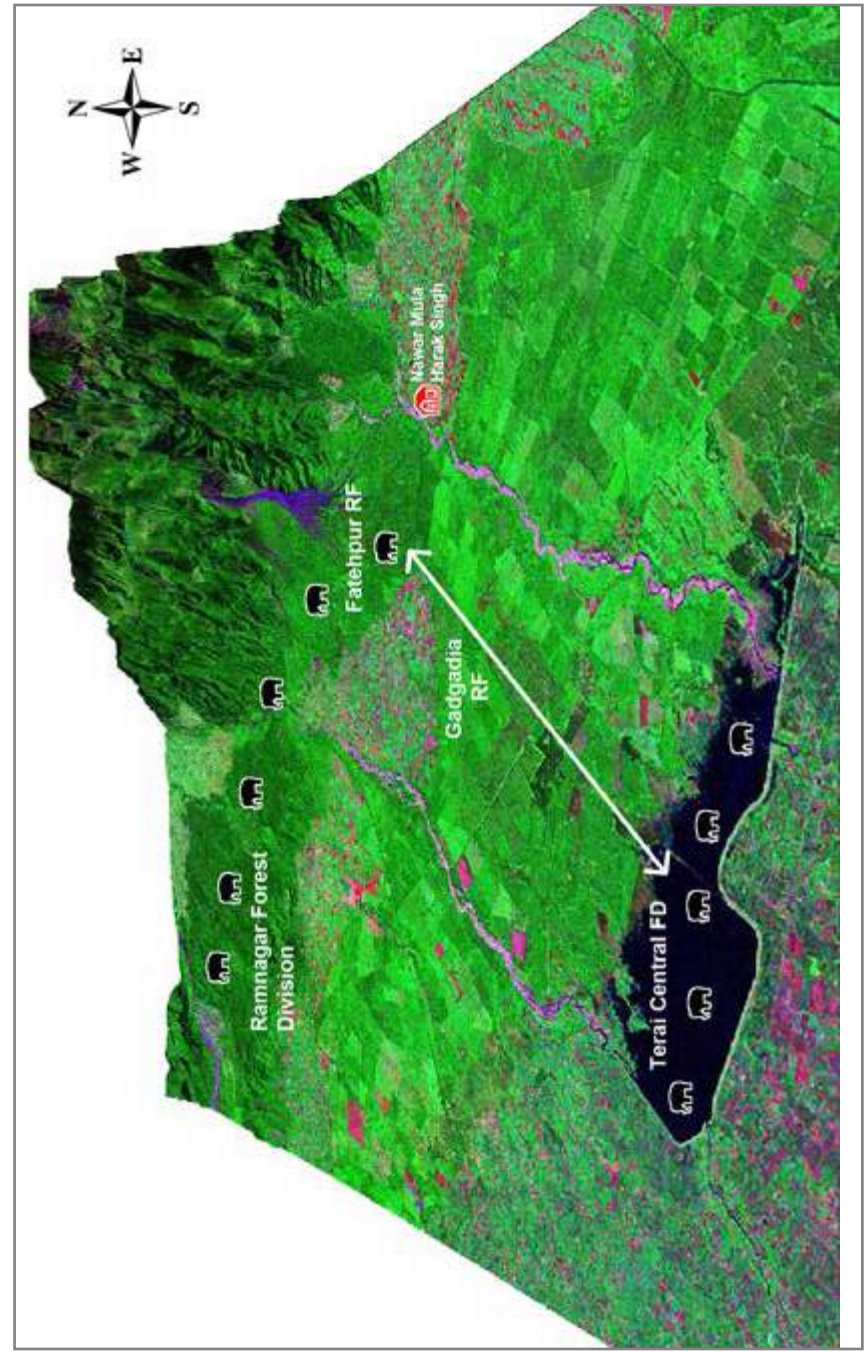
Conservation feasibility: High

This corridor connects the Fatehpur Range of Ramnagar Forest Division with the Gadgadia Range of Terai Central Forest Division. The Ramnagar-Haldwani road cuts through the bottlednecked portion of the corridor, which is about four kilometres wide. Biotic pressure exerted by fringe villages and agriculture on the leased land in the fringes of the corridor in Terai Central Forest Division are major threats to the elephant population in the region.

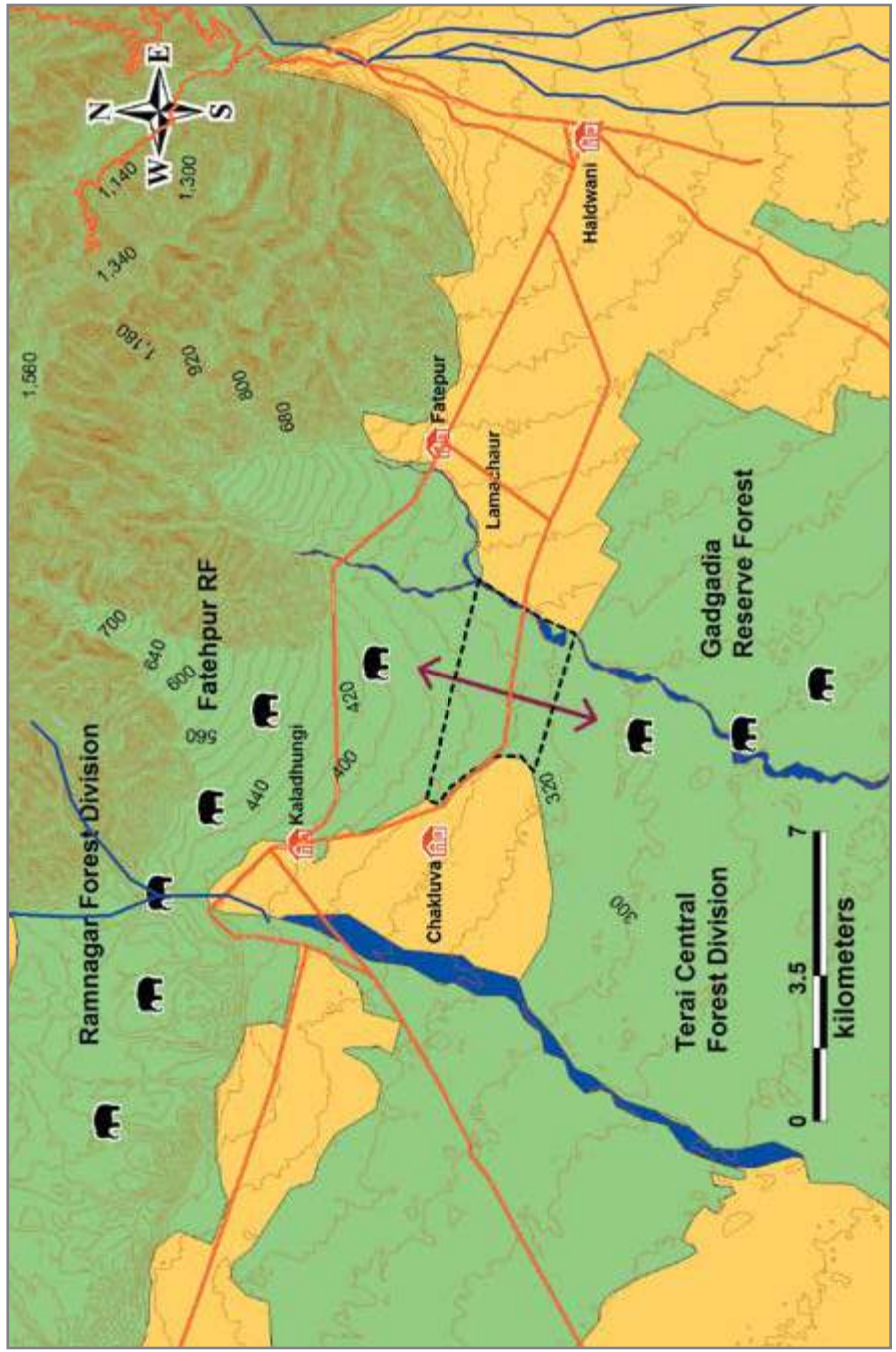
Alternate Name	Nihal-Bhakra
State	Uttarakhand
Connectivity	Ramnagar Forest Division with Terai Central Forest Division
Length and Width	0.5 km and 4 km
Geographical coordinates	29° 13′ 1″-29° 15′ 0″ N 79° 21′ 36″-79° 25′ 0″ E
Legal status	Reserve Forest
Major land use	Forest and agriculture
Major habitation/settlements	Nil
Forest type	Mixed Plantation
Frequency of usage by elephants	Occasional

FORESTS AND ELEPHANTS

Corridor Habitat Status: A total of 51 plant species were recorded in the sampled area (0.16 ha). The average GBH and height recorded were 75.41 cm and 15.59 metres respectively. Average tree density was 330 trees per ha. *Tectona grandis, Shorea robusta, Cassia fistula, Ehretia laevis, Mallatus phillipensis* and *Trewia nudiflora*



3D Map showing the landscape of the Fatehpur-Gadgadia Corridor



Map of the Fatehpur–Gadgadia Corridor

were the dominant tree species in the corridor. The ground cover was dominated by shrubs (64.87 %), herbs (29.93%) and grasses (3.2%). The remaining area was barren ground.

Estimated elephant numbers in the landscape

Ramnagar forest Division: 84
Terai Central Division: 10
(Source: Elephant Population Estimation, Uttarakhand, 2015)

It is estimated that about 15-20 elephants use the corridor. The corridor is also being extensively used by tigers and leopards.

Forest/Land use

River: Kaligad nullah
Road: Ramnagar-Kaladungi-Haldwani State Highway (SH 41)

Other ecological importance

Mountain Range: Himalayas
Elephant Range: North-Western Landscape
Elephant Reserve: Shivalik Elephant Reserve

HUMAN DIMENSIONS

Threats

1. Anthropogenic pressure: Cattle grazing coupled with firewood and fodder extraction by inhabitants of fringe villages have threatened the habitat quality of the corridor forest. The eastern and western parts of the corridor have over 14 villages on the fringes.

2. Traffic on the state highway: Heavy traffic on SH 41 threatens elephant movement between the habitats. On an average, 250 vehicles were recorded moving through the corridor per hour.

3. Large-scale farming on encroached *khatta* and leased land in and around the corridor.

Corridor dependent villages: Lamachaur, Bidrampur, Rampur, Deipur, Puranpur, Guljatpur Ramsingh, Gulrajpur banki, Khadakpur, Sakatpur, Surpur and Pratappur (western side), and Puranpur Kumalia, Ratanpur Isai and Isai Nagar (eastern side).

Human–Elephant Conflict: The corridor falls under three forest ranges: Fatehpur, Gadgadia and Kaladungi of the Ramnagar and Terai Central Forest Divisions. In the Kaladungi Range, 16 cases of crop damage and human injury were reported from 2006 to 2009. Crop-raiding was very high in the Fatehpur Range, with 89 cases reported between 2002 and 2013.

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent encroachment and developmental activities affecting elephant movement.

2. Vehicular speeds on the state highway should be regulated in the corridor area by the placement of suitable physical barriers, especially between 6 pm and 6 am.

3. Encroached land should be reclaimed and further encroachment of the corridor forest prevented.



Fig. 4.08: Documenting evidence of elephant presence in the corridor



Fig. 4.09: An elephant drinking water from a water source in peak summer season

4.11
Kilpura-Khatima-Surai

Ecological priority: Medium

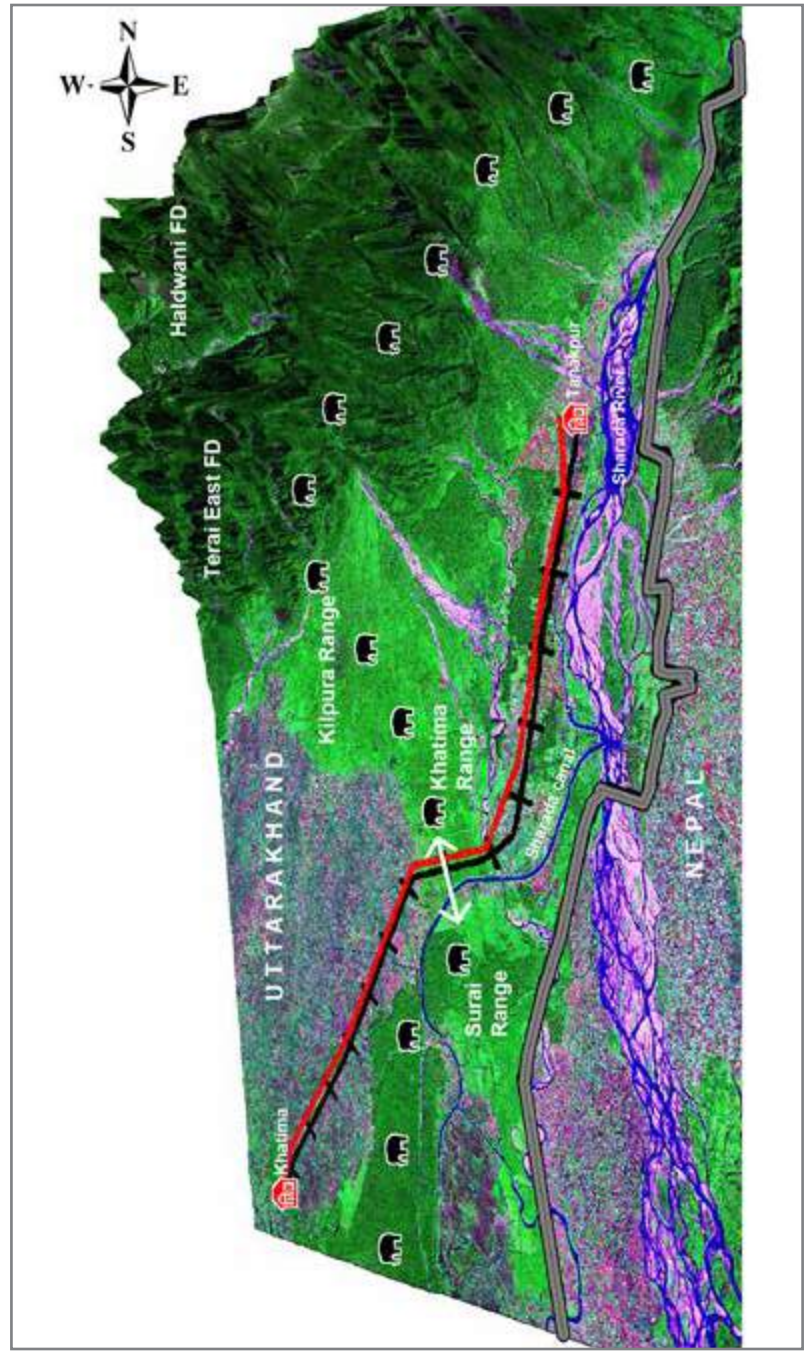
Conservation feasibility: Low

This corridor is located in the Khatima Range and connects it with the Kilpura and Surai Ranges of Terai East Forest Division. The forest patches of the Khatima Range area are a vital link in the chain of connectivity between Haldwani Forest Division, Pilibhit Forest Division and the forests of Nepal. Khatima Range has been fragmented by encroachment and infrastructural development. Elephants cross the Khatima-Tanak highway and railway track, move between Banrawat Basti and Chakarpur village, and cross the Sharda main canal between Majgaon and Pachouri villages.

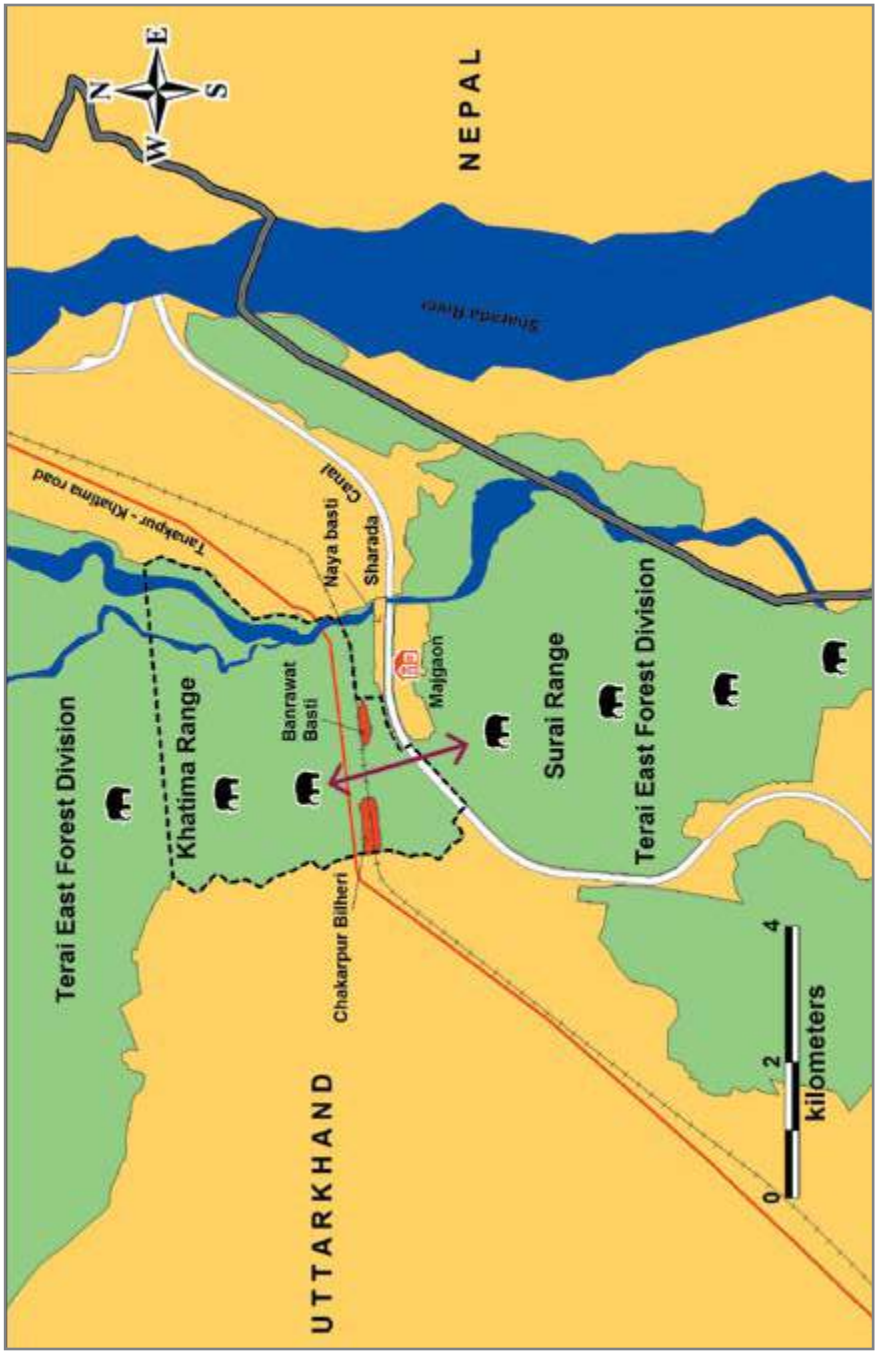
State	Uttarakhand
Connectivity	Kilpura Range, Khatima and Surai Ranges of Terai East Division
Length and Width	2 km and 0.75 -3.5 km
Geographical coordinates	28° 57′ 22″-28° 59′ 56″ N 80° 0′ 55″-80° 3′ 58″ E
Legal status	Reserve Forest, Patta Land
Major land use	Forest, settlement, agriculture, Sharda canal, NH 125, railway line
Major habitation/settlements	Banrawat Basti
Forest type	Dry deciduous sal forest and plantation
Frequency of usage by elephants	Occasional; mostly by lone bulls and small herds

FOREST AND ELEPHANTS

Corridor Habitat Status: The corridor area along NH 125 and in its adjoining forest



3D Map showing the landscape of the Kilpura-Khatima-Surai Corridor area



Map of the Kilpura–Khatima–Surai Corridor

blocks is dominated by *Tectona grandis*. The forest department has demarcated an area of 50 ha for the plantation of bamboo for elephants in Gosukuan Beat. A tree density of 475 trees per ha was estimated in the corridor area. *Tectona grandis* (92%) was the major tree species found in the sampled area of 0.08 ha, followed by *Acacia catechu* (5%). Ground cover was completely open in the teak plantation area. The average GBH was found to be 68.63 cm with a highest GHB of 119 cm.

Estimated elephant numbers in the landscape

Terai East Forest Division: 21

(Source: Elephant Population Estimation, Uttarakhand, 2015)

Forest/Land use

Settlements: Chakarpur, Majgaon, Banrawat Basti (encroachment) and Naya Basti (encroachment)

Road: Khatima-Tanakpur (NH 125)

Railway track: Khatima-Tanakpur

Buildings/Artefacts: Sharda main canal

Other ecological importance

Mountain Range: Himalayas

Elephant Range: North-Western Landscape

Elephant Reserve: Shivalik Elephant Reserve

Protected Area: Nandhaur Wildlife Sanctuary

HUMAN DIMENSIONS

Threats

1. Encroachments: Encroachments in the Gosukuan Beat, namely Banrawat Basti, Chakarpur Bilheri and Naya Basti along the Sharda canal, and Pachoria lie directly in the elephant path towards Nakatal forest.

2. Settlements: Banrawat Basti, Chakarpur Bilheri, Naya Basti and Majgaon

settlements on either side of Sharda canal have narrowed the width of the corridor.

3. Anthropogenic pressure: Cattle grazing and fuelwood collection in the corridor forest by about 25 fringe villages has degraded the habitat quality.

4. Traffic: NH 125 connecting Khatima and Tanakpur (now four-laned) is a busy road due to its proximity and connectivity with Nepal and Uttar Pradesh. On average, 266 vehicles per hour were recorded in the corridor area, with 384 vehicles per hour plying between 6am and 6 pm, and 147 vehicles per hour between 6 pm and 6 am.

5. Sharda canal: This canal passes through the corridor. A high water level and strong current near Lohiya Head obstruct elephant movement between the habitats.

6. Rail traffic: 18 trains run through the corridor of which four run between 6 pm and 6 am. The track is metre gauge and there is local demand to convert this to broad gauge, which will worsen the situation.

Corridor Villages: Banrawat Basti (15 families), Chakarpur Bilheri , Naya Basti (15 families) and Majgaon settlements (300 families) are located in the corridor. Of these, Banrawat Basti and Naya Basti consist entirely of encroached land. Some encroachment is reported in Chakarpur Bilheri (130 families) as well.

Corridor dependent villages: Bilheeri, Pachpokariya, Devipura, Banbasa, Bamanpuri, Bhajanpur, Kutuwa patti, Majgaon, Pachouri, Lohiya Head, Chakarpur, Gosu Kuman, Bhudai, Amauan and Jhan Kaieya.

Human – Elephant conflict: Crop-raiding by elephants is a major concern in the area. Discussions with villagers revealed that since 2012 and 2013 elephants have been visiting the villages in two seasons, where earlier they only visited in the winters. Villagers do not claim damages for crop losses due to low compensation and delays. Forest department records revealed that most instances of human-elephant conflict have taken place in Kilpura Range. Five cases of human death and two cases of human injury due to elephants were reported in Terai East Division between 2011 and 2013.

Cattle lifting by tigers has also been reported by villagers.

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent encroachment and developmental activities affecting elephant movement.

2. Encroachments in the corridor area of Banrawat Basti, Chakarpur Bilheri and Naya Basti could be relocated in consultation with villagers. The corridor area should be monitored regularly to prevent further encroachment by fringe villages.

Land identified to secure the corridor

Settlement	Families	Area
Banrawat Basti	15	8.6 ha
Chakarpur Bilheri	125-130	20 ha
Naya Basti along Sharda canal	15	10.8 ha

05

ELEPHANT CORRIDORS OF CENTRAL INDIA

Sandeep Kr Tiwari, Subrat Kr Behera, K Ramkumar, Chanchal Kr Sar, D Swain and R Sukumar



THE ELEPHANT HABITATS OF CENTRAL INDIA are spread over an area of 21,000 sq km in the states of Jharkhand, Odisha, Chhattisgarh and part of southern West Bengal, at times extending to Madhya Pradesh and Bihar. The 3128-odd elephants (*MoEF&CC, 2017*) in this range occupy the most fragmented elephant habitats in the country; habitats that have been degraded and fragmented due to mining, shifting cultivation and linear infrastructural elements (highways, railways, canals etc). Human-elephant conflict is very high and although the area supports less than 10% of the elephant population of the country, it accounts for almost 45% of all human deaths due to elephants in India.

Jharkhand has two distinct elephant populations, viz. Palamau and Singhbhum, and about 678 elephants (*MoEF&CC, 2017*). The Palamau population occupies about 1200 sq km of Betla National Park, Palamau Tiger Reserve and adjoining areas. In recent years, elephants have started moving into new areas of Hazaribagh, Ranchi, Ramgarh, Bokaro, Dhanbad, Giridih, Deogarh, Dumka, Pakur, Godda and Sahibganj, passing through fragmented forest patches, agricultural land and human settlements. Elephants have also started moving to Bihar and West Bengal from these areas. This has increased human-elephant conflict, especially crop depredation, and it has become a major challenge for Division managers to manage these elephants and minimise conflict.

The Singhbhum population occupies about 2570 sq km of the available forest area of Dalma Wildlife Sanctuary and the forests of Saranda, Porhat, Kolhan, Saraikala (formerly North Chaibasa) and Dhalbhum Forest Divisions. About ten elephant corridors are located in this landscape. Mining is one of the most serious threats to the elephant habitats of this region, with Singhbhum being known for its large reserves of hematite iron ore, constituting 25% of the total known reserves in India.

Mining activities in the Manoharpur mines and the transport of ore have severely affected the overall habitat and threatened the movement of elephants in these areas. Elephant movement between Dalma Wildlife Sanctuary and Saraikala Forest Division has been threatened by the heavy traffic on National Highway 33, the construction of the Subarnarekha canal, the Tatanagar-Chandil railway, various stone crushing units that have come up along the highway, and the expansion of human settlements and agriculture land almost till the foothills of Dalma Wildlife Sanctuary. Habitat degradation has also threatened elephant movement between Dalma Wildlife Sanctuary and the Matha Range of Purulia Forest Division (West Bengal). The elephant habitats of the Mosabani Range of Dhalbhum Forest Division have also been severely affected by increased agricultural activities and anthropogenic pressure, impairing the movement of elephants from Mosabani Range to Rakhamines Range of Dhalbhum Forest Division. The degradation of elephant habitats in Jharkhand has also resulted in the migration of elephants to the adjoining areas of Chhattisgarh, leading to increased human-elephant conflict. To strengthen the conservation of the Singhbhum elephant habitats, which lack a Protected Area, Project Elephant has declared 4529 sq km of the elephant habitat as Elephant Reserve I.

The degradation of elephant habitats in Jharkhand and Odisha has resulted in migration of elephants to the adjoining areas of Chhattisgarh, leading to increased human-elephant conflict.

The elephant habitats of Odisha are spread across 11,000 sq km of forests. In Odisha, almost 72% of the elephant population is spread across 14 Forest Divisions – Angul circle (Angul, Satkosia, Athmallik, Athgarh and Dhenkanal divisions), Baripada circle (Baripada, Similipal Tiger Reserve, Balasore, Karanjia and Rairangpur divisions), Sambalpur circle (Bamra and Rairakhol divisions) and Rourkella circle (Bonai and Deogarh divisions), all on the north bank of the Mahanadi River – and requires larger conservation attention. A burgeoning human population, spread of human settlements and ensuing development activities (mining, industry, linear infrastructure etc) have degraded and fragmented elephant (and other wildlife) habitats in the state, leading to isolation of animal populations and increased interface with humans. This has led to elevated levels of human-elephant conflict. Over 461 people have lost their lives in elephant-related incidents and about Rs 7.5 crore has been

paid by the state government as ex-gratia support for human deaths caused by elephants between April 2009 and February 2017. During the same period, about Rs 98.8 crores has also been paid for crop depredation by elephants. Linear infrastructure elements like railway lines (*Chatterjee et al., 2014)*, irrigation canals and roads have further fragmented the wildlife habitat. The Rengali Dam constructed across the Brahmani River in Rengali village (Angul district) and the two irrigation canals aimed at improving the state's agricultural prosperity have severely fragmented the wildlife habitats to the north of the Mahanadi River in the state. While these development activities have facilitated cultivation in areas not earlier conducive to agriculture, they have created physical barriers to animal movement, especially for larger mammals like elephants, leading to increased conflict particularly in the Dhenkanal and Angul districts.

The Mahanadi River divides Odisha's elephant habitats into two parts. While the habitats to the north of the river (Mayurbhanj, Keonjhar, Bamra, Rairakhol, Angul, Dhenkanal, Athamallik, Bonai and Athagarh areas) are threatened by severe mining activities, a growing human population and expansion of agriculture, the habitats to the south (about 5030 sq km) are threatened by shifting cultivation. There are four major elephant populations in the state.The population in Similipal-Kuldiha-Hadgarh and adjoining areas comprises about 500 elephants. It is spread over three Protected Areas, viz. Similipal Tiger Reserve, Hadgarh Wildlife Sanctuary and Kuldiha Wildlife Sanctuary, and is in continuity with Noto Reserve Forest, Sukinda Reserve Forest and Badampahar Reserve Forest. Four elephant corridors are located in this landscape.

While Kuldiha Wildlife Sanctuary, Hadgarh Wildlife Sanctuary and Similipal National Park were once part of a larger continuous stretch of forest area, Kuldiha has now been disconnected from Similipal. The elephant movement between Hadgarh and Kuldiha has been severely hindered by chromite mining at Baula Reserve Forest as well as the expansion of settlements and agricultural land, resulting in increased human-elephant conflict. Similarly, elephant movement from Similipal (Odisha) to South Chaibasa (Jharkhand) occurs through the degraded forest patches of Badampahar Reserve Forest, Budhipat and Basila Reserve Forest. Movement between the north Similipal and Tapoban (Jhargram, West Bengal) area has been severely threatened by mining and agricultural activities, and elephants have changed their route between Nayagram, Chandabila, Keshorekha (Kharagpur Forest Division) to Rasgovindpur (Baripada Forest Division), Nilgiri of Balasore Wildlife Division and Kuldiha Wildlife Sanctuary. From 2013, Odisha began construction of irrigation canals, trenches and live fencing to block the movement of elephants coming from West Bengal. The Mayurbhanj Elephant Reserve has been constituted to strengthen the conservation of elephants in this area.

The population of Satkosia-Baisipalli and adjacent areas of Athmallik and Angul Forest Division is situated in the central part of Odisha and includes two Protected Areas: Satkosia Gorge Tiger Reserve and Baisipalli Wildlife Sanctuary, forming part of the Mahanadi Elephant Reserve (1023 sq km). Satkosia-Baisipalli forms a continuous habitat bifurcated by the Mahanadi River. Sar and Lahiri-Choudhury (2002) has identified five major crossing points used by elephants to cross the Mahanadi. The construction of the Manjhor dam has obstructed the movement of elephants between Taleipathar Reserve Forest and the Baruni East and Baruni West Reserve Forests, an important link between Satkosia and Khalasuni. The construction of the Talcher-Sambalpur railway line, irrigation canals, mining and illegal felling of trees have led to the fragmentation of elephant habitats in this area and an increase in human-elephant conflict. Three elephant corridors are located in this landscape.

In Odisha, the Rengali Dam constructed across the Brahmani River, as well as two major irrigation canals, have fragmented habitats north of the Mahanadi

The population of the South Keonjhar plateau and adjacent areas is spread over 2600 sq km and includes the Deogan, Ghatgaon and Telkoi Ranges of Keonjhar Forest Division and the Kamakhyanagar East and West Ranges of Dhenkanal Forest Division. Considerable deterioration of elephant habitat has occurred in the Dhenkanal Forest Division due to the construction of the Rengali irrigation canal at Samal as well as other medium-sized irrigation canals. This, coupled with

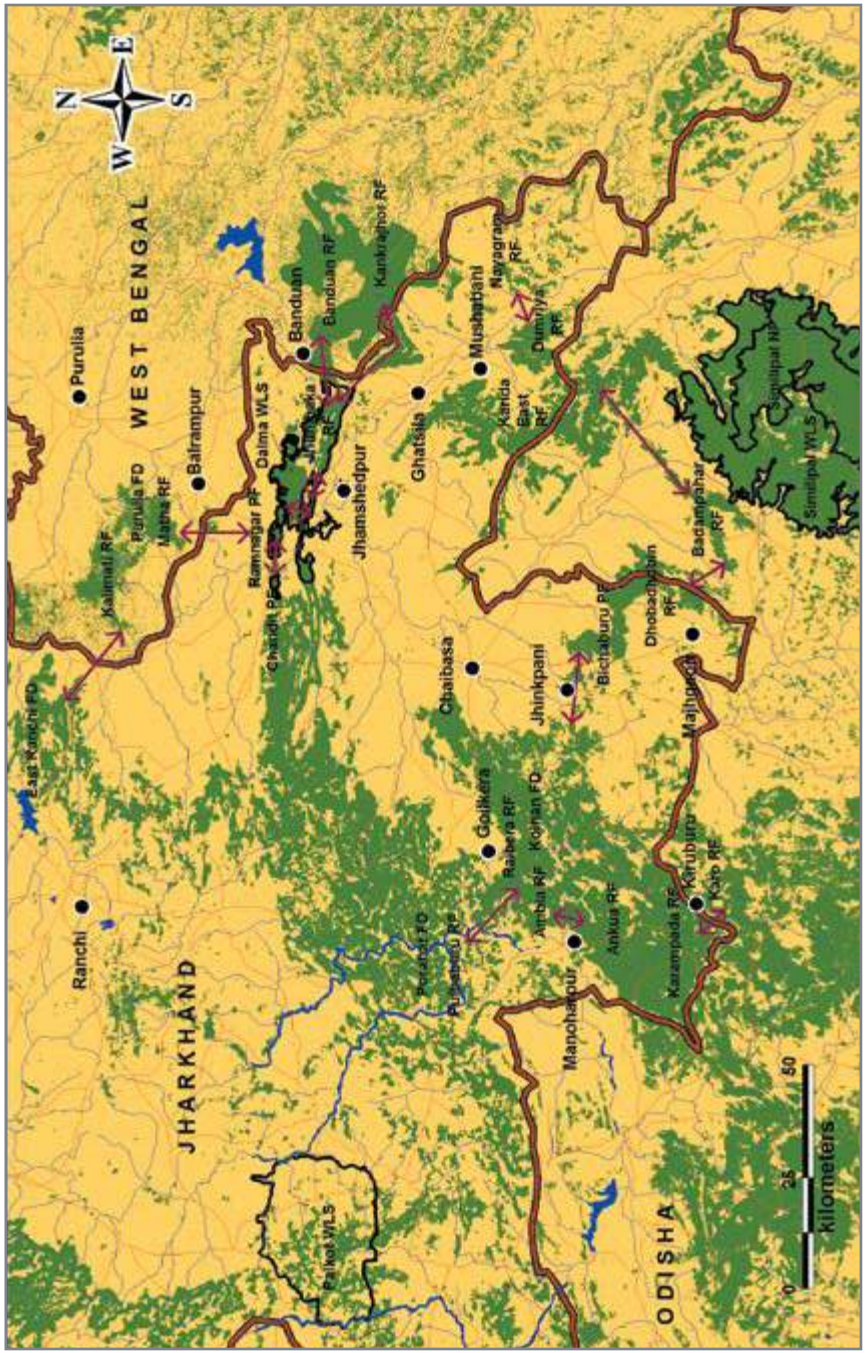
encroachment, has led to habitat fragmentation – though elephants still move between the Kahneijena Reserve Forest and Anantapur Reserve Forest across the Brahmani River, crossing the Rengali canal near Joka village and at a few other points. Habitat degradation and encroachment in and around Saptasajya Reserve Forest in Dhenkanal Forest Division has severely hindered the elephant movement between north-east Dhenkanal and south-west Dhenkanal. This, along with heavy mining in the neighbouring Sukinda Range of Athagarh Forest Division and the Daitan range of Anandapur (WL) Division, has severed the elephant connectivity between Angul and Similipal. Three elephant corridors are located in this landscape although the future of elephant movement from Anantapur Reserve Forest to Aswakhola Reserve Forest and Kapilas Wildlife Sanctuary is bleak. Mining, irrigation canals, encroachment and monoculture plantations have led to the shrinkage and degradation of elephant habitat and increased conflict in the Keonjhar Forest Division.

The Madanpur-Rampur-Kotgarh and Chandrapur population is to the south of the Mahanadi and covers the districts of Phulbani, Kalahandi, Ganjam, Gajapati and Raygada. A major part of this area is under shifting cultivation and Kotgarh and Lakhari are the only Protected Areas. Elephant movement between Kotgarh Wildlife Sanctuary and Kalahandi used to occur in the past but has now ceased due to shifting cultivation and encroachment. Elephant movement between Kotgarh Wildlife Sanctuary and Chandrapur Reserve Forest takes place through degraded forest patches. The populations of Lakhari Valley Wildlife Sanctuary and Mahendragiri have been isolated from each other and from other elephant populations. The current corridor in this region is between Kotagarh Wildlife Sanctuary and Pankhalgudi Reserve Forest.

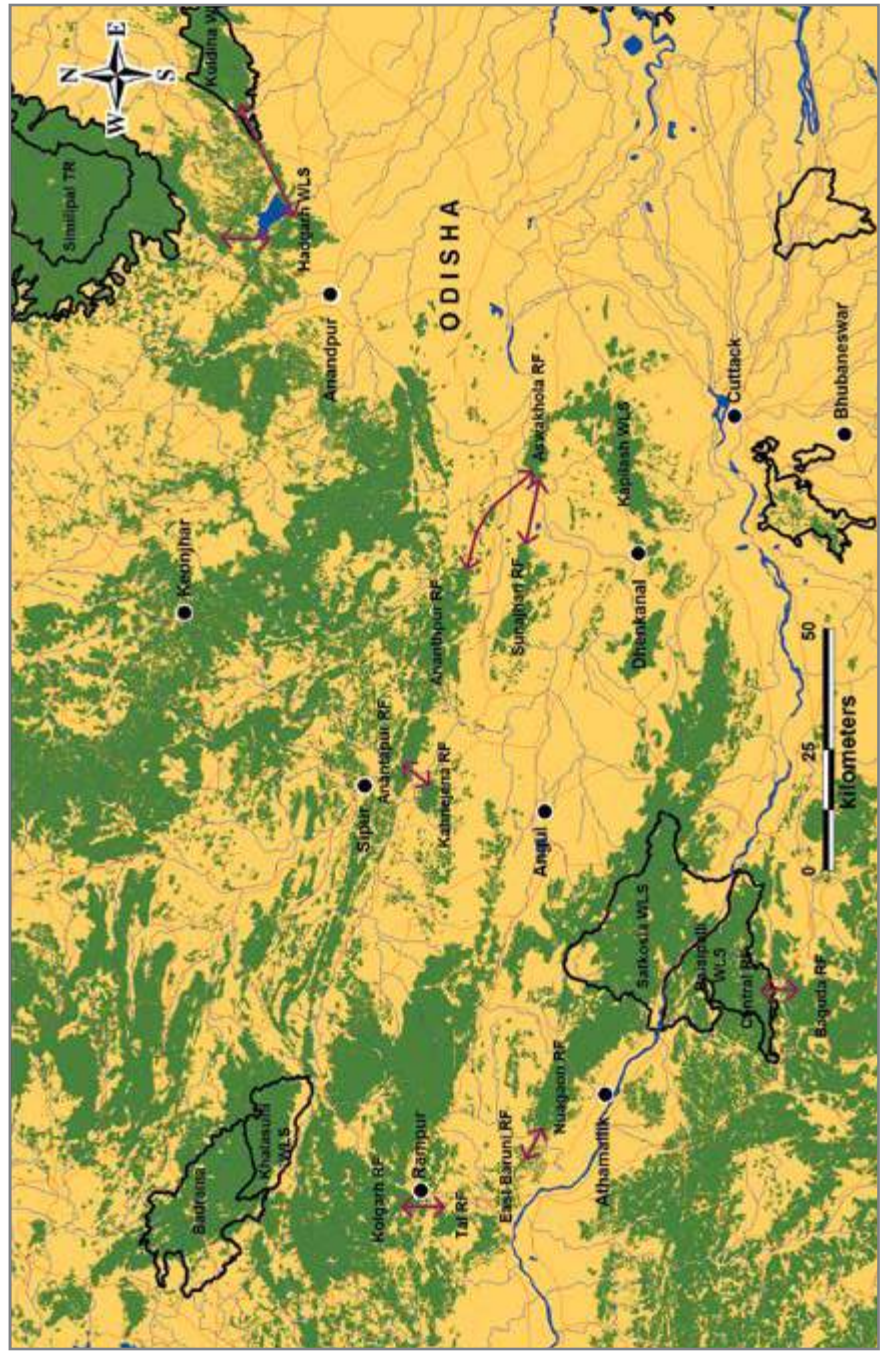
Chhattisgarh has a small elephant population which had originally migrated from Jharkhand and Odisha during the 1980s and 1990s. During the last few decades, the forested areas in these two states have been degraded due to illegal felling, encroachments, industrialisation and mining (*Singh and Chowdhury, 1999; Singh, 2000*). The deterioration in habitat quality has forced elephants to undertake long-range disoriented movements by using smaller forest patches to move to larger forest areas. This is one of the major causes for the migration of elephants into Chhattisgarh and at times extending to Madhya Pradesh. Historically, according to Forsyth (1889), northern Chhattisgarh used to have elephants. However, they became locally extinct in the early part of the 20th century (*Krishnan, 1972*). In 1988, elephants entered Chhattisgarh from Jharkhand and caused extensive damage to life and property. It was thought that these elephants had strayed from their original migration routes and had come to Chhattisgarh by mistake. In 1993, the government of what was then Madhya Pradesh captured 10 elephants in order to prevent any more elephants from migrating into Chhattisgarh. However, just two years after this operation, i.e. from 1995 onwards, elephants began regularly gaining access to Chhattisgarh, disproving the previous capture theory.

Human-elephant conflict cases have been increasing from the year 2000 as the number of migratory elephants coming into Chhattisgarh has steadily increased (*Singh, 2002*). In 1988, only 18 elephants migrated into Chhattisgarh. From 1998 onwards the elephant population in the state has increased gradually, reaching 247 in 2017 (*MoEF&CC, 2017*). This population occupies about 3625 sq km of forest area in Surguja Division, Koriya Division, Surajpur Division, Jashpur Division, Balrampur Division, Dharamjaigarh Division, Korba Division, Raigarh Division, Badalkhol Wildlife Sanctuary, Samarsot Wildlife Sanctuary, Tamorpingla Wildlife Sanctuary and Guru Ghasidas National Park. Two new elephant corridors have been identified in the state, namely Tamorpingla–Jashpur and Surguja–Jashpur. Human-elephant conflict in Chhattisgarh has resulted in 290 human deaths between 2009-10 and 2016-17. A sum of Rs 7.3 crores has been paid as ex-gratia for human deaths and Rs 14.25 crores for crop damage and loss of property.

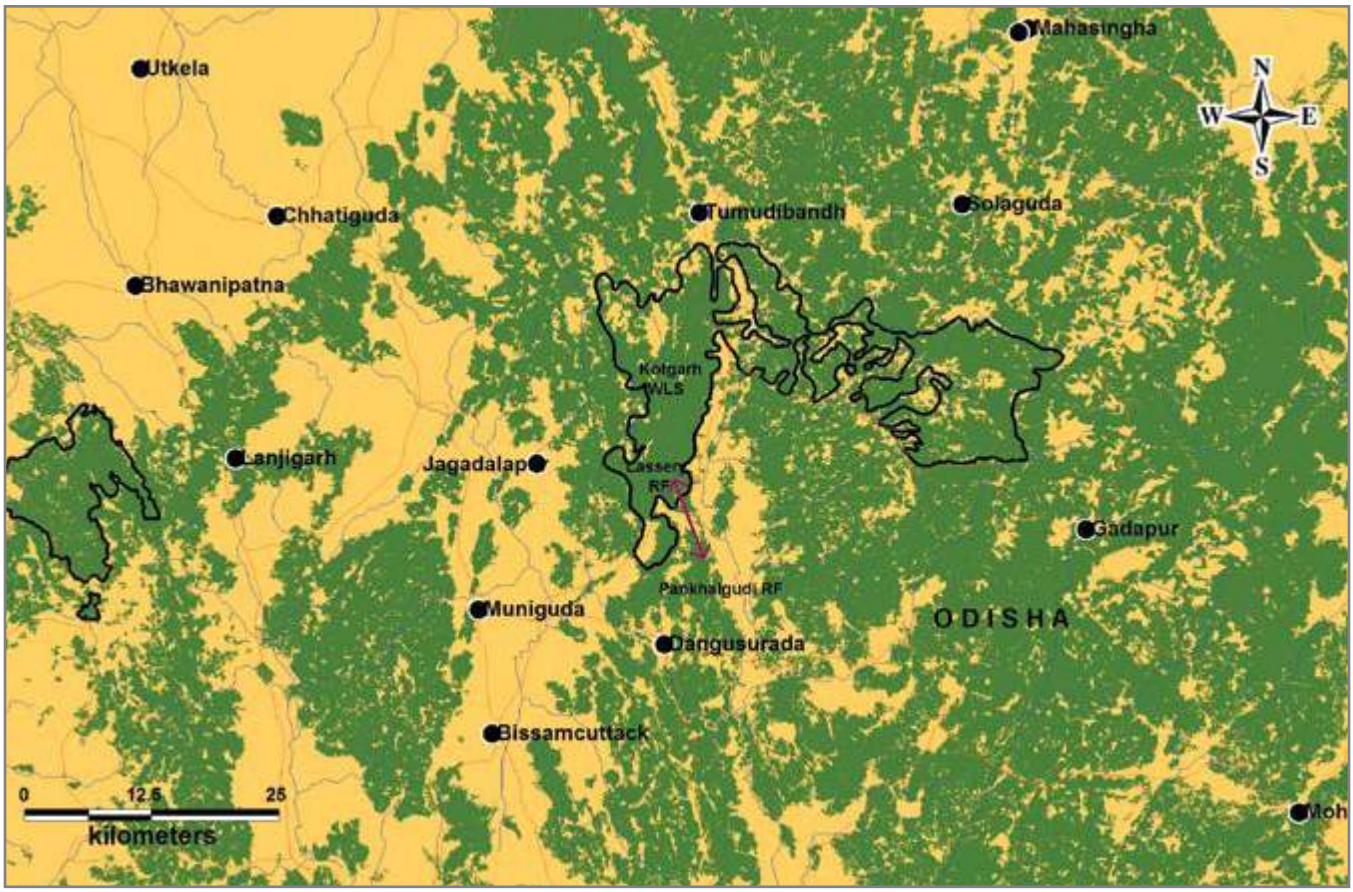
Southern West Bengal also supports a sizable elephant population (194 elephants; *MoEF&CC, 2017*), mainly in the Puruliya (Purulia Division, Kangsabati North Division and Kangasabati South Division), West Midnapore (Midnapore Division, Rupnarayan Division, Jhargram Division and Kharagpur Division) and Bankura districts (Bankura North Division and Bankura South Division) (*Chanda, undated*). Elephants from Dalma Wildlife Sanctuary (Jharkhand) move to West Midnapore and Kangsabati South Forest Divisions, and from Ranchi to Puruliya Forest Division, and from Baripada Forest Division (Odisha) to Kharagpur Forest Division.



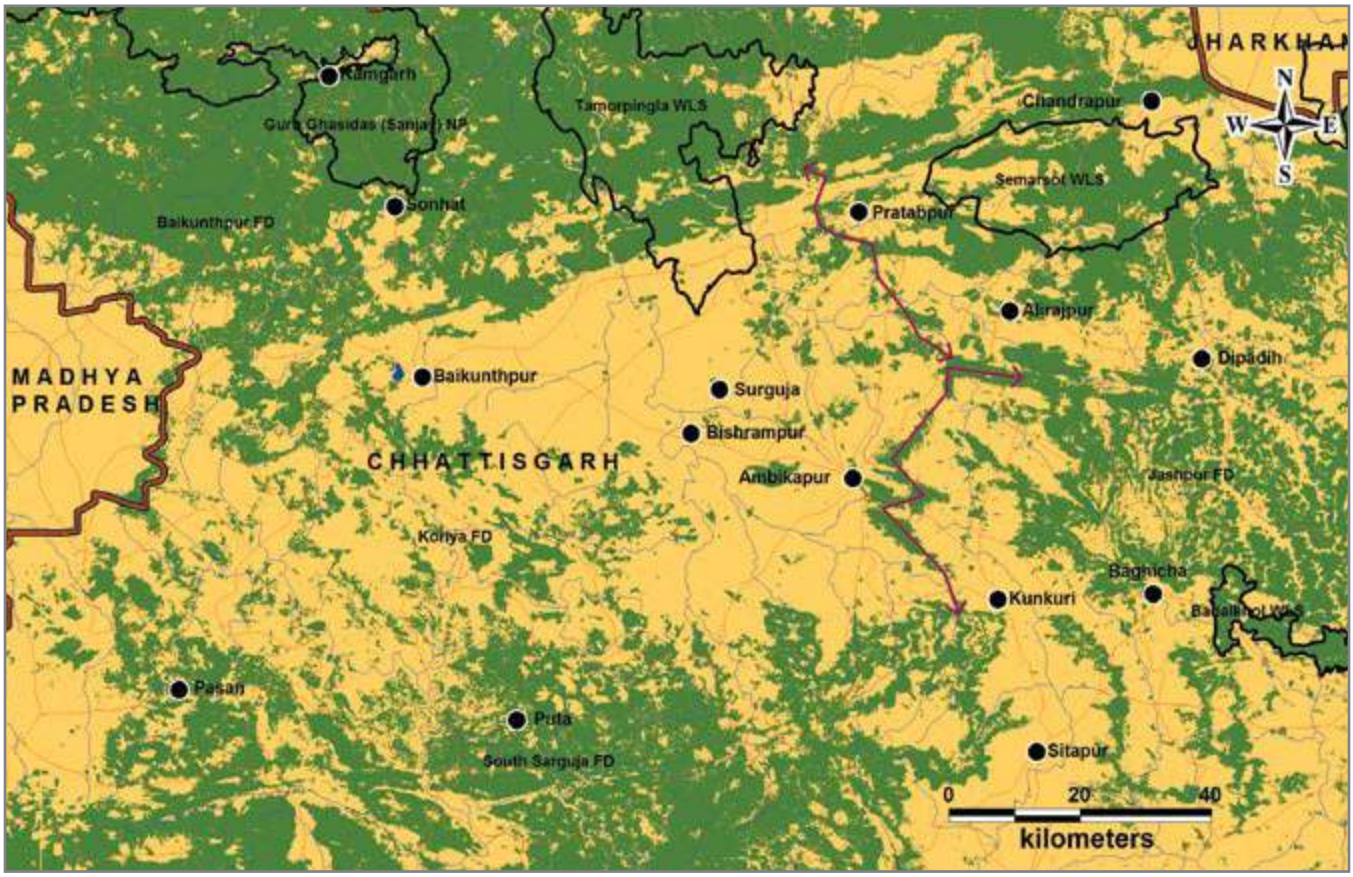
Elephant corridors in Central India – I



Elephant corridors in Central India – II



Elephant Corridors in Central India - III



Elephant Corridors in Central India - IV

5.01

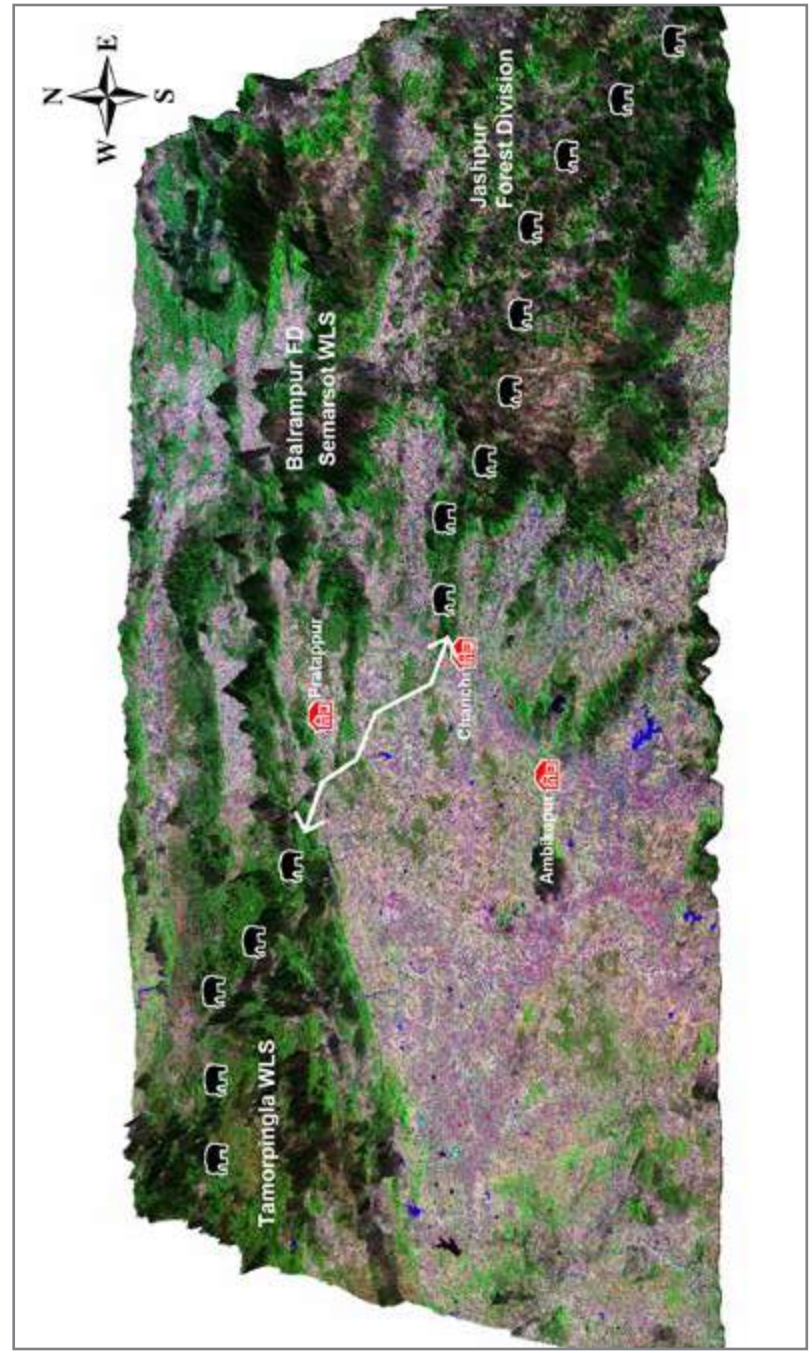
TAMORPINGLA - JASHPUR

Ecological Priority: High

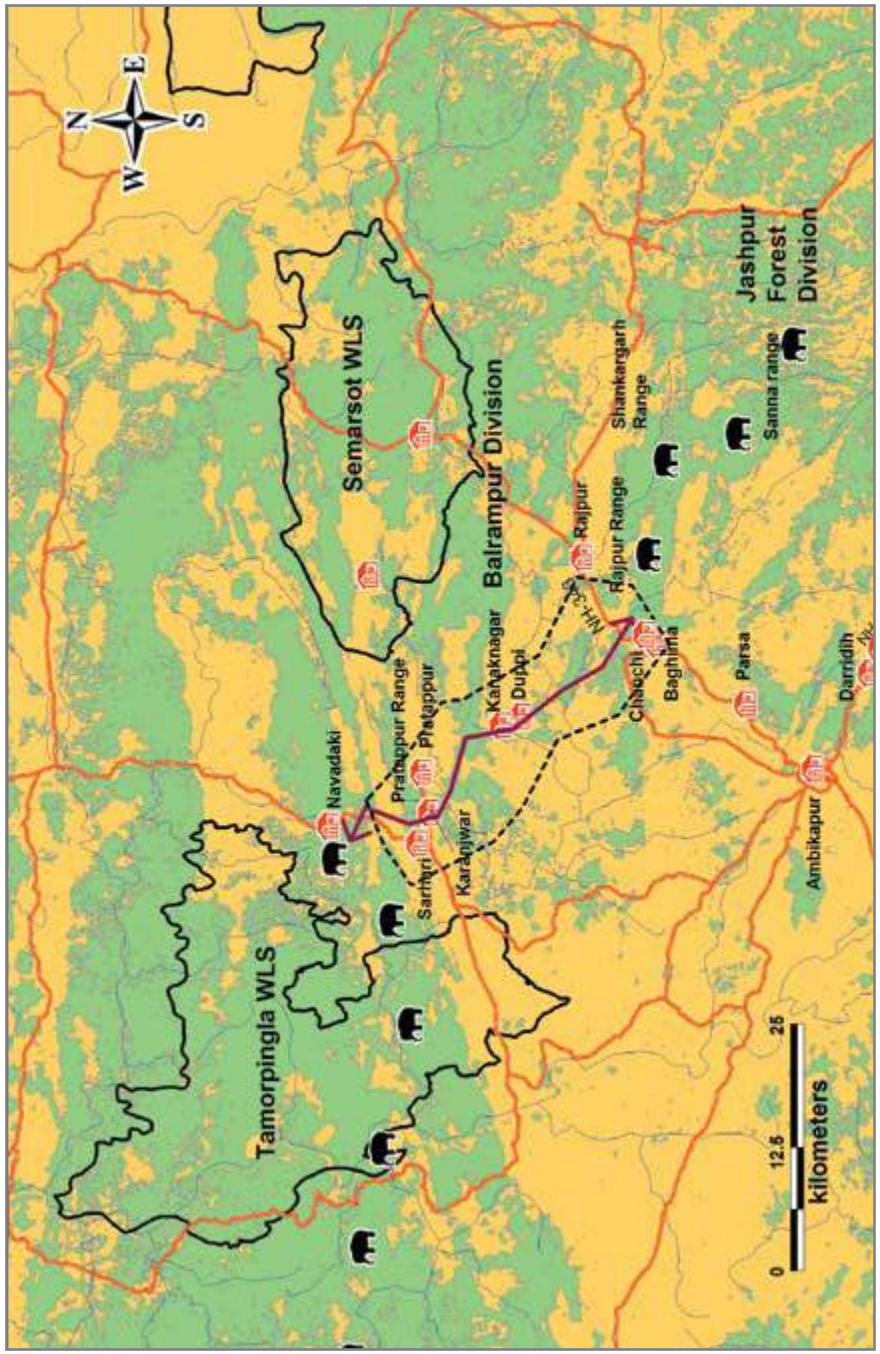
Conservation Feasibility: Medium

This corridor connects the elephant population of Tamorpingla Wildlife Sanctuary to Jashpur Forest Division. Elephants move from the Ghui Range of Tamorpingla through several settlements, agricultural lands and fragmented forest patches of the Pratappur Range of Surajpur Forest Division and the Rajpur and Shankargarh Ranges of Balrampur Forest Division, leading on to the Sanna Range of Jashpur Forest Division. The elephants cross the Ambikapur-Pratappur highway between Dharampur and Gotgaon, and the Ambikapur-Semarsot highway near Chanchi.

State	Chhattisgarh
Connectivity	Tamorpingla Wildlife Sanctuary and Jashpur Forest Division
Length and Width	35 km and 0-1 km
Geographical coordinates	23° 15′ 22″- 23° 31′ 45″ N 83° 5′ 8″- 83° 23′ 26″ E
Legal status	Reserve Forest, Revenue and Patta Land
Major land use	Agriculture, Settlement, Plantation and forest
Major habitation/settlements	About 20 villages in the corridor and 10-12 on its fringes
Forest type	Plantation and mixed dry deciduous and sal forest
Frequency of usage by elephants	Regular; especially during cropping season (August to November/ December)



3D map showing the landscape of the Tamorpingla-Jashpur Corridor



Map of the Tamorpingla-Jashpur Corridor

FORESTS AND ELEPHANTS

Corridor habitat status: The corridor forest consists of fragmented forest patches. The vegetation is dominated by sal (*Shorea robusta*), most of it being planted by the forest department. Other associated species present in the corridor area are *Tectona grandis*, *Cassia fistula, Terminalia tomentosa, Embilica officinalis, Anogeissus latifolia, Diospyros melanoxylon, Pongamia pinnata, Madhuca indica, Boswellia serrata, Butea frondosa, Sizigium cumini* etc. Patches of *Dendrocalamus strictus* were also seen. Signs of wood cutting and lopping were noticed in most of the tree species. The ground cover consisted of grasses (50%) followed by barren ground (21%), herbs (15 %) and shrubs (14%).

Estimated elephant numbers in the landscape

Tamorpingla Wildlife Sanctuary: 30-40
Jashpur Forest Division: 58-60
(*Elephant Census Chhattisgarh, 2012*)

Forest/Land use

Forest Type: Mixed dry deciduous forest dominated by sal and teak plantation
Settlements: More than 20 villages in the corridor and about 10-12 fringe villages
Agriculture: Paddy, sugarcane and maize
Highway: Ambikapur- Pratappur and Ambikapur- Semarsot (NH 343)

Other ecological importance

Elephant Range: Central India
Nearest Protected Area: Tamorpingla Wildlife Sanctuary
Elephant Reserve: Badalkhol-Tamarpingla

HUMAN DIMENSIONS

Threats

1. *Agriculture and Settlements:* More than 20 villages are located in the corridor and about 10-12 villages on the fringes of the corridor. The expansion of these villages and the biotic pressure they exert has threatened the corridor habitat.

2. People's dependency on forest resources: Fuelwood and NTFP collection has degraded the corridor forest.

3. Vehicular traffic: There is high vehicular traffic on the Ambikapur-Rajpur-Ramaujganj highway (NH 343) passing through the corridor.

4. Changed cultivation patterns, with maize and sugarcane being grown on a large scale, are attracting elephants to agriculture fields. Sugar factories have also come up close to the corridor.

Corridor villages: Pahiya, Ghat Pendari (Ghui Range), Chandora, Samai, Daldali, Gotagaon, Tukudad, Sidhara, Dharampur, Ganeshpur (Pratappur Range), Chora, Dhuppi, Narsingpur, Lamnia, Chilmakala, Baski, Amdari (Rajpur Range), Jargim (Shankargarh Range) and Dagri (Sanna Range).

Corridor dependent villages: Mani, Damurkholi, Sarhari, Khorma, Madannagar (Pratappur Range), Karji, Chanchi, Patrapara (Rajpur Range), Manoharpur and Podikudh (Sankargarh Range).

Human-Elephant Conflict: All the corridor and fringe villagers are affected by conflict with a high level of crop and property damage reported every year. More than 45-50 houses are reported damaged in and around the corridor area annually.

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent encroachment and developmental activities affecting elephant movement.

2. Eco-development support needs to be provided to corridor and fringe villages to reduce dependency on forest resources. Fuel-efficient stoves should be distributed to minimise fuelwood extraction from the forest. This will also help prevent retaliation against elephants in these areas.

3. Habitat improvement activities, including the plantation of native species and protection of corridor forests, should be taken up on a priority basis.

4. Alternate cropping patterns need to be be practiced, weaning villagers away from growing sugarcane and maize.

5. No construction should be allowed on either side of the highways passing through the corridor.



Fig. 5.01: A house damaged by elephants in the corridor

5.02

SURGUJA - JASHPUR

Ecological Priority: High

Conservation Feasibility: Medium

This corridor connects the elephant population of Surguja Forest Division with that of Jashpur Forest Division. Elephants move through several settlements, agricultural lands and fragmented forest patches from the Sitapur, Ambikapur and Lundra Ranges of Surguja Forest Division to the Rajpur (near Chanchi) and Shankargarh Ranges of Balrampur Forest Division, finally leading to the Sanna Range of Jashpur Forest Division.

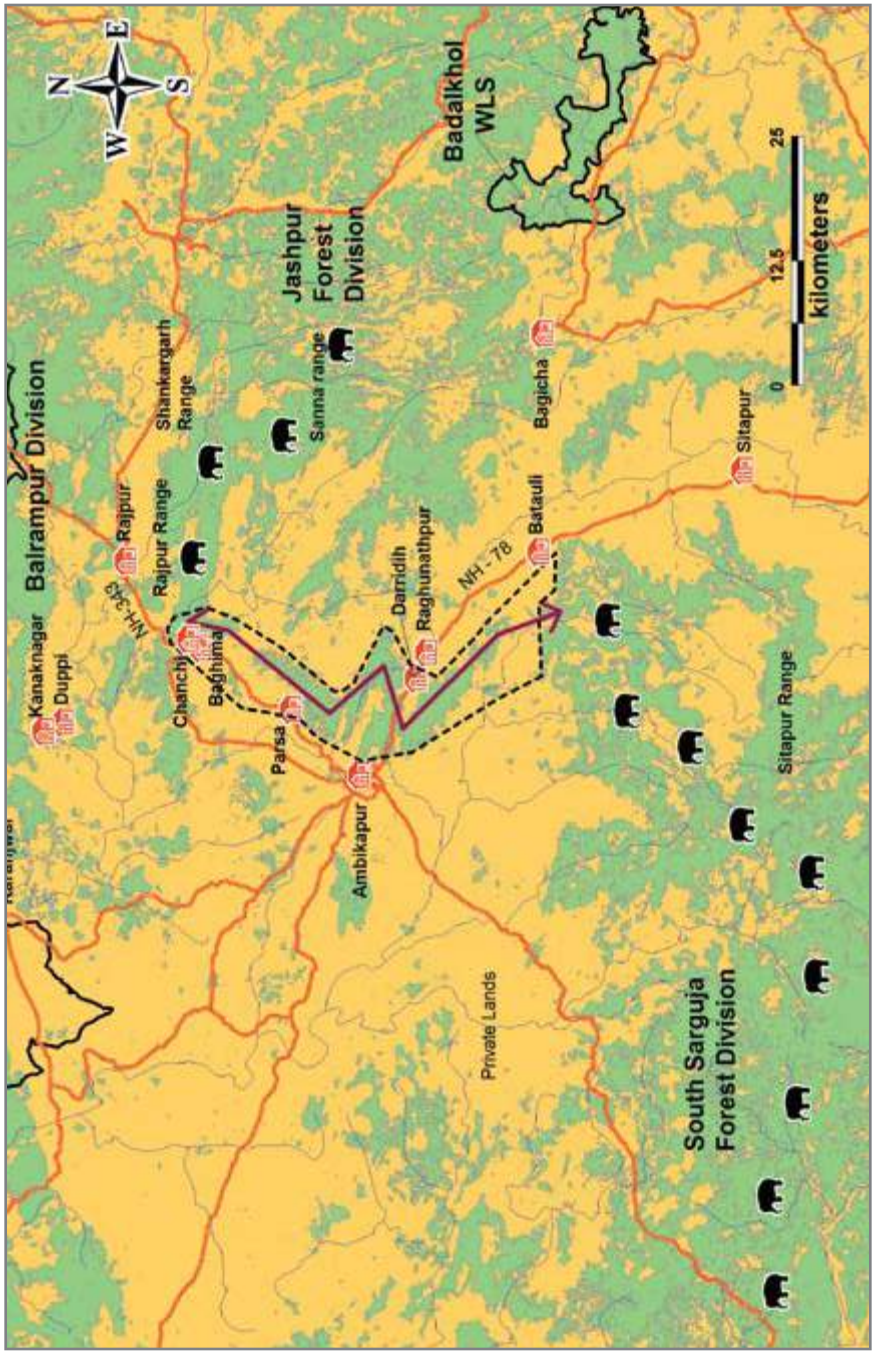
State	Chhattisgarh
Connectivity	Surguja FD with Jashpur FD
Length and Width	45 km and 0-2 km
Geographical coordinates	22° 56′ 48″- 23° 17′ 46″ N 83° 13′ 5″- 83° 25′ 20″ E
Legal status	Patta Land, Revenue Land and Reserve Forest
Major land use	Forests, agriculture and settlements
Major habitation/settlements	About 12-14 villages in the corridor
Forest type	Plantation and mixed sal deciduous forest
Frequency of usage by elephants	Regular, especially during cropping season (August to November/ December)

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 33 plant species were recorded in the sampled area, dominated by *Shorea robusta*. Other plants species found were *Terminalia*



3D map showing the landscape of the Surguja – Jashpur Corridor



Map of the Surguja – Jashpur Corridor

tomentosa, Tectona grandis, Buchania lanzon, Bombex ceiba, Cassia fistula, Embilica officinalis, Anogeissus latifolia, Diospyros melanoxylon, Madhuca indica etc. Maximum average GBH was recorded in *Bombax ceiba* (34 cm), followed by *Madhuca indica* (21.75 cm), *Shorea robusta* (17.42 cm) and *Buchania lanzon* (17.17 cm). Ground cover vegetation included grasses (35%), shrubs (25%), herbs (15%) and barren ground (25%).

Estimated elephant numbers in the landscape

About 40-50 elephants extensively use this corridor as part of their annual seasonal migration, especially from August to November/December.

Surguja Forest Division: 20-25
Balrampur Forest Division: 15-20
Jashpur Forest Division: 58-60
(Elephant Census Chhattisgarh, 2012)

Forest/Land use

Forest: Mixed dry deciduous forest dominated by sal
Settlements: About 12-14 villages in the corridor and about 18 villages on the fringes
Agriculture: Paddy, maize, sugarcane, millet
Roadways: Ambikapur-Rajpur-Ramanujganj (NH 343) and Ambikapur-Sitapur-Pathalgaon (NH 78)
Other structures: Baki Dam

Other ecological importance

Elephant Range: Central India
Nearest Protected Area: Semarsot Wildlife Sanctuary
Elephant Reserve: Badalkhol-Tamorpingla

HUMAN DIMENSIONS

Threats

1. *Agriculture and human settlements:* There is a large number of villages in and around the corridor exerting tremendous biotic pressure on the corridor.

2. Vehicular traffic: The Ambikapur-Rajpur-Semarsot (NH 343) and the Ambikapur-Sitapur-Pathalgaon (NH 78) highways pass through the corridor. Six-wheeled and four-wheeled vehicles were recorded around the clock.

3. Use of forest resources: Fuelwood and NTFP collection by inhabitants of corridor and fringe villages has degraded the corridor forest and connecting habitats.

4. Changed cultivation patterns, with maize and sugarcane being grown on a large scale, attract elephants to agricultural fields.

There are several villages located in and around the corridor. People are mostly engaged in farming and are also dependent on forest areas for fuelwood and NTFP collection.

Corridor villages: Kalipur, Gahila (Surguja Range), Ajirnakala, Kakana (Ambikapur Range), Balrampur, Banda, Bhaski and Amdari (Rajpur Range), Jargim (Shankargarh Range) and Dagri (Sanna Range).

Corridor dependent villages: Gangapur, Barkali, Sikilma, Raghunathpur (Sitapur Range), Ranpurkhud, Jamdi, Parsa, Hasuli (Ambikapur Range), Balrampur, Barion, Bhaski, Chanchi, Patrapara (Rajpur Range), Jamoni, Murka (Lundra Range), Manoharpur and Podikudh (Sankargarh Range).

Human-Elephant Conflict: Many villages in the corridor area – viz. Parsa, Baghima, Chanchi, Khokhania, Rawatpur, Duppi, Chachi, Arra, Narsingpur, Bada, Parasaguddi, Saini, Okra, Rajpur, Baria, Kakna, Kodu, Gopalpur, Parsaguri, Baria, Lao etc – are affected by depredations caused by elephants. Six cases of human deaths caused by elephants were reported in and around the Sitapur Range of Surguja Forest Division between 2009 and 2013. A total of 228 cases of house damage by elephants were also recorded in the Sitapur Range.

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent encroachment and developmental activities affecting elephant movement.

2. Alternate cropping patterns should be introduced, weaning villagers away from sugarcane and maize.

3. Habitat improvement in open forest areas and protection of the corridor forests should be taken up on a priority basis.

4. No construction should be allowed on either side of the highways passing through the corridor.



Fig. 5.02: Microhabitat in the corridor

5.03

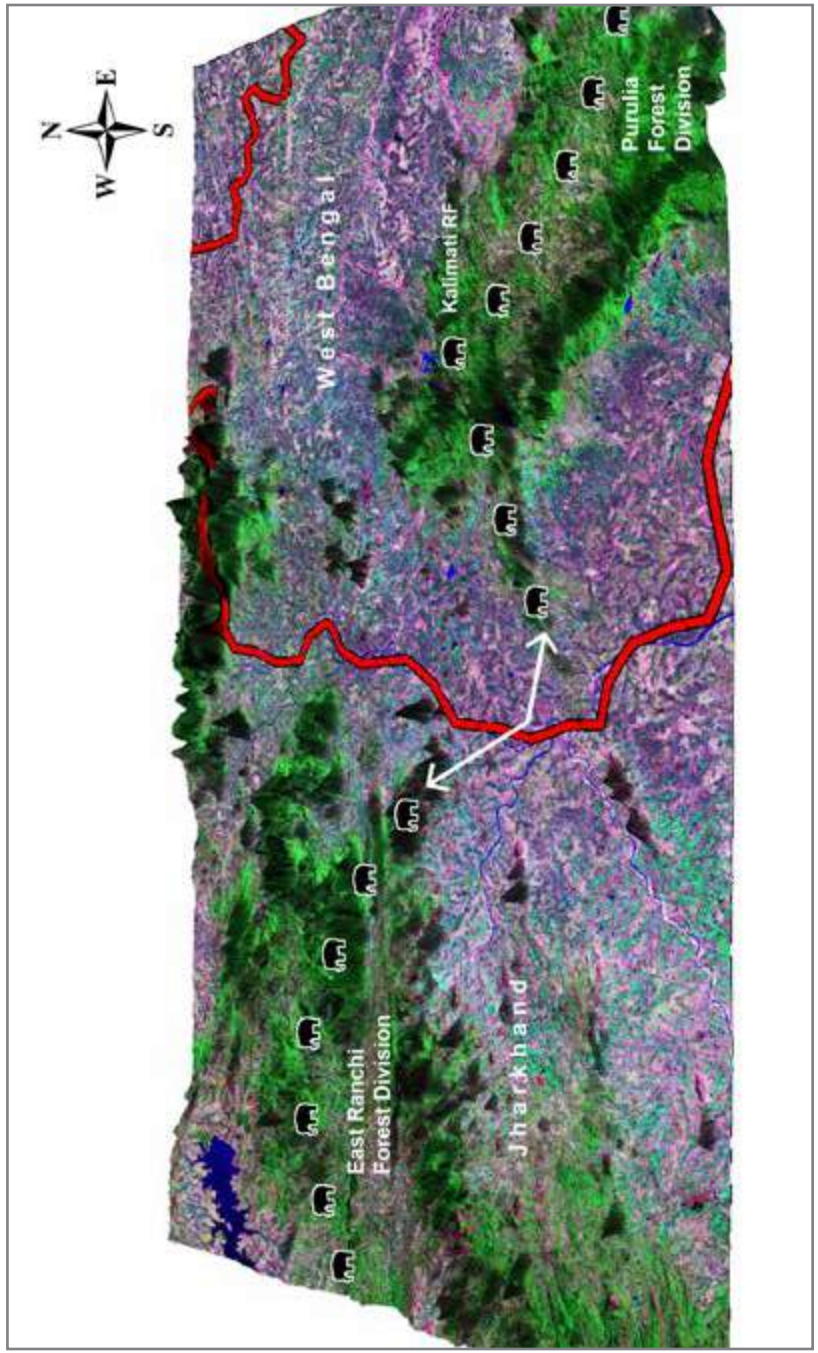
MAHILONG - KALIMATI

Ecological Priority: Medium

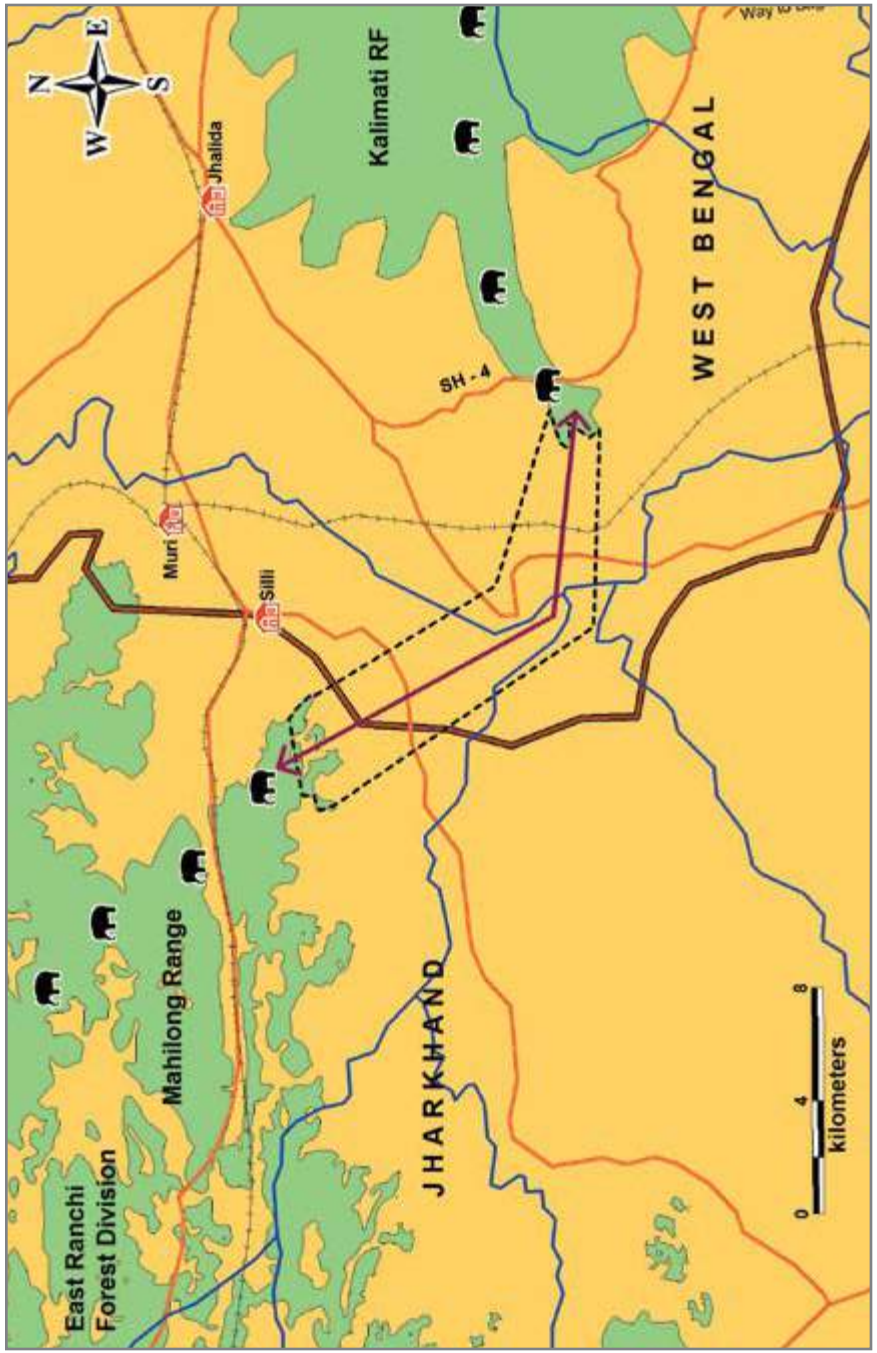
Conservation Feasibility: Low

The Mahilong -Kalimati corridor connects forest blocks in the Mahilong and Bundu Ranges under Ranchi Forest Division in Jharkhand, with the Jhalda and Bagmundi Ranges under Purulia Forest Division in West Bengal. Elephant movement from Mahilong takes place in two directions. One goes south towards the Bagmundi Range (near Hesla) through Bundu, Sonahato and Jamudag, crosses the Subarnarekha River near Pusti, and then through Hesla to the Bagmundi Range. The other moves to the Jhalda Range and crosses Subarnarekha River north of Silli and south of Muri. State Highway 4 connecting Balarampur and Jhalda passes through the corridor in the Duarsuni Protected Forest. The establishment of a hydro-electric power project in the Ayodhya Hills near Baghmundi has affected the elephant population in Ayodhya Hills and the usage of this corridor.

State	Jharkhand and West Bengal
Connectivity	Mahilong and Bundu Ranges of Ranchi Forest Division with Jhalda and Baghmundi Ranges of Purulia Forest Division
Length and Width	18 km and 0-0.5 km
Geographical coordinates	23° 14′ 20″- 23° 20′ 23″ N 85° 46′ 6″- 85° 54′ 25″ E
Legal status	Protected Forest and Patta Lands
Major land use	Forest, agriculture fields, human habitations
Major habitation/settlements	About 18 villages in and around the corridor
Forest type	Tropical dry deciduous forest
Frequency of usage by elephants	Regular, throughout the year



3D map showing the landscape of the Mahilong - Kalimati Corridor



Map of the Mahilong – Kalimati Corridor

FORESTS AND ELEPHANTS

Corridor habitat status: The corridor comprises degraded and barren lands with *Butea monosperma* plants, agriculture fields, human habitations and the Subarnarekha River intersecting its area.

Estimated elephant numbers in the landscape

Ranchi Forest Division: 17-20

Purulia Forest Division: 10-12

(*Elephant Census Jharkhand, 2012* and *Elephant Census West Bengal, 2010*)

Forest/Land use

Forest type: Tropical dry deciduous forest (mostly degraded forest patches)

Agriculture: Mostly paddy and vegetables

Human habitation: Major settlements include Khamar, Hesla, Pusti, Rangamati, Bhakuyadi, Jintudih, Dibadih, Salsudi, Poring Chauli, Jamudag, Saread, Dirsir, Sonahatu, Baghadih, Bhorangadih, Damari, Bundu and Edalhatu

River: Subarnarekha River

Roadway: Jhalda-Baghmundi State Highway (SH 4)

Railway: Chitarpur-Muri-Chandil

Other ecological importance

Mountain Range: Ayodhya Hills

Elephant Range: Central India

HUMAN DIMENSIONS

Threats

1. Human habitation: Closely located and densely populated villages are situated in the corridor. The expansion of human habitations has hindered elephant movement in the corridor.

2. *Agriculture:* Vast expanses of agricultural fields are present in the corridor. Farmers cultivate paddy and vegetables extensively. Levels of crop depredation by elephants are high.

3. Railway traffic: A section of the Chandil-Muri railway track passes through the corridor. In 2008, an elephant was killed in a train-hit incident near Bhusudih village.

4. Hydro-electric project: The establishment of a hydel power project in the Ayodhya Hills near Baghmundi affects once continuous elephant movement from the Hensla Protected Forest to the Ayodhya hill ranges.

5. State Highway: SH 4 connecting Balrampur and Jhalda passes through the corridor in the Duarsuni Protected Forest, though traffic flow is not heavy.

Densely located and populated villages are present in the corridor. Agriculture is the main source of livelihood and the villagers extensively cultivate paddy and vegetables.

Corridor villages: Hesla, Pusti, Bhakuyadi, Jintudih, Dibadih, Poring Chauli and Sonahatu are major settlements.

Corridor dependent villages: Khamar, Rangamati, Salsudi, Jamudag, Saread, Dirsir, Baghadih, Bhorangadih, Damari, Bundu and Edalhatu.

Human-Elephant Conflict: Crop depredation by elephants is the main cause of human-elephant conflict in this area. Farmers suffer high economic losses, more due to the damage caused to vegetables rather than to paddy. Two elephant deaths occurred due to train-hits near the corridor on September 26, 2016.

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent encroachment and developmental activities affecting elephant movement.

2. Measures should be taken to mitigate human-elephant conflict, which fosters a negative attitude among local communities towards elephant conservation.

3. Habitat restoration of the corridor forest, especially in Puruliya Division, needs to be prioritised.



Fig. 5.03: The Chandil–Muri railway line passing through the corridor

5.04

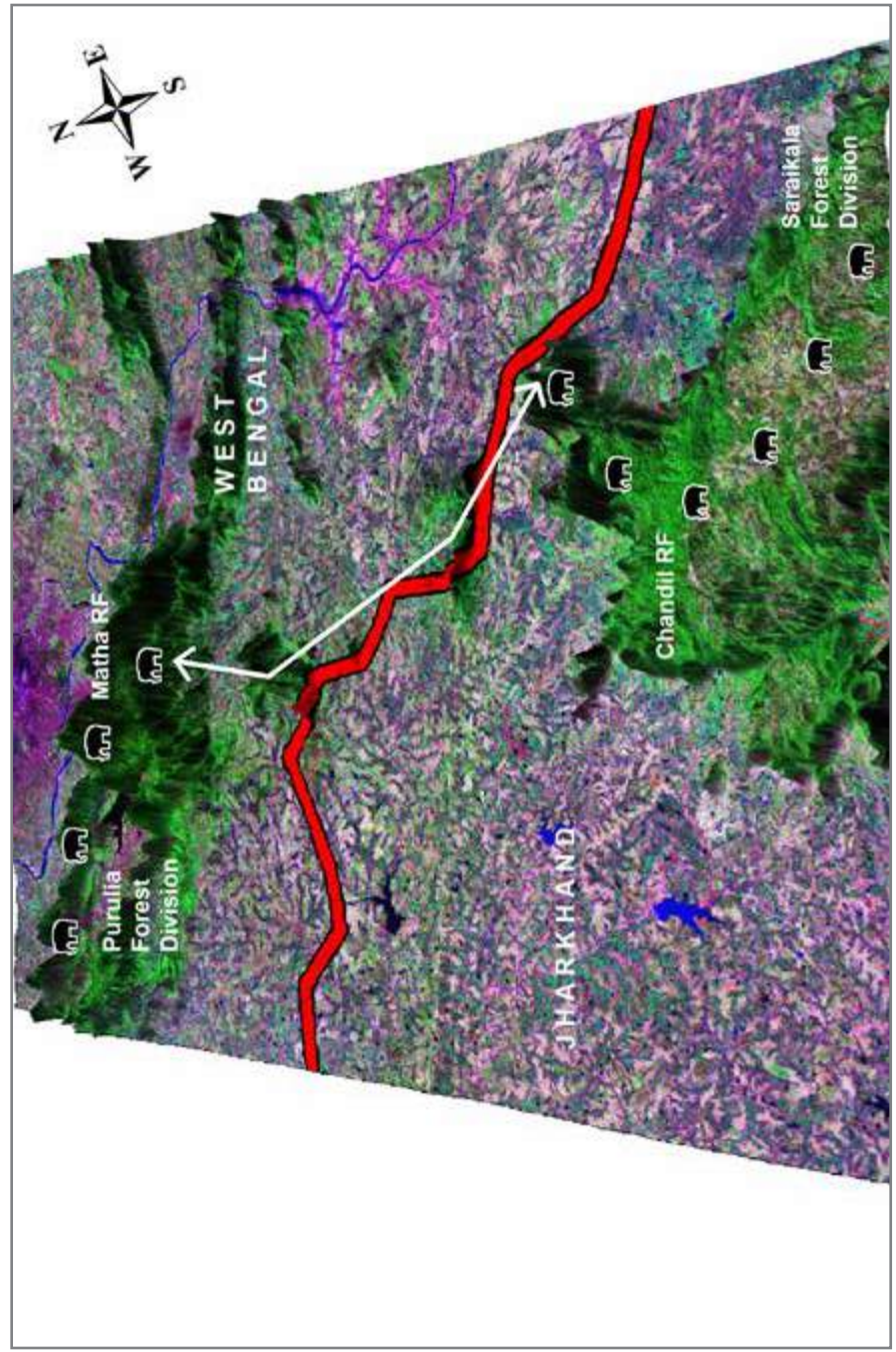
CHANDIL - MATHA

Ecological Priority: Low

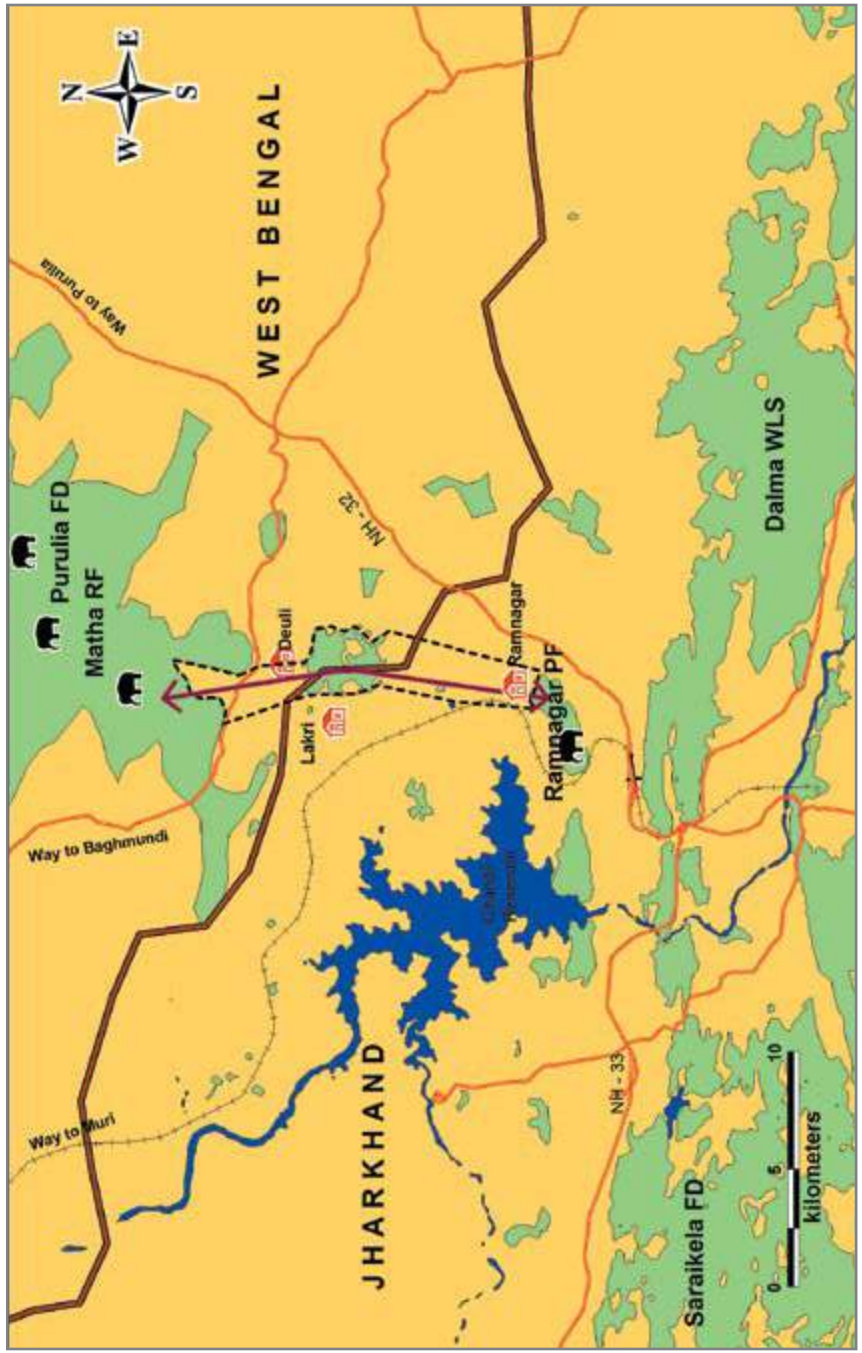
Conservation Feasibility: Medium

This corridor connects the Gundu and Ramnagar Protected Forests located in the Chandil Range of Saraikela Forest Division in Jharkhand, with the Matha Reserve Forest located in the Matha Range of Purulia Forest Division in West Bengal. Elephants move through fragmented forest patches (Burudih Protected Forest, Kadla Protected Forest, Chatarma Protected Forest and Digadih Protected Forest), and densely located human habitations with agriculture fields. Elephants from Matha Reserve Forest cross State Highway 4 in the Digadih Protected Forest between the villages of Bansidih and Buchungdih, then move to Ramnagar Protected Forest through Burudih Protected Forest, Chaturma Protected Forest and Kadla Protected Forest, and over ten villages.

State	Jharkhand and West Bengal
Connectivity	Chandil Range of Saraikela Forest Division with Matha Range of Purulia Forest Division
Length and Width	16 km and 1-2 km
Geographical coordinates	22° 59′ 32″- 23° 8′ 4″ N 86° 5′ 56″- 86° 8′ 22″ E
Legal status	Protected Forest, Patta Lands and Revenue Lands
Major land use	Human habitation, agriculture fields and forests
Major habitations/settlements	Ramnagar, Murugdih, Jugilang, Puriara, Patardih, Kadla, Chatarma, Lakri, Burudih, Ponda, Dumurdihi, Jopahadi, Bansdih, Srirampur, Khududih and Dhaska
Forest type	Tropical dry deciduous forest
Frequency of usage by elephants	Rare



3D map showing the landscape of the Chandil - Matha Corridor



Map of the Chandil – Matha Corridor

FORESTS AND ELEPHANTS

Corridor habitat status: Forest patches of the Kadla, Burudih, Chatarma and Digidih Protected Forests lie within the corridor. Digidih Protected Forest (through which State Highway 4 passes) is an open forest dominated by *Shorea robusta*. Plantation of *Acacia auriculiformis* is also present along the forest border in the corridor. The forest patches are severely degraded.

Estimated elephant numbers in the landscape

Saraikela Forest Division: 30

Purulia Forest Division: 10-12

(Elephant Census Jharkhand, 2012 and *Elephant Census West Bengal, 2012)*

Forest/Land use

Forest type: Tropical dry deciduous with fragmented forest patches

Human habitation: Ramnagar, Murugdih, Jugilang, Puriara, Patardih, Kadla, Chatarma, Lakri, Burudih, Ponda, Dumurdihi, Jopahadi, Bansdih, Srirampur, Khududih and Dhaska

Agriculture: Paddy

Roadway/Highway: State Highway 4 connecting Balarampur and Jhalda

Railway Track: Chandil-Muri

Other ecological importance

Mountain Range: Chotanagpur Plateau

Elephant range: East-Central India

Nearest Protected Area: Dalma Wildlife Sanctuary

HUMAN DIMENSIONS

Threats

1. Human habitation and agriculture fields: The corridor comprises at least 16 villages and a vast expanse of agricultural fields, which disconnects the forest

between the Gundu and Ramnagar Protected Forests and Matha Reserve Forest.

2. Encroachment: People from villages surrounding Kadla, Burudih, Chatarma and Digidih Protected Forests have encroached upon the corridor forest, causing fragmentation and disconnection within the corridor.

3. Biotic pressure: Villagers of corridor fringe villages depend upon the corridor forest for fuelwood, *Shorea robusta* leaves, other NTFP and livestock grazing.

4. Highway: SH4 connecting Balarampur and Jhalda bisects the corridor in the Digidih Protected Forest. Vehicular traffic is seen mostly during the day.

5. Railway track: The track connecting Chandil and Muri passes along the Ramnagar Protected Forest near Gunda village. This has obstructed elephant movement between Ramnagar Protected Forest and Dalma Wildlife Sanctuary.

Around sixteen villages are located in and around the corridor. Villagers of the fringe villages are mostly dependent on agriculture and daily wage labour for their livelihood. They graze livestock and collect fuelwood, *Shorea robusta* leaves and other NTFP from the corridor forest.

Corridor villages: Ramnagar, Murugdih, Ruriara, Kadla, Chatarma, Burudih, Bansdih and Srirampur

Corridor dependent villages: Jugilang, Patardih, Chatarma, Lakri, Ponda, Dumurdihi, Jopahadi, Khududih and Dhaska

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent encroachment and developmental activities affecting elephant movement. The corridor area could be notified as an ecofragile area to provide legal protection.

2. Habitat restoration of degraded forest patches in Kadla, Burudih, Chatarma and Digidih Protected Forests should be taken up.

3. Clearing of encroached territory in the corridor and subsequent habitat restoration will be required to increase connectivity.



Fig. 5.04: State Highway 4 passing through the corridor

5.05

DALMA - CHANDIL

Ecological Priority: Medium

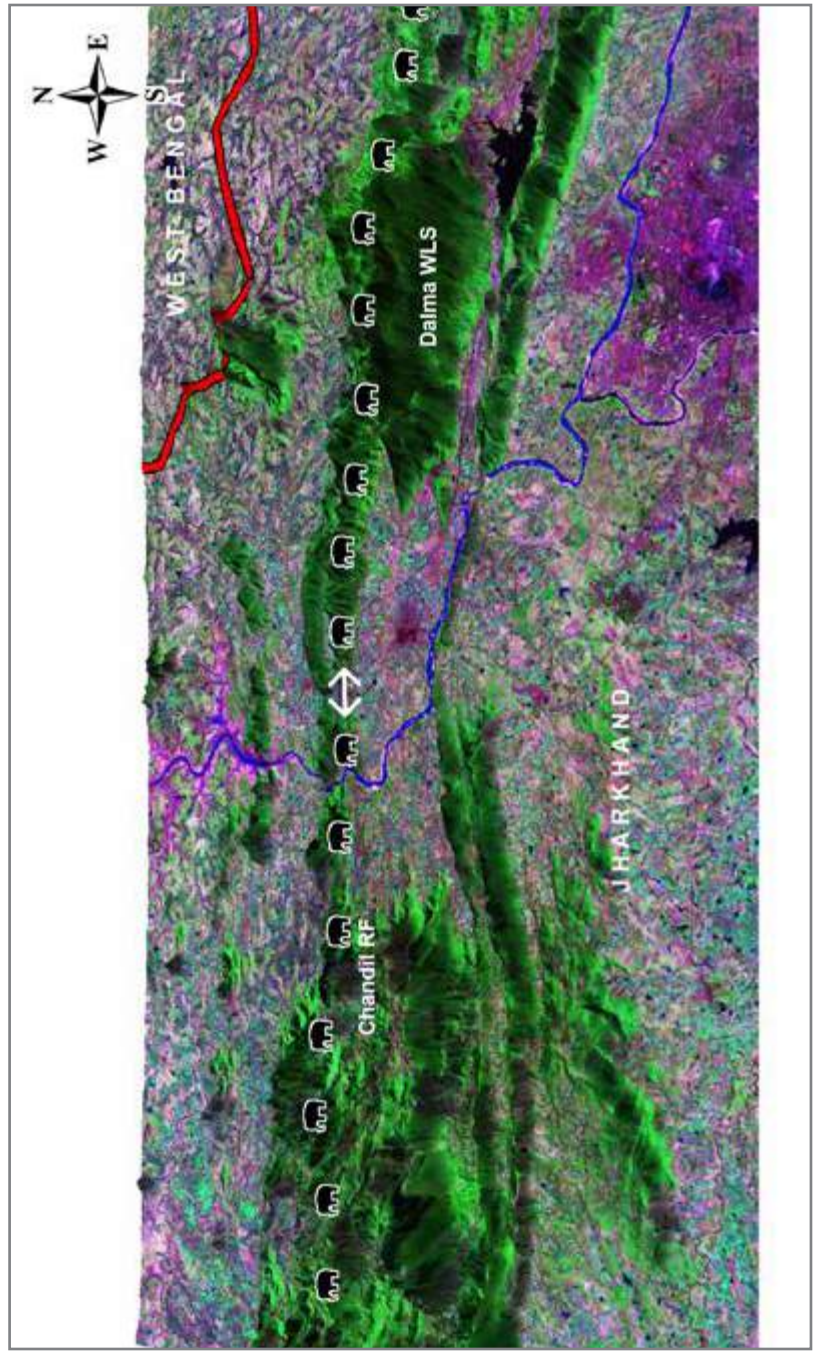
Conservation Feasibility: Medium

This corridor connects Dalma Wildlife Sanctuary with the Chandil Range of Seraikela Forest Division. National Highway 33 and 32, and the railway track connecting Jamshedpur and Chandil, with steep embankments between Saharbera and Patta villages, bisect the corridor, hindering elephant movement. Elephants cross the road and railway track under the bridge and enter Golchakar (a circular intersection), then move to the Chandil Range through narrow forests and private lands. They also cross NH 33 near Patta village to move between the habitats.

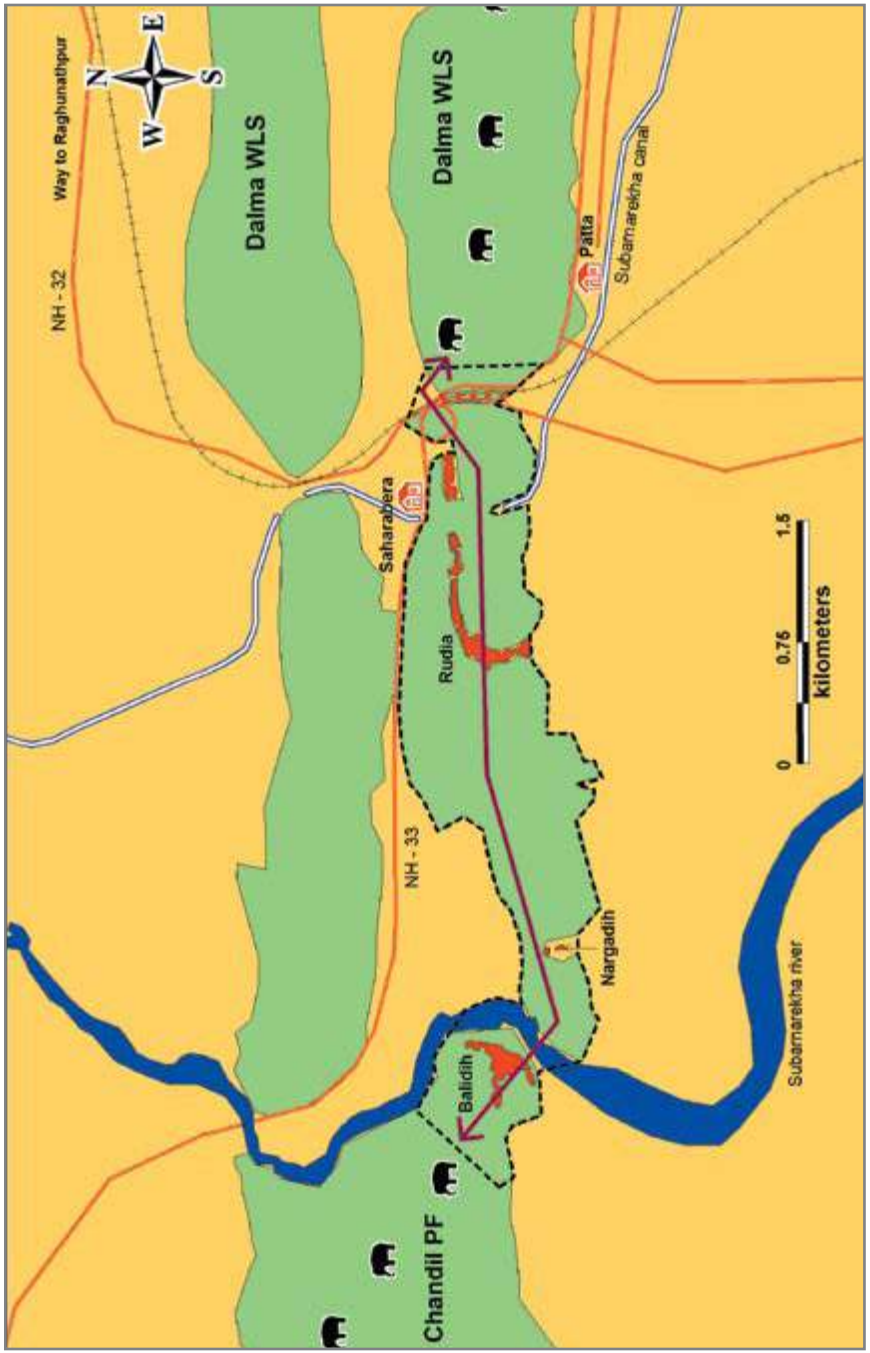
State	Jharkhand
Connectivity	Dalma Wildlife Sanctuary of Ranchi Forest Division and Chandil Range of Seraikela Forest Division
Length and Width	5 km and 0.1-0.9 km
Geographical coordinates	22° 55′ 44″- 22° 56′ 24″ N 86° 0′ 33″- 86° 3′ 31″ E
Legal status	Reserve Forest and Patta Land
Major land use	Forest, agriculture and settlement
Major habitation/settlements	Rudia (Nargadih hamlet)
Forest type	Tropical dry deciduous sal forest
Frequency of usage by elephants	Rare; seasonal

FORESTS AND ELEPHANTS

Corridor habitat status: The corridor comprises fragmented and degraded forest patches. The vegetation is dominated by sal (*Shorea robusta*) and other species including *Buchanania lauzen*, *Anogeissu slatifolia*, *Diospyros melanoxylon*, *Cleistanthus collinus, Bombax ceiba, Terminalia sp, Adina cordifolia, Madhuca latifolia,*



3D map showing the landscape of the Dalma – Chandil Corridor



Map of the Dalma – Chandil Corridor

Gmelina arborea etc. The ground cover is mostly bushes of *Lantana sp, Helicterisi sora* etc and barren ground.

Estimated elephant numbers in the landscape

Dalma Wildlife Sanctuary: 156
Seraikela Forest Division: 30
(Elephant Census Jharkhand, 2012)

Forest/Land use

Forest type: Tropical dry deciduous sal forest
Human habitation: Nargadih, Darda, Rudia and Balidiha
Agriculture: Paddy
River: Subarnarekha River and canal
Roadway: NH 33 and 32 and Chandil-Kandra-Seraikela road
Railway Track: Chandil-Jamshedpur
Buildings/Artefacts: High-tension power line

Other ecological importance

Mountain Range: Chotanagpur Plateau
Elephant Range: East-Central India
Elephant Reserve: Singhbhum Elephant Reserve
Nearest Protected Area: Dalma Wildlife Sanctuary

HUMAN DIMENSIONS

Threats

1. Road: National Highway 33 connecting Jamshedpur with Ranchi and another road connecting Chandil with Kandra pass through the corridor. Vehicular traffic remains high on both roads around the clock: 480 vehicles per hour during the day and 207 vehicles per hour at night on NH 33, and 362 vehicles per hour during the day and 171vehicles per hour at night on the Chandil-Kandra-Seraikela road.

2. Expansion of NH 33 is in progress and this will further fragment the corridor.

3. A railway track connecting Jamshedpur and Chandil passes through the corridor with steep embankments inside the corridor area, obstructing elephant movement. Traffic intensity on the track was high, with 4.6 trains per hour during the day and four trains per hour at night (in 2015).

4. Human habitation: Rudia, Nargadih (Nargadih, Chalakbera Tola), Chaipur, Darda and Patta are villages located in and around the corridor forest, considerably reducing the width available for elephant movement. Human dependence on forest resources (fuelwood, NTFP, cattle grazing) has further deteriorated the forest.

5. Agriculture: Expansion of agriculture fields in the villages of Darda and Balidiha has fragmented the corridor.

6. Canal: About 200 m of the Subarnarekha irrigation canal passes through the corridor, hindering elephant movement.

7. Degradation of Chandil Reserve Forest due to biotic pressure of fringe villages.

Corridor villages: Nargadih, and the agricultural fields of Rudia, Darda, Chainpur and Balidih villages are located inside the corridor forest. These areas have reduced the width of the corridor.

Corridor dependent villages: Balidiha (90 families), Rudia (460 families), Nargadih, Chalakbera Tola, Patta (272 families), Chainpur (168 families), Seharbera (105 families) and Darda.

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent encroachment and developmental activities affecting elephant movement.

2. Expansion of NH 33 in the corridor area should be accompanied with appropriate mitigation measures.

3. An overpass is needed on the railway track passing through the corridor. Embankments along the railway track near Patta village need to be made less steep.

4. In consultation with the villagers, 34 acres of private lands in Nargadih, Darda, Rudia and Balidiha villages could be secured.

5. Five families from Nargadih hamlet located inside the corridor could be voluntarily relocated outside the corridor.

6. Habitat restoration is required in the degraded patches of Chandil Range in the corridor.

7. The construction of an overpass on Subarnarekha canal in the corridor area is in progress and will facilitate elephant movement.

8. Coordination is needed between Highway Authorities, the Railways and Irrigation, Revenue and Forest Departments to plan mitigation measures while undertaking developmental activities in the region.

Land identified to secure the corridor

About 34 acres of agricultural lands in Balidih, Darda and Rudia villages have been identified for the corridor's securement. In addition, one acre of land is to be secured with the voluntary relocation of five households from Nargadih hamlet.

Village Name	Area (acres)	Priority
Balidih	13	P1
Nargadih	1	P1
Rudia	15	P1
Darda	4.5	P2

5.06

DALMA - RUGAI

Ecological Priority: Medium

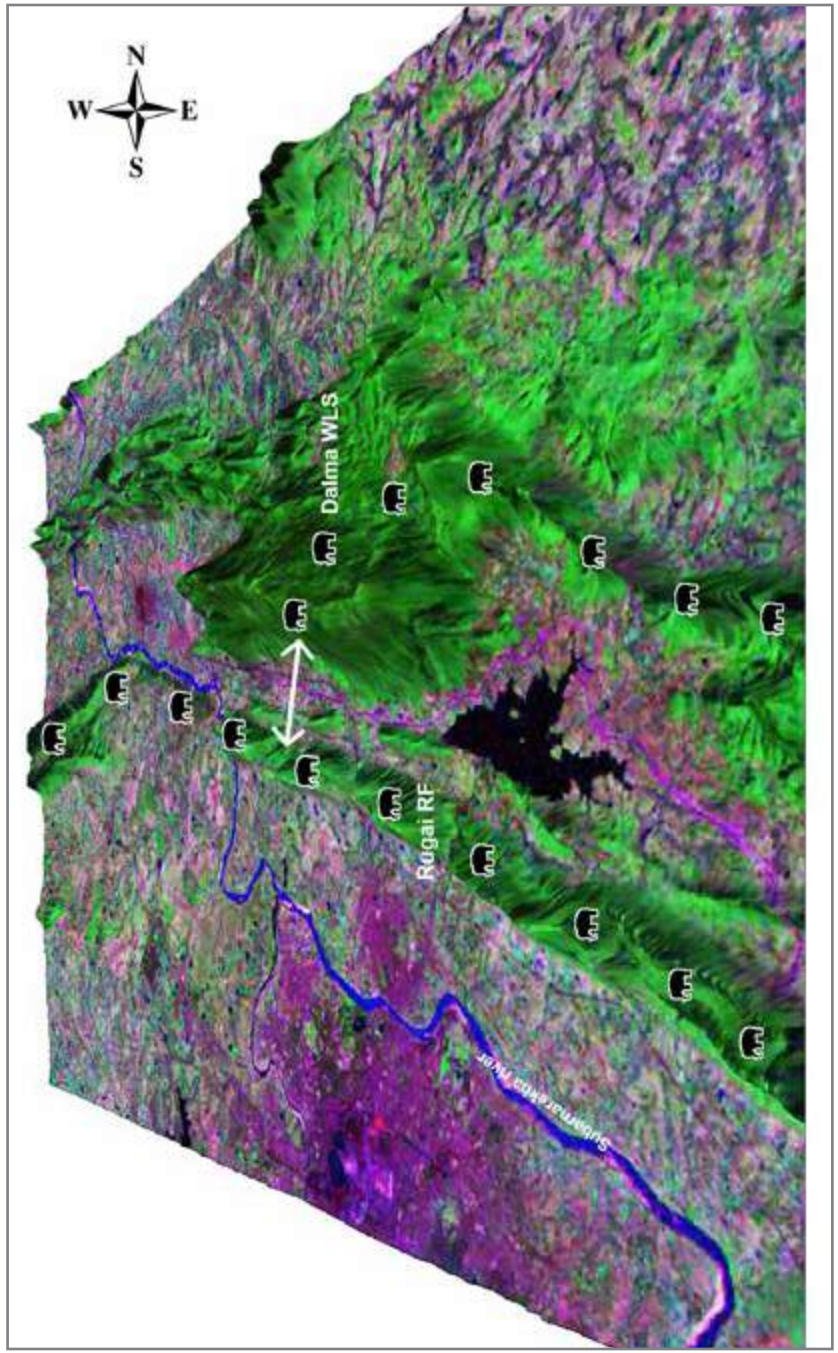
Conservation Feasibility: Medium

The Dalma-Rugai corridor connects Dalma Wildlife Sanctuary with the Rugai Protected Forest (Jorai Pahar PF) of Seraikela Forest Division through private lands. Elephants move from Rugai Protected Forest to Dalma Wildlife Sanctuary through Ramgarh village, negotiating agriculture fields, stone crusher plants, fenced plots, heavy traffic on NH 33, and the Subarnarekha irrigation canal.

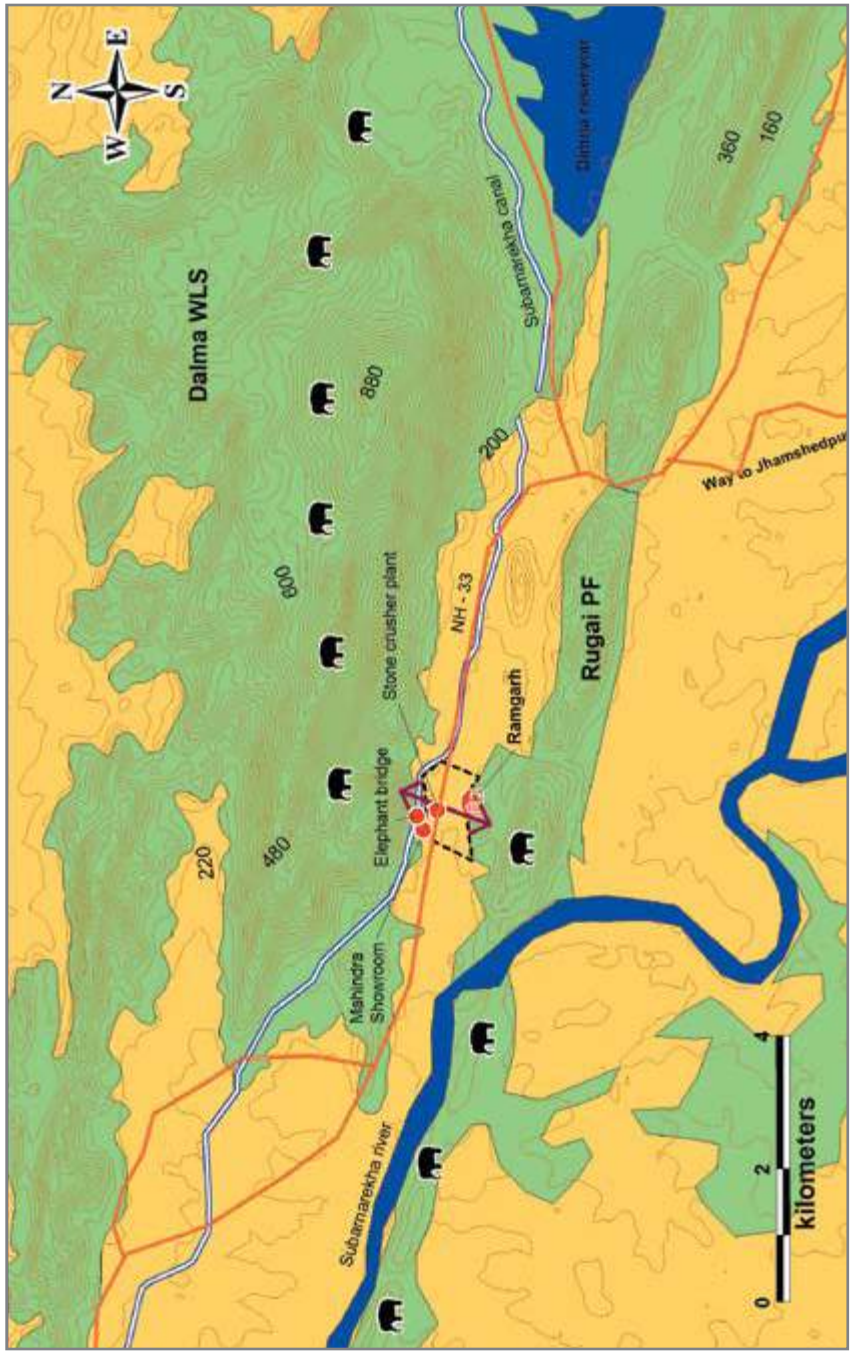
State	Jharkhand
Connectivity	Dalma Wildlife Sanctuary and Rugai Protected Forest
Length and Width	1.5 km and 1 km
Geographical coordinates	22° 52′ 34″- 22° 53′ 3″ N 86° 8′ 57″- 86° 9′ 50″ E
Legal status	Patta Land
Major land use	Agriculture fields and human habitation
Major habitation/settlements	Ramgarh
Forest type	Tropical dry deciduous sal forest on both side of the corridor
Frequency of usage by elephants	Occassional

FORESTS AND ELEPHANTS

Corridor habitat status: The corridor comprises private agricultural lands and NH 33. The forests of Dalma Wildlife Sanctuary are dominated by sal (*Shorea robusta*). Other species include *Buchanania lanzen*, *Anogeissus latifolia*, *Diospyros melanoxylon*, *Terminalia tomentosa*, *Adina cordifolia*, *Madhuca latifolia*, *Embelica officinalis* etc.



3D map showing the landscape of the Dalma – Rugai Corridor



Map of the Dalma – Rugai Corridor

Estimated elephant numbers in the landscape

Dalma Wildlife Sanctuary: 156

Saraikela Forest Division: 30

(Elephant Census Jharkhand, 2012)

Forest/Land use

Forest type: Tropical dry deciduous sal forest on both sides of the corridor

Human habitation and agricultural fields: Ramgarh (Dangortoli, Rangatand and Ramgarh hamlets)

River: Subarnarekha irrigation canal

Roadway: NH 33

Buildings/Artefacts: Dalma View Lodge and Restaurant, Stone crusher plants, high tension power lines

Other ecological importance

Mountain Range: Chotanagpur Plateau

Elephant Range: Central Landscape

Elephant Reserve: Singhbhum Elephant Reserve

Nearest Protected Area: Dalma Wildlife Sanctuary

HUMAN DIMENSIONS

Threats

1. Highway: National Highway 33 connecting Jamshedpur and Ranchi passes through the corridor. Vehicular traffic is high on the road around the clock. The traffic intensity recorded was 469 vehicles per hour from 6 am to 6 pm, and 201 vehicles per hour from 6 pm to 6 am.

2. Irrigation canal: Subarnarekha irrigation canal passes through the corridor between the foothills of Dalma Wildlife Sanctuary and NH 33.

3. Human habitation: Three hamlets (Dangortoli, Rangatand and Ramgarh) of Ramgarh village are located on the fringes of the corridor.

4. Stone crusher plants: Three stone crusher plants (one functional and two abandoned) are located inside the corridor, hindering elephant movement.

5. Compound walls and fencing of plots in the corridor also hinder elephant movement.

6. Dalma View Restaurant, a Mahindra showroom and a factory are located in the corridor along NH 33.

Corridor dependent villages: Ramgarh (Rangatand, Rasikadih and Dangortoli), Kanderbera (226 families), Sahijharna, Jamdih.

This corridor has no forest connectivity and consists entirely of private lands, largely under cultivation. Three hamlets (Dangortoli, Rangatand and Ramgarh) of Ramgarh village are located on the fringes of the corridor. About 100 families are living in these hamlets. The main livelihood of the villagers is daily wage labour and agriculture. Villagers depend on the forest for fuelwood.

Name of Hamlet	Families
Dangortoli	22
Rangatand	35
Ramgarh	42
Darda	4.5

Human-Elephant Conflict: Cultivation of palatable crops in the corridor fringe areas attracts elephants and results in crop raids. Human-elephant conflict is high in the corridor area, especially during the paddy season.

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent encroachment and developmental activities affecting elephant movement.

2. An overpass for vehicle movement needs to be constructed on NH 33 in the corridor area, between Latitude 22°53'1.7"N / Longitude 86°09' 20.0"E, and Latitude 22°53' 1.20"N / Longitude 86°09' 22.54"E. The overpass should be about 75 m before sloping down at both ends, so that elephants get a clear width to move below it.

3. In consultation with local stakeholders, secure 31 acres of private lands along NH 33 and undertake habitat restoration in the secured land.

4. No buildings, factories and other developmental activities should be permitted inside the corridor area.

5. Existing stone crushers, Dalma View Restaurant and the Mahindra showroom should be shifted out of the corridor.

6. A suitable bridge has been constructed on Subernarekha canal in the corridor and this will facilitate elephant movement.

7. All fences and compound walls in the corridor should be removed in consultation with owners.

5.07

DALMA - ASANBARI

Ecological Priority: Medium

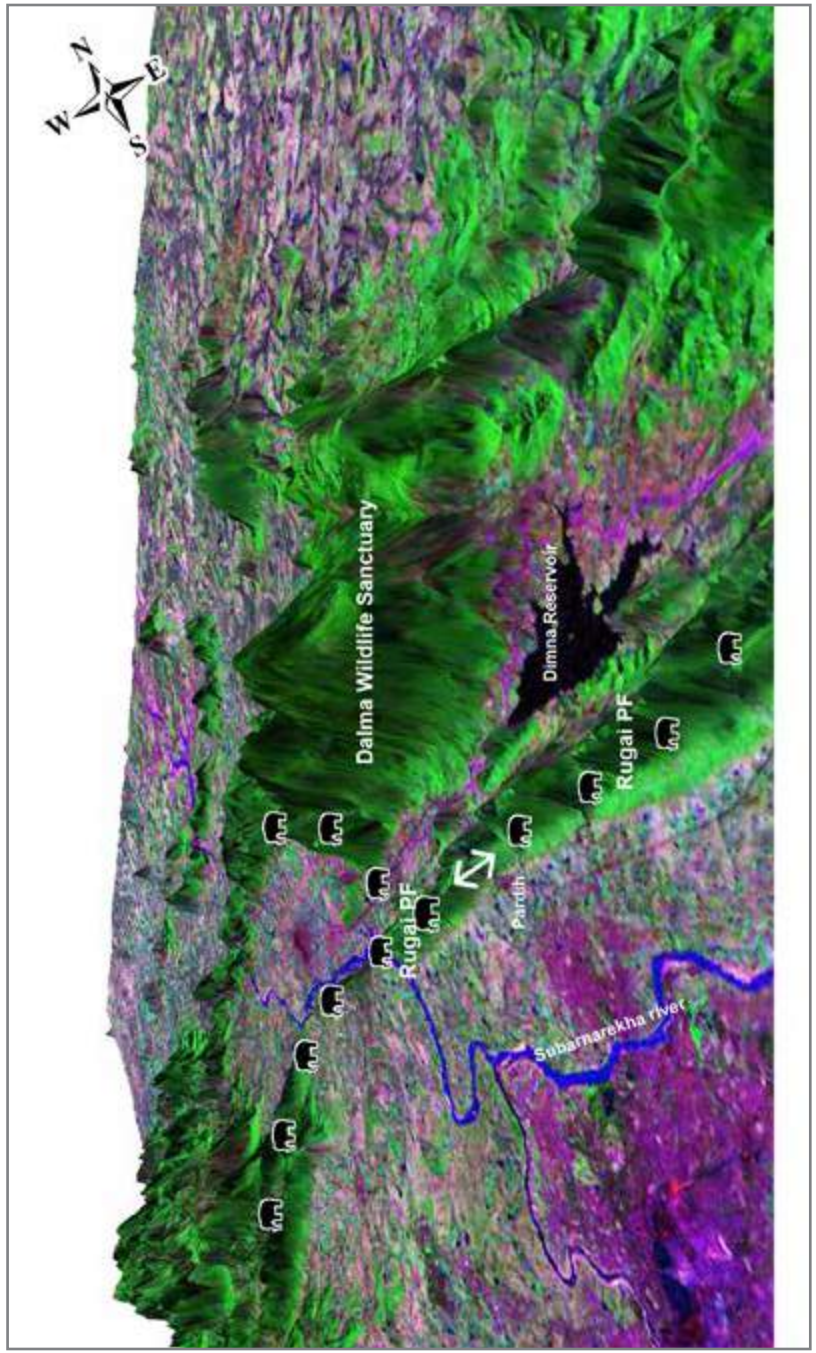
Conservation Feasibility: High

This corridor connects Dalma Wildlife Sanctuary with the Asanbari Protected Forest of Seraikela Forest Division. Elephant movement between Dalma Wildlife Sanctuary and Seraikela Forest division takes place through the low hills between the Kalibari Temple and Pardih village. High traffic on NH 33, which passes through the corridor, is a major obstacle to animal movement.

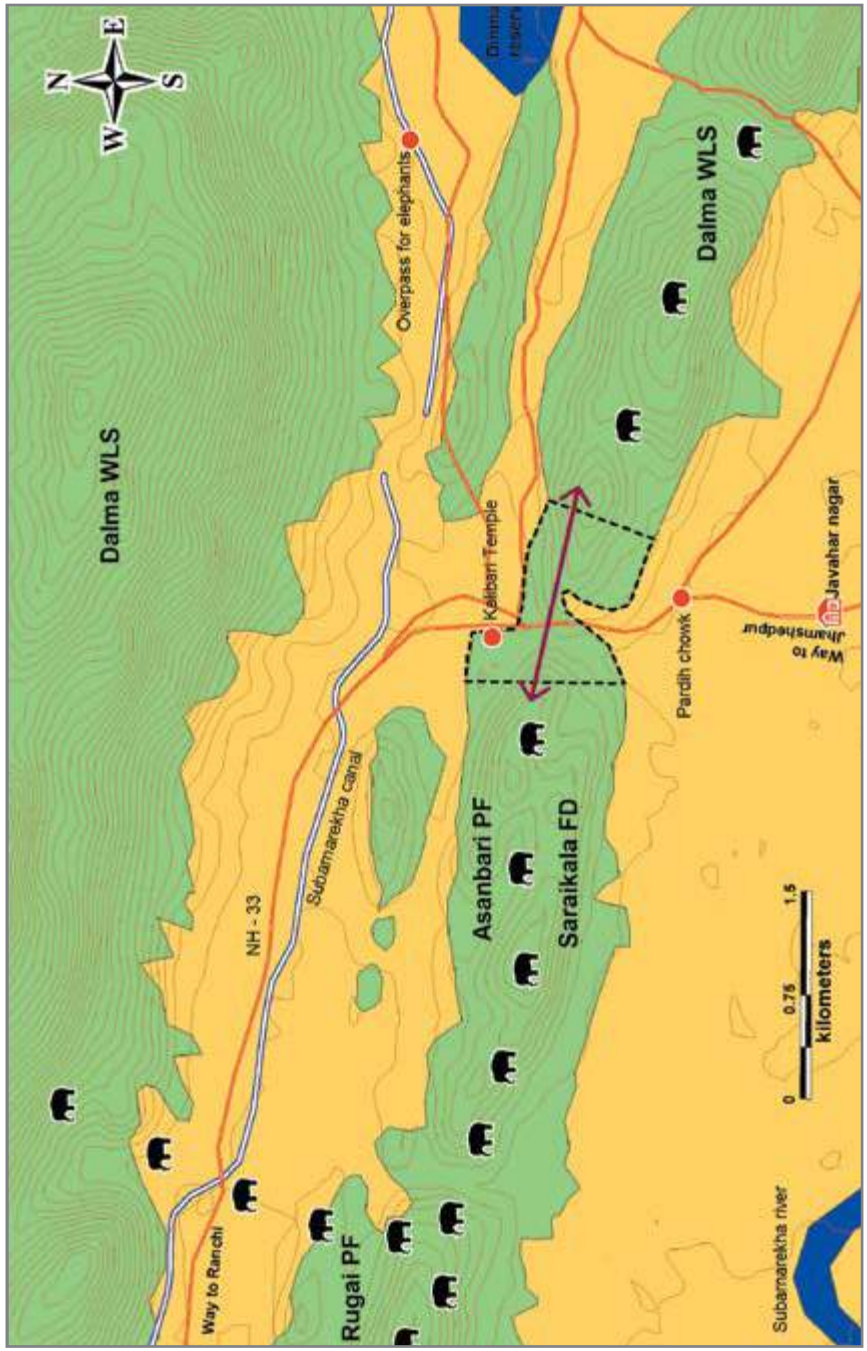
State	Jharkhand
Connectivity	Dalma Wildlife Sanctuary and Seraikela Forest Division
Length and Width	1 km and 0.28 - 0.45 km
Geographical coordinates	22° 51′ 11″- 22° 51′ 55″ N 86° 11′ 57″- 86° 12′ 44″ E
Legal status	Reserve Forest and Protected Forest
Major land use	Forest and highway
Major habitation/settlements	Nil
Forest type	Tropical dry deciduous sal forest on both sides of the corridor
Frequency of usage by elephants	Occasional

FORESTS AND ELEPHANTS

Corridor habitat status: The corridor comprises forest land on either side of NH 33. The forest is dominated by sal (*Shorea robusta*). Other species include *Terminalia tomentosa*, *Madhuca indica*, *Emblica officinalis*, *Buchanania lanzen*, *Anogeissus latifolia*, *Diospyros melanoxylon*, *Trewia nudiflora* etc. The ground cover is mostly grasses (*Chrysopogon aciculatus*, *Heteropogon sp*), along with *Lantana sp.*



3D map showing the landscape of the Dalma – Asanbari Corridor



Map of the Dalma – Asanbari Corridor

Estimated elephant numbers in the landscape

Dalma Wildlife Sanctuary: 156

Seraikela Forest Division: 30

(Elephant Census Jharkhand, 2012)

Forest/Land use

Forest type: Tropical dry deciduous sal forest

Human habitation: Nil

Agriculture: Paddy

Roadway: National Highway 33 (Tatanagar-Chandil-Ranchi)

Buildings/Artefacts: A temple

Other ecological importance

Mountain Range: Chotanagpur Plateau

Elephant Range: Central Landscape

Elephant Reserve: Singhbhum Elephant Reserve

Nearest Protected Area: Dalma Wildlife Sanctuary

HUMAN DIMENSIONS

Threats

1. High traffic on NH 33 connecting Jamshedpur and Ranchi passes through the corridor. Vehicular traffic remains high on the road around the clock. Traffic intensity recorded was 469 vehicles per hour from 6am to 6pm, and 201 vehicles per hour from 6pm to 6 am.

2. Encroachment and human habitation: There are small settlements on either side of NH 33 near the Kalibari Temple. One village is Mirjadi. There are also a few roadside *dhabas* (eateries) on the fringes of the corridor.

Corridor villages: Nil

Corridor dependent villages: Mirjadi, Phadalgora, Pardih, Goalpara

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and necessary action should be taken to prevent activities detrimental to animal movement.

2. An overpass for vehicle movement needs to be constructed on NH 33 in the corridor area, to facilitate unhindered movement of elephants. This overpass should be about 105 metres long before sloping down at both ends. It should be constructed between 22°51′39.5″N, 86°12′7.5″E and 22°51′36.1″N, 86°12′7.9″E.

3. Construction of hotels and *dhabas* on either side of the road near the Kalibari Temple should be prohibited and protection provided to the corridor forest on either side of the road.

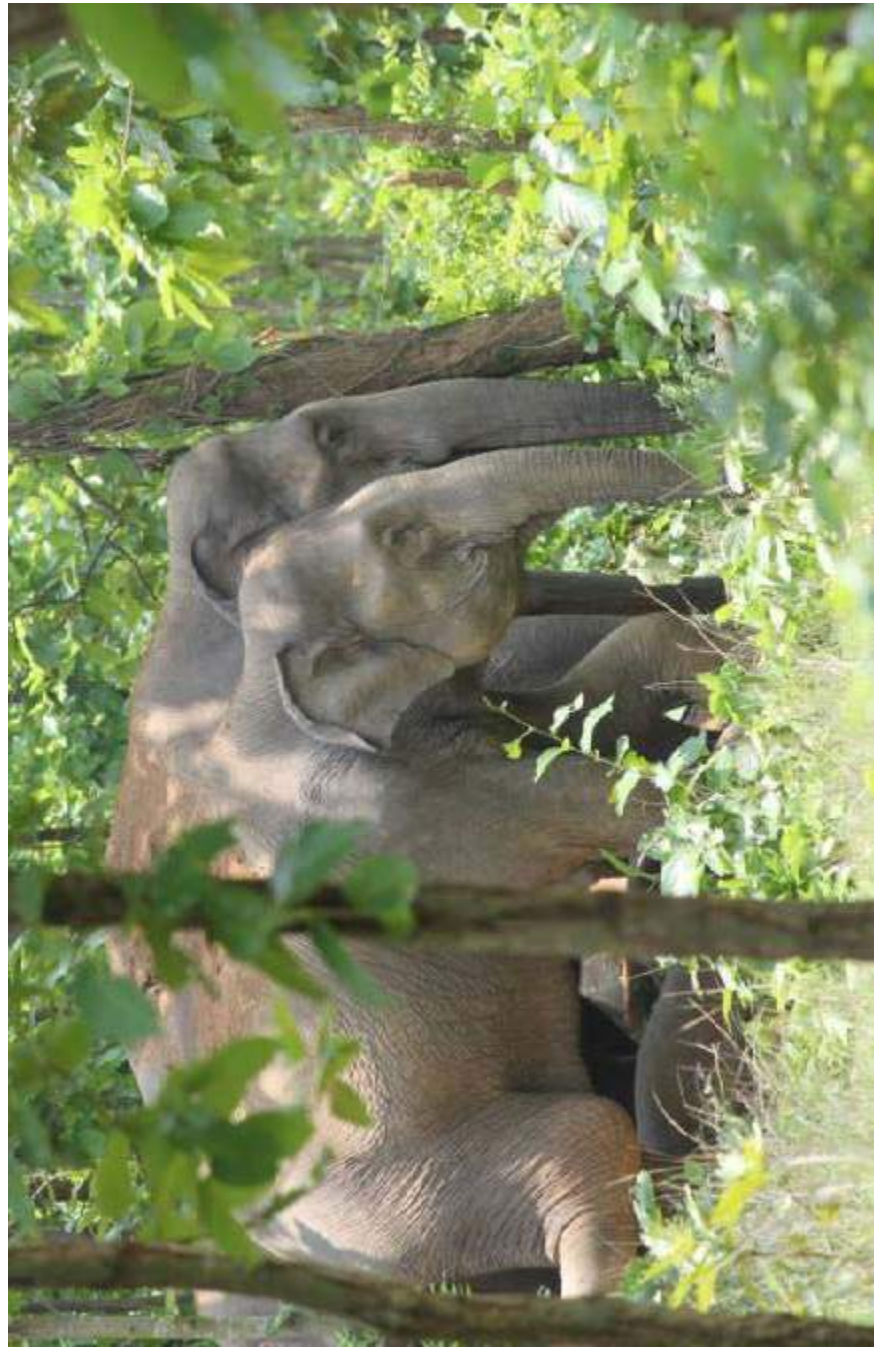


Fig. 5.05: Elephant passing through the corridor

5.08

JHUNJHAKA - BANDUAN

Ecological Priority: Medium

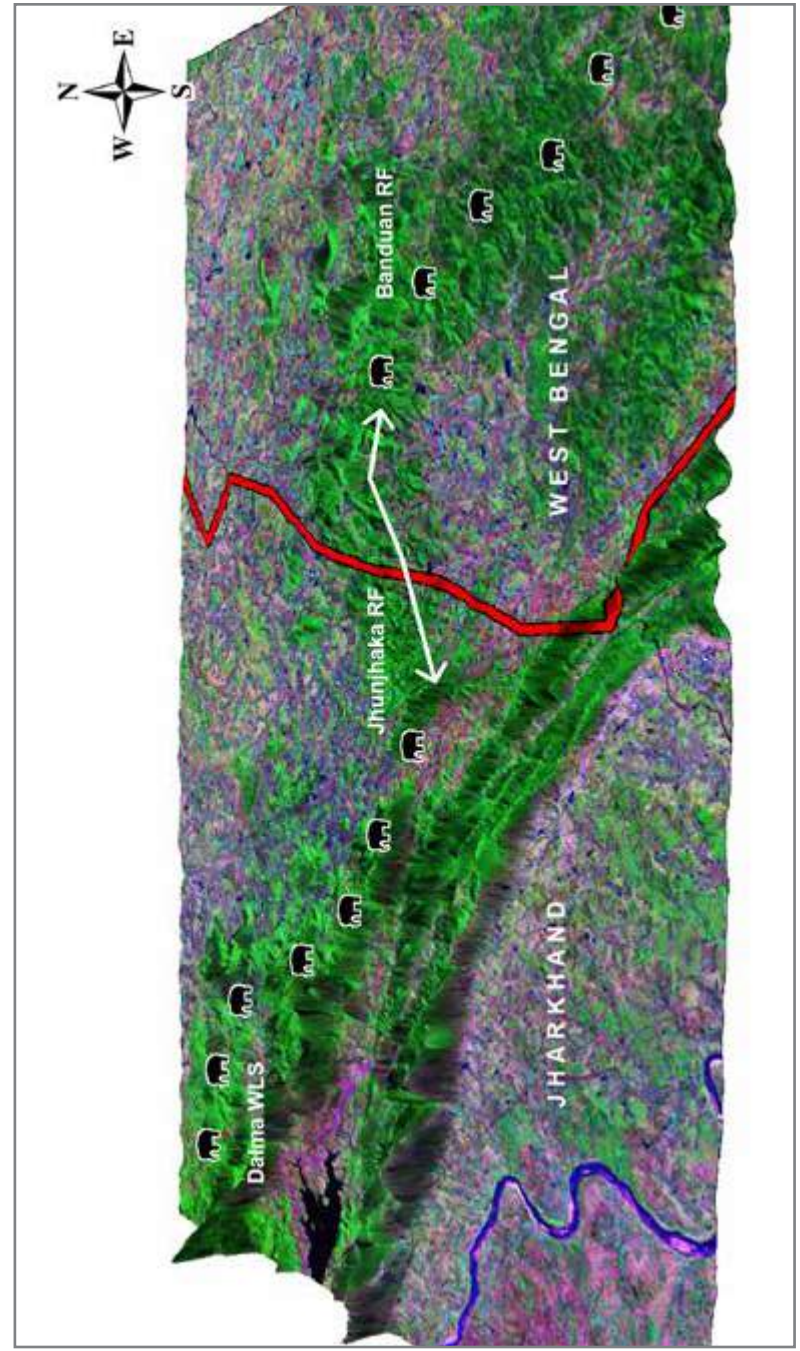
Conservation Feasibility: Medium

This corridor connects the Pagda and Chimti forest blocks of Dalma Wildlife Sanctuary in Jharkhand with the Banduan Range of Kangsawati South Division in West Bengal. The corridor comprises fragmented forest patches with human habitations and agriculture fields. Its usage by elephants has decreased in recent years.

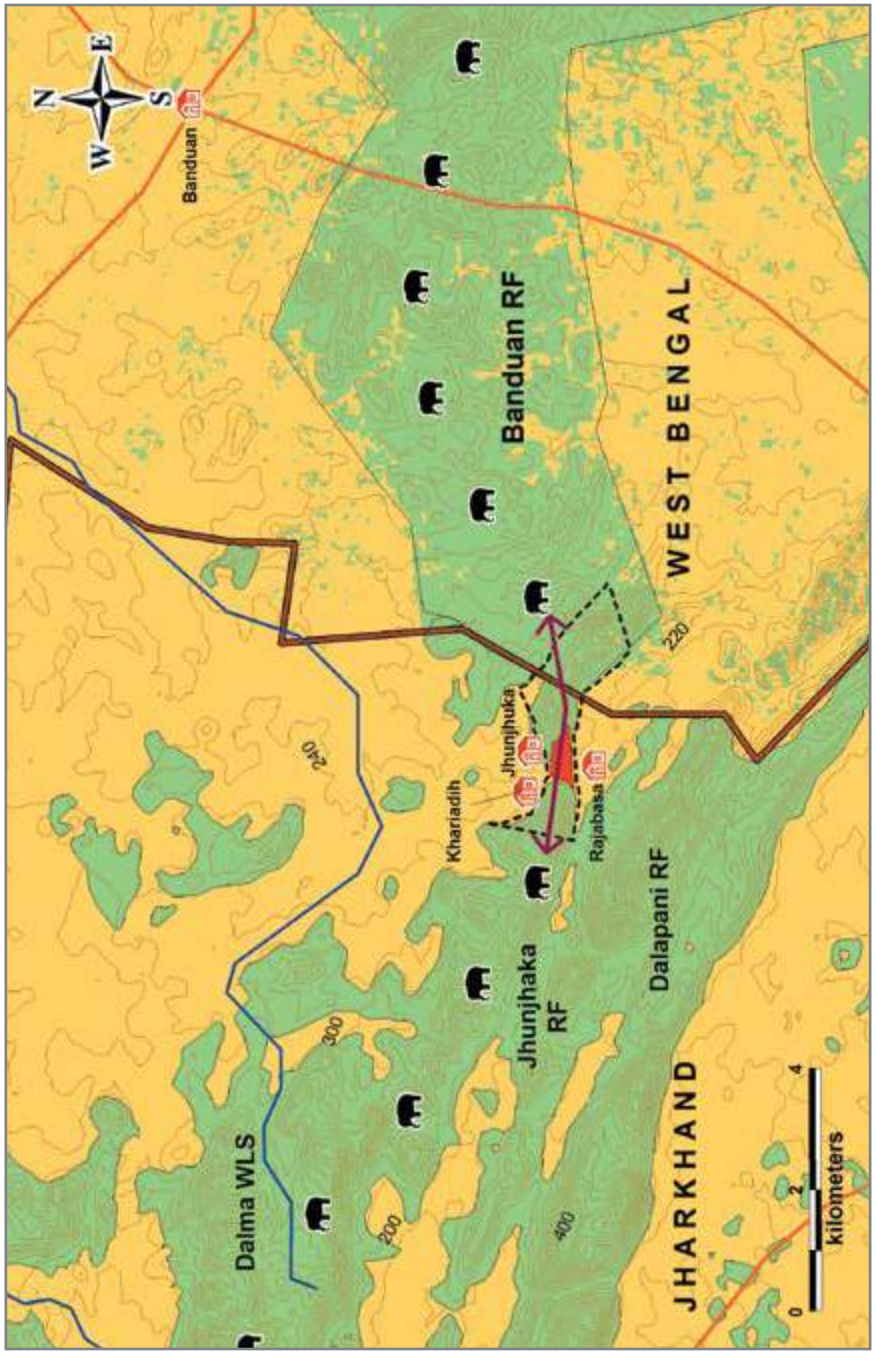
Alternate Name	Dalma-Banduan, Jhilimilli
State	Jharkhand and West Bengal
Connectivity	Dalma Wildlife Sanctuary and Banduan Range of Kangsawati South Forest Division
Length and Width	12 km and 0-2 km
Geographical coordinates	22° 48′ 36″- 22° 49′ 54″ N 86° 23′ 48″- 86° 26′ 17″ E
Legal status	Protected Forest, Patta Land
Major land use	Forest, human settlements and agriculture fields
Major habitation/settlements	Jhunjuka, Rajabasa, Meghadaha
Forest type	Tropical dry deciduous forest
Frequency of usage by elephants	Occasional and seasonal

FORESTS AND ELEPHANTS

Corridor habitat status: The corridor forest is dominated by *Shorea robusta*. Other species include *Terminalia tomentosa*, *Madhuca indica*, *Anogeissus latifolia*, *Diospyros melanoxylon*, *Buchanania lanzen* etc. The corridor has reasonably good forest cover but biotic pressure is slowly degrading the corridor forest.



3D map showing the landscape of Jhunjhaka – Banduan Corridor



Map of Jhunjhaka – Banduan Corridor

Estimated elephant numbers in the landscape

Jamshedpur Forest Division: 14
Dalma Wildlife Sanctuary: 156
Kangsawati South Division: 15-20
(Elephant Census Jharkhand, 2012 and *Elephant Census, West Bengal 2012)*

Forest/Land use

Forest type: Tropical dry deciduous
Human habitation: Rajabasa, Jhunjhka, Meghadaha, Burhigoda, Tungburu, Jorsia, Sarkia, Gangamana
Agriculture: Paddy
Roadway: Village roads

Other ecological importance

Mountain Range: Chotanagpur Plateau
Elephant range: Central India
Elephant Reserve: Mayurjharna Elephant Reserve
Nearest Protected Area: Dalma Wildlife Sanctuary

HUMAN DIMENSIONS

Threats

1. Human habitation and agriculture fields: Rajabasa and Jhunjuka villages are located in the corridor.

2. Encroachment: Encroachment of corridor forest by fringe villagers, for settlements and agriculture, has further reduced the corridor's width.

A total of eight villages are located between Jhunjhaka Protected Forest and Banduan Reserve Forest along the state borders. They depend upon the corridor forest for fuelwood and other forest produce. Agriculture is the main source of livelihood for the locals.

Corridor villages: Rajabasa, Jhunjhuka

Corridor dependent villages: Meghadaha, Burhigoda, Tungburu, Jorsia, Sirka, Gangamana

Human–Elephant Conflict: Human-elephant conflict is mainly in the form of crop damage in the fringe villages. The villages most affected are Jorsia, Rajabasa and Jhunjhka, as per secondary information from villagers.

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent the encroachment of corridor forests and developmental activities detrimental to animal movement.

2. Encroachments upon the corridor area need to be evicted.

3. The fragmented and degraded corridor forest needs restoration and improvement.

4. Alternatives need to be sought for Jhunjhka and Rajabasa villages, which lie in the path of a regular elephant movement route in the corridor.

Land identified to secure the corridor: In consultation with villagers, 67 acres of land identified in Rajabasa and Jhunjhuka villages needs to be secured.



Fig. 5.06: Large-scale agriculture in the corridor



Fig. 5.07: A human settlement in the corridor

5.09

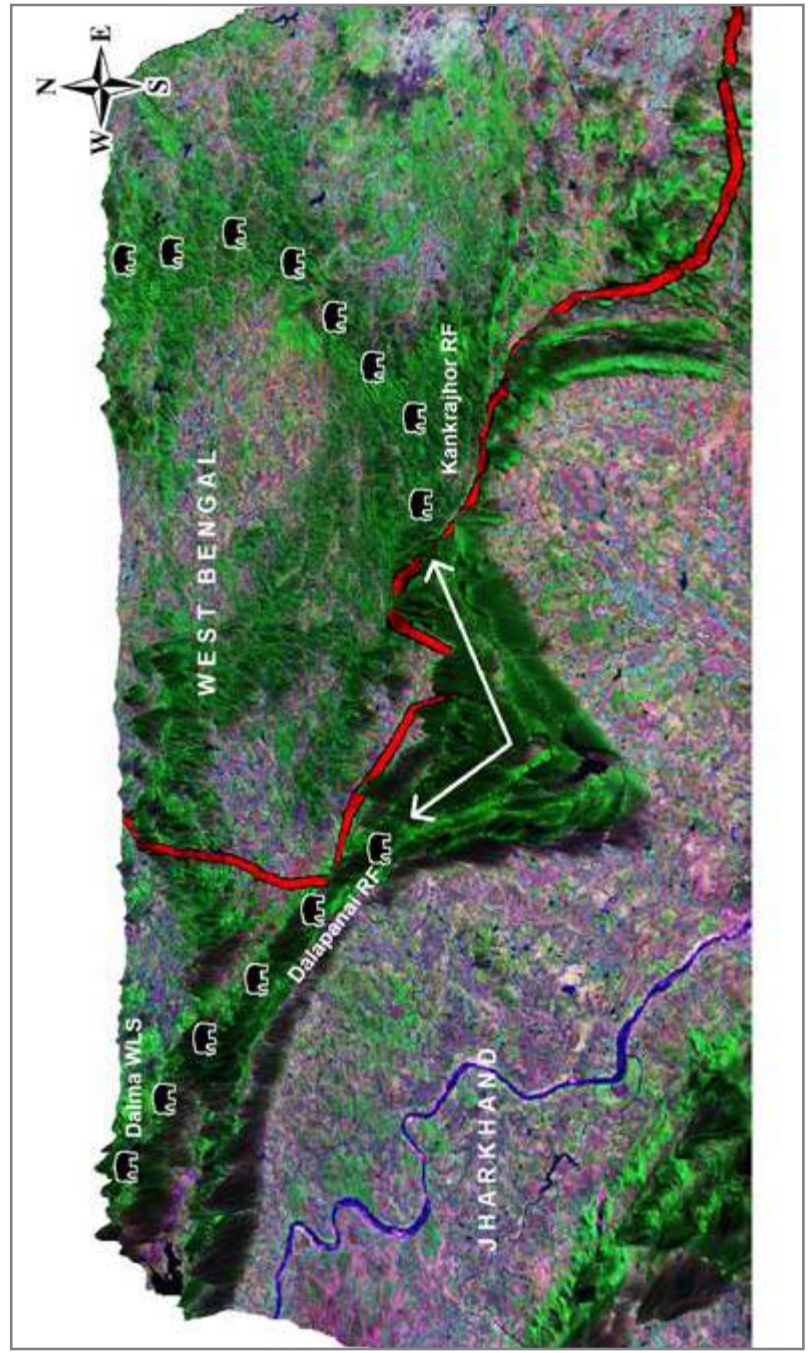
DALAPANI - KANKRAJHOR

Ecological Priority: Medium

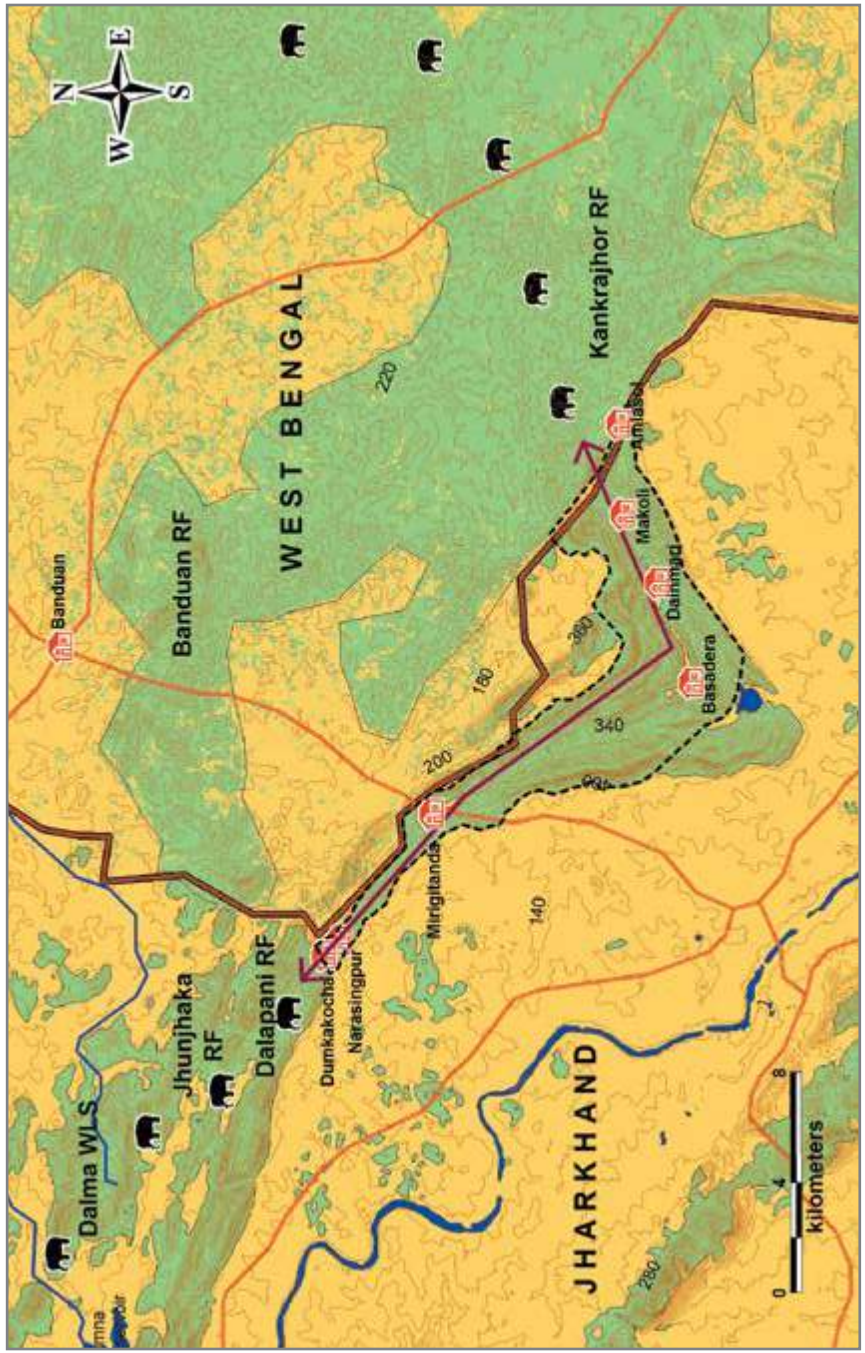
Conservation Feasibility: Medium

This corridor connects Dalapani Reserve Forest of the Jamshedpur Forest Division, Jharkhand, with the Kankrajhor Protected Forest of West Midnapur Forest Division in West Bengal. It thereby connects the elephant population of Dalma Wildlife Sanctuary with that of West Midnapur Forest Division. Elephants move through the hilly forest patches of Basadera Reserve Forest, as well as human habitations and agriculture fields. The corridor has good forest cover presently, but an ever-expanding human presence in the plains, with settlements and agriculture, is affecting elephant movement.

Alternate Name	Ghatsila-Kankrajhor
State	Jharkhand and West Bengal
Connectivity	Dalma Wildlife Sanctuary and Kankrajhor Protected Forest
Length and Width	22-25 km and 0.55 – 2.5 km
Geographical coordinates	22° 38′ 60″- 22° 47′ 32″ N 86° 23′ 54″- 86° 36′ 5″ E
Legal status	Reserve Forest, Patta Lands
Major land use	Forest, human habitation and agriculture fields
Major habitation/settlements	Amlasol, Jambadi, Makoli, Dainmari, Basadera, Mirigitanda
Forest type	Tropical dry deciduous sal forest
Frequency of usage by elephants	Occassional



3D map showing the landscape of the Dalapani – Kankrajhor Corridor



Map of the Dalapani – Kankrajhor Corridor

FORESTS AND ELEPHANTS

Corridor habitat status: The vegetation of the corridor forest is typically dry deciduous, dominated by *Shorea robusta*. The corridor has good forest cover in most parts and is continuous until Amlasol village along the interstate border of Jharkhand and West Bengal.

Estimated elephant numbers in the landscape

Jamshedpur Forest Division: 14
Dalma Wildlife Sanctuary: 156
West Midnapore Forest Division: 25-30
(Elephant Census Jharkhand, 2012 and *Elephant Census, West Bengal 2012)*

Forest/Land use

Forest type: Tropical dry deciduous sal forest
Human habitation: Amlasol, Jambadi, Makoli, Dainmari, Basadera, Mirigitanda
Agriculture: Paddy
Buildings/Artefacts: Burudi Dam
Roadway: Village roads

Other ecological importance

Mountain Range: Chotanagpur Plateau
Elephant Range: Central India
Elephant Reserve: Mayurjharna Elephant Reserve
Nearest Protected Area: Dalma Wildlife Sanctuary

HUMAN DIMENSIONS

Threats

1. Encroachment of corridor forest: Villagers from fringe villages have encroached upon corridor forest areas for agriculture and habitation.

2. Human habitation and agriculture: Around ten villages are located in and around the corridor and their agricultural fields lie within the corridor.

3. Biotic pressure: Local people depend upon the corridor forest for their daily needs – fuelwood, NTFP and cattle grazing, all of which affect habitat quality.

4. Roads: Village roads, especially the Ghatsila-Banduan road, pass through the corridor.

Corridor villages: Amlasol, Jambadi, Makoli, Dainmari, Basadera, Mirigitanda.

Around ten villages are located in and around the corridor forest. People depend upon agriculture and forest produce for their livelihood. Amlasol and Basadera lie within the prime elephant movement areas of the corridor.

Corridor dependent villages: Ambjharana, Dumkakocha, Asanapani, Thurkadaha.

Human–Elephant Conflict: Elephants mostly use this corridor during the cropping season for migratory movement and to raid crops. Crop damage is a major concern in the area.

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent the encroachment of corridor forests and developmental activities detrimental to animal movement.

2. The forest department should strictly protect the corridor and prevent further encroachments inside the corridor forest on either side of the Ghatsila-Banduan road.



Fig. 5.08: The village of Mirigitanda is located within the corridor



Fig. 5.09: A view of the corridor with agricultural land in between

5.10

DUMRIYA - NAYAGRAM

Ecological Priority: Medium

Conservation Feasibility: Medium

The Dumriya-Nayagram corridor connects the Dumriya Reserve Forest of Mosabani Range with the Nayagram Reserve Forest of Chakuliya Range under Jamshedpur Forest Division. National Highway 33, which connects Jharkhand with Odisha and West Bengal, bisects the corridor near Pitajuri village. In addition, the Subarnarekha irrigation canal runs through the corridor in the foothills of Dumriya Reserve Forest. Both linear infrastructural elements pose a major hindrance to elephant movement.

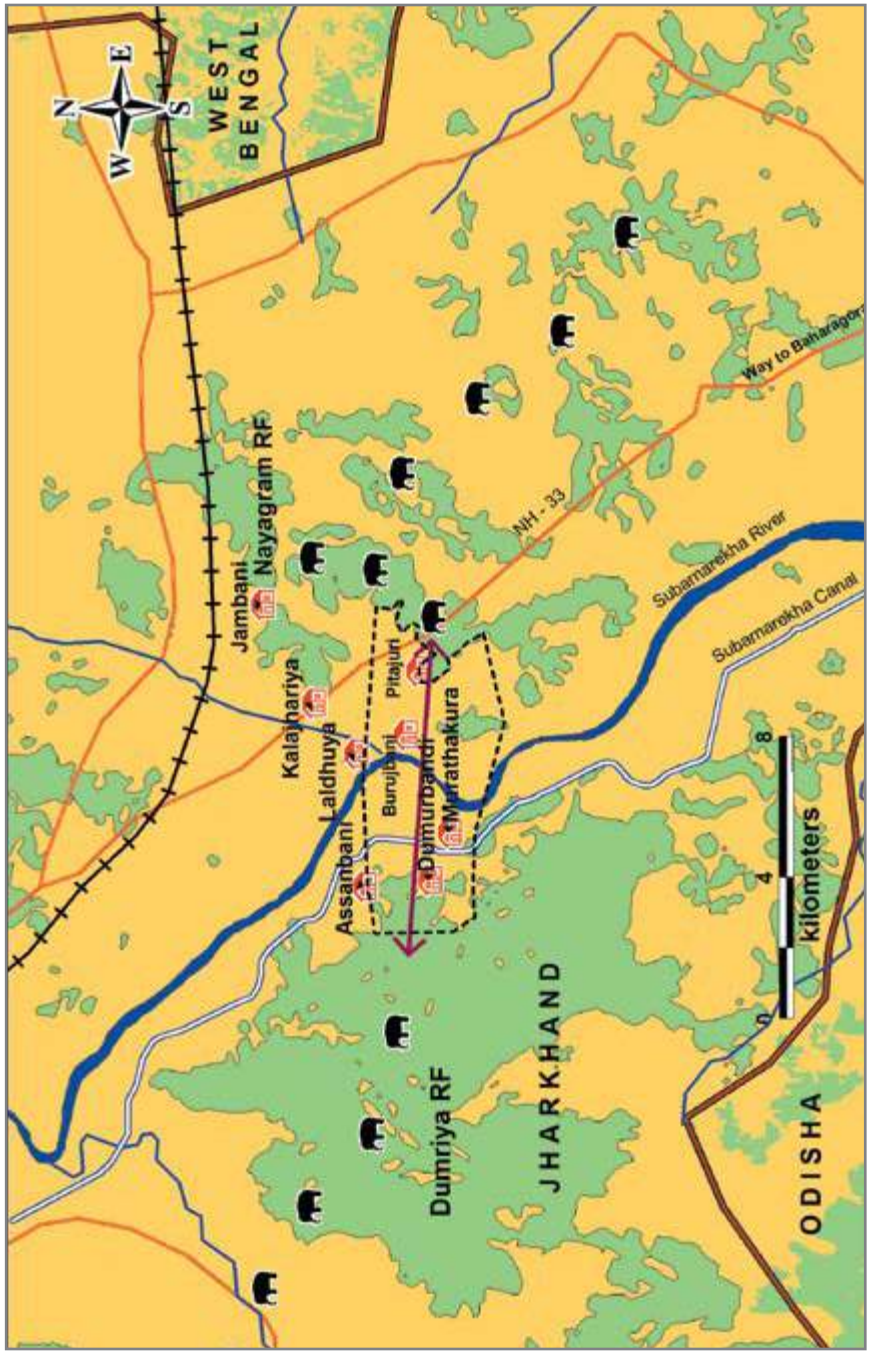
Alternate Name	Mosabani - Chakuliya
State	Jharkhand
Connectivity	Mosabani Range with Chakuliya Range
Length and Width	6.5 km and 0-1 km
Geographical coordinates	22° 23′ 34″- 22° 25′ 46″ N 86° 32′ 52″- 86° 38′ 24″ E
Legal status	Protected Forest, Patta Land
Major land use	Forest, human habitation and agriculture fields
Major habitation/settlements	Chandanpur
Forest type	Tropical dry deciduous sal forest
Frequency of usage by elephants	Occassional

FORESTS AND ELEPHANTS

Corridor habitat status: The vegetation of the corridor forest is dominated by *Shorea robusta*. Other species include *Terminalia tomentosa*, *Diospyros melanaxylon*, *Buchanania lanzan*, *Anogeissus latifolia*, *Lagerstroemia parviflora*, *Adina cordifolia*,



3D map showing the landscape of the Dumriya – Nayagram Corridor



Map of the Dumriya – Nayagram Corridor

Pterocarpus marsupium, *Terminalia chebula* etc. The corridor forest has been degraded and forest cover has greatly reduced.

Estimated elephant numbers in the landscape

Jamshedpur Forest Division: 14

(Elephant Census Jharkhand, 2012)

Forest/Land use

Forest type: Tropical dry deciduous sal forest

Human habitation: Chandapur

Agriculture: Paddy

Roadway/Highway: National Highway 33

Artefacts: Subarnarekha irrigation canal

Railway: Railway track connecting Tatanagar and Kharagpur

Other ecological importance

Mountain Range: Chotanagpur Plateau

Elephant Range: Central India

Elephant Reserve: Mayurjharna Elephant Reserve

Nearest Protected Area: Dalma Wildlife Sanctuary

HUMAN DIMENSIONS

Threats

1. National Highway: National Highway 33 passes through the corridor between Nayagram and Pitajuri villages, fragmenting the corridor at Nayagram Reserve Forest. The highway has high vehicular traffic around the clock as it connects Jamshedpur with Odisha and West Bengal.

2.Irrigation canal: The Subarnarekha irrigation canal passes through the corridor between the Subarnarekha River and Dumariya Reserve Forest near Bhakar and

Murgadih villages. The canal, with its cemented embankments, has fragmented the corridor and obstructed elephant movement between Nayagarh and Dumriya Reserve Forests.

3. Brick kilns are located along the bank of Subarnarekha River near Chandapur village, hindering elephant movement.

4. Railway track: The track connecting Tatanagar and Kharagpur passes through the Nayagram Reserve Forest near Rajabasha village and affects the corridor usage by elephants.

5. Biotic pressure: The dependence of villagers from fringe villages upon the corridor forest for fuelwood, NTFP and other daily needs has affected the habitat quality of the corridor forest.

Corridor villages: Only one village, Chandanpur, with 85-95 families is located in the corridor. The village is situated along the bank of the Subarnarekha River.

Corridor dependent villages: Murgadih, Gariyas, Pitajuri, Nayagram, Bhakar, Jhariya, Sagadih, Jamua, Machadih and Rajabasa.

Human–Elephant Conflict: Conflict occurs mainly due to crop damage by elephants during their seasonal movement.

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent non-forestry and developmental activities detrimental to the corridor.

2. Traffic on NH 33 needs to be regulated and the speed limit enforced through the use of suitable physical barriers in the corridor area.

3. An animal-friendly overpass on the Subarnarekha canal will facilitate elephant movement between Dumriya and Nayagram Reserve Forests.

4. Brick kilns near Chandanpur on the Subarnarekha river bank should be closed.

5. Habitat restoration of degraded corridor areas is required.



Fig. 5.10: Brick kilns located near Chandanpur village on the Subarnarekha river bank

5.11

RAIBERA - PULBABURU

Ecological Priority: Medium

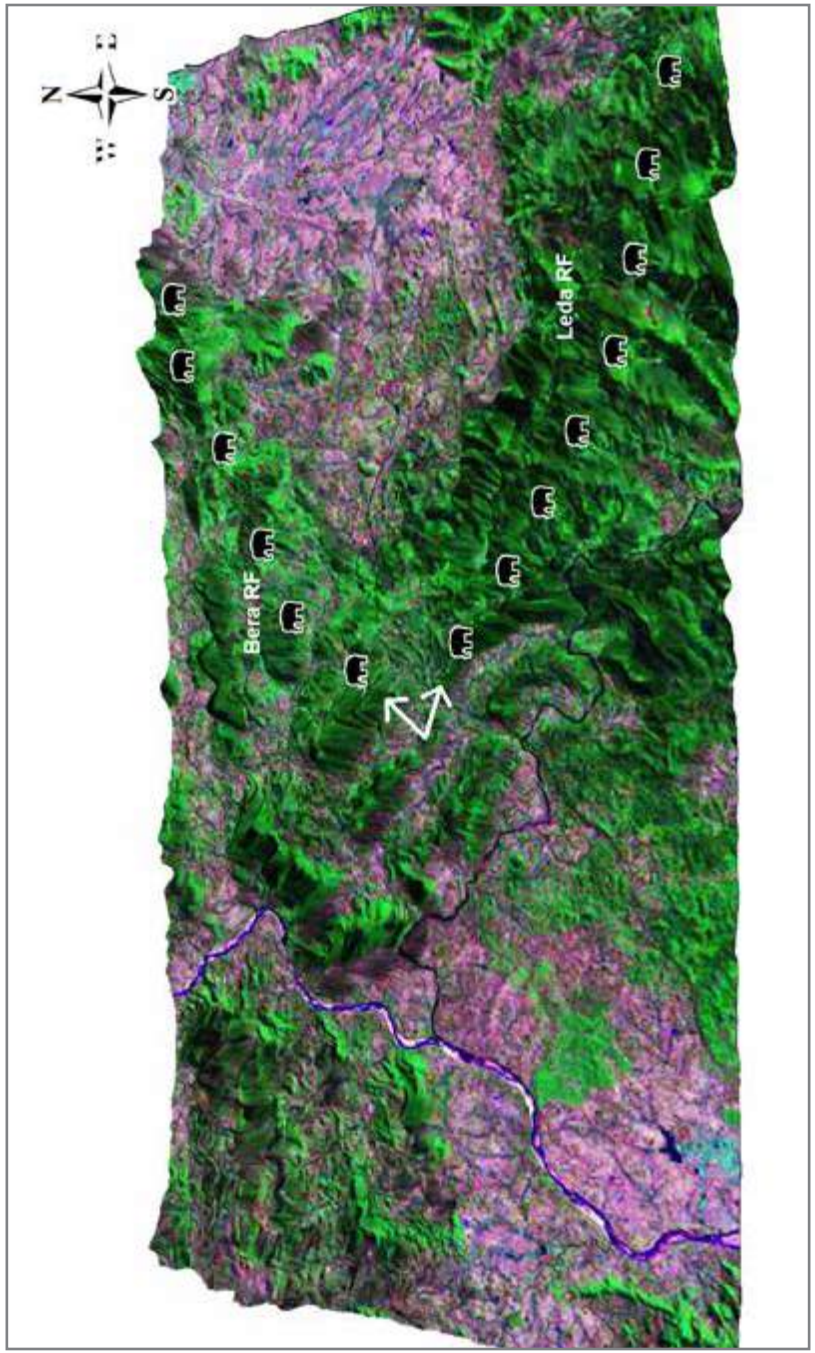
Conservation Feasibility: Medium

This corridor connects the Raibera Protected Forest of Kolhan Forest Division with Pulbaburu Protected Forest of Porahat Forest Division. Forest cover has been fragmented due to a railway track connecting Goilkera and Manoharpur, and the expansion of agriculture in Raibera and Koinena villages.

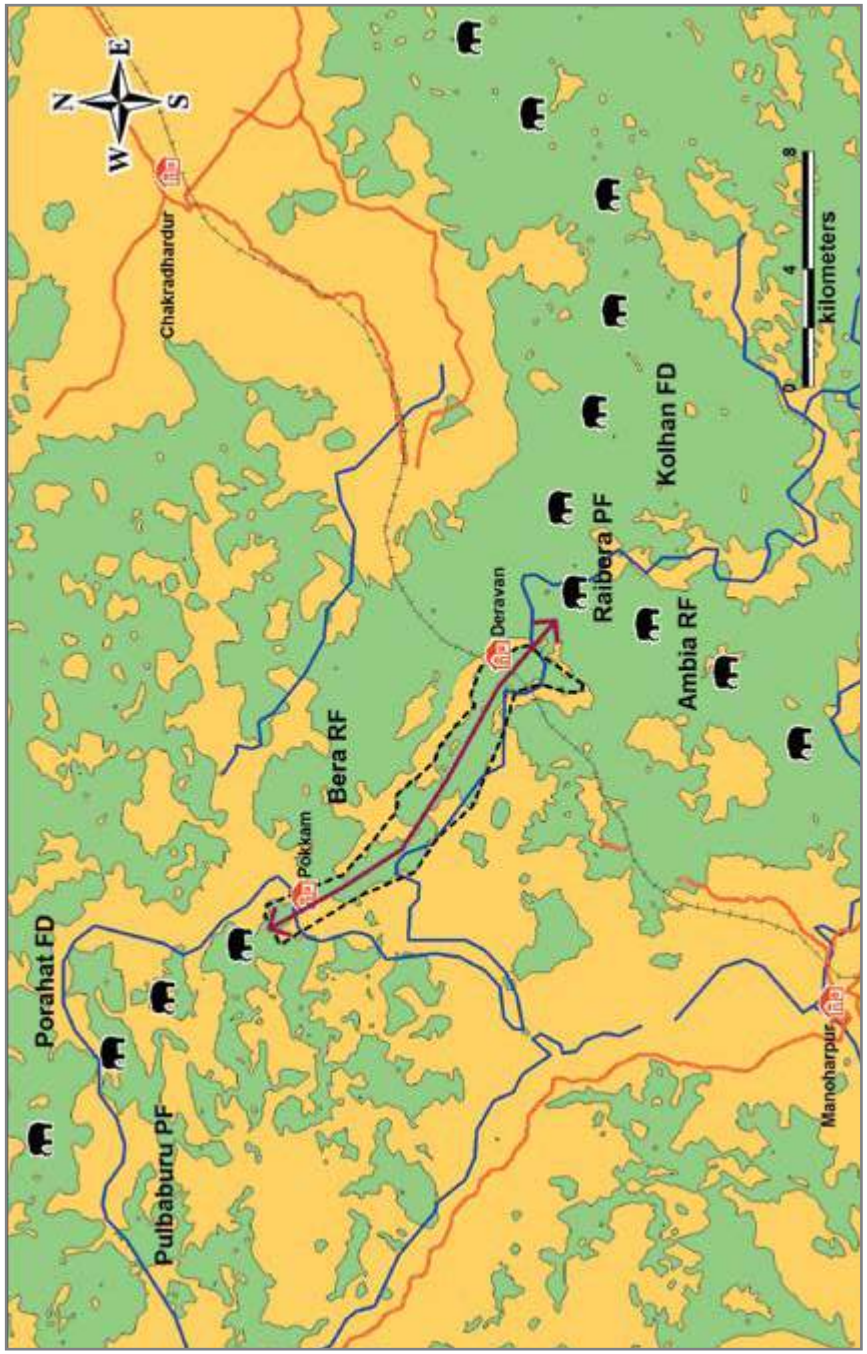
Alternate Name	Leda-Bera
State	Jharkhand
Connectivity	Raibera Protected Forest of Kolhan Forest Division with Pulbaburu Protected Forest of Porahat Forest Division
Length and Width	10 km and 1-2 km
Geographical coordinates	22° 27′ 11″- 22° 33′ 2″ N 85° 13′ 4″- 85° 18′ 56″ E
Legal status	Reserve Forest, Patta Lands
Major land use	Forests, agriculture fields, settlements
Major habitation/settlements	Raibera and Koinena
Forest type	Tropical dry deciduous and sal forest
Frequency of usage by elephants	Rare

FORESTS AND ELEPHANTS

Corridor habitat status: Vegetation in the corridor area is dominated by *Shorea robusta*, with degraded forest patches.



3D map showing the landscape of the Raibera – Pulbaburu Corridor



Map of the Raibera - Pulbaburu Corridor

Estimated elephant numbers in the landscape

Porahat Forest Division: 3-5

Kolhan Forest Division: 8

(Elephant Census Jharkhand, 2012)

Forest/Land use

Forest type: Tropical dry deciduous and sal forest

Human habitation: Raibera and Koinena

Agriculture: Paddy

Railway: Goilkera-Manoharpur

River: Karo

Other ecological importance

Mountain Range: Chotanagpur Plateau

Elephant Range: Central India

Elephant Reserve: Singhbhum Elephant Reserve

HUMAN DIMENSIONS

Threats

1. Railway track: The railway track connecting Goilkera and Manoharpur passes through the corridor. More than 40 trains ply on this track every day, making it a significant threat to elephants passing through the corridor. The railway network here is being expanded, which will further affect elephant movement.

2. Agricultural expansion: The expansion of agricultural fields has reduced the corridor width and is fragmenting the corridor forest.

3. Biotic pressure: Inhabitants of fringe villages are dependent upon the corridor forest for fuelwood and NTFP, and for livestock grazing. This has degraded the habitat.

Corridor villages: Raibera (32 families) and Koinena (about 100 families) are two villages located in and around the corridor on the regular elephant movement route. People are mostly farmers and sell fuelwood at Derawan Railway Station (fulewood is also transported to Rourkela and Chakradharpur).

Corridor dependent villages: Panta, Dugnia, Derawan, (about 100 familes), Mukundpur (120 familes), and Taraisol.

Human–Elephant Conflict: Nine elephants died due to train-hits in this stretch between 1994 and 2015. No human casualties have occurred in the corridor fringe villages, though crop and property damage is quite significant, especially in Raibera and Koinena.

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent developmental activities detrimental to animal movement.

2. Train speeds within the corridor area need to be regulated, especially during the night.

3. Improve enforcement to prevent extraction of wood from the forest. Undertake restoration of the corridor forest.



Fig. 5.11: Elephant movement data being recorded from a group of villagers



Fig. 5.12: The railway line that passes through the corridor (photo taken from locomotive engine)

5.12

ANKUA - AMBIA

Ecological Priority: High

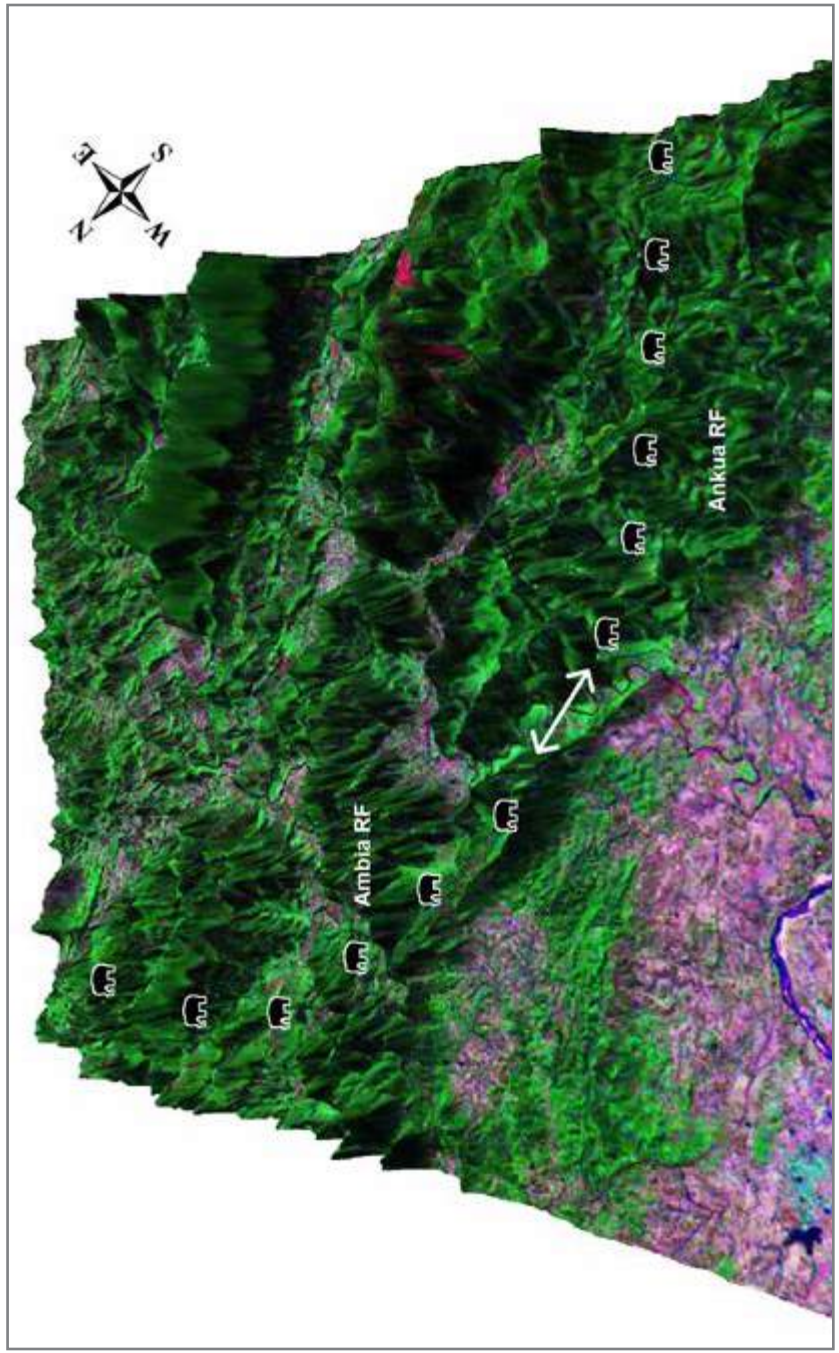
Conservation Feasibility: Medium

The Ankua-Ambia corridor connects Ankua Reserve Forest of Saranda Forest Division with Ambia Reserve Forest of Kolhan Forest Division. Recent encroachments and the expansion of agriculture lands along the Koina River and the Manoharur-Chotanagar road (about 1-3 km from Kamarbera village) within the last decade has disconnected the corridor forest, severely hindering elephant movement. Iron ore mines located in Ankua Reserve Forest to the south of the corridor have affected elephant habitat and could lead to fragmentation in future.

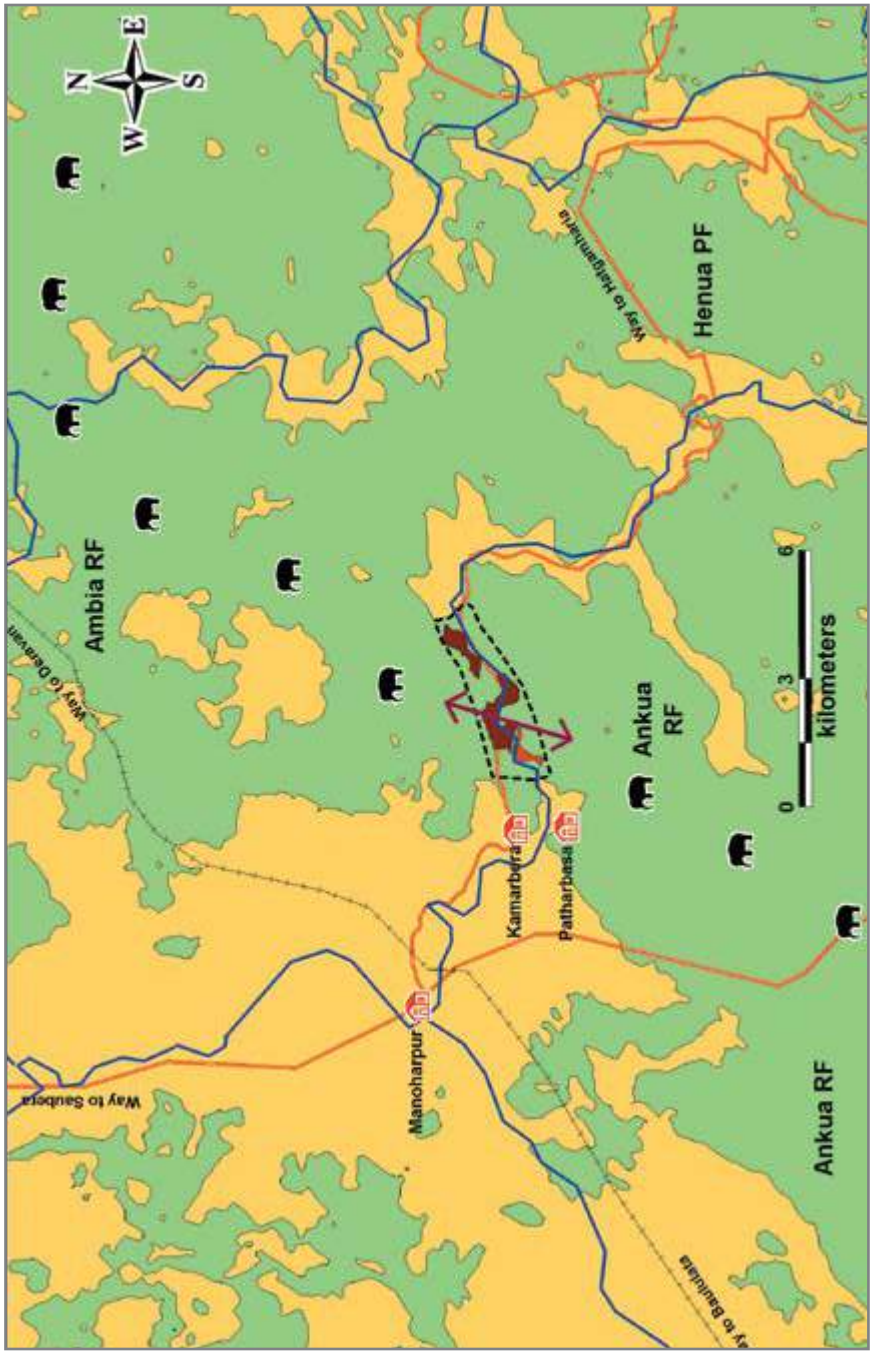
State	Jharkhand
Connectivity	Ankua Reserve Forest (Saranda Forest Division) with Ambia Reserve Forest (Kolhan Forest Division)
Length and Width	1 km and 2.5-3 km
Geographical coordinates	22° 20’ 50”- 22° 22’ 19” N 85° 15’ 1”- 85° 17’ 26” E
Legal status	Reserve Forest
Major land use	Forests, agriculture fields
Major habitation/settlements	Nil
Forest type	Tropical dry deciduous sal forest
Frequency of usage by elephants	Regular, throughout the year (Oct-Feb and Apr-June)

FOREST AND ELEPHANTS

Corridor habitat status: The corridor forest is dominated by sal (*Shorea robusta*). Other species include *Anogeissus latifolia*, *Boswellia serrata*, *Wendlandia tinctoria*,



3D map showing the landscape of the Ankua – Ambia Corridor



Map of the Ankua - Ambia Corridor

Gardenia sp, *Phoenix acaulis*, *Eulaliopsis binata*, *Dillenia pentagyna* and *Zizyphus xylopyrus* etc.

Estimated elephant numbers in the landscape

Kolhan Forest Division: 08
Saranda Forest Division: 154
(Elephant Census Jharkhand, 2012)

Forest/Land use

Forest type: Tropical dry deciduous sal forest
Agriculture: Paddy
Roadway: Manoharpur-Chotanagra PWD Road
River: Koina River

Other ecological importance

Mountain Range: Saranda Hills
Elephant Range: Central India
Elephant Reserve: Singhbhum Elephant Reserve

HUMAN DIMENSIONS

Threats

1. Encroachment: Within the last decade, about 340 acres of corridor forest have been encroached upon by villagers from fringe villages (Kamarbera, Soda and Patherbasa).There is a possibility of more encroachment being undertaken with the intention of getting more patta land under the Forest Rights Act.

2. Iron ore mines in Ankua Reserve Forest have affected elephant movement.

3. Heavy vehicle movement on the Manoharpur-Chotanagra PWD road has hindered elephant movement.

4. Collection of NTFP and fuelwood for commercial purposes by the people of fringe villages has degraded the corridor forest.

The villagers of Kamarbera, Soda and Patherbasa have encroached upon about 340 acres of corridor forest in the last decade by. Of this, they have recieved patta for about 50 acres of land as per the Forest Rights Act. The encroachers have undertaken agriculture after clearing the corridor forest. They are also collecting NTFP and fuelwood from the corridor for domestic and commercial purposes. No human habitations have been established on corridor lands thus far.

Corridor dependent villages: Kamerbera, Timra and Soda.

Human–Elephant Conflict: Land use has changed drastically in the corridor area over the last ten years or so. Tribal communities are undertaking shifting cultivation on the elephant path inside the corridor. Cultivation of paddy in corridor fringe areas attracts elephants, who regularly use the corridor and raid crops.

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent the encroachment of corridor forest and developmental activities affecting animal movement.

2. The approximately 290 acres of corridor land encroached upon by villagers of Kamarbera, Soda and Patherbasa should not be considered for patta under the Forest Rights Act. These lands should be made free of encroachment.

3. In consultation with villagers, about 50 acres of patta land in Patherbasa village need to be secured.

4. No more new mines should be allowed in the Ankua and Ambia Reserve Forests.

5. Habitat restruction of corridor area made free of encroachment.

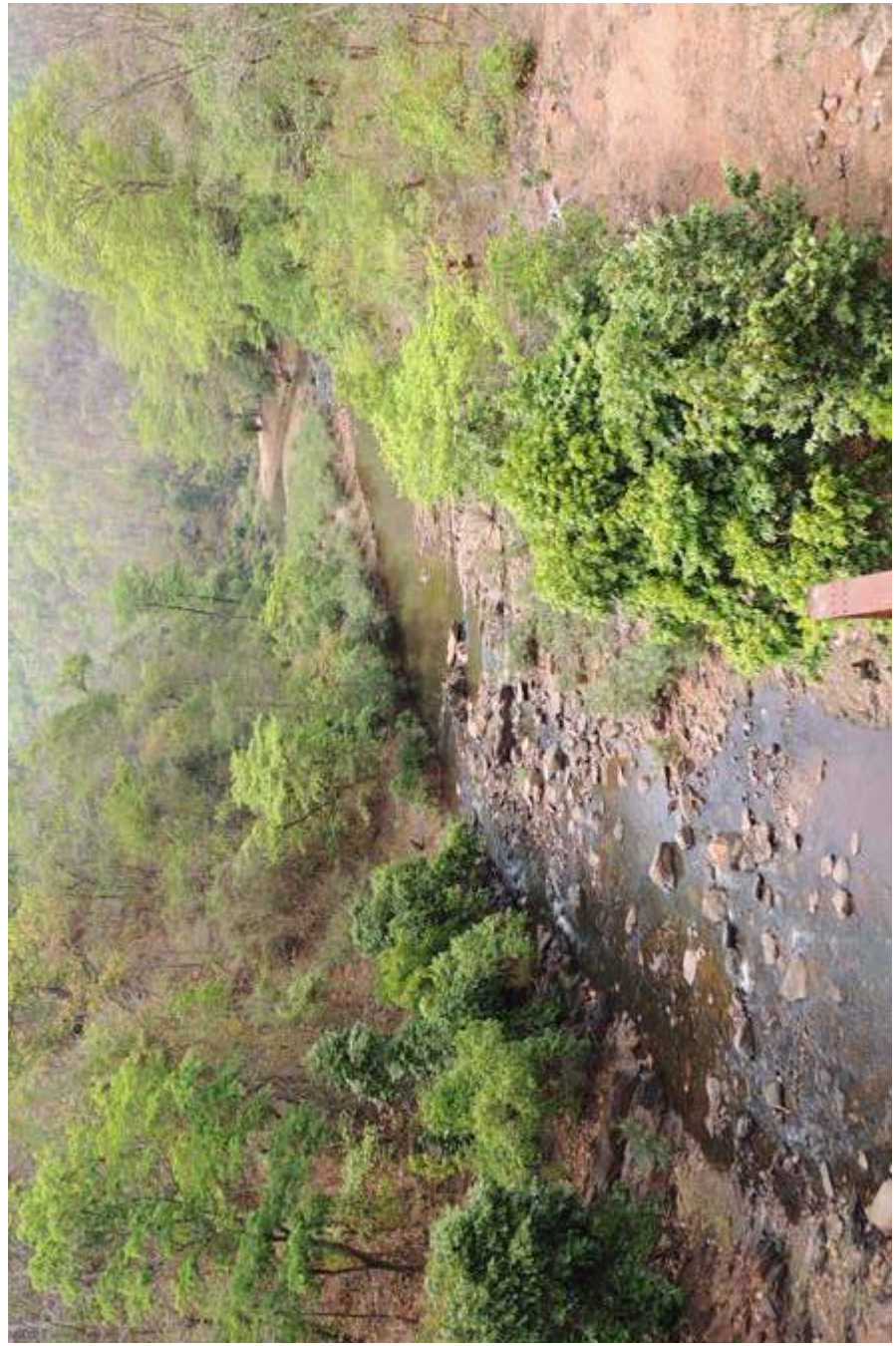


Fig. 5.13: Forest cover in the corridor area

5.13

ANJADBERA - BICHABURU

Ecological Priority: Medium

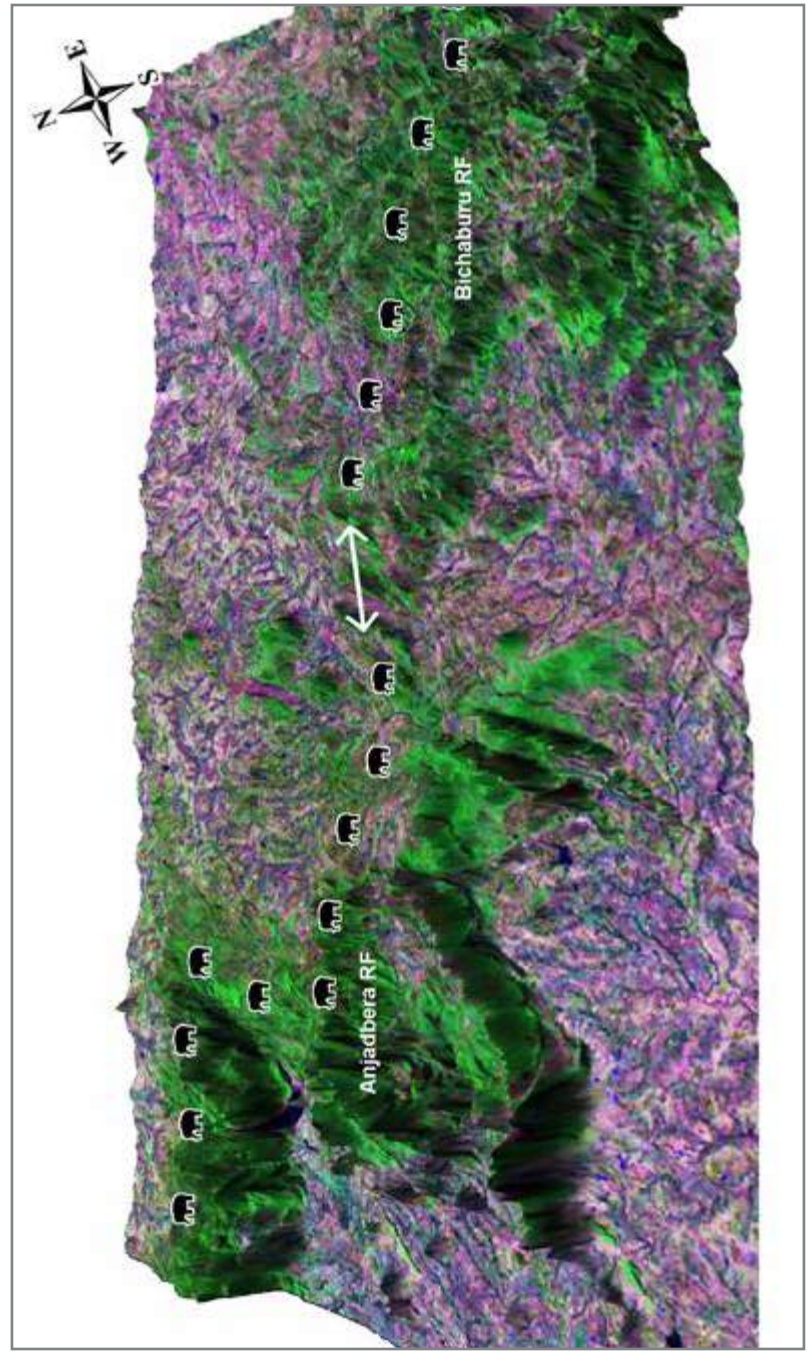
Conservation Feasibility: Low

This corridor connects the Bichaburu Protected Forest of Chaibasa Forest Division with the Anjadbera Protected Forest of Saranda Forest Division. Elephants move between both habitats through narrow and fragmented forest patches, a railway track, National Highway 75, human habitations and agricultural lands.

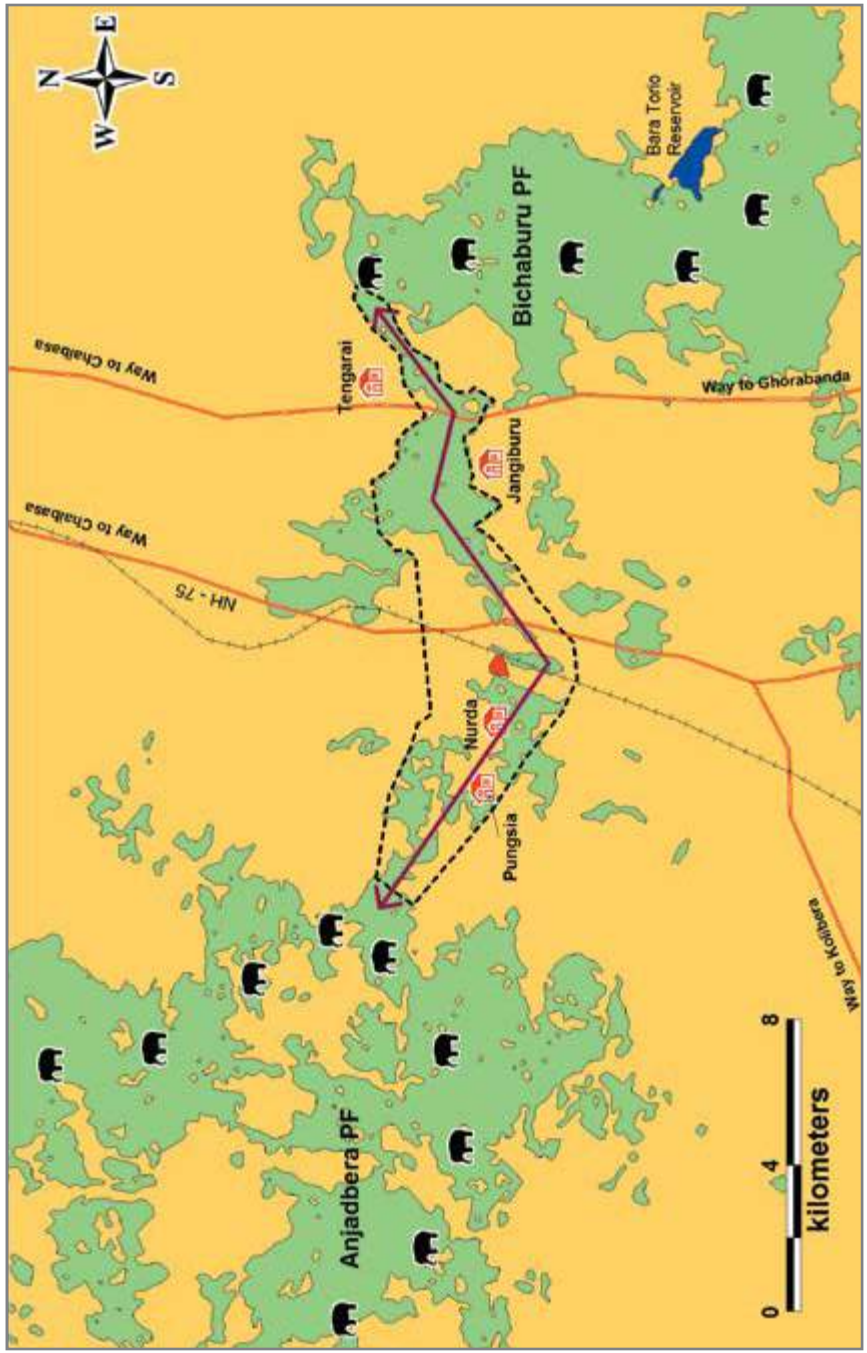
State	Jharkhand
Connectivity	Bichaburu PF with Anjadbera PF
Length and Width	19 km and 0-1.5 km
Geographical coordinates	22° 17′ 54″- 22° 21′ 13″ N 85° 40′ 54″- 85° 50′ 47″ E
Legal status	Protected Forest, Patta Land
Major land use	Forests, agricultural land and settlements
Major habitation/settlements	Kudapi, Bada Nurda, Pungsia
Forest type	Tropical dry deciduous sal forest
Frequency of usage by elephants	Regular and seasonal (Oct-Feb)

FORESTS AND ELEPHANTS

Corridor habitat status: The corridor forest is degraded and dominated by sal (*Shorea robusta*). Other major species include *Buchanania lanzan*, *Terminalia tomentosa*, *Madhuca indica*, *Schleicher aoleosa*, *Dalbergia paniculata*, *Pterocarpus marsupium* etc. Signs of wood cutting and lopping were found on almost 30% of the trees in the surveyed area.



3D map showing the landscape of the Anjadbera – Bichaburu Corridor



Map of the Anjadbera - Bichaburu Corridor

Estimated elephant numbers in the landscape

Chaibasa Forest Division: 38

Saranda Forest Division: 154

(Elephant Census Jharkhand, 2012)

Forest/Land use

Forest type: Tropical dry deciduous sal forest

Human habitation and agriculture fields: Kudapi, Bada Nurda, Pungsia

Roadway: National Highway 75 (Chaibasa-Jaintgarh)

Railway: Railway track (Chaibasa-Noamundi)

Buildings/Artefacts: High-voltage transmission line

Other ecological importance

Mountain Range: Saranda Hills, Chotanagpur Plateau

Elephant Range: Central India

Elephant Reserve: Singhbhum Elephant Reserve

HUMAN DIMENSIONS

Threats

1. National Highway: NH 75 passes through the corridor. Vehicular traffic was recorded at 137 vehicles per hour between 6 am and 6 pm, and 55 vehicles per hour between 6 pm and 6 am. Elephants cross the highway north of Haat Gamhariya.

2. A railway track connecting Chaibasa and Noamundi passes through the corridor near Kudapi village. On average 90 trains pass through this corridor every day, of which 43 trains run from 6 pm to 6 am, hindering elephant movement.

3. Steep embankments along the railway track inside the Bichaburu Protected Forest allow elephants to cross only near Kudapi village in the corridor.

4. Human habitation and agriculture fields: More than ten villages/hamlets are located in and around the corridor forest. Of these, Kudapi, Pungsia and Bada Nurda mostly hinder elephant movement. The agricultural lands of Kudapi village completely disconnect the corridor.

Corridor villages: Kudapi, Bada Nurda, Pungsia. The people from Kudapi (30 families), Bada Nurda (350 families) and Pungsia villages are the major stakeholders in this corridor. Most of the people are farmers and daily wage labourers and are dependent on the corridor forest for fuelwood, timber and NTFP.

Corridor dependent villages: Chhota Illigara, Rangabasa, Saparamguttu, Banguttu, Paramsahi.

Human–Elephant Conflict: High in both forest divisions. Some 28 human deaths, 16 cases of human injury and six elephant deaths were reported between 2002 and 2013 in Chaibasa Forest Division. More than 15 cases of human injury and two human deaths were reported during the same period in Saranda Forest Division.

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent developmental activities that hinder animal movement.

2. In consultation with villagers, 30 acres of agricultural land needs to be secured in Kudapi village.

3. Vehicle speeds on NH 75 need to be restricted through physical barriers during peak elephant movement hours.

4. The frequency of trains is very high. This has to be regulated at night and the speed of trains reduced in the corridor area.

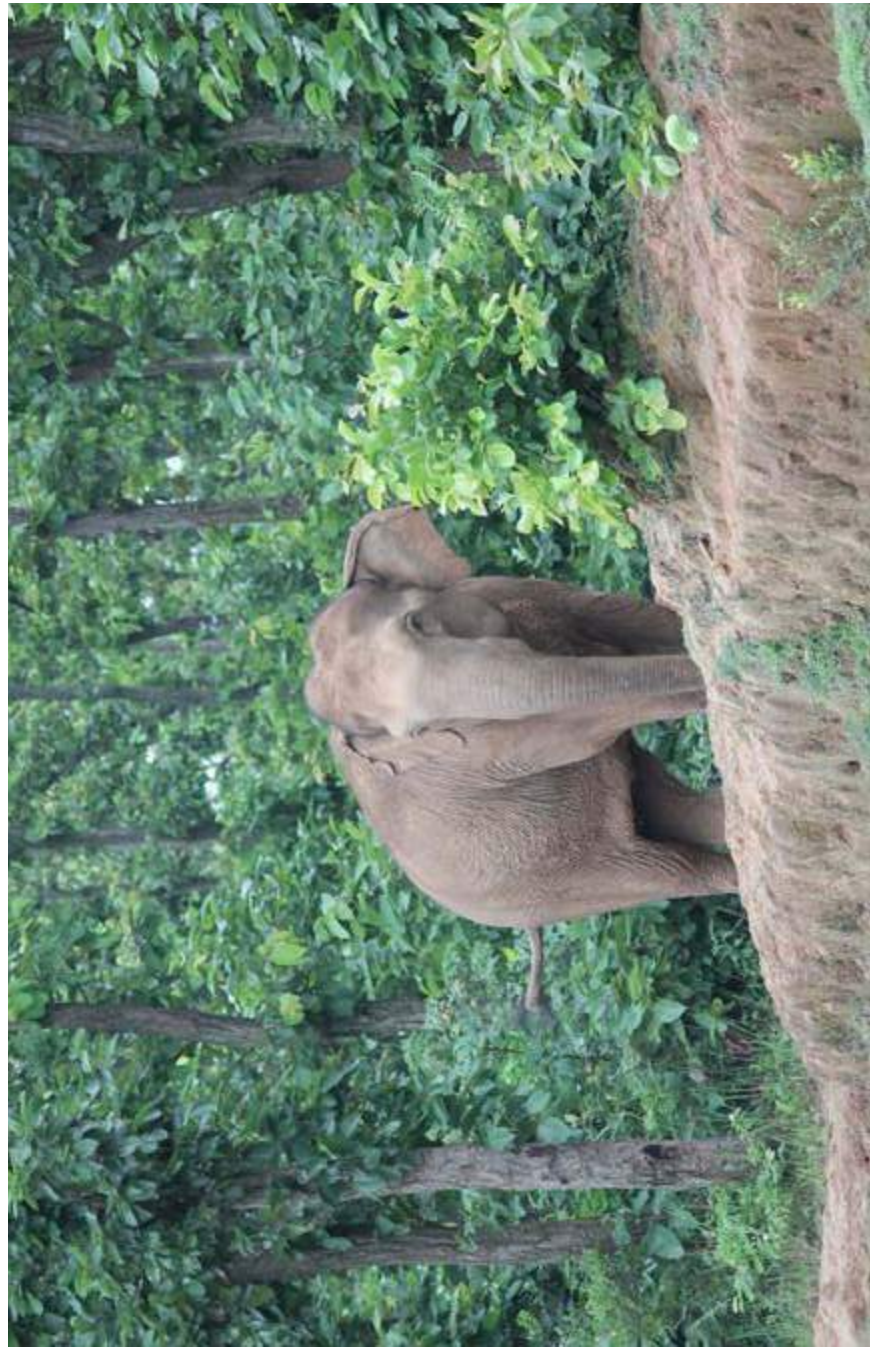


Fig. 5.14: An elephant on the fringes of the forest in the Anjadbera – Bichaburu Corridor

5.14

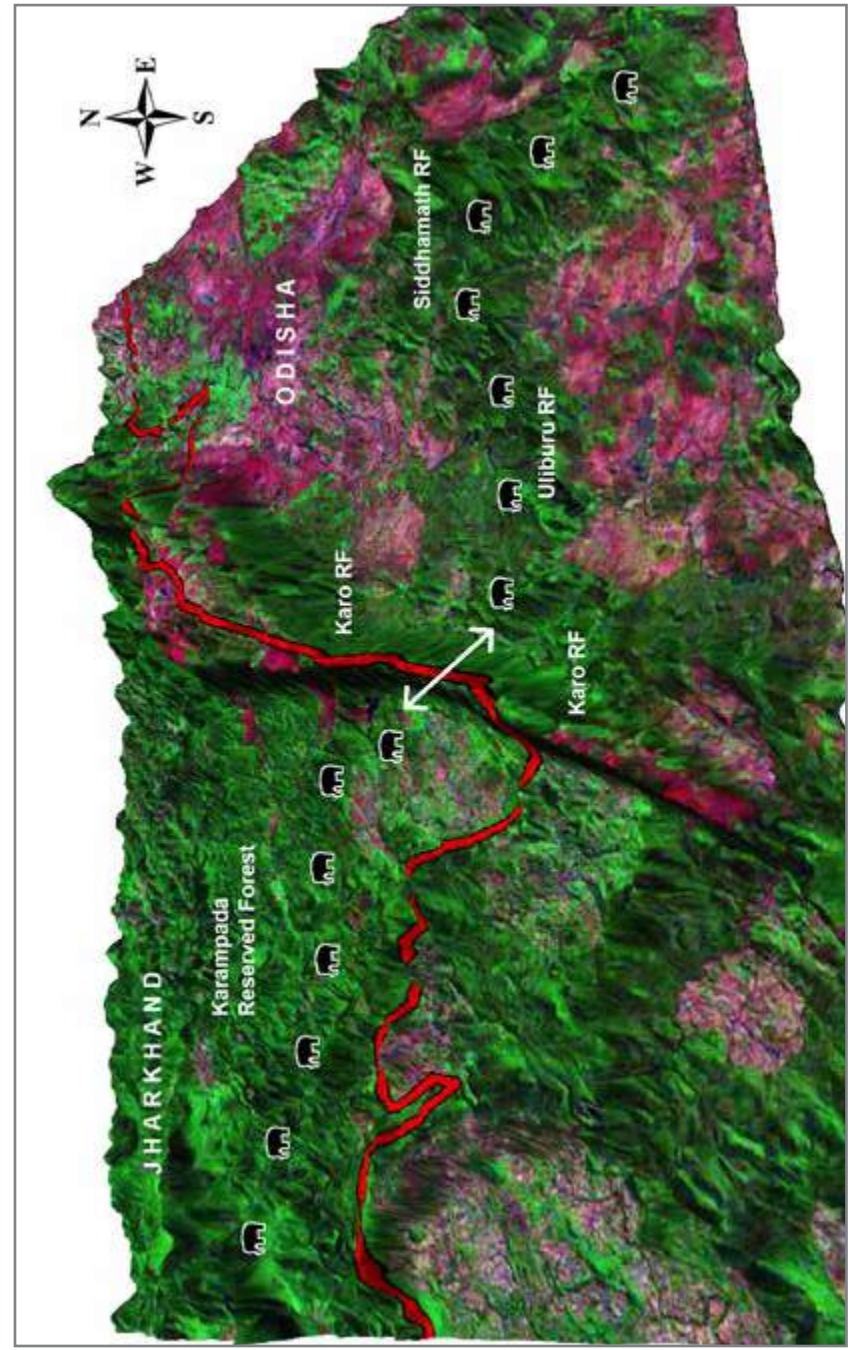
KARO - KARAMPADA

Ecological Priority: High

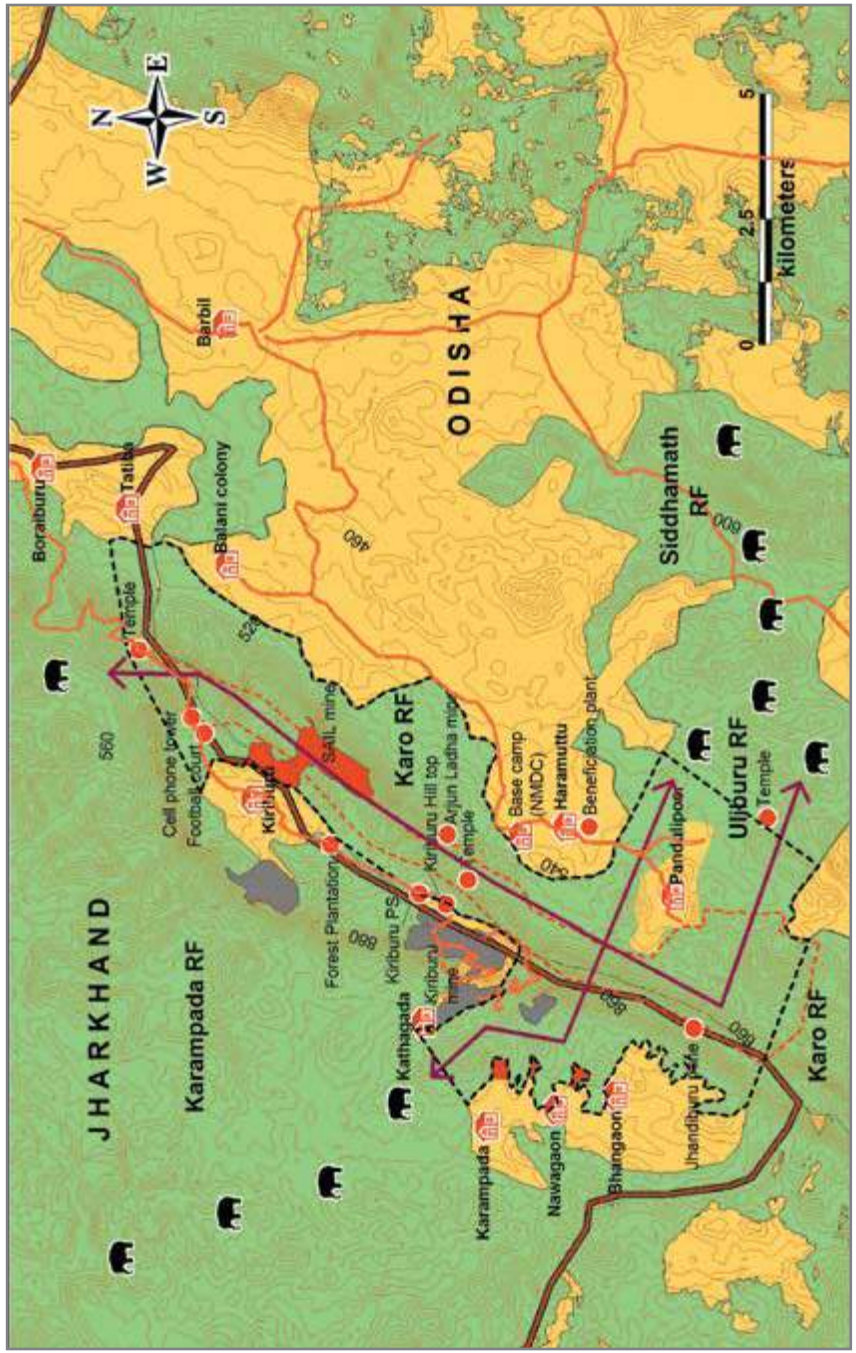
Conservation Feasibility: Medium

This corridor connects the Karo and Sidhamatha Reserve Forests of Keonjhar Forest Division in Odisha with the Karampada Reserve Forest of Saranda Forest Division in Jharkhand. The terrain is hilly and dominated by mines. Currently, elephant movement occurs between the Karo and Karampada Reserve Forests via Panduliposi and Haramotto-Kolhapunduli-Jhandiburu-Nawagaon-Karampada. Elephant movement has also been reported near Kiriburu Hill Top and the Arjun Ladha mine near Jhirina nullah. The foothills of Karo Reserve Forest are ideal for elephant movement and if a part of the SAIL mining area is left for the corridor and restored, there is a possibility that elephants can use the foothills to move between Karo and Karampada Reserve Forests.

State	Odisha and Jharkhand
Connectivity	Karo and Sidhamatha Reserve Forest in Odisha with Karampada Reserve Forest in Jharkhand
Length and Width	8.4-19 km and 0-1.8 km
Geographical coordinates	22° 0′ 23″- 22° 8′ 8″ N 85° 14′ 4″- 85° 20′ 45″ E
Legal status	Reserve Forest, Patta Land
Major land use	Forest, mines and human settlements
Major habitation/settlements	Haramotto, Kolhapunduli, Bangaon, Nawagaon, Karampada
Forest type	Tropical dry deciduous forest
Frequency of usage by elephants	Regular and seasonal (Sep-Dec)



3D map showing the landscape ofthe Karo-Karampada Corridor



Map of the Karo-Karampada Corridor area showing the land to be secured

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 23 plant species were found in the sampled area of 0.16 ha. Of these, seven species were palatable to elephants. The maximum frequency found was of *Shorea robusta* (42), followed by *Anogeissus latifolia* (11), *Terminalia tomentosa* (10), *Diospyros melanoxylon* (10) and *Symplocos racemosa* (4). Maximum average GBH was found in *Lannea coromandalica* (168 cm), *Buchanania lanzan* (97 cm), *Pterocarpus marsupium* (92 cm), *Ailanthus excelsa* (89 cm) and *Shorea robusta* (71.84 cm). Maximum average height was found in *Lannea coromandalica* (16.76 m), followed by *Shorea robusta* (14.61 m), *Terminalia bellirica* (13.34 m), *Ailanthus excelsa* (12.8 m) and *Syzygium cumini* (12.8 m). Signs of wood cutting and lopping were high, indicating severe pressure on the habitat. *Lantana camara* had invaded the corridor forming large expanses of open areas.

The proportion of ground cover included barren ground (71.25%), shrubs (24.06%), herbs (2.81%) and grasses (1.88%).

Estimated elephant numbers in the landscape

Keonjhar Forest Division: 47
Saranda Forest Division: 154

The elephant population in the Barbil Forest Range of Keonjhar Forest Division decreased from 38 individuals in 2002-03 to only six individuals in 2011-12. *(Elephant Census, Odisha, 2015* and *Elephant Census, Jharkhand 2012)*

Forest/Land use

Forest types: Tropical dry deciduous forest
Mines: Bolani mine (Steel Authority of India Ltd) and Arjun Ladha mine
Buildings/Artefacts: Factories and industral units
Human settlements: Haramotto, Kolhapunduli, Bangaon, Nawagaon, Karampada

Other ecological importance

Mountain Range: Parts of Garhjat Hills
Elephant Range: Central India
Elephant Reserve: Baitarani Elephant Reserve; Singhbhum Elephant Reserve

HUMAN DIMENSIONS

Threats

1. Mines: SAIL's Bolani mine and the Arjun Ladha mine located between Kiriburu town and Haramotto village have totally blocked elephant movement through the foothills.

2. Beneficiation plant in Haramotto: The construction of a beneficiation plant in Haramotto village located in the prime elephant movement area has hindered elephant movement and could severely hamper such movement in the future.

3. Human settlements: Biotic pressure (extraction of fuelwood, sal leaves etc) from Haramotto, Kolhapunduli, Base Camp, Kiriburu Hill Top, Kiriburu Town, Nawagaon, Bhangaon and Karampada, all situated in and around the corridor, has affected the corridor forest and elephant movement.

Corridor villages: A total of five villages are located in and around the corridor. Of these, Haramotto and Kolhapunduli lie in the prime elephant movement area and were considered for a detailed survey. Wildlife Trust of India surveyed a total of 15 families across these villages; all surveyed households have agricultural land but more than 80% of them have left it fallow. Employment in nearby mines and factories leads to less cultivation in Haramotto. Villagers of Kolhapunduli depend on cultivation and also on daily wage labour.

Corridor dependent villages: Haramotto, Kolhapunduli, Kiriburu Hill Top, Kiriburu Township, Bangaon, Nawagaon, Karampada.

Human-Elephant Conflict: Three elephant deaths were reported in the Barbil Forest Range of Keonjhar Forest Division due to conflict between 2008-09 and 2011-12. Five human deaths and two cases of human injury were also reported from Barbil Forest Range between 2007-08 and 2011-12. Further, villagers reported that elephant attacks had claimed four human lives in Kolhapunduli village in the last decade. None of these cases were registered by the forest department and the victim's families did not receive any ex-gratia support. Crop damage by elephants has been decreasing over the years as a result of less cultivation as well as a reduction in elephant movement.

CONSERVATION PLAN

1. The corridor should be notified by the state forest department and legally protected under an appropriate law. Action should be taken to prevent illegal mining and construction, and the diversion of forest land for non-forestry and developmental activities within the corridor area.

2. To bridge the framented area of the corridor, 373 acres of the SAIL Bolani mining area needs to be secured and restored.

3. Private lands (69 acres) in Karampada and Nawagaon need to be secured in consultation with villagers.

4. The lease to the Arjun Ladha mine which is located very close to the corridor should be cancelled to maintain unhindered elephant movement. Coal should be transferred by conveyor belt instead of vehicles to minimise disturbance.

5. The construction of the beneficiation plant in Haramotto village should be stopped.

6. No mining should be allowed between Jhandiburu and Kiriburu mines.

7. Habitat restoration of degraded and mined area in the corridor is required.

Land identified to secure the corridor

An area of 441.9 acres (mines and private land) has been identified for the securement of the corridor.

	Area in acres	**Priority**
SAIL Bolani Mines	373	P1
Karampada	42.9	P2
Nawagaon	26	P2

5.15

BADAMPAHAR - DHOBADHOBIN

Ecological Priority: Medium

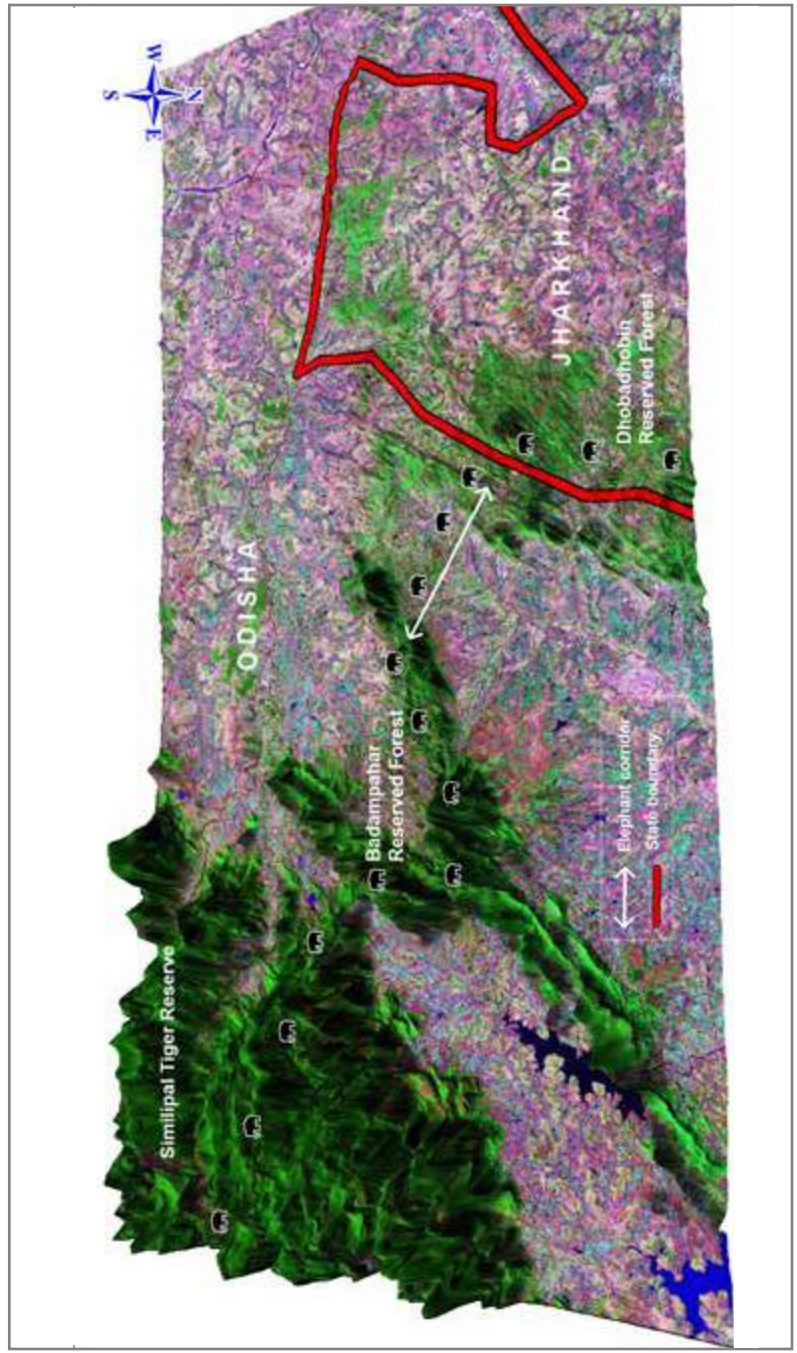
Conservation Feasibility: Medium

This corridor connects Badampahar Reserve Forest of Odisha with Dhobadhobin Reserve Forest of Jharkhand, leading on to Haldipokhari Reserve Forest of Chaibasa. The corridor comprises fragmented forest patches of the Budhipat Demarcated Protected Forest and Basila Reserve Forest, as well as agriculture fields and human settlements that maintain connectivity between Similipal Tiger Reserve and South Chaibasa.

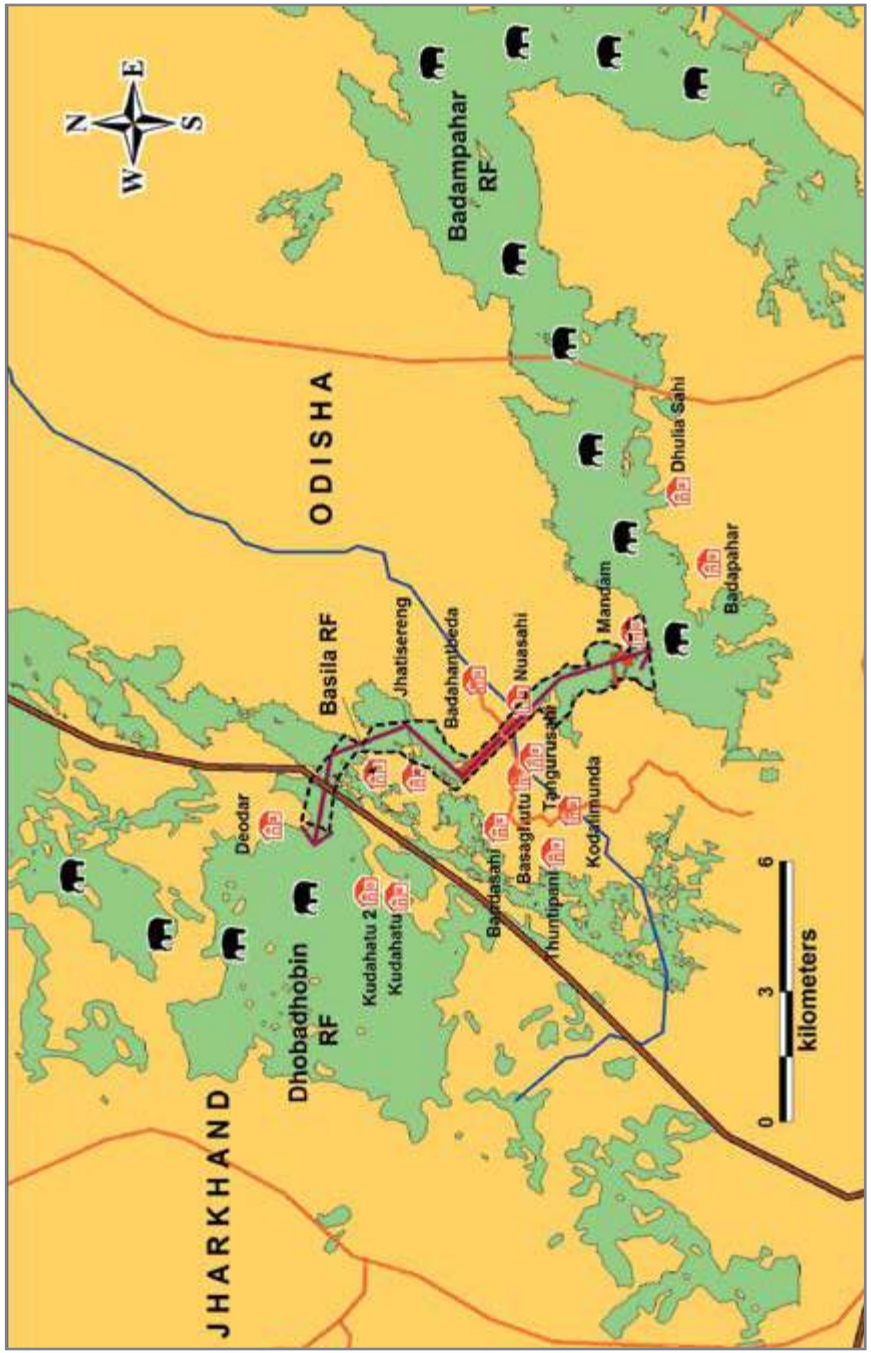
State	Odisha and Jharkhand
Connectivity	Mayurbhanj Elephant Reserve (Odisha) and Chaibasa (Jharkhand)
Length and Width	11 km and 0-1km
Geographical coordinates	22° 1′ 58″- 22° 6′ 21″ N 85° 59′ 1″- 86° 1′ 56″ E
Legal status	Demarcated Protected Forest (DPF), Village Forest and Patta Lands
Major land use	Forest, agriculture land and human settlements
Major habitation/settlements	Jhatisiring, Basaghutu, Tungurusahi, Batisahi, Thuntipani
Forest type	Tropical dry deciduous forest
Frequency of usage by elephants	Occassional; bulls and small herds

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 18 plant species were found in sampled area of 0.16 ha. Of these, eight species are elephant food species. The maximum



3D map showing the landscape of the Badampahar - Dhobadhobin Corridor



Map of the Badampahar – Dhobadhobin Corridor

frequency recorded was of *Shorea robusta* (127), followed by *Buchanania lanzan* (11), *Terminalia tomentosa* (7) and *Madhuca indica* (6). Maximum average GBH was found in *Terminalia bellirica* (120 cm), followed by *Schleicher aoleosa* (76 cm), *Dalbergia paniculata* (50 cm) and *Pterocarpus marsupium* (38 cm). Maximum average height was found in *Terminalia bellirica* and *Schleichera oleosa* (10.67 m), followed by *Dalbergia paniculata* (9.14 m) and *Shorea robusta* (8.24 m). Signs of both wood cutting and lopping were found in 46% of the total plants in the sampled areas, indicating that the corridor vegetation is under immense pressure.

The ground cover result shows a higher percentage of barren ground (42%), followed by shrubs (36%), grasses (17%) and herbs (5%).

Estimated elephant numbers in the landscape

Karanjia Forest Division: 56
Rairangpur Forest Division: 48
Similipal Tiger Reserve Core: 337
Chaibasa South Forest Division: 38
(Elephant Census Odisha, 2015, and *Elephant Census Jharkhand, 2012)*

Forest/Land use

Forest Type: Tropical dry deciduous forest
Human settlements: Jhatisiring, Basaghutu, Tungurusahi, Ramasahi, Mandam
Agriculture land
Road: State Highway 49 and Neunti-Jhaldunguri village road
Artefacts: Power lines

Other ecological importance

Mountain Range: Parts of Garhjat Hills
Elephant Range: East-Central India
Nearest Protected Area: Similipal Tiger Reserve
Elephant Reserve: Mayurbhanj Elephant Reserve
Nearest Tiger Reserve: Similipal Tiger Reserve
Biosphere Reserve: Similipal Biosphere Reserve

HUMAN DIMENSIONS

Threats

1. Fragmentation: Expansion of human settlements within and on the fringes of the corridor, agriculture fields, roads (Neunti-Jhaldunguri) etc have fragmented the corridor between Basila Reserve Forest and Budhipat DPF.

2. Expansion of settlements: Expansion of Basaghtu village and a weekly market along the Neunti-Jhaldunguri road passing through the corridor hinders elephant movement.

3. Biotic pressure: Villagers collect fuelwood, timber, *Shorea robusta* leaves and other NTFP, and graze their livestock. This has deteriorated the corridor forest.

4. Highway: SH 49 connecting Jashipur and Rairangpur passes through the corridor, fragmenting Budhipat DPF and Badampahar Reserve Forest. The average vehicle movement on the highway was found to be 70.17 vehicles per hour. The average vehicle movement was found high for two-wheelers (30.67) followed by four-wheelers (25.6), heavy vehicles (7.85) and six-wheelers (6.04).

5. Mines: Mining activities (iron ore and china clay) in the Badampahar Reserve Forest affect elephant movement in the corridor.

6. Encroachment: Encroachment of the corridor forest in Budhipat DPF and Basila Reserve Forest for agriculture and the establishment of settlements has further fragmented the corridor forest and reduced corridor width.

Corridor dependent villages: Jhatisiring, Thuntipani, Badahatnabeda, Basaghutu, Tungurusahi, Batisahi, Gobardhansahi, Kodaldhua, Jharbeda, Sagarsahi, Balanposi, Bhagabandi, Ramasahi, Genteisahi, Neunti, Nawana, Pahadpur and Mandam. A total of 18 villages are located in and around the corridor. Of these, 79 households in five villages (Thuntipani, Basaghutu, Batisahi, Jhatisiring and Tungurusahi) were surveyed. More than 90% of the sampled households reported agriculture as their principal livelihood. Villagers depend on the corridor forest for collection of fuelwood and wood for construction, agricultural purposes, livestock grazing and fodder, medicinal plants, *Shorea robusta* leaves and other NTFP.

Human–Elephant conflict: Expansion of agriculture fields in the corridor has resulted in the fragmentation of the corridor forest and subsequently increased the trend of crop damage by elephants. Crop damage and shared habitats are the main sources of conflict between humans and elephant in this area.

The official records of human-elephant conflict for Rairangpur and Karanjia Forest Divisions shows 23 human deaths, 13 human injuries and 12 elephant deaths between 2002-03 and 2012-13. More than 70% of villagers reported an increased intensity of conflict and attributed it to an increased elephant population, followed by loss of forest area, increase in human settlements and change in elephant behaviour.

CONSERVATION PLAN

1. The corridor should be notified by the state forest department and legally protected under an appropriate law. Action should be taken to prevent encroachment of forest land, illicit felling of trees and developmental activities detrimental to the corridor.
2. In consultation with villagers, identified lands (230 acres) in Basaghutu, Tungurusahi, Ramasahi and Mandam villages need to be secured.
3. Prevent expansion of human settlements and encroachment along the Neunti-Jhaldunguri road, which would further obstruct the corridor.
4. Undertake the restoration of degraded corridor forest in Budhipat DPF and Basila Reserve Forest.

Land identified to secure the corridor: The corridor has been fragmented between Budhipat DPF and Basila Reserve Forest. The fragmentation occurs due to agricultural lands, the Neunti-Jhaldunguri road and human settlements, i.e. Tungurusahi and Basaghutu. To maintain connectivity, land from the following villages needs to be secured with the due consent of villagers: Basaghutu and Tungursahi: 170 acres; Tungursahi: 11 acres; Ramasahi: 19 acres; Mandam: 30 acres.

5.16

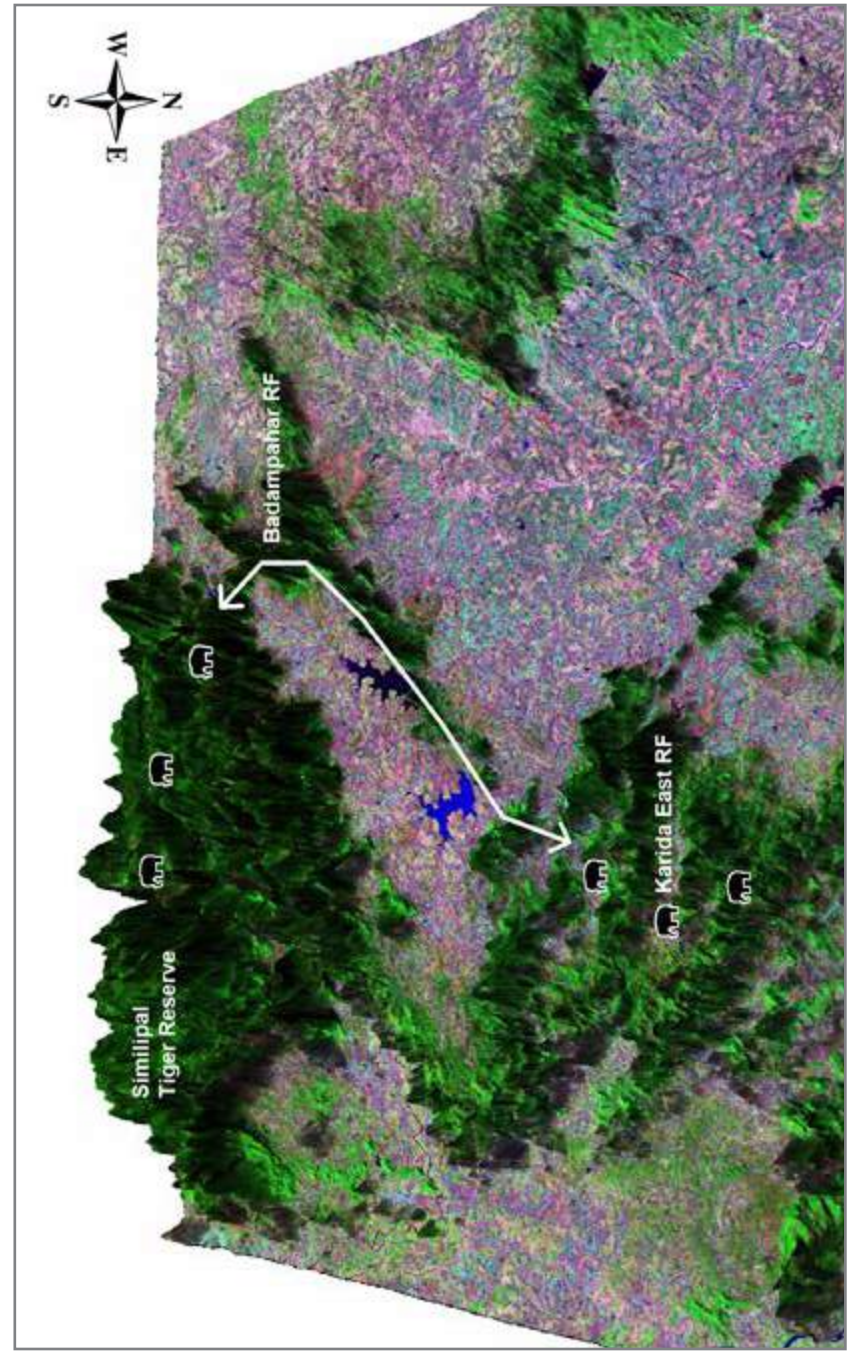
BADAMPAHAR - KARIDA EAST

Ecological Priority: Medium

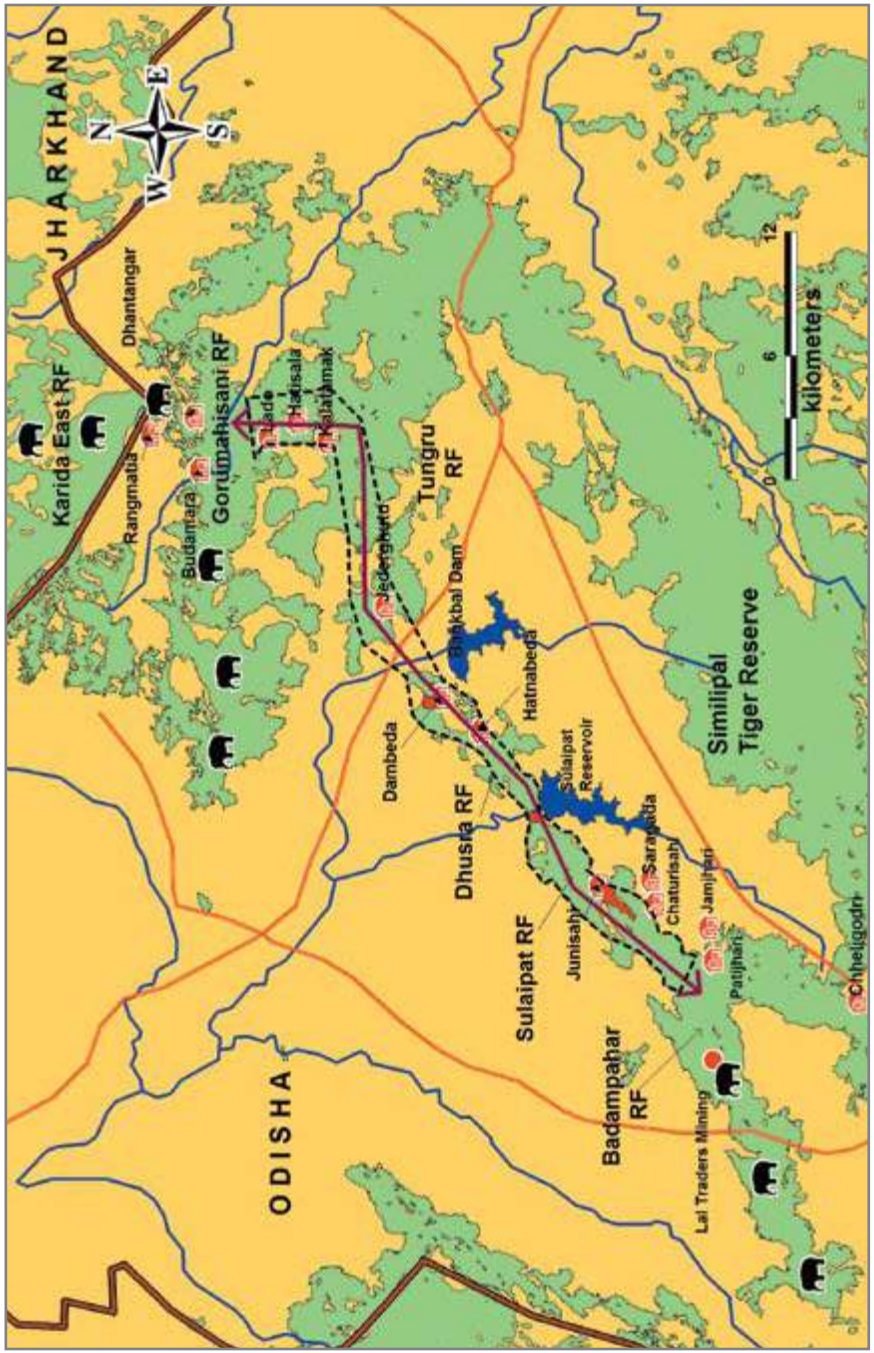
Conservation Feasibility: Low

This corridor connects Badampahar Reserve Forest of Odisha with Karida East Reserve Forest of Jharkhand, thereby maintaining elephant movement between Similipal Tiger Reserve, Odisha and the Mosabani Range of Jamshedpur Forest Division, Jharkhand. From Similipal the elephants pass through Dhusara Reserve Forest, Teltangia Village Forest, Dhinkia Demarcated Protected Forest (DPF), Pidhakata and Tunguru Reserve Forest. Elephant movement has greatly reduced between Badampahar and Dhusura Reserve Forests due to mining in Badampahar Reserve Forest, Sulaipat Dam and Suliapat irrigation canal. Similarly, elephant movement between Dhinkia DPF and Dhusura Reserve Forest has markedly reduced due to human settlements, agriculture fields, construction of irrigation canals and the presence of an electric sub-station.

State	Odisha and Jharkhand
Connectivity	Similipal Tiger Reserve of Odisha and Jamshedpur Forest Division of Jharkhand
Length and Width	34.5 km and 0-1.5 km
Geographical coordinates	22° 4′ 35″- 22° 16′ 21″ N 86° 9′ 10″-86° 26′ 16″ E
Legal status	Reserve Forest, Patta Land, Revenue Land
Major land use	Forest, agriculture fields, human settlements
Major habitation/settlements	Damabeda, Kuajhari, Jederghutu, Bijatala
Forest type	Tropical dry deciduous sal forest
Frequency of usage by elephants	Occasional; bulls and small herds



3D map showing the landscape of the Badampahar – Karida East Corridor



Map of the Badampahar – Karida East Corridor

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 15 plant species were found in the sampled area of 0.20 ha. Of these, seven were elephant food species. The maximum frequency recorded was of *Shorea robusta* (101), followed by *Cleistanthus collinus* (40), *Buchanania lanzan* (28), *Diospyros melanoxylon* (21) and *Terminalia tomentosa* (19). Maximum average GBH was found in *Neuri* (vernacular name; 70 cm) followed by *Shorea robusta* (55.15 cm), *Syzygium cumini* (49 cm), *Cleistanthus collinus* (34.68 cm) and *Teminalia tomentosa* (34 cm). Maximum average height was found in *Neuri* (16.76 m) followed by *Shorea robusta* (13.29 m), *Hollarhena antidysenterica* (9.14 m), *Cleistanthus collinus* (7.96 m), *Maduca indica* (7.37 m). Signs of woodcutting and lopping were found in 14.1% of the total plants in the sampled area, especially *Shorea robusta*, *Terminalia tomentosa*, *Buchanania lanzan* and *Diospyros melanoxylon*. Elephant fodder species were found with wood cutting and lopping signs.

The ground cover had the highest percentage of barren ground (57.5%), followed by shrubs (26%), grasses (11.5%) and herbs (5%).

Estimated elephant numbers in the landscape

Karanjia Forest Division: 56
Rairangpur Forest Division: 48
Similipal Tiger Reserve Core: 337
Jamshedpur Forest Division: 38
(Elephant Census Odisha, 2015, and Elephant Census Jharkhand, 2012)

Forest/Land use

Forest type: Tropical dry deciduous sal forest
Rivers / Riverway: Khadakei and Bankabal Rivers, irrigation canals
Roadway: State Highway 50 connecting Baripada and Rairangpur
Human settlements: Damabeda, Kuajhari, Jederghutu, Bijatala
Building/Artefacts: Sulaipat and Bankabal Dam, Mines, Electric sub-station

Other ecological importance

Mountain Range: Parts of Garhjat Hills
Elephant Range: East-Central India
Nearest Protected Area: Similipal Wildlife Sanctuary and Similipal National Park
Elephant Reserve: Mayurbhanj Elephant Reserve
Tiger Reserve: Similipal Tiger Reserve
Biosphere Reserve: Similipal Biosphere Reserve

HUMAN DIMENSIONS

Threats

1. Irrigation canals: The cemented surface of the irrigation canals running on either side of State Highway 50 and Sulaipat canal are major obstacles to elephant movement through the corridor.

2. Mines in Badampahar Reserve Forest: Iron ore mines in the Badampahar Reserve Forest and corresponding activities like blasting and heavy vehicular movement have severely affected elephant movement.

3. Highway traffic: SH 50 connecting Baripada and Rairangpur passes through the corridor. On average, 79.5 vehicles per hour were found to ply through the corridor. Average vehicle movement was found high for two-wheelers (38.96) followed by four-wheelers (30.88), six-wheelers (7.92) and heavy vehicles (1.75). Between 10 pm and 7 pm the average vehicle movement was 23 per hour.

4. Electric sub-station: The construction of an electric sub-station is in progress in the corridor near the Bankabal River.

5. Human settlements and biotic pressure: The settlements and agricultural lands of Damabeda, Bijatala, Kuajhari and Jederghutu villages have fragmented the corridor between Dhusura Reserve Forest and Dhinkia DPF. The biotic pressure exerted by fringe villages (grazing, fuelwood and NTFP extraction) of fringe villages has further degraded the corridor forest.

6. Cultivation in Lakhanchhatar and nearby areas has reduced and degraded the corridor forest.

A total of 64 villages are located in and around the corridor. Of these, 46 families in three villages (Jederghutu, Kuajhari and Damabeda) were surveyed. All the respondents depend upon agriculture for their livelihood, and some work as labourers to augment their income. More than 90% of the sampled households depend upon the corridor forest for fuelwood. Villagers also collect *Shorea robusta* leaves, other NTFP and medicinal plants. Farmers mainly cultivate paddy once a year, hence crop depredation by elephants occurs seasonally. All respondents reported human-elephant conflict.

Corridor dependent villages: Chauradihi, Dudhijharan, Bhuyanbasha, Netrajharan, Talapokhari, Bhuyanbasha, Ghudurupala, Tiakati, Sarupali, Jagannathpur, Badapurunapani, Badajodi, Saragada, Chaturisahi, Patharakata, Gunduria, Jamajhari, Pitajhari, Khandadera, Karanjharan, Burudihi, Asansikha, Balikatha, Taldiha, Karkachia, Khadiasar, Bhalkichua, Jadapokhari, Hatnabeda, Tulasibani, Teltangia, Damabeda, Bijatala, Jederghutu, Karanjei, Kuajhari, Banki, Paunsia, Kunjakachu, Gargadihi, Bantuligada, Edelbeda, Bandgaun, Kendua, Nuagaon, Sapghara, Baliam, Sargada, Sanabantha, Badabantha, Baduakacha, Saranda, Tunguru, Kalatamak, Jhumukapahari, Hatisala, Heselgoda, Lado, Daleidihi, Budamara, Dhantangar, Tiakati, Lakhanchhatar and Rangamatia.

Human-Elephant Conflict: Crop damage is the major source of conflict in and around the corridor. High levels of conflict are reported in the villages of Jederghutu, Kuajhari and Karanjei, which are situated close to the forest. Five elephant deaths (due to conflict and unknown reasons) were reported in Rairangpur Forest Division between 2002-03 and 2012-13. Five human deaths / cases of human injury due to elephant attacks were reported in the same period.

CONSERVATION PLAN

1. The corridor should be legally protected by the state forest department under an appropriate law, and action should be taken to prevent mining activities, encroachment of forest land, illicit felling, slash-and-burn cultivation and developmental activities detrimental to the corridor.

2. Overpasses are needed at regular intervals on the cemented surface of the irrigation canals to facilitate elephant movement in the corridor area.

3. The electric sub-station should be shifted out of the corridor.

4. Prohibit mining activities in and around the Badampahar Reserve Forest.

5. Secure private lands under Bijatala, Damabeda, Kuajhari, Karanjei and Jederghutu villages, between Dhinkia DPF and Dhusara Reserve Forest.

6. Prevent the expansion of human settlements along the highway near the Bijatala chowk and hamlet of Kuajhari village.

7. Restore the fragmented and degraded Dhusara Reserve Forest and forest cover between Kalatamak and Jhumukapahari villages to maintain connectivity between Tunguru Reserve Forest and Sarli Reserve Forest.

8. Prevent sagging of the electric transmission line (it should be maintained at 20 feet or 6.6 m above the ground) passing through the corridor forest from the sub-station.

Land identified to secure the corridor: The corridor is surrounded by villages and large private lands present between and around the forest patches. Potential sites have been identified in Kuajhari, Karanjei, Jederghutu, Damabeda and Bhitaramda villages to secure the corridor.



Fig. 5.15: Commerical extraction of *Shorea robusta* leaves from the corridor and nearby forest



Fig. 5.16: A field officer undertaking habitat assessment

5.17

SIMILIPAL - SATKOSIA

Ecological Priority: High

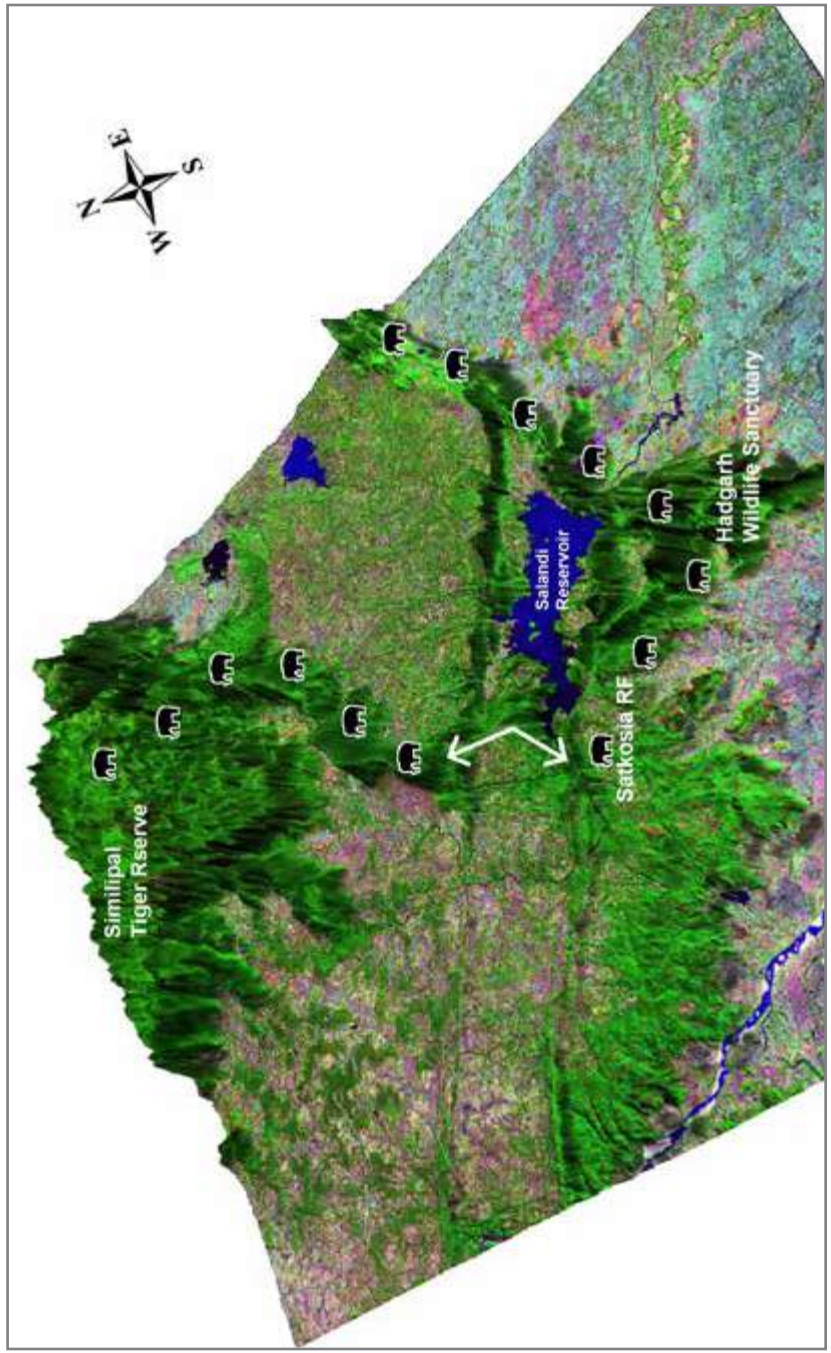
Conservation Feasibility: Medium

This corridor connects Similipal Tiger Reserve and Hadgarh Wildlife Sanctuary through the Noto and Satkosia Reserve Forests. Local people from the Bhaliadala Gram Panchayat have encroached upon the corridor forest for agriculture and habitation, causing fragmentation. The corridor is used by several other wildlife species including tigers (*Panthera tigris*) and sloth bears (*Melursus ursinus*).

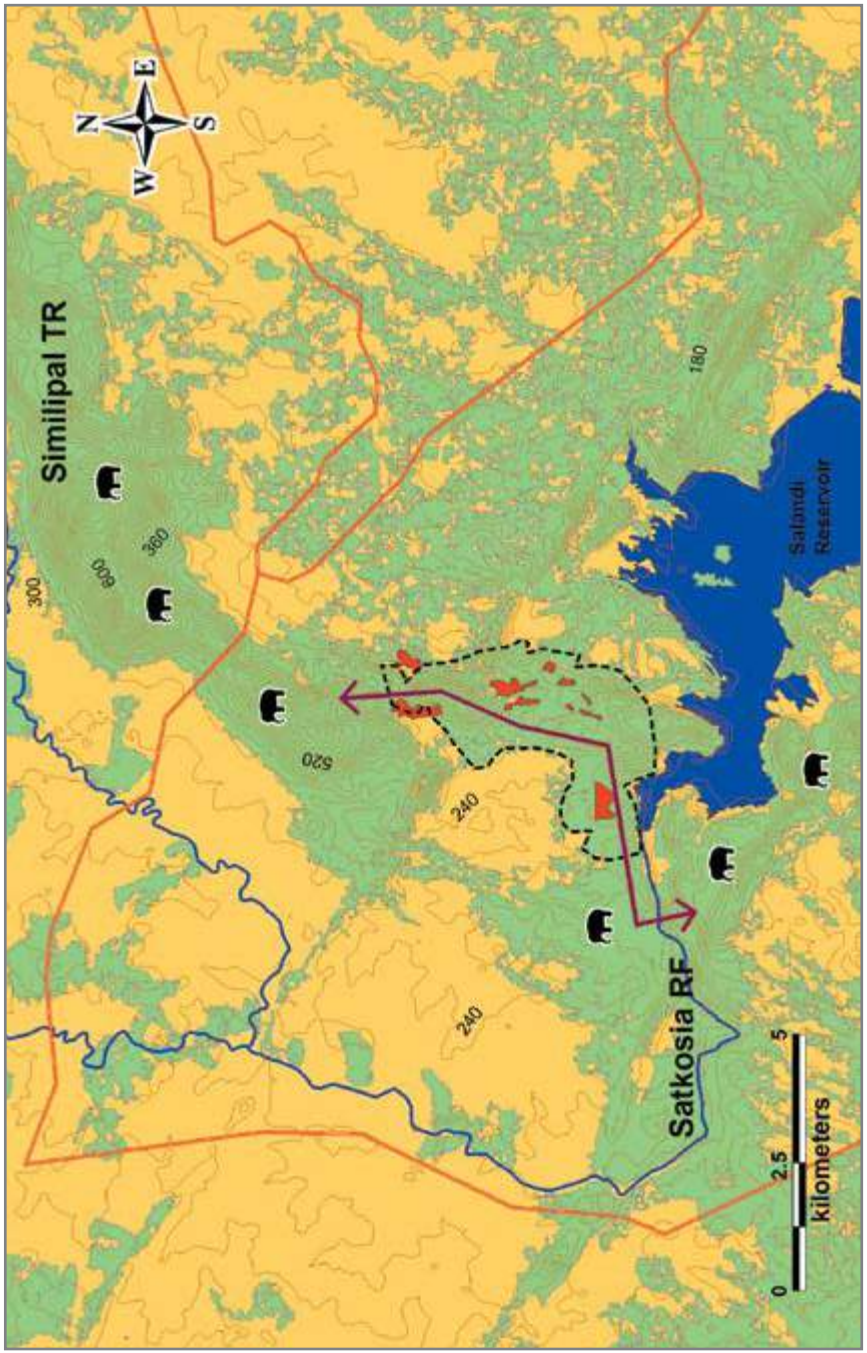
Alternate Name	Similipal - Hadgarh
State	Odisha
Connectivity	Similipal Tiger Reserve and Hadgarh Wildlife Sanctuary
Length and Width	7 km and 0.2-1.5 km
Geographical coordinates	21° 21' 46"- 21° 24' 37" N 86° 12' 60"- 86° 15' 28" E
Legal status	Reserve Forest, Tiger Reserve and Revenue Land
Major land use	Forest, private lands, encroachment areas and human settlements
Major habitation/settlements	Kumbhalar, Bhaliadiha, Baigananali, Bennuadhar, Asurkhal, Noto
Forest type	Tropical dry deciduous sal forest
Frequency of usage by elephants	Regular and seasonal

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 33 plant species were found in the sampled area of 0.16 ha. Of these, 10 were elephant food species.



3D map showing the landscape of the Similipal – Satkosia Corridor



Map of the Similipal – Satkosia Corridor

The maximum frequency found was of *Shorea robusta* (101), followed by *Terminalia tomentosa* (14), *Glochidion lanceolarium* (10), *Syzygium cumini* (10) and *Cleistanthus collinus* (7). Maximum average GBH was found in *Albizia lebbeck* (101 cm), followed by *Madhuca indica* (95.5 cm), *Garuga pinnata* (94.5 cm), *Terminalia tomentosa* (88.17 cm) and *Anogeissus latifolia* (84.33 cm). Maximum average height was found in *Albizia lebbeck* (19.81 m), followed by *Anogeissus latifolia* (15.24 m), *Garuga pinnata* (13.41 m), *Terminalia tomentosa* (12.93 m) and *Madhuca indica* (10.67 m). Signs of both wood cutting and lopping were found in 49.75% of the total plants in the sampled areas. *Shorea robusta* was found with considerable signs of lopping and cutting. The ground cover was found to mostly be barren ground (58.12%), followed by shrubs (30.63%), herbs (5.94%) and grasses (5.31%).

Estimated elephant numbers in the landscape

Hadgarh Wildlife Sanctuary: 45
Baripada Forest Division: 68
Karanjia Forest Division: 56
Similipal Tiger Reserve Core: 337
(Elephant Census Odisha, 2015)

Forest/Land use

Forest Type: Tropical dry deciduous forest
Agriculture fields
Human habitations: Kumbhalar, Bhaliadiha, Baigananali, Bennuadhar, Asurkhal and Noto
Road: Thakurmunda-Udala road

Other ecological importance

Mountain Range: Parts of Garhjat Hills
Elephant Range: East Central India
Protected Areas: Similipal Wildlife Sanctuary, Similipal National Park and Hadgarh Wildlife Sanctuary
Elephant Reserve: Mayurbhanj Elephant Reserve
Tiger Reserve: Similipal Tiger Reserve
Biosphere Reseve: Similipal Biosphere Reserve

HUMAN DIMENSIONS

Threats

1. Encroachment of corridor forest: Tribal migrants have come and settled in the area by clearing the corridor forest, in anticipation of receiving patta land under the Forest Rights Act.

2. Road: The road connecting Thakurmunda and Udala passes through the corridor. The side wall along the road hinders animal movement. Traffic intensity is low at present.

3. Proposed road: The construction of a Major District Road (MDR 70) is proposed through Similipal via Dongadiha village, connecting Thakurmunda and Udala. This will endanger the movement of elephants.

4. Anthropogenic pressure: Local people depend upon the corridor forest for timber as well as the collection of *Shorea robusta* leaves and other NTFP, for subsistence as well as commercial purposes. This affects the health of the corridor vegetation.

5. Forest Fires: Forest fires occur every year. Locals set fires to collect *Madhuca indica* flowers.

Corridor villages: Chandanjharana, Benuadhara, Baigananali and Kumbhalar.

Corridor dependent villages: Masaghati, Satbedi, Jajapur, Dhinkisal, Jamnda, Baghdapa, Purunapani, Kudisila, Kumbhalar, Jambani, Bhaliadiha, Baigananali, Bennuadhar, Jharajhari, Asurkhal, Chandanjharana (a hamlet of Asurkhal), Ghantiadhara, Panaposi, Banamunda, Mulapala, Baghuanala, Jadipada, Bhejidiha, Karanjagada, Noto, Purunapani, Bhurguda, Khatuapada, Askoti, Dhanchaturi, Sandei, Patrapada, Khukund, Dongadiha.

A total of 34 villages are located in and around the corridor. Of these, 30 households in six villages (Asurkhal, Baigananali, Benuadhar, Dhinkisal, Jajapur and Kumbhalar) were surveyed. All these villages are tribal dominated settlements and people have encroached upon forest areas. Tribal people from other areas clear forest areas and settle, hoping to get patta land under the Forest Rights Act. Of the six surveyed villages, Benuadhar and Kumbhalar are located in regular elephant movement areas in the corridor. Agriculture is the primary livelihood of the respondents (87%). Villagers also sell *Shorea robusta* leaves and other forest produce for their livelihood and are engaged in daily wage labour. They also depend upon the corridor forest for their daily needs, including fuelwood, wood for construction, and the extracton of mahula, kendu, kusuma, chara, siali, bhalia, karanja, jamun, rai flower, wild vegetables and mushrooms.

Human–Elephant Conflict: In 2010-11, one elephant death occurred due to conflict in the Thakurmunda range of Karanjia Forest Division. No human deaths have occurred in the corridor area although two people were injured in elephant attacks in the Satkosia and Thakurmunda Forest Ranges of Karanjia Forest Division. Crop depredation and property damage has been reported in the corridor fringe villages.

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent the encroachment of corridor forest, illegal tree felling and developmental activities hindering elephant movement.
2. In consultation with villagers, the corridor forest needs to be secured by relocating people from Benuadhar, Baigananali, Kumbhalar and Chandanjharan villages, which are located inside the corridor.
3. The proposed expansion of Major District Road 70 should be halted or appropriate mitigation measures planned.
4. Collection of *Shorea robusta* leaves and other NTFP should be regulated from the corridor forest and eco-development support be provided to the villagers.

Land identified to secure the corridor: In consultation with villagers, land from four villages needs to be secured: Benuadhar (21 families with 116 acres), Chandanjharan (10 families with 40 acres), Baigananali (9 families with 38 acres) and Kumbhalar (16 families with 8 acres).

5.18

BAULA - KULDIHA

Ecological Priority: Medium

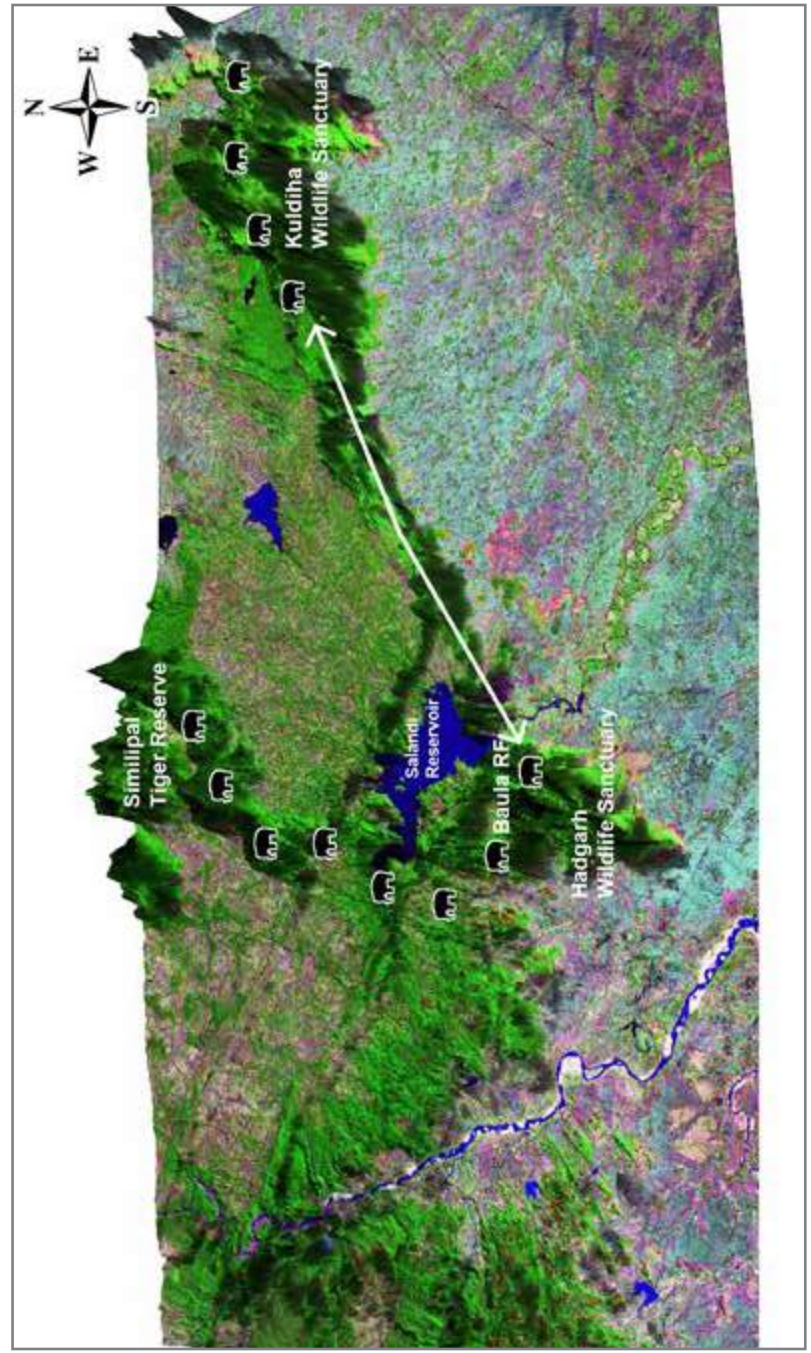
Conservation Feasibility: Medium

This corridor connects Hadgarh Wildlife Sanctuary with Kuldiha Wildlife Sanctuary. Elephant movement occurs through hillocks and forest patches dotted with a significant number of stone quarries. At times elephants also move to Hadgarh Wildlife Sanctuary north of the Salandi Reservoir. The presence of stone quarries and encroachment of the corridor forest by locals for agriculture and habitation has caused fragmentation. This has forced elephants to use the hill tops to move between the habitats.

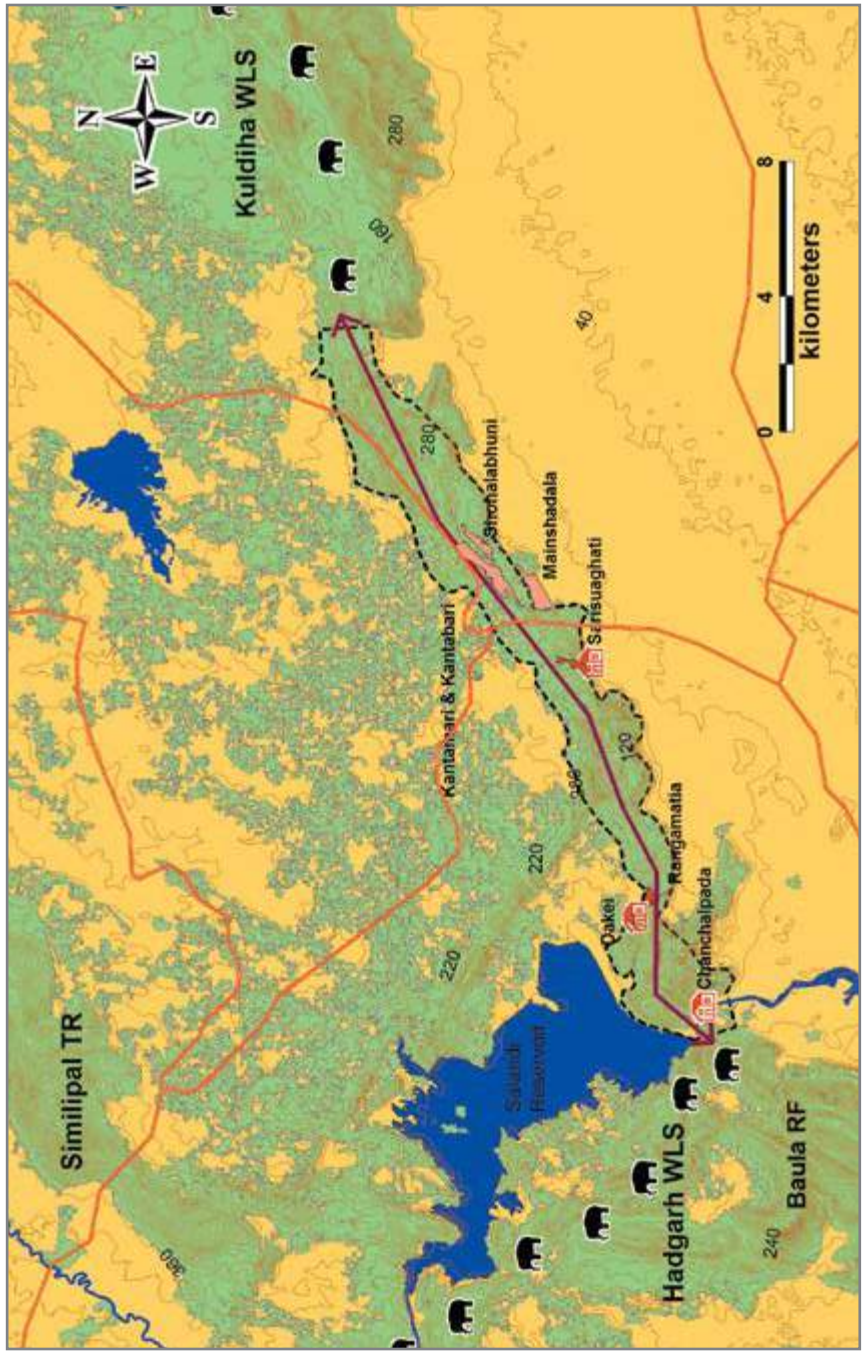
Alternate Name	Hadgarh-Kuldiha
State	Odisha
Connectivity	Hadgarh Wildlife Sanctuary and Kuldiha Wildlife Sanctuary
Length and Width	25 km and 0.3-2.0 km
Geographical coordinates	21° 16′ 41″- 21° 23′ 25″ N 86° 17′ 41″- 86° 29′ 51″ E
Legal status	Reserve Forest, Revenue Forest and Patta Land
Major land use	Forest, stone quarries, agriculture fields and human settlements
Major habitation/settlements	Nuabalipala, Rangamatia, Dakei, Shohalabhauni, Kantamari, Kantabari, Ranipokhari
Forest type	Tropical dry deciduous sal forest
Frequency of usage by elephants	Occassional

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 42 plant species were found in the sampled area of 0.16 ha. Of these, 12 species are palatable to elephants. The maximum



3D map showing the landscape of the Baula – Kuldiha Corridor



Map of the Baula – Kuldiha Corridor

frequency found was of *Shorea robusta* (46), followed by *Terminalia tomentosa* (13), *Cleistanthus collinus* (9), *Albizia lebbeck* (8) and *Lagerstroemia parviflora* (6). Maximum average GBH was found in *Ailanthus excel*s (97 cm) followed by *Pongamia pinata* (71 cm) and *Ziziphus oenoplia* (63 cm). Maximum average height was found in Dala Sujuni (15.24 m), followed by *Ailanthus excels* (13.72 m), *Albizia lebbeck* (5.83 m) and *Cassia fistula* (5.49 m). Signs of both wood cutting and/or lopping were found in 70% of the total plants in the sampled areas. *Shorea robusta* was found with considerable signs of lopping and wood cutting, which shows the corridor vegetation is under immense anthropogenic pressure. The ground cover included barren ground (58.44%), shrubs (27.50%), herbs (7.19%) and grasses (6.88%).

Estimated elephant numbers in the landscape

Hadgarh WLS: 45
Baripada Forest Division: 68
Balasore Wildlife Division: 89
(Elephant Census Odisha, 2015)

Forest/Land use

Forest type: Tropical dry deciduous sal forest
Buildings/Artefacts: Stone quarries and crushers
Agriculture fields
Human habitations: Nuabalipala, Rangamatia, Dakei, Shohalabhauni, Kantamari, Kantabari, Ranipokhari
Road: Connecting Oupada and Kaptipada

Other ecological importance

Mountain Range: Parts of Eastern Ghats
Elephant range: East-Central India
Elephant Reserve: Mayurbhanj Elephant Reserve
Protected Areas: Hadgarh Wildlife Sanctuary and Kuldiha Wildlife Sanctuary

HUMAN DIMENSIONS

Threats

1. Stone quarries: A large number of stone quarries are located in and around the corridor forest. Quarrying activities affect elephant movement through the corridor and have substantially narrowed its width and caused the habitat to deteriorate.

2. Stone crusher plants are also present close to the corridor forest, hindering elephant movement.

3. Encroachment for agriculture and habitation: Tribals have encroached upon the corridor forest in the hope of getting patta land under the Forest Rights Act.

4. Anthropogenic pressure: Local people extract fuelwood in large quantities from the corridor forest for domestic as well as commercial purposes. They also depend upon the corridor forest for collection of *Shorea robusta* leaves, other NTFP, and livestock grazing.

5. Establishment of a brick kiln near Chanchalpada village downstream of the Salandi Reservoir affects corridor usage by elephants.

6. A compound wall along the road between Salandi Dam and Hadgarh village obstructs elephant movement.

7. Construction of a new road connecting Siadimalia and Bhanra through the corridor has caused fragmentation. The steep embankments of this road have affected elephant movement.

8. Cemented embankments downstream of the Salandi Reservoir also affect elephant movement.

Corridor villages: Shohalabhauni, Kantamari and Kantabari, Sarisuaghati, Rangamatia, Dakei, Singhasahi (Maishadala Village).

A total of 36 villages are located in and around the corridor. Of these, 49 families in five villages (Shohalabhauni, Kurhadighasa, Nuabalipal, Rangamatia and Dakei) were surveyed. Nuabalipal village was relocated from inundated areas of the Salandi Reservoir. Dakei is an encroached village, about four to five years old. Thirteen families of Banra village have cleared the corridor forest and settled in Dakei.

A majority (94%) of sampled villagers are farmers and or daily wage labourers in the nearby stone quarries and stone crusher plants. Local people also sell fuelwood in large quantities in nearby markets for their livelihood. Villagers depend upon the corridor forest for the collection of fuelwood, *Shorea robusta* leaves, chara, kusuma, mahula, karanja, kendu, wild potato, rai flower, amla, mango, mushroom, bhalia, bel, jamun and wild vegetables.

Corridor dependent villages: Hadgarh, Chanchalpada, Ketaki, Phuljhar, Nuabalipala, Rangamatia, Ketaki, Rangamati, Rangamati, Siadimalia, Bhanra, Bageipur, Kuturiapal, Gagua, Kadaligadia, Gadapokhari, Mankadapa, Kaithagadia, Paikapada, Mainshadala, Kurhadibasa, Ranipokhari, Kusumdaspur, Khuntadihapatna, Lenkasahi, Gadasahi, Kabataghai,Ranipokhari, Kantabari, Shohalabhauni, Tolagadia, Kathachua, Kantamari, Ambadahi, Sarisua, Duguda.

Human–Elephant conflict: No elephant death has occurred due to conflict in the corridor area during the last decade. Official records show the loss of six human lives from 2006-07 to 2013-14 due to elephant attacks in the Hadgarh and Soro Forest Ranges that fall under the corridor. Incidents of crop and property damage remain high in Gadasahi and adjoining villages close to Kuldiha Wildlife Sanctuary.

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent encroachment of the corridor forest, illegal tree felling and developmental activities hindering elephant movement.

2. No stone quarries should be allowed in the corridor forest. Lease permits of existing stone quarries within the corridor should be cancelled.

3. No activities should be allowed from 6 pm to 6 am in stone quarries that are located within 500 metres of the boundary of the corridor.

4. Habitat needs to be restored once stone quarries are vacated from inside the corridor.

5. Shohalabhauni, Kantamari, Kantabari, Sarisuaghati, Rangamatia, Dakei and Singhasahi (Maishadala village) need to be secured in consultation with villagers on a priority basis.

6. Encroached areas of Shohalabhauni, Dakei, Kantabari and Kantamari villages need to be cleared.

7. Brick kilns downstream of the Salandi Reservoir near Chanchalapada should be closed.

8. No developmental or other activities obstructing elephant movement between the dam area and Hadgarh village should be permitted.

Land identified to secure the corridor: In consultation with villagers, the following identified areas need to be secured on a priority basis:

Village	Families	Area in acres	Priority
Shohalabhauni	50	59.0	P2
Kantamari and Kantabari	65	181.0	P2
Sarisuaghati	9	37.5	P1
Rangamatia	15	37.6	P1
Dakei	13	10.4	P1
Singhasahi (Mainshadala Village)	11	124	P2



Fig. 5.17: Stone quarrying in the corridor area



Fig. 5.18: Degraded corridor forest

5.19

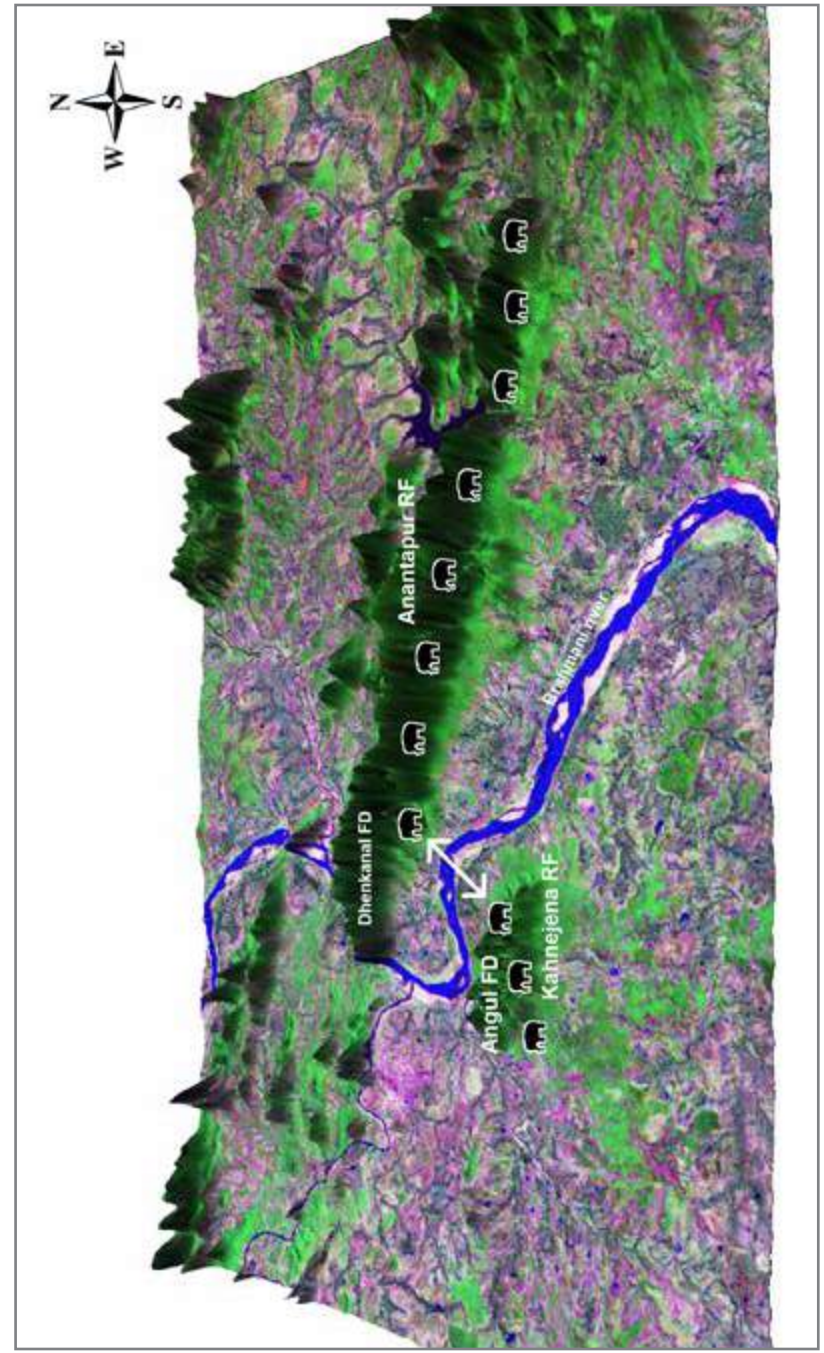
KANHEIJENA - ANANTAPUR

Ecological Priority: Medium

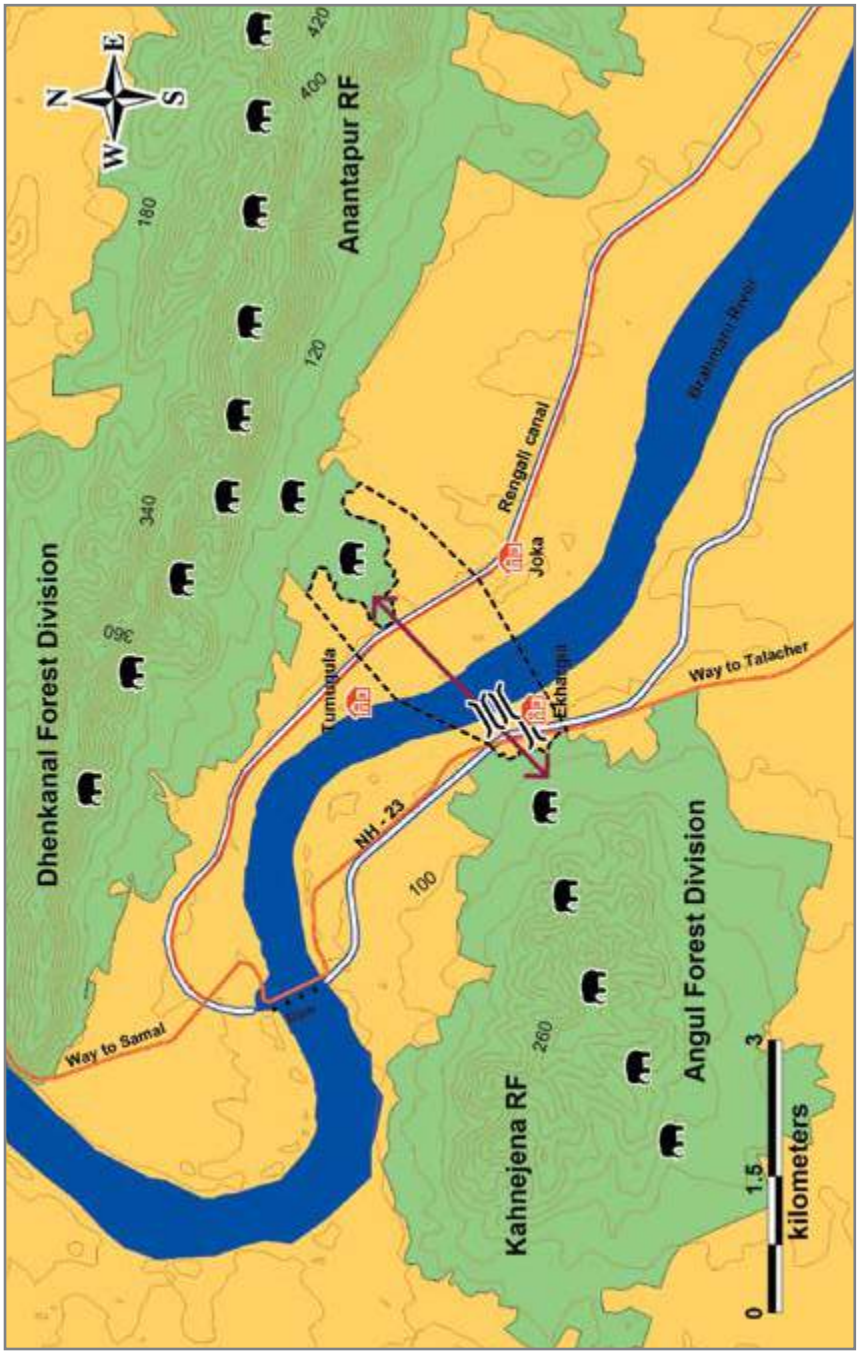
Conservation Feasibility: Low

The corridor connects Kanheijena Reserve Forest of Angul Forest Division with Anantapur Reserve Forest of Dhenkanal Forest Division. Elephants from Satkosia Wildlife Sanctuary and Handapa Reserve Forest move through adjoining forest patches of Simuliapadar Reserve Forest, Durgapur Reserve Forest, Nisha Protected Forest, Kuio Protected Forest, Kauchiakhol Reserve Forest, Rakas Reserve Forest and Kanheijena Reserve Forest to Anantapur Reserve Forest. National Highway 23, the construction of the Rengali irrigation canals, establishment of brick kilns on the Brahmani river bank, and the presence of industries (fly-ash brick plant, sponge iron and tar refinery) in Ekagharia village are major hurdles in the corridor, severely affecting elephant movement.

State	Odisha
Connectivity	Talcher Range of Angul Forest Division to Mahabir Road Range of Dhenkanal Forest Division through private lands
Length and Width	3 km and 0-0.5 km
Geographical coordinates	21° 2′ 54″- 21° 4′ 26″ N 85° 9′ 20″- 85° 11′ 5″ E
Legal status	Private land and forest
Major land use	Agriculture field, river, canal, human settlement, highway, industries
Major habitation/settlements	Ekagharia, Bikisar, Jaka and Tumugula
Forest type	Tropical dry deciduous forest
Frequency of usage by elephants	Occasional and seasonal



3D map showing the landscape of the Kanheijena – Anantapur Corridor



Map of the Kanheijena – Anantapur Corridor

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 17 plant species were found in the sampled area of 0.12 ha. Of these 10 species are palatable to elephants. The maximum frequency found was of *Shorea robusta* (101), followed by *Buchanania lanzan* (22), *Terminalia tomentosa* (9) and *Semecarpus anacardium* (8). Maximum average GHB was found in *Diospyros melanoxylon* (95 cm), followed by *Haldina cordifolia* (47 cm), *Aegle marmelos* (45.5 cm), *Terminalia tomentosa* (44.44 cm) and *Anogeissus latifolia* (40.5 cm). Maximum average height was found in *Aegle marmelos* (12.5 m), followed by *Terminalia tomentosa* (11.14 m), *Haldina cordifolia* (10.97), *Lannea coromandalica* (10.26 m) and *Dalbergia paniculata* (10.06 m). Signs of wood cutting and lopping were minimal in the sampled aea. Since village committees have been protecting the nearby forests, there is a reduced likelihood of illegal tree felling.

The proportions of ground cover were: grasses (5.83 %), herbs (7.08 %), shrubs (47.08 %) and barren ground (40 %).

Estimated elephant numbers in the landscape

Satkosia Wildlife Division: 146
Angul Forest Division: 40
Dhenkanal Forest Division: 165
(Elephant Census Odisha, 2015)

Forest/Land use

Forest type: Tropical dry deciduous forest
Agriculture: Paddy
Habitations: Ekagharia, Bikisar, Jaka and Tumugula
Riverway: Rengali irrigation canals
Roadway: National Highway 23 connecting Talcher to Pallahara
Railway: Talcher (Odisha) to Bimlagarh (Jharkhand)
Buildings/Artefacts: Brick kilns, industries and factories, power lines

Other ecological importance

Elephant Range: Central India

Nearest Elephant Reserve: Proposed Baitarani ER

Nearest Protected Area: Satkosia Wildlife Sanctuary and Kapilash Wildlife Sanctuary

HUMAN DIMENSIONS

Threats

1. Rengali Canals: Two irrigation canals bisect the corridor on either side of the Brahmani River. The cemented surface of the canals and the absence of suitable overpasses has severely obstructed elephant movement.

2. Highway: NH 23 connecting Talcher to Pallahara traverses the corridor. Vehicular traffic was found to be 198.42 vehicles per hour from 6 am to 6 pm and 58.37 vehicles per hour from 6 pm to 6 am. Traffic remains high during the operating hours of the factories located in and around the corridor.

3. Brick kilns: Many brick kilns are established on the bank of the Brahmani River within the corridor. Excavation of soil has resulted in the formation of deep pits, and human activities as well as vehicular movement hinder the movement of elephants. The construction of a new railway track through the corridor, connecting Talcher to Bimlagarh, will further affect elephant movement.

4. Industries and factories: Establishment of factories and industries in Ekagharia village, such as Bindal Sponge Iron Ltd, Inter Continental Tar Refiners Ltd, and SMP Infra Pvt Ltd Fly Ash Brick Plant affect corridor usage.

5. Settlements and expansion of agriculture: Expansion of Tumugula, Jaka, Ekagharia and Bikisar villages as well as agricultural lands has hindered elephant movement.

Corridor villages: A total of eight villages are located in and around the corridor. Of these 79 families in four villages (Ekagharia, Bikisar, Tumugula and Jaka) were surveyed. Agriculture is the chief livelihood of the villagers in Jaka and Tumugula. However, the majority of villagers in Ekagharia and Bikisar primarily depend upon the nearby industries and factories for their livelihood. A majority of the sampled families depend upon the corridor forest for fuelwood extraction, which is especially high in Tumugula and Bikisar. All respondents in Bikisar, Tumugula and Jaka reported human-elephant conflict. Villagers from Tumugula and Jaka reported an increased intensity of conflict and attributed this to an increase in the elephant population, loss of forest cover, an increase in human settlements, and a change in elephant behaviour.

Corridor dependent villages: Ekagharia, Bikisar, Bilinda, Jaka, Tumugula, Dangarbeda, Patuapali and Sarasikipal.

Human–Elephant Conflict: Conflict has been increasing over time. Between 2006-07 and 2012-13, 16 people lost their lives and 13 were injured in elephant attacks in the Talcher and Mahavir Road Forest Ranges of Angul and Dhenkanal Forest Divisions. During the same period, eight elephant deaths were reported in these two forest ranges.

CONSERVATION PLAN

1. The corridor should be legally protected by the state forest department under an appropriate law to prevent encroachment of the river banks, diversion of forest land for non-forestry activities, and developmental activities in the corridor.

2. All brick kilns established along the river within the corridor should be closed.

3. Vehicular speed on NH 23 needs to be regulated through the use of physical barriers within the corridor area.

4. Animal-friendly overpasses need to be created on the Rengali irrigation canals to facilitate elephant movement. The overpass on the Rengali right bank canal should be located about 250 m from the fly-ash brick plant towards Angul (N 21.049689° E 85.159013°). On the Rengali left bank canal, the overpass should

be between Tumugula and Jaka village (N 21.065069° E 85.169378°).

5. Private lands measuring 124 acres (in Jaka, Tumugula and Ekagharia villages) need to be secured.

6. The railway track being constructed through the corridor requires appropriate mitigation measures to prevent a negative impact on elephant movement.

7. Strengthen village committees for better protection and conservation of the corridor.

Land identified to secure the corridor

Jaka and Tumugula: 89 acres
Ekagharia: 35 acres
Benuadhar (21 families): 116 acres
Chandanjharan (10 families): 40 acres
Baigananali (9 families): 38 acres
Kumbhalar (16 families): 8 acres



Fig. 5.19: Rengali irrigation canal passing through the corridor



Fig. 5.20: Industries in Ekagharia village

5.20

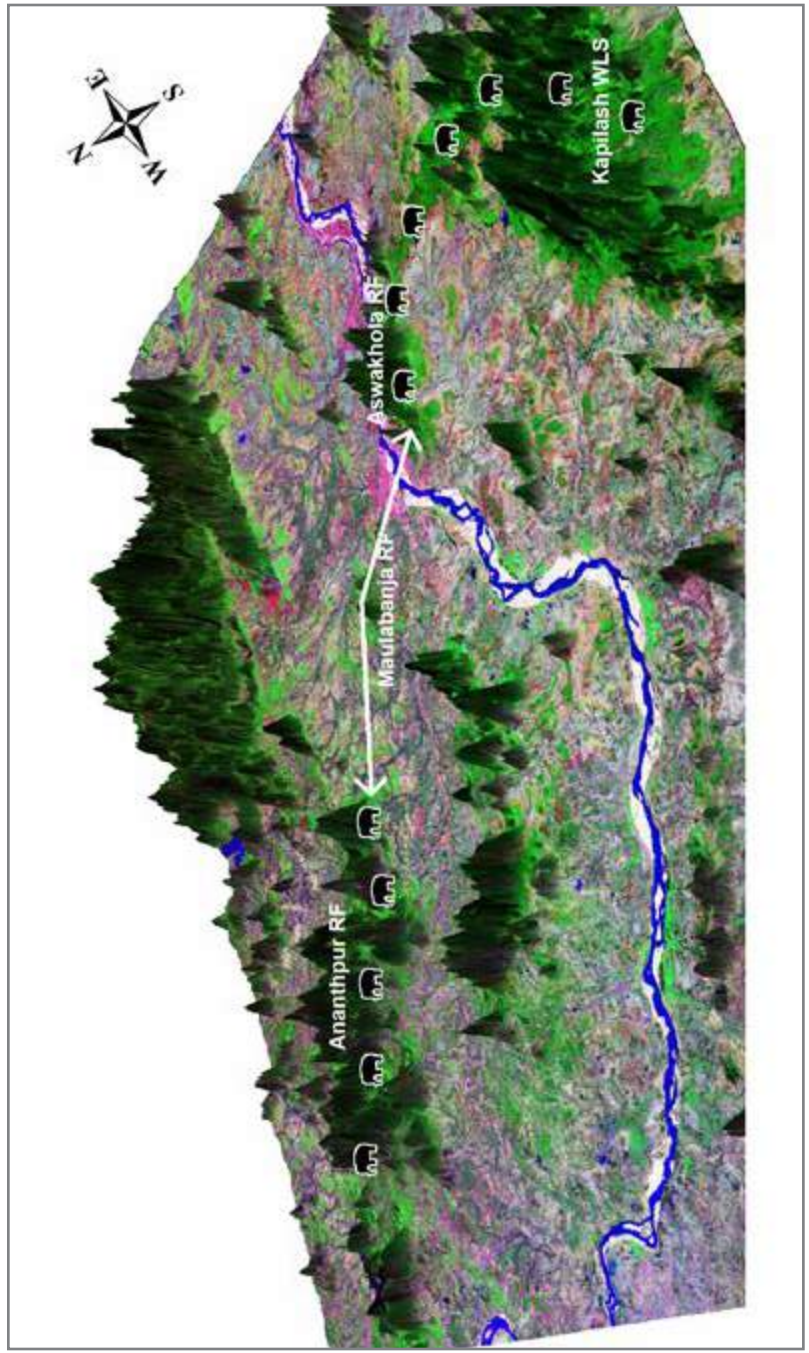
ANANTAPUR - ASWAKHOLA (VIA JIRIDIMAL)

Ecological Priority: Medium

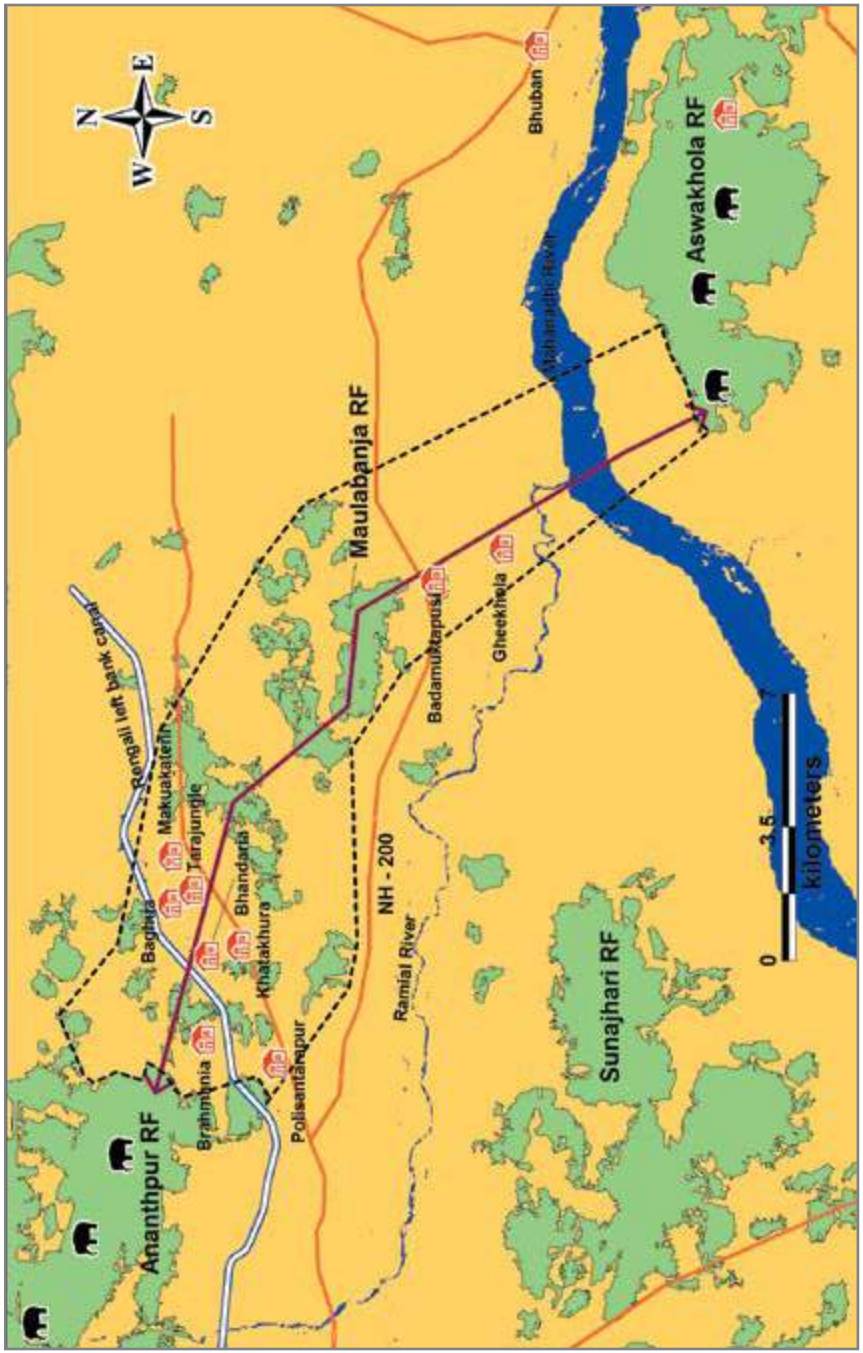
Conservation Feasibility: Low

The corridor connects Anantapur Reserve Forest and Aswakhola Reserve Forest of Dhenkanal Forest Division, thereby maintaining elephant movement between Anantapur Reserve Forest and Kapilash Wildlife Sanctuary. Elephants move through fragmented forest patches (Jiridamali Reserve Forest, Maulabhanja Reserve Forest and Tipilei Reserve Forest) in a human dominated landscape with a vast expanse of agriculture fields. National Highway 200 and the Rengali left bank irrigation canal are key artefacts passing through the corridor, affecting elephant movement. The proposed expansion of NH 200 and construction of a new railway line connecting Angul and Sukinda will further affect elephant movement through the corridor.

State	Odisha
Connectivity	Anantapur Reserve Forest and Kapilash Wildlife Sanctuary
Length and Width	25 km and 0-0.5 km
Geographical coordinates	20° 50′ 19″- 20° 59′ 29″ N 85° 34′ 32″- 85° 46′ 17″ E
Legal status	Reserve Forest and Patta Land
Major land use	Forest, agriculture land, human habitation, irrigation canal
Major habitation/settlements	Brahmania, Khatakhura, Bhandaria, Kandhabola, Tulasiposi, Jamunakota, Krushnapur, Orhana, Karamula and Majhipala
Forest type	Tropical dry deciduous sal forest
Frequency of usage by elephants	Occasional and seasonal



3D map showing the landscape of the Anantapur - Aswakhola (via Jiridimal) Corridor



Map of the Anantapur – Aswakhola (via Jiridimal) Corridor

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 25 plant species were reported from the sampled area of 0.16 ha. Of these, seven were found to be elephant food species. The maximum tree frequency found was of *Shorea robusta* (225), followed by *Buchanania lanzan* (10), *Pterocarpus marsupium* (10) and *Madhuca indica* (9). Maximum average GBH was found in *Haldina cordifolia* (63 cm), followed by *Xylia xylocarpa* (58 cm), *Pterocarpus marsupium* (57.1 cm), *Casia fistula* (50 cm) and *Ziziphus xylopyra* (48 cm). Maximum average height was found in *Pterocarpus marsupium* (14.72 m), followed by *Shorea robusta* (11.50 m), *Ougeinia oojeinensis* (11.28 m), *Xylia xylocarpa* (10.67 m) and *Casia fistula* (9.75 m). A total of 10.46% of sampled trees showed signs of lopping and/or wood cutting. *Shorea robusta* was the species most affected.

The proportions of ground cover were recorded as: barren ground (62.81%), shrubs (26.88%), herbs (6.25%) and grasses (4.06%).

Estimated elephant numbers in the landscape

Dhenkanal Forest Division: 165

(Elephant Census, Odisha, 2015)

Forest/Land use

Forest type: Tropical dry deciduous sal forest

Settlements: Brahmania, Khatakhura, Bhandaria, Kandhabola, Tulasiposi, Jamunakota, Krushnapur, Orhana, Karamula and Majhipala

Agriculture field: Paddy

Roadway: NH 200 (Talcher-Chandikhol), Kamakhyanagar-Kankadahada PWD road

Irrigation Canal: Rengali left bank canal

Artefacts: Power line

Other ecological importance

Mountain Range: Parts of Garhjat Hills

Elephant Range: East-Central India

Nearest Protected Area: Kapilash Wildlife Sanctuary
Elephant Reserve: Proposed Baitarani Elephant Reserve
Nearest Tiger Reserve: Satkosia Tiger Reserve

HUMAN DIMENSIONS

Threats

1. Irrigation Canal: The Rengali left bank canal and its sub-canals pass through the corridor, fragmenting the once intact Jiridamali Reserve Forest and hindering elephant movement.
2. Roadways: NH 200 connecting Talcher and Chandikhol, and another PWD road connecting Kamakhyanagar and Kankadahada pass through the corridor. Vehicle traffic was recorded at 402 vehicles per hour between 6 am and 6 pm and 202 vehicles per hour between 6 pm and 6 am on NH-200; and 157 vehicles per hour between 6 am and 6 pm and 44 vehicles per hour between 6 pm and 6 am on the PWD road. The expansion of NH 200 to a four-lane roadway will further affect elephant movement.
3. Proposed railway track: A railway track connecting Angul and Sukinda is being constructed through the corridor, parallel to NH 200. This will bisect the corridor near Mathakargola village.
4. Stone crusher plants: Stone crushers are present within the corridor near the villages of Brahmania and Jamunakota.
5. Elephant Proof Trench: The digging of a trench along the villages to mitigate human-elephant conflict has obstructed normal elephant movement and led to the increased fragmentation of the corridor forest.
6. Farm houses: Two farm houses with mango orchards are located within the corridor: along the Kamakhyanagar-Kankadahada road and in Tulsiposi village near Maulabhanja Reserve Forest.

Corridor villages: Brahmania, Khatakhura, Bhandaria, Baghabasa, Kandhabola, Tulasiposi, Jamunakot, Krushnapur, Orhana, Majhipala and Karamula. About 26 villages are located in and around the corridor.

Corridor dependent villages: Hatibari, Goradapal, Surapratapapur, Anlapala, Gobindapur, Marthapur, Badamuktaposi, Tangarapada, Mahupala, Godipokhari, Arachua, Balisahi, Tarajungle, Makuakateni, Baghua.

Human–Elephant Conflict: Conflict is quite high in and around the corridor area. Between 2002-03 and 2012-13, 24 human lives were lost due to elephants (in the Kamakhyanagar East and West Ranges). Crop damage is the chief concern of farmers in the corridor area and has resulted in a negative attitude towards elephant conservation and the securement of the corridor.

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent developmental activities affecting elephant movement.

2. Animal friendly overpasses should be created on the Rengali irrigation canal and its sub-canals to facilitate elephant movement.

3. Vehicle speeds on NH 200 need to be regulated within the corridor area.

4. Necessary mitigation measures should be taken to minimise the impact of the NH 200 expansion as well as the new railway track being built in the area.

5. Trenches and/or fences obstructing elephant movement should be removed and should not be encouraged as methods of mitigating human-elephant conflict.

6. Lease permits of existing stone crusher plants and quarries falling within the elephant movement range should be cancelled.

5.21

ASWAKHOLA - SUNAJHARI

Ecological Priority: Medium

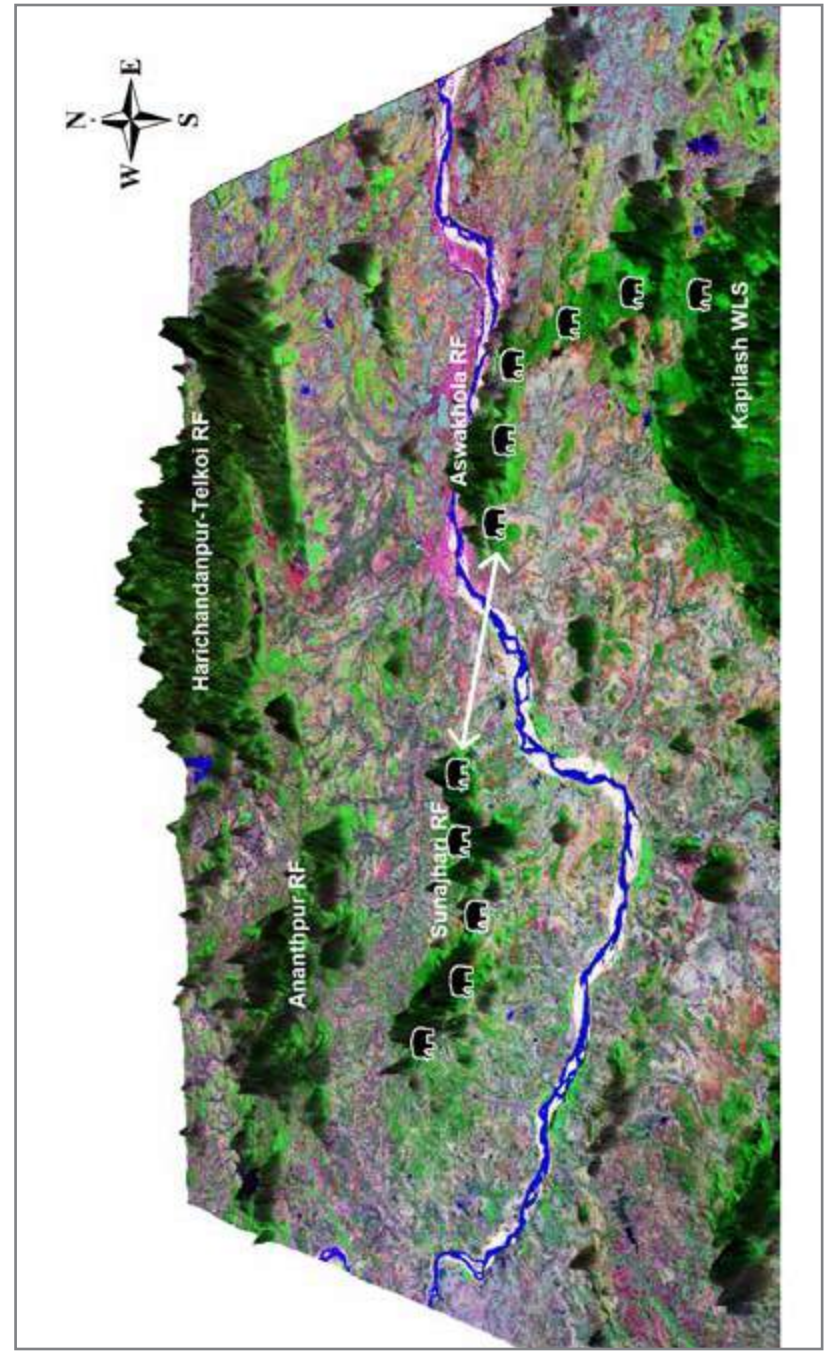
Conservation Feasibility: Medium

This corridor connects Aswakhola Reserve Forest and Sunajhari Reserve Forest, thereby connecting the elephant populations of Anantapur Reserve Forest and Kapilash Wildlife Sanctuary. Elephant movement occurs through densely populated villages and a vast expanse of agriculture fields. Elephants cross the Brahmani River near Kaluriapatna and Goradiha villages. A sub-canal of the Rengali left bank canal passes through the corridor along the foothills of Sunajhari Reserve Forest.

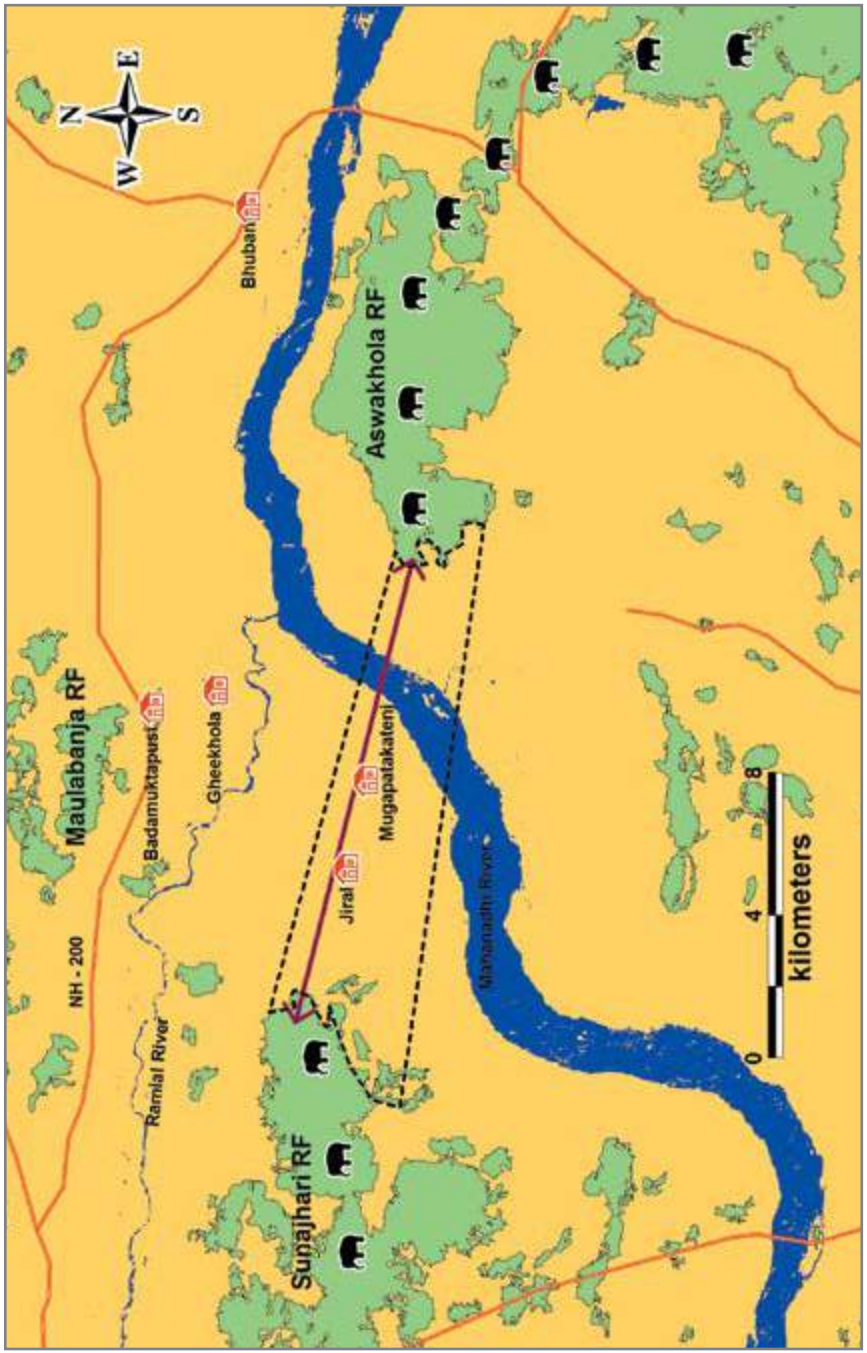
State	Odisha
Connectivity	Anantapur Reserve Forest and Kapilash Wildlife Sanctuary
Length and Width	Length 13.5 km, width 0- 0.5 km
Geographical coordinates	20° 49′ 11″- 20° 52′ 26″ N 85° 35′ 56″- 85° 45′ 25″ E
Legal status	Patta Land
Major land use	Forest, agriculture fields, human habitations, river
Major habitation/settlements	Makundapur, Kanka, Kaluriapatna, Latadeipur, Radhadeipur, Goradiha, Balichaturi, Balipada, Dimiria, Saradeipur
Forest type	Tropical dry deciduous forest
Frequency of usage by elephants	Occasional and seasonal

FORESTS AND ELEPHANTS

Corridor habitat status: The corridor comprises private lands, agriculture fields and river banks. Plantations of *Acacia catechu*, cashew and other species are found along the river bank.



3D map showing the landscape of the Aswakhola – Sunajhari Corridor



Map of the Aswakhola – Sunajhari Corridor

Estimated elephant numbers in the landscape

Dhenkanal Forest Division: 165

(Elephant Census, Odisha, 2015)

Forest/Land use

Agriculture: Paddy

Habitations: Makundapur, Kanka, Kaluriapatna, Latadeipur, Radhadeipur, Goradiha, Balichaturi, Balipada, Dimiria, Saradeipur

River: Brahmani

Irrigation canal: A sub-canal of the Rengali left bank canal

Other ecological importance

Elephant Range: Central India

Mountain Range: Parts of Garhjat Hills

Nearest Protected Area: Kapilash Wildlife Sanctuary

Elephant Reserve: Proposed Baitarani Elephant Reserve

HUMAN DIMENSIONS

Threats

1. Human habitations: Around 13 highly populated villages are located in and around the corridor. Elephants move through the village areas between the habitat patches.

2. Agriculture fields: A vast expanse of crop fields falls within the corridor. Farmers plant crops twice a year.

3. Irrigation canal: A sub-canal of the Rengali left bank canal passes through the corridor near Santrapur village in the foothills of Bhairapur Reserve Forest.

Corridor dependent villages: Makundapur, Kanka, Kendupada, Kaluriapatna, Latadeipur, Radhadeipur, Goradiha, Ranka, Balichaturi, Balipada, Santrapur, Dimiria and Saradeipur.

Human–Elephant Conflict: Crop depredation by elephants is a major concern in the region. Farmers plant their crops twice a year and agriculture is the primary livelihood of the local people.

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent developmental activities hindering elephant movement.

2. Measures should be taken to mitigate human-elephant conflict. Additionally, ex-gratia support should be provided to victims, which will help in eliciting the support of local communities for elephant conservation and corridor securement.

3. Active participation of local communities is required for the mitigation of human-elephant conflict.



Fig. 5.21: A settlement in the corridor



Fig. 5.22: Fuelwood extraction from the corridor forest by villagers

5.22

BUGUDA - CENTRAL

Ecological Priority: Medium

Conservation Feasibility: Low

The Buguda-Central corridor connects Baisipali Wildlife Sanctuary with North Ghumusar Forest Division through the Central Reserve Forest of Nayagarh Forest Division. The corridor comprises teak plantations, revenue lands, private lands, a river, National Highway 57, a college, and human settlements. The presence especially of Buguda Colony, the college and NH 57 in the corridor area has impacted elephant movement through the corridor. Soil erosion further leads to fragmentation of the corridor.

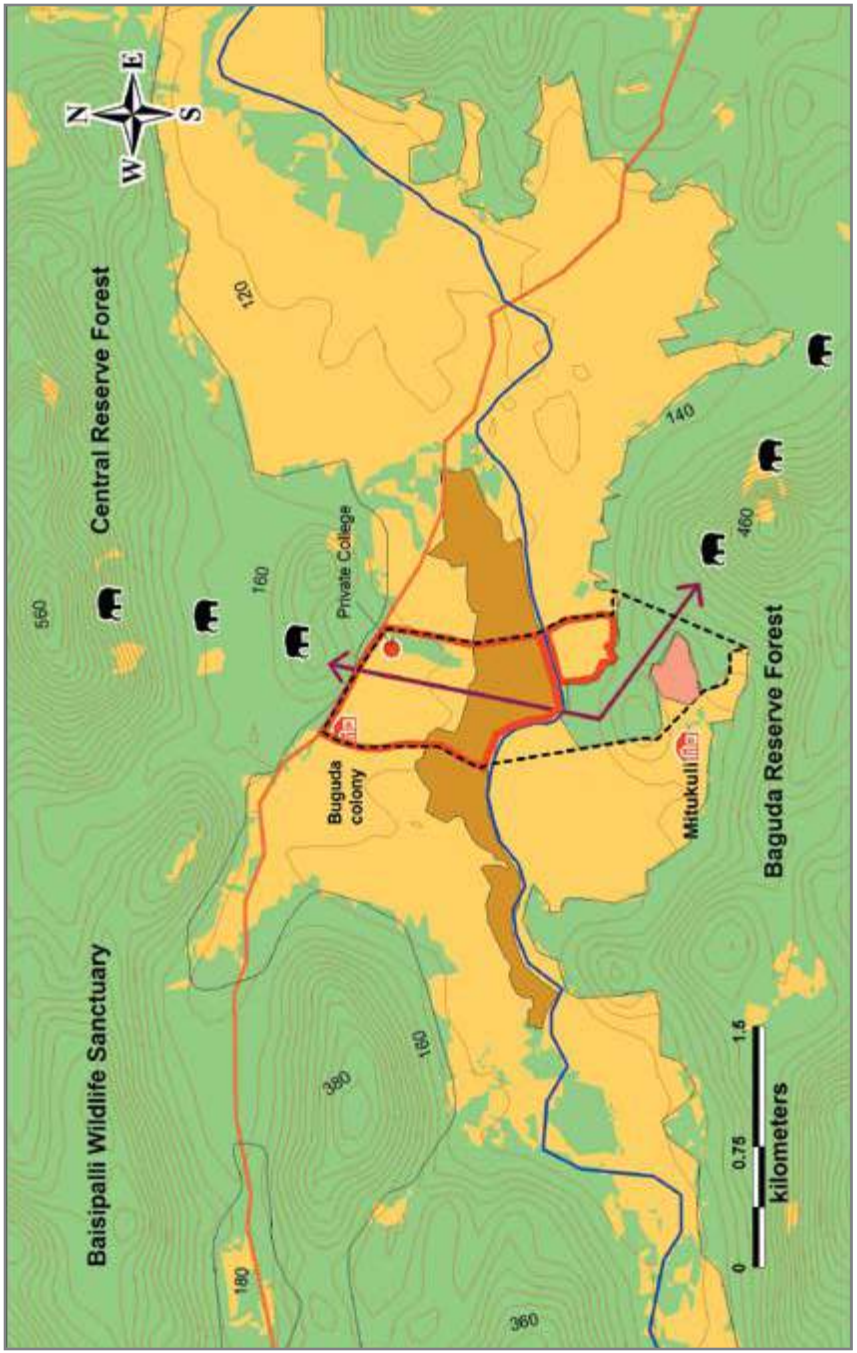
Alternate Name	Baisipali WLS - Central RF
State	Odisha
Connectivity	Baisipali Wildlife Sanctuary to North Ghumusar Forest Division
Length and Width	2.2 km and 0.2-0.3 km
Geographical coordinates	20° 22’ 53”- 20° 24’ 19” N 84° 43’ 22”- 84° 44’ 1” E
Legal status	Revenue Land, Patta Land
Major land use	Agriculture fields, human settlements, road, college
Major habitation/settlements	Buguda Colony
Forest type	Tropical dry deciduous forest
Frequency of usage by elephants	Regular (throughout the year)

FOREST AND ELEPHANTS

Corridor habitat status: A total of 20 plant species were found in a sampled area of 0.8 ha. Of these, seven are palatable to elephants. The maximum frequency recorded was of *Shorea robusta* (12), followed by *Buchanania lanzan* (6), *Terminalia*



3D map showing the landscape of the Buguda–Central Corridor



Map of the Baguda – Central Corridor area showing the land to be secured

tomentosa (4), *Cleistanthus collinus* (3) and *Semecarpus anacardium* (3). Maximum average GBH was found in *Madhuca indica* (128 cm), followed by *Bombax ceiba* (111 cm), *Mitragyna parviflora* (109 cm) and S*horea robusta* (108.82 cm). Maximum average height was found in *Madhuca indica* (19.81 m), followed by *Bombax ceiba* (16.76 m), *Shorea robusta* (16.57 m) and *Mitragyna parviflora* (15.24 m). Signs of wood cutting and lopping were found in 28.26% of sampled plants, including species palatable to elephants such as *Shorea robusta, Buchanania lanzan* and *Mitragyna parviflora.*

The ground cover showed a high percentage of barren ground (35.00%), followed by herbs (29.38%), shrubs (26.25%) and grasses (9.38%).

Estimated elephant numbers in the landscape

Nayagarh Forest Division: 17
Mahanadi Wildlife Division: 88
North Ghumsur Forest Division: 21
(Elephant Census Odisha, 2015)

Forest/Land use

Legal status: Revenue land, Patta land
Agricultural fields
Buildings/Artefacts: Private college, Kendu leaf storehouse, Solar fencing
Road: NH 57 (Nayagarh-Boudh)

Other ecological importance

Mountain Range: Part of Eastern Ghats
Elephant Range: East-Central India
Protected Area: Baisipali Wildlife Sanctuary
Elephant Reserve: Mahanadi Elephant Reserve
Tiger Reserve: Satkosia Tiger Reserve

HUMAN DIMENSIONS

Threats

1. National Highway: NH 57 connecting Nayagarh to Boudh district bisects the corridor near Buguda Colony. There is vehicular traffic on the highway around the clock.

2. College: A private college has been established on government land since 1994. This has further encroached three acres of land in plot no. 344. The presence of this college has also led to the expansion of shops, hotels and other structures along the highway.

3. Human settlements: Human settlements and agricultural fields are present within the corridor.

4. Solar fencing: In order to mitigate human-wildlife conflict and provide safe passage to elephants, the forest department has erected a solar fence. However, this has become a barrier to elephants using the corridor rather than providing safe passage.

5. Soil erosion: Rain water flowing from the Baisipali Wildlife Sanctuary has caused soil erosion, resulting in a pit more than 15 feet deep being formed along the highway in the corridor, hindering elephant movement.

6. The Brutanga Irrigation Project on the Brutanga River (a tributary of the Mahanadi) has been approved and the irrigation canal will pass through the corridor. This will impact elephant movement.

7. A proposed railway track connecting Khurdha with Bolangir is a potential threat to the corridor.

Corridor dependent villages: Buguda Colony (41 families), Buguda (67 families), Jhintikabari (40 families), Mitukuli (45 families) and Tilabadi (60 families). There

are five villages in and around the corridor. Of these, Buguda Colony with about 41 families is situated to the south of the National Highway within the corridor. Most of the villagers are farmers and depend upon the forest patches for their daily needs.

Human-Elephant Conflict: Crop depredation by elephants is reported in the area. No human or elephant casualties have been reported in the area in the last few years.

CONSERVATION PLAN

1. The corridor should be legally protected by the state forest department under an appropriate law, and necessary measures should be taken to prevent developmental activities detrimental to the corridor and elephant movement.

2. Land under the revenue department between Baisipali Wildlife Sanctuary and Central Reserve Forest should be handed over to the forest department to develop forest cover.

3. In consultation with villagers, Buguda Colony which is located inside the corridor could be secured.

4. In consultation with villagers, agriculture lands in Mitukuli village located to the south of the Brutanga River could be secured.

5. The private college established in the corridor along the highway should be relocated.

6. Soil erosion along the highway needs to be checked.

7. Mitigation measures should be put in place for the forthcoming Brutanga Major Irrigation Project, where the irrigation canal will pass through the corridor.

Land identified to secure the corridor: The width of the corridor varies from 200-300 metres and is very narrow for elephant movement. Given the importance of the corridor and the need to mitigate human-elephant conflict, Buguda Colony (41 families) could be considered for relocation following due consultation with villagers and the provision of a suitable compensation package. Similarly, the private college present in the critical elephant movement route has been identified for relocation outside the corridor. Agriculture fields under Mitukuli village on the south bank of the Brutanga River have also been identified to secure the corridor.

Details of land to be secured:

1. Buguda Colony: Patta land: 161. 0 acres
2. Private College: Revenue land: 3.00 acres
3. Mitukuli: 33 + 21 acres



Fig. 5.23: Buguda Colony situated in the corridor



Fig. 5.24: NH 57 with heavy traffic passing through the corridor

5.23

NUAGAON-BARUNI

Ecological Priority: High

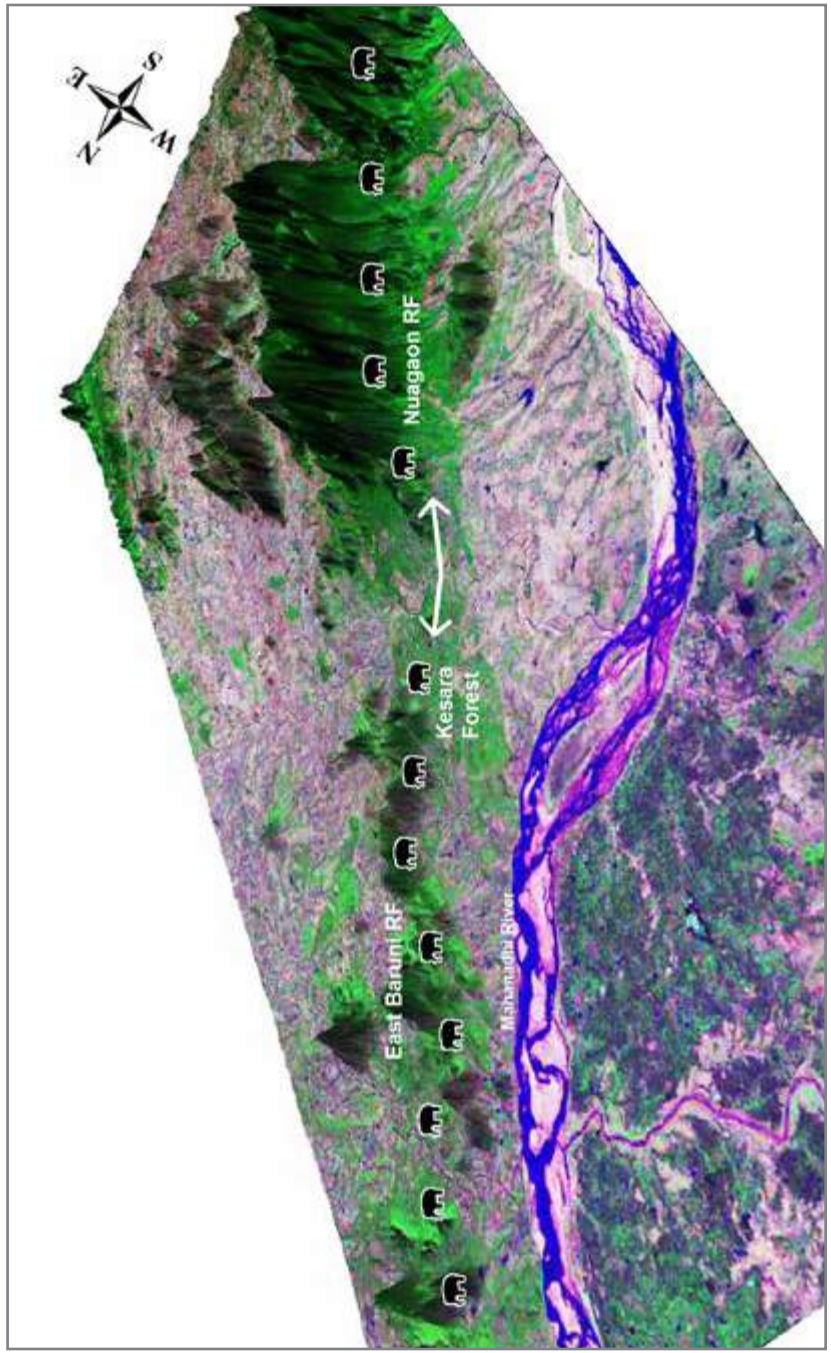
Conservation Feasibility: Medium

This corridor connects Nuagaon Reserve Forest with Baruni Reserve Forest (East & West) thereby connecting the elephant population of Satkosia Tiger Reserve and Khalasuni Wildlife Sanctuary through Raun Reserve Forest and Tal Reserve Forest. The construction of the Manjore Medium Irrigation Project near Manarbeda village has caused fragmentation and deterioration of the corridor forest and affected elephant movement between these habitats.

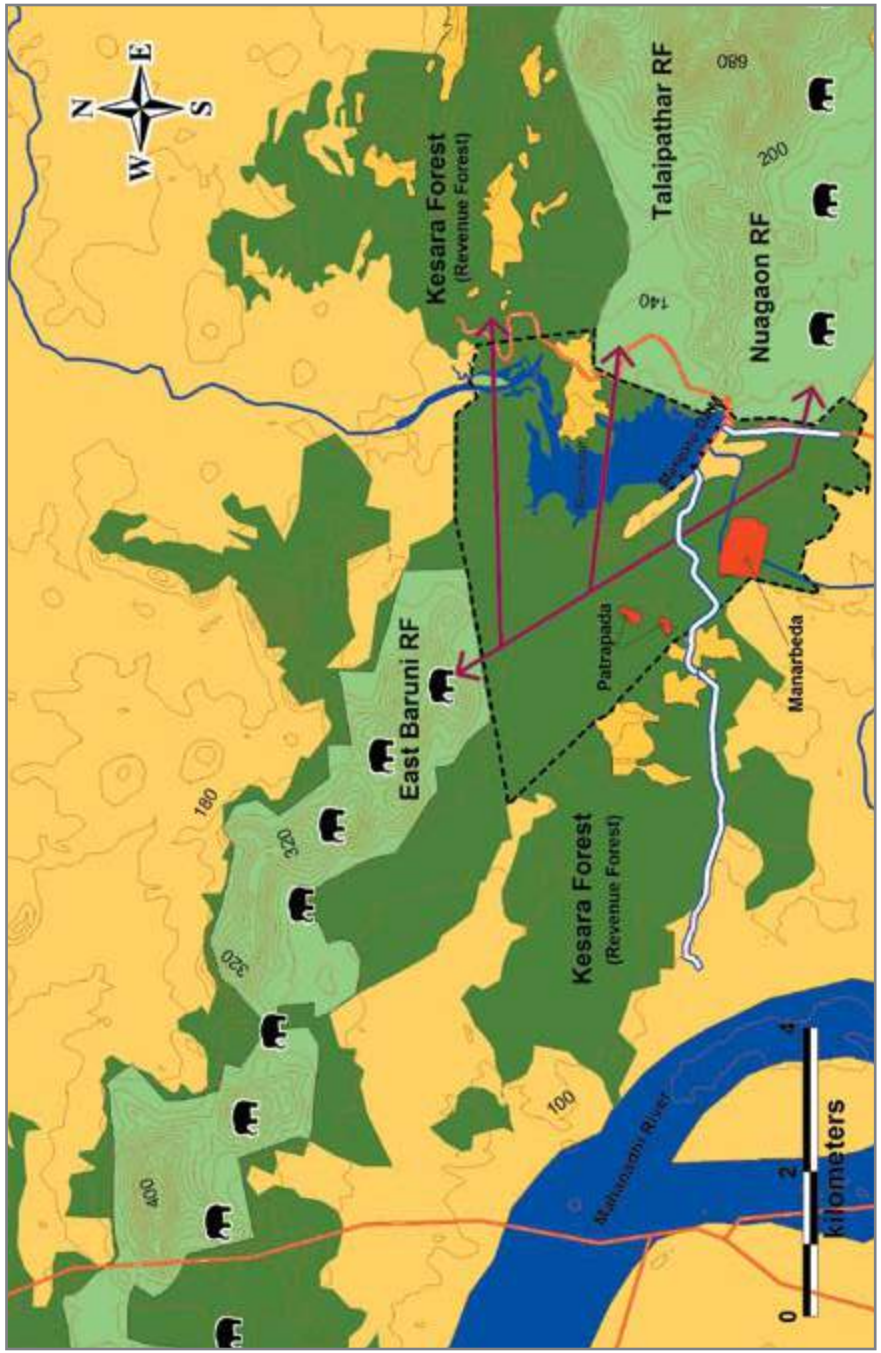
State	Odisha
Connectivity	Satkosia Wildlife Sanctuary and Baruni (East & West) Reserve Forest
Length and Width	4-5.8 km and 0.57-3.5 km
Geographical coordinates	20° 48′ 46″- 20° 51′ 53″ N 84° 23′ 10″- 84° 26′ 57″ E
Legal status	Reserve Forest and Khesara Forest
Major land use	Forest, agriculture field, human settlements, Manjore Medium Irrigation Project
Major habitation/settlements	Manarbeda, Patrapada
Forest type	Tropical dry deciduous forest
Frequency of usage by elephants	Regular

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 23 plant species were recorded in the sampled area of 0.16 ha. Of these, eight are elephant food species. The maximum frequency recorded was of *Shorea robusta* (42), followed by *Anogeissus latifolia* (26), *Terminalia tomentosa* (12) and *Cleistanthus collinus* (8). Maximum average GBH was found in *Madhuca indica* (108 cm) followed by *Boswellia serrata* (90.33



3D map showing the landscape of the Nuagaon–Baruni corridor



Map of the Nuagaon–Baruni Corridor area showing the land to be secured

cm), *Diospyros melanoxylon* (79.75 cm) and *Cochlospermum religiosum* (79 cm). Maximum average height was found in *Boswellia serrata* (15.85 m), followed by *Cochlospermum religiosum* (14.43 m), *Dalbergia paniculata* (14.02 m) and *Madhuca indica* (12.8 m). Of a total of 129 plants found in the sampled area, 34 were found felled, showing extensive wood cutting in the corridor forest.

The proportions of ground cover were: barren ground (39.06%), shrubs (30.94%), grasses (17.81%) and herbs (12.19%).

Estimated elephant numbers in the landscape

Athamalik Forest Division: 56
Satkosia Wildlife Division: 146
Rairakhol Forest Division: 9
(Elephant Census Odisha, 2015)

Forest/Land use

Agriculture: Paddy
Human habitations: Manarbeda and Patrapada
Artefacts: Manjore Medium Irrigation Project (MIP), irrigation canal
Road: Madhapur-Bamur RD Road

Other ecological importance

Mountain Range: Parts of Garhjat Hills
Elephant Range: Central India
Elephant Reserve: Mahanadi Elephant Reserve
Nearest Protected Area: Satkosia Wildlife Sanctuary
Tiger Reserve: Satkosia Tiger Reserve

HUMAN DIMENSIONS

Threats

1. Human settlements: Manarbeda and Patrapada, two villages situated in the corridor, have expanded due to the resettlement of families for the Manjore Medium Irrigation Project, resulting in the width of the corridor being reduced.

2. Land use changes: Excavation of soil during the construction of the Manjore Medium Irrigation Project has resulted in portions of corridor forest being cleared, with some areas now under cultivation and others allocated to relocated families.

3. Buildings of the Manjore Irrigation Project: The guest house and staff quarters are situated between the dam and a forest patch within the corridor, obstructing elephant movement.

4. Road and Irrigation Canal: The Bamur-Madhapur road and two canals running from the Manjore Irrigation Project traverse the corridor, fragmenting a once continuous forest patch.

5. Tourist movement: The Manjore Irrigation Project attracts tourists around the year, reaching a peak in winter which is also the peak season for elephant movement.

6. Anthropogenic pressure: People from within a periphery of 10-15 km of the corridor extensively extract forest produce from Nuagaon and Baruni (East and West) Reserve Forests, for subsistence as well as commercial purposes.

7. One stone crusher plant is functional next to the corridor forest near Manarbeda village.

8. Traffic intensity: Vehicle movement is restricted from early mornings to late evenings, with no movement from 9pm to 4 am. More than 90% of vehicles are two- and four-wheelers.

Corridor villages: Manarbeda and Patrapada. A total of 19 villages are present in and around the corridor. Some 41 families in these two villages were surveyed, revealing that agriculture is the primary livelihood and more than 80% of the total lands occupied by the respondents are under cultivation. Villagers depend upon the corridor forest for fuelwood, agriculture, and extracting the leaves of *Shorea robusta* and *Diospyros melanoxylon*.

Corridor dependent villages: Manarbeda, Patrapada, Naktideol, Gudgudu, Routpada, Muchhapur, Digipadar, Nuagaon, Saragiseni, Madanpur, Sorisapanka, Chandrapur, Bhartapur, Purunapani, Kumurisingha, Singharimunda, Bhagbanpur, Barapadar, Tulsipur.

Human-Elephant Conflict: Increased incidences of conflict are reported due to a purported rise in elephant numbers, resulting in increased crop damage in villages in and around the corridor. Between 2002-03 and 2011-12, nine elephant and five human deaths were reported due to conflict. Elephant deaths have been occurring every year since 2007-08.

The surveyed villagers indicated that they believed human-elephant conflict had risen due to an increase in the elephant population. However, they also considered the loss of forest area, increase in human settlements, and a change in elephant behaviour (with elephants coming to the Manjore Dam for water) as reasons. Most villagers suggested solar fencing along the forest border to secure the corridor, as well as the protection and improvement of elephant habitat. Some suggested the formation of a special squad to guard elephants.

CONSERVATION PLAN

1. The corridor should be notified by the state forest department and legally protected under an appropriate law to prevent encroachment, diversion of forest land for non-forestry activities and developmental activities that hinder animal movement.

2. In consultation with the villagers, about 136 acres of identified lands near Manarbeda and Patrapada village could be secured.

3. Voluntary relocation of 15 families of Manarbeda 1 (Tulasimunda hamlet) to an alternate site outside the corridor could be initiated.

4. Construction should be avoided in the areas downstream of the Manjore Dam, especially on the forest fringes.

5. The cementing of both sides of the irrigation canal should be prevented to facilitate elephant movement.

6. The Khesara forest in the corridor area needs to be notified as a Reserve Forest.

7. Ensure that illegal tree felling and extraction of stones is stopped.

8. Establishment of new stone crusher plants should not be allowed at least 500 metres from the corridor.

9. Tourist movement needs to be regulated and picnics should not be entertained in corridor areas (near the Manjore Dam).

Land identified to secure the corridor

Two sites in Patrapada and one site in Manarbeda (below the Manjore Irrigation Project) have been identified to secure the corridor. Fifteen families from Tulasimunda hamlet of Manarbeda need to be relocated.



Fig. 5.25: Irrigation canal and Madhapur–Bamur road running parallel through the corridor

5.24

TAL-KHOLGARH

Ecological Priority: High

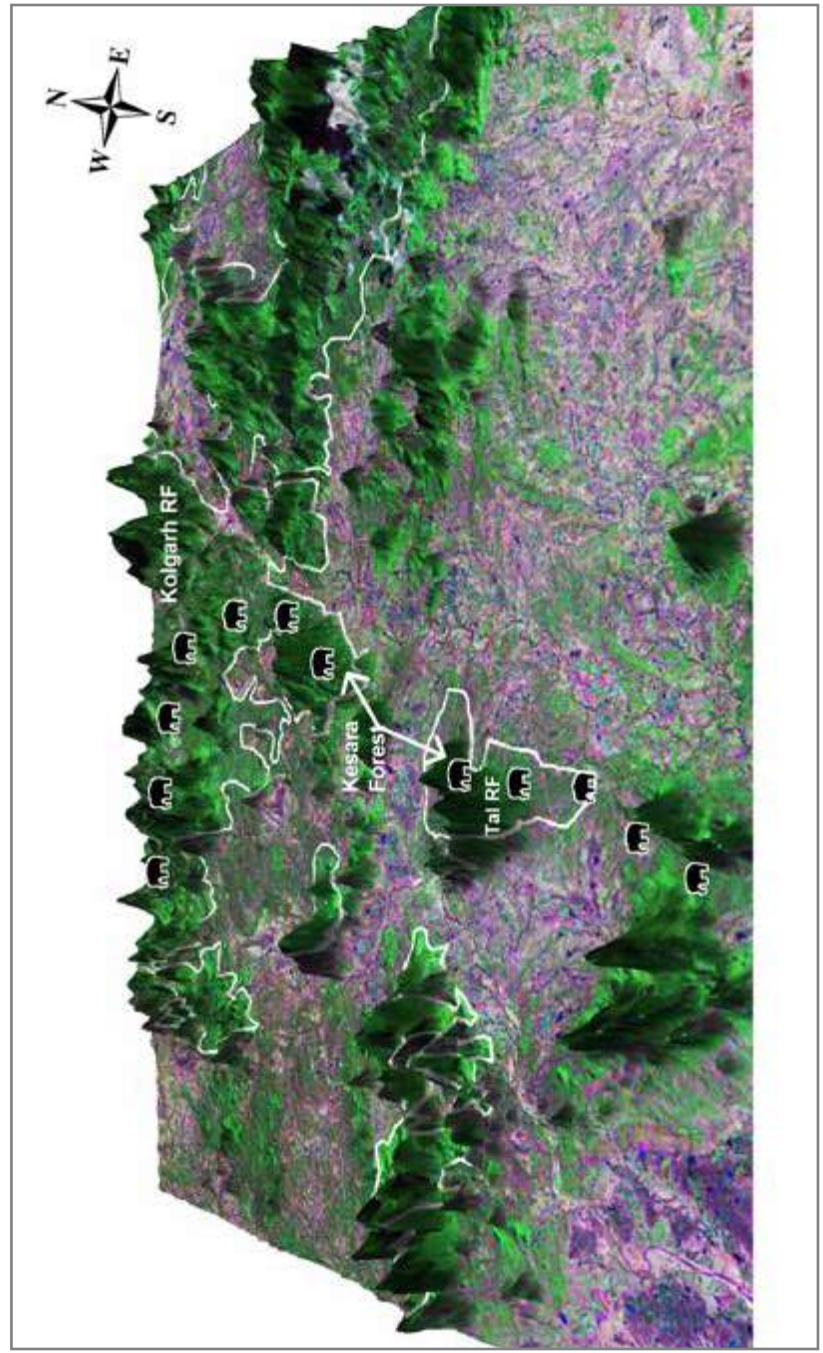
Conservation Feasibility: Medium

This corridor connects Tal Reserve Forest with Kholgarh Reserve Forest and Landakot Reserve Forest, thereby allowing for elephant movement between Khalasuni Wildlife Sanctuary and Satkosia Wildlife Sanctuary through Baruni Reserve Forest (East & West) and Raun Reserve Forest. National Highway 55 and the railway track connecting Angul and Sambalpur districts pass through the corridor. Heavy traffic on NH 55 and infrastructure development along the highway has affected elephant movement. The proposed conversion of NH 55 to four lanes and of the railway to double lanes will aggravate the situation. Elephants cross the railway track between Kuhi and Purunagarh villages.

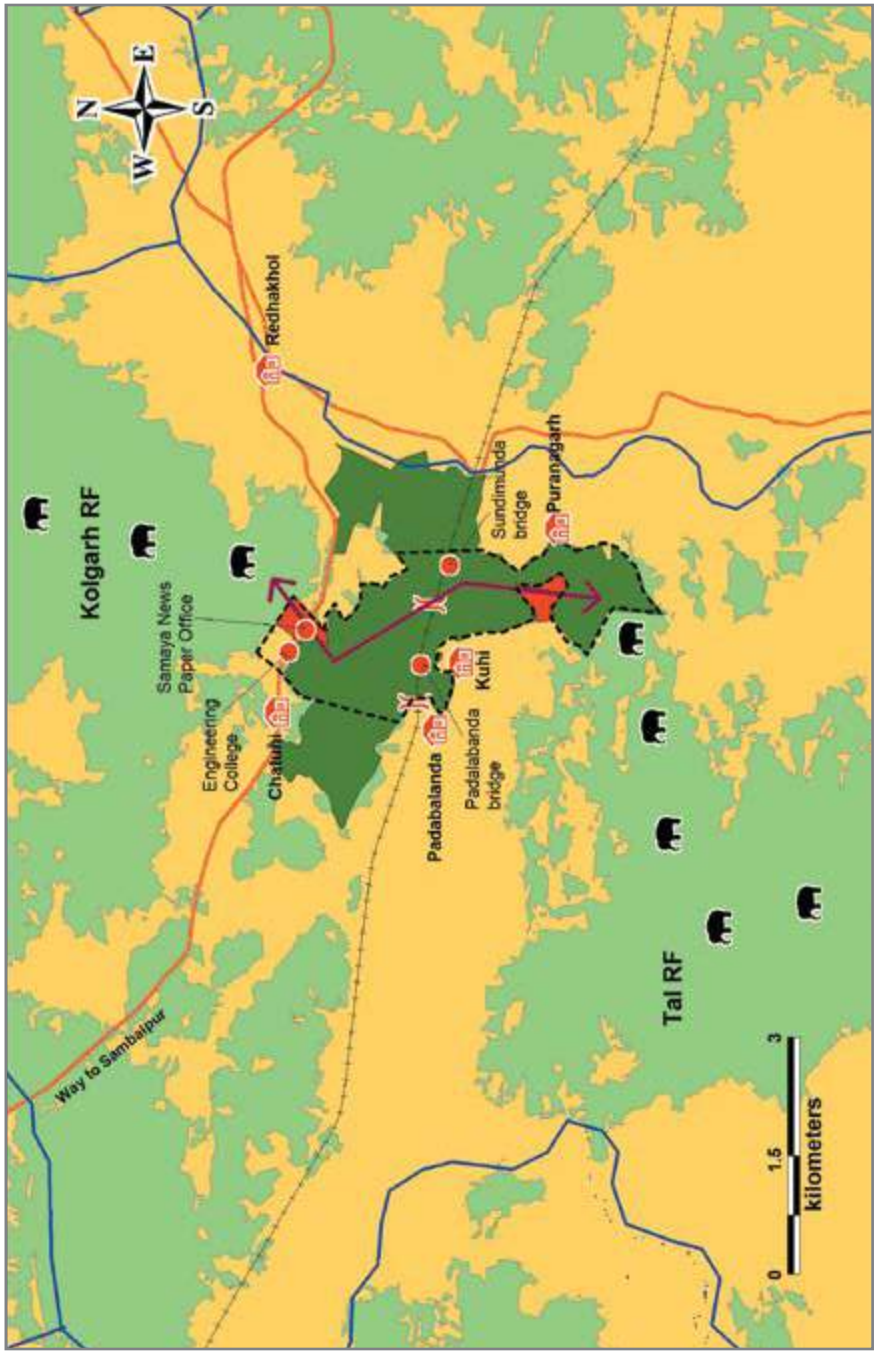
State	Odisha
Connectivity	Satkosia Wildlife Sanctuary and Khalasuni Wildlife Sanctuary
Length and Width	5 km and 0-1 km
Geographical coordinates	21° 1′ 36″- 21° 4′ 21″ N 84° 17′ 53″- 84° 19′ 14″ E
Legal status	Reserve Forest, Khesara Forest
Major land use	Forest, agriculture, human habitation, highway, railway
Major habitation/settlements	Purunagarh, Kuhi, Barsikia
Forest type	Tropical dry deciduous forest
Frequency of usage by elephants	Regular and seasonal

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 18 plant species were recorded in the sampled area. Of these, eight are palatable to elephants. The maximum average GBH



3D map showing the landscape of the Tal–Kholgarh Corridor



Map of the Tal-Kholgarh Corridor area showing the land to be secured

was found in *Bombax ceiba* (137 cm), followed by *Lagerstroemia parviflora* (101), *Buchanania lanzan* (82), *Lannea coromandalica* (75.33). Maximum average height was found in *Buchanania lanzan* (15 cm), followed by *Bombax ceiba* (12.9 cm) and *Lannea coromandalica* (12.5 cm). The highest tree frequency was of *Terminalia tomentosa* (14), followed by *Cleistanthus collinus* (9), *Mitragyna parvifolia* (8) and *Anogeissus latifolia* (4). More than 50% of the total trees found in the sampled plot had been lopped, showing a severe threat to the corridor habitat.

The proportion of ground cover recorded was barren ground (39.38%), shrubs (33.13%), grasses (18.75%) and herbs (8.75%).

Estimated elephant numbers in the landscape

Athamalik Forest Division: 56
Satkosia Wildlife Division: 146
Rairakhol Forest Division: 9
(Elephant Census Odisha, 2015)

Forest/Land use

Forest type: Tropical dry deciduous forest
Habitations: Kuhi, Purunagarh, Barasikiya
Agriculture fields
Highway: NH 55 (conecting Sambalpur and Cuttack)
Railway: Sambalpur-Angul

Other Ecological Importance

Elephant Reserve: Sambalpur Elephant Reserve
Nearest Protected Area: Khalasuni Wildlife Sanctuary
Nearest Tiger Reserve: Satkosia Tiger Reserve

HUMAN DIMENSIONS

Threats

1. National Highway: NH 55 connecting Sambalpur and Cuttack passes through the corridor. Average traffic was found to be 258.29 vehicles per hour from 6 am

to 6 pm and 105.87 vehicles per hour from 6 pm to 6 am.

2. Obstructions: A private nursery with 20 acres of land and an industrial unit (Meerabasanti Industry Pvt Ltd) situated near Barsikia village on either side of NH 55 have obstructed the corridor.

3. Railway: A three-kilometre stretch of the Sambalpur-Angul railway track passes through the corridor. Elephants cross the track between the villages of Podabalanda and Purunagarh. There is a proposal for this track to be expanded, which will further deteriorate the corridor.

4. Construction along the highway: The construction of industries, hotels and an engineering college, and the expansion of settlements near NH 55, have further fragmented the corridor.

5. Encroachment: Purunagarh, Kuhi and Chiriginipal villages have encroached upon the corridor, reducing its width significantly.

6. Power lines: Part of the corridor forest has been cleared for the high-tension power lines that pass through it.

Corridor villages: Purunagarh and Barasikia.

A total of 11 villages are located in and around the corridor. Of these, four villages, namely Puruagarh, Kuhi, Barasikia and Birachandrapur, are located very close to the corridor. Sixty-three families in these four villages were surveyed. Villagers depend upon agriculture and are marginal farmers with landholdings of up to five acres. Almost 20% of the total land occupied by the farmers is left fallow due to frequent crop damage by elephants. Villagers depend upon the corridor forest for fuelwood, cattle grazing, agriculture, wood for contruction of houses, grasses for making brooms, and *Shorea robusta* leaves.

Corridor dependent villages: Barsikia, Podabalanda, Kuhi, Purunagarh, Damagarh, Tal, Tumbamal, Ambjhari, Bijakhaman, Kendumunda and Chiriginipal.

Human-Elephant Conflict: Three human deaths caused by elephant attacks were reported between 2002-03 and 2011-12 in the corridor area. Farmers from the surrounding villages leave a significant portion of their fields uncultivated due to frequent crop damage by elephants. Elephants have also reportedly killed livestock in this area.

All the respondents reported an increase in human-elephant conflict in the corridor area. They viewed an increase in elephant population, the loss of forests and the increase in human settlements as the main causes of conflict.

CONSERVATION PLAN

1. The corridor should be legally protected by the state forest department under an appropriate law to prevent encroachment, diversion of forest land for non-forestry activities, and developmental activities inimical to animal movement.

2. The lands identified near Purunagarh, Birachandrapur (including the nursery) and Barsikiya could be secured in consultation with villagers and conserved with the active participation of the local communities and district administration.

3. Notification of the Khesara Forest in the corridor area as a Reserve Forest.

4. No developmental activities should be permitted on either side of National Highway 55 in the corridor.

5. Meerabasanti Industry Pvt Limited needs to be shifted out of the corridor area.

6. Suitable barriers need to be placed on NH 55 to restrict vehicle speed during peak elephant movement. A flyover should be constructed for vehicles in the corridor area so that elephants can safely pass through the corridor.

7. The proposed railway expansion should include appropriate mitigation measures. An underpass could be considered within the corridor area.

Land identified to secure the corridor

Village	Extent of area (in acres)	Priority
Birachandrapur and Barasikia	52	P 1 P 1
Kuhi	17.5	P 2
Purunagarh 1	34	P1
Purunagarh 2	36.5	P2



Fig. 5.26: National Highway 55 passing through the corridor



Fig. 5.27: Sambalpur–Angul railway track passing through the corridor

5.25

KOTAGARH - PANKHALGUDI

Ecological Priority: High

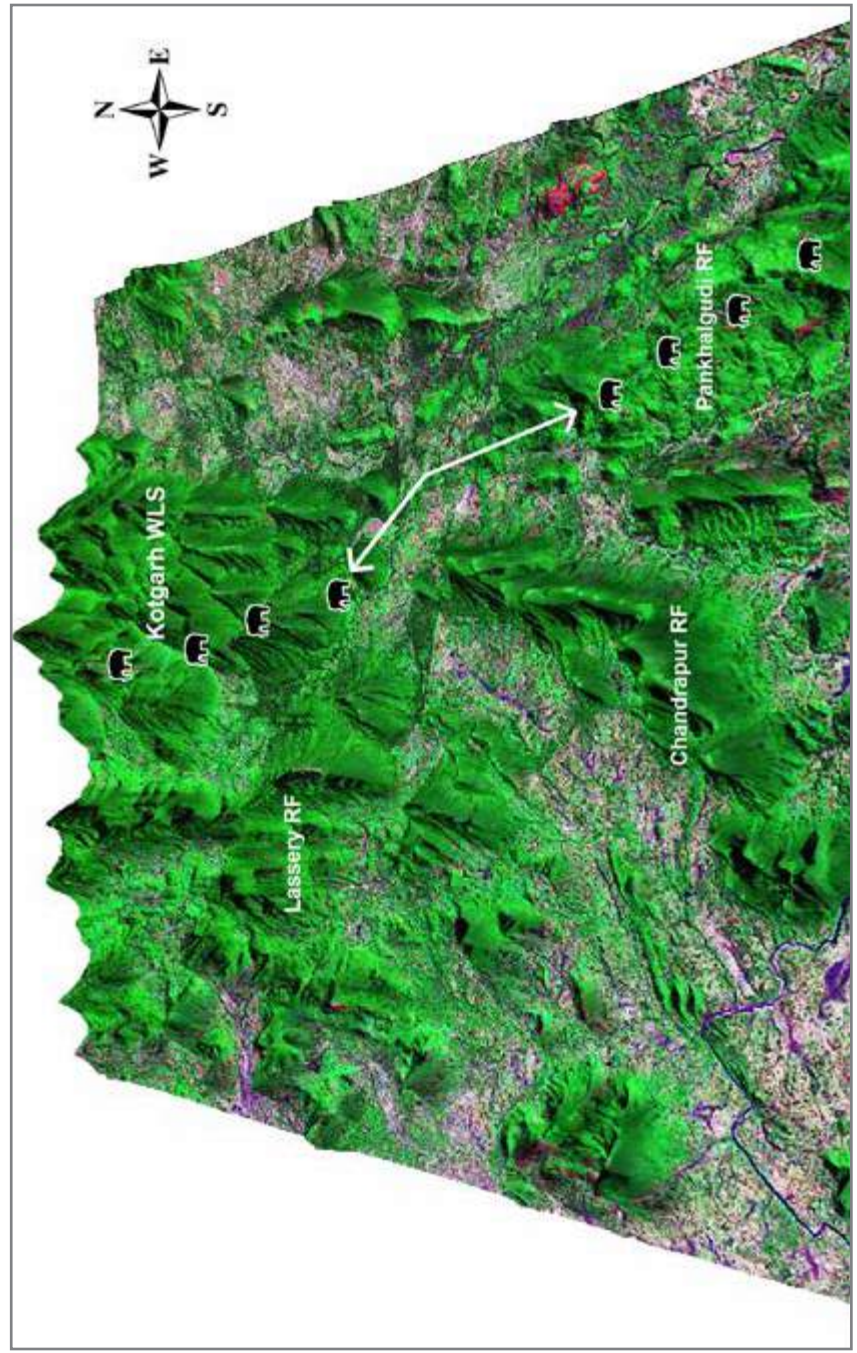
Conservation Feasibility: Medium

This corridor connects Kotagarh Wildlife Sanctuary with Pankhalgudi Reserve Forest under the Muniguda Range of Rayagada Forest Division. Elephants from Kotagarh Wildlife Sanctuary cross State Highway 5 between Pandaripi and Getabali village to enter Laseri Extension Forest and Madagurdi Reserve Forest, leading on to Pankhalgudi Reserve Forest. Agricultural activity in the forest areas has fragmented and degraded the habitat and reduced elephant movement.

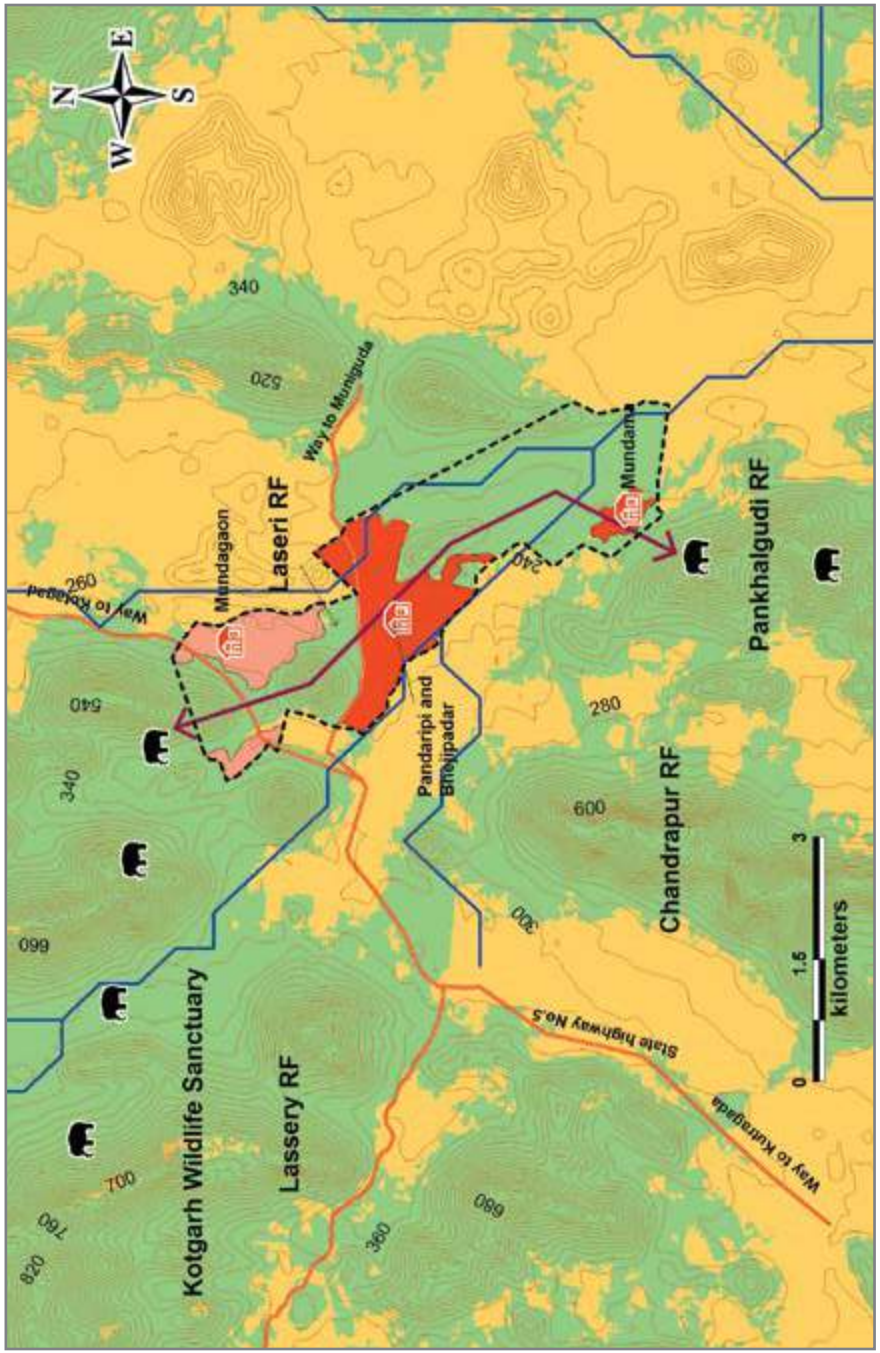
Alternate Name	Kotgarh-Chandrapur
State	Odisha
Connectivity	Kotagarh Wildlife Sanctuary and Pankhalgudi Reserve Forest under Rayagada Forest Division
Length and Width	7 km and 0.1-1.2 km
Geographical coordinates	19° 40′ 38″- 19° 43′ 54″ N 83° 40′ 32″- 83° 43′ 13″ E
Legal status	Reserve Forest and Patta Lands
Major land use	Forest, agriculture field, settlement
Major habitation/settlements	Mundagaon, Pandaripi, Nua Bhandiri, Bhejipadar, Mundama, Majhurkupa
Forest type	Tropical dry deciduous sal forest
Frequency of usage by elephants	Regular and seasonal

FORESTS AND ELEPHANTS

Corridor habitat status: The corridor consists of fragmented forest patches, agriculture fields and human habitation. The forest cover is almost intact along



3D map showing the landscape of the Kotagarh – Pankhalgudi Corridor



Map of the Kotagarh – Pankhalgudi Corridor area showing the land to be secured

SH 5 and the vegetation is dominated by *Shorea robusta*. The connecting forest between Laseri Extension Reserve Forest and Madagudi Reserve Forest comprises scattered stretches of degraded forest patches. Pankalgudi Reserve Forest was reported to harbour abundant bamboo patches; shifting cultivation has degraded these and opened up the once intact forest.

Estimated elephant numbers in the landscape

Balliguda Forest Division: 46
Rayagada Forest Division: 9
(Elephant Census, Odisha, 2015)

Forest/Land use

Forest type: Tropical dry deciduous sal forest
Agriculture fields: Permanent and shifting cultivation
Human habitation: Mundagaon, Pandaripi, Nua Bhandiri, Bhejipadar, Mundama, Majhurkupa
Road: State Highway 5
River: Chauladhua and Pipadi

Other ecological importance

Mountain Range: Parts of Eastern Ghats
Elephant Range: Central India
Elephant Reserve: Proposed South Orissa Elephant Reserve
Protected Area: Kotagarh Wildlife Sanctuary

HUMAN DIMENSIONS

Threats

1. Cultivation: Agriculture is extensively practiced by locals within the corridor forest in Pankhalgudi Reserve Forest, Madagudi Reserve Forest, Laseri Extension Reserve Forest and Kotagarh Wildlife Sanctuary.

2. Shifting cultivation and habitations: The prevalence of shifting cultivation means that people also shift habitations when they move to new areas.

3. Encroachment: People have encroached upon the corridor forest for agriculture, and have established settlements with the intention of getting patta land under the Forest Rights Act.

4. Expansion of State Highway 5: Although the present traffic intensity is only about 11 vehicles per hour, this is expected to increase with the expansion of the road and industrial growth in the area (Vedanta Aluminium Refinery and JK Paper Mills in Rayagada district).

Corridor villages: Pandaripi, Mundagaon, Nua Bhandiri, Bhejipadar and Majhurkupa are located in critical areas of the corridor.

Twenty villages are located in and around the corridor. Villagers are mostly farmers and depend upon casual labour for their livelihood. They depend upon the corridor forest for *Shorea robusta* leaves, mushrooms and other NTFP, as well as fuelwood, timber and livestock grazing. People from other parts have encroached upon the corridor forest. This is a common practice: people clear forest patches, practice agriculture for three to five years then shift to new sites. Rice, mandia (*Eleusine coracana*), maize (*Zea maize*), koer, jhodanga (*Vigna unguiculata*), kadua, biri (*Vigna mungo*), simba (*Dolichos lablab*) and brinjal are the primary crops.

Corridor dependent villages: Pandaripi, Getabali, Mundagaon, Nua Bhandiri, Bhejipadar, Majhurkupa, Kalesiguda, Mundama, Sulikupda, Nilliguda, Panaspadar, Madagudi, Kalagudi, Gotagudi, Kesaragudi, Jubagudi and Mudiguda.

Human-Elephant Conflict: Eight human deaths and one case of human injury caused by elephants were reported in 2009-10 in Balliguda Forest Division. In Rayagada Forest Division, three elephant deaths (two electrocutions in 2009-10, one poaching incident in 2011-12) and seven human deaths (one in 2006-07, four in 2007-08, two in 2010-11) occurred due to conflict.

Crop depredation and property damage by elephants have also been reported in the corridor fringe villages of Pandaripi, Mundagaon, Bhejipadar, Nua Bhandiri and Majhurkupa.

CONSERVATION PLAN

1. The corridor should be legally protected by the state forest department under an appropriate law, and necessary action should be taken to prevent the encroachment of corridor forest and developmental activities detrimental to the corridor.

2. Cultivation and encroachment for settlement should be prevented in the corridor forest. Also, the existing encroached settlements and areas under shifting cultivation need to be cleared.

3. Forest patches degraded due to shifting cultivation and encroachment should be restored.

4. Identified lands need to be secured in consultation with villagers.

Land identified to secure the corridor

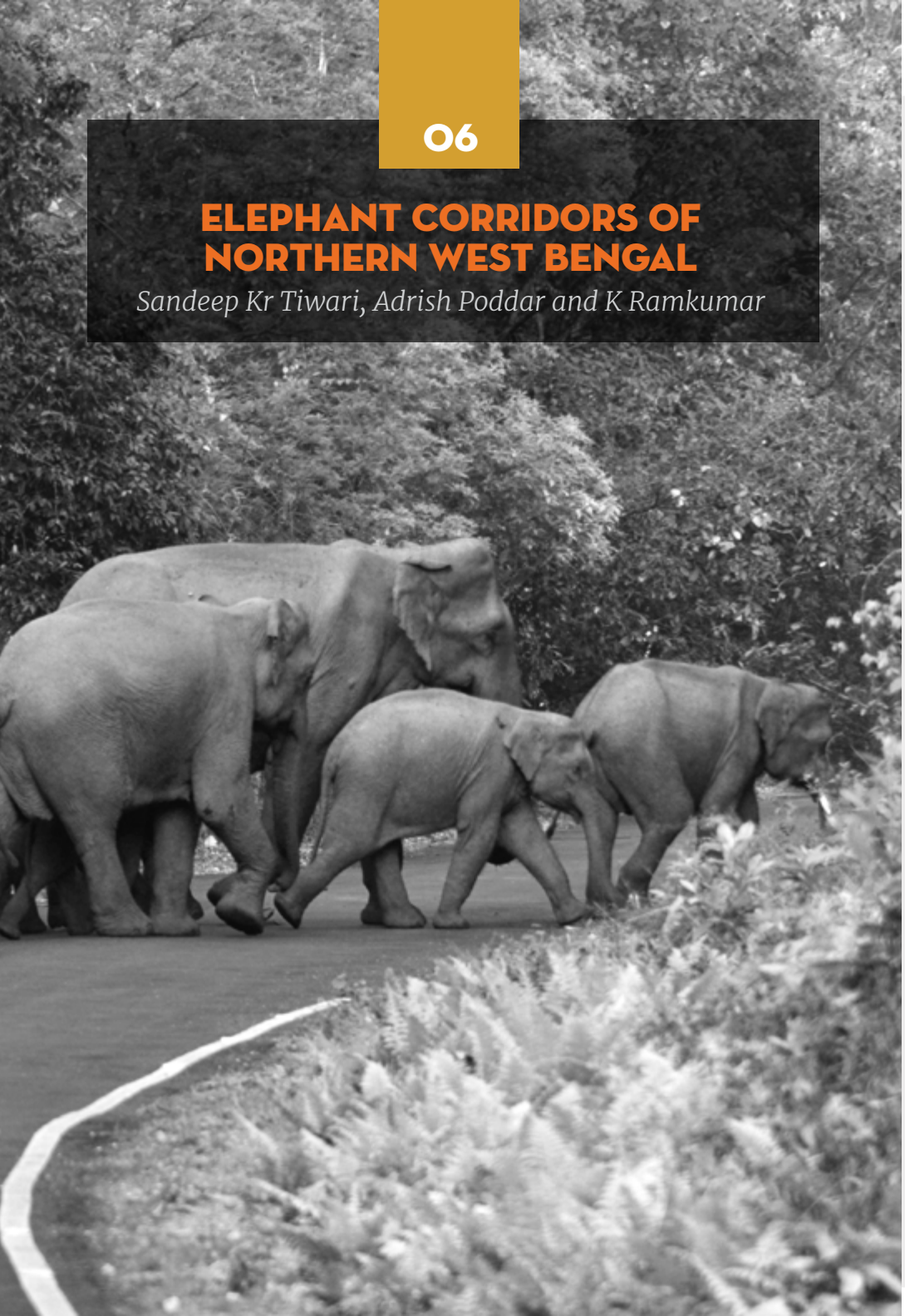
The connectivity between Laseri Reserve Forest and Laseri Extension Reserve Forest (between the villages of Pandaripi and Mundagaon) has been decreasing due to the encroachment of forest land for agriculture and the establishment of human settlements. A vast expanse of private land is also present between Laseri Extension Reserve Forest and the confluence of the Chauladhua and Pipadi Rivers. This area belongs to the villagers of Pandaripi, Bhejipadar and Nuabalipal. Fragmentation of forest patches has been hindering elephant movement between Kotagarh Wildlife Sanctuary and Muniguda Range. The following extent of land is required to secure the corridor:

Village	Families	Area in acres	Priority
Pandaripi and Bhejipadar	60+7	372.5	P1
Mundagaon	20	245	P1
Bhejipadar	20	187	P2
Mundama	10	60	P2

06

ELEPHANT CORRIDORS OF NORTHERN WEST BENGAL

Sandeep Kr Tiwari, Adrish Poddar and K Ramkumar



<< Elephants crossing Buxa – Titi (via Beech) Corridor in northern West Bengal

THE ELEPHANTS OF NORTHERN WEST BENGAL represent the westernmost extension of the North-Eastern population of Asian elephants in India. The Western Duars lie at the confluence of the Himalayas and the Indo-Gangetic flood plains. The elephant range is bounded by Nepal to the west, Bhutan to the north and Bangladesh to the south. Forest landscape connectivity is maintained between Nepal, Bhutan and India. The region has about 488 elephants (*MoEF&CC, 2017*) between the Sankosh and Mechi Rivers and spread over the districts of Darjeeling, Jalpaiguri, Alipurduar and Coochbehar, comprising nine forest divisions: Kurseong, Wildlife I, Baikunthapur, Kalimpong, Wildlife II, Jalpaiguri, Wildlife III , Buxa Tiger Reserve (East) and Buxa Tiger Reserve (West) (*Das, undated*). The elephant population of northern West Bengal is contiguous with the Chirang-Ripu Elephant Reserve in Assam as well as adjacent habitats of Bhutan and Nepal. Biogeographically, the entire northern elephant range comprises two major biotic provinces: the Siwalik/Bhabar and the lower Gangetic plains. The area is part of the Eastern Himalayan biodiversity hotspot.

Northern West Bengal has a forest area of 3051 sq km (25.7% of the state's forest area), of which elephant habitat is confined to about 2000 sq km in three distinct geographical zones:

(a) The Terai zone between the Mechi River and the Teesta River, comprising forest areas under Kurseong Division and Wildlife Division I (Mahananda Wildlife Sanctuary).

(b) The Western Duars zone between the Teesta and the Torsa Rivers, comprising the Apalchand Range of Baikunthapur Division; Jalpaiguri Division and Wildlife Division II (including Gorumara National Park and Chapramari Wildlife Sanctuary); Kalimpong Division and Wildlife Division III (including the western part of Jaldapara Wildlife Sanctuary).

(c) The Eastern Duars zone between the Torsa and Sankosh Rivers bordering Assam and Bhutan, and the forests of Wildlife Division III (eastern part of Jaldapara Wildlife Sanctuary and Buxa Tiger Reserve).

The elephant range in North Bengal consists of flat, slightly undulating to hilly terrain up to an elevation of 1750 m, with numerous rivers (Mechi, Teesta, Torsa, Raidak, Jainti, Dima, Basra, Diana, Murti, Jaldhaka, Neora, Leesh-Gheesh, Balason, Sankosh) and hill streams running from north to south. The average annual rainfall is 3498 mm with temperature varying between 8ºC and 32ºC. The forest types found in this region include dry deciduous, moist deciduous, semi evergreen and evergreen forests, with sal (*Shorea robusta*) and its associates dominating.

About 34% of the elephant range in North Bengal is under forest cover, 22% under tea plantation, 17% under agriculture and 27% under human habitation and development activities. As per the 2011 census, the average human density in the Duars and the Terai region is 679 persons per sq km.

Although the region supports less than 2% of the total elephant population of India, it accounts for almost 12% of all human deaths caused by elephants in the country. Cases of human injury or death, crop depredation and property damage are on the increase. Between 2007-08 and 2015-16, 433 cases pertaining to loss of human life were recorded in North Bengal – which translates to over 48 human lives lost per year due to elephants. Between 2011-12 and 2015-16, the state forest department paid an ex-gratia of more than Rs 7.7 crore for human injury or loss of life, crop depredation and damage to houses/huts, apart from the large sums of money spent to undertake mitigation measures to reduce human-elephant conflict.

Elephants in North Bengal have significantly larger home ranges than in most other parts of the country; the average home range is estimated to be 588 sq km in Buxa Tiger Reserve (*Sukumar et al., 2003*). This high degree of ranging by elephants in search of food, along with a high human population density and activity, increases conflict in the landscape.

Major elephant movement takes place through the tea gardens. Almost 90% of the tea gardens in Jalpaiguri (Alipurduar included) and 30% in Darjeeling are within the zone of conflict. Another major hurdle to the free movement of elephants and their conservation is the railway track between Siliguri Junction and Alipurduar Junction that stretches over 168 km, almost 74 km (44% of its length) of which is through forest that includes three Protected Areas (Mahananda, Chapramari and Jaldapara Wildlife Sanctuaries as well as buffer areas of Buxa Tiger Reserve), and passes through 10 important elephant passages/corridors. This track was responsible for the death of 27 elephants between 1974 and 2003. It was converted into broad gauge in 2003 and nearly 56 elephants died between 2004 and 2016. Due to the high mortality of animals, it has come to be known as the 'killer track'.

A major conservation hurdle is the railway track between Siliguri junction and Alipurduar junction, which has caused the death of 56 elephants between 2004 and 2016

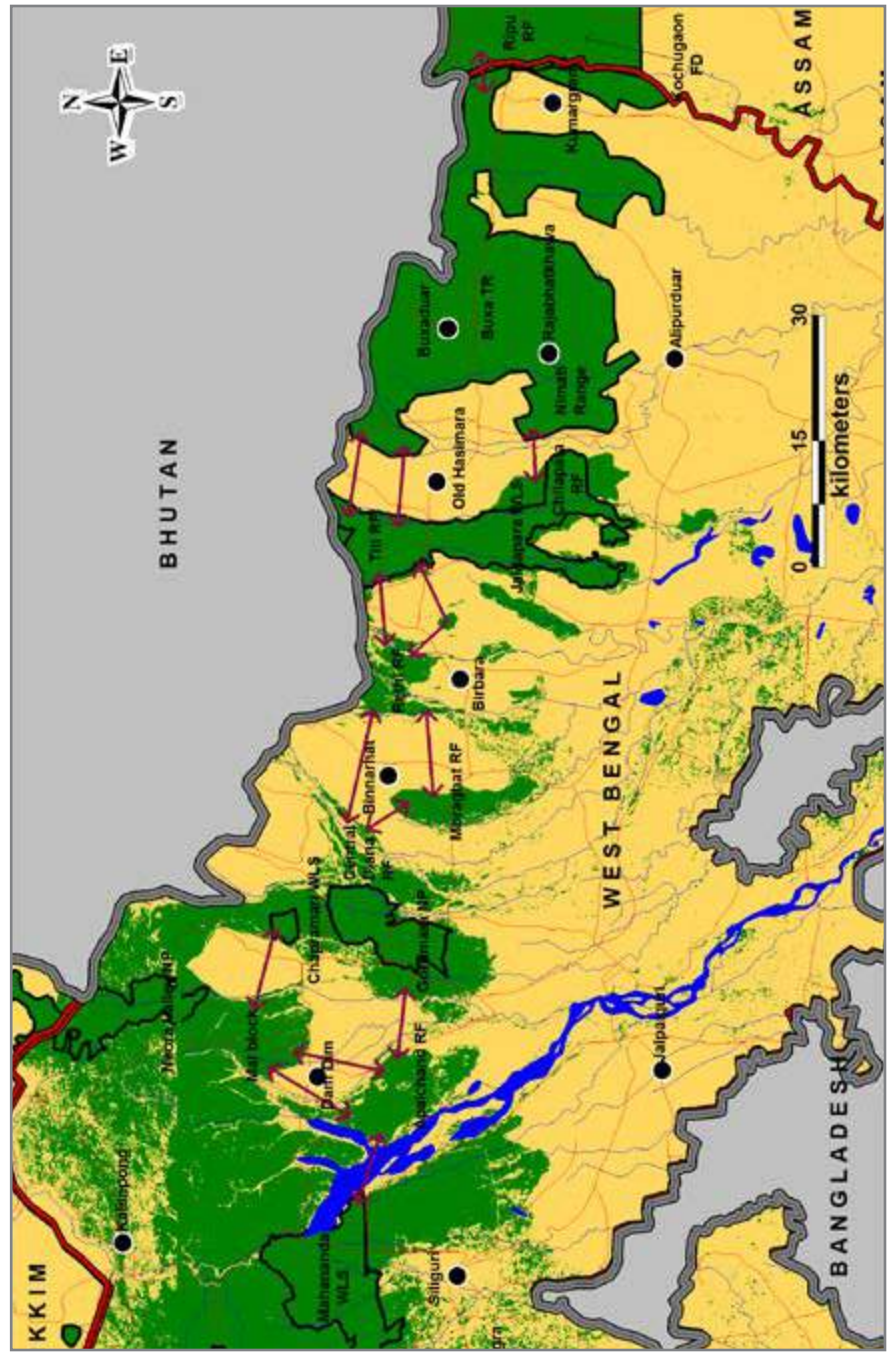
Both the Terai and the Western Duars have patchy habitat (human habitation and tea gardens interspersed with forests) through which regular elephant movement occurs. The main concern about the elephant population of Northern West Bengal is the increasing trend of human-elephant conflict, which is a major hurdle in the conservation of elephants in the region (*Das, undated, Chakraborty, 2015 and Mukherjee, 2016*). Only the elephant population (about 235 elephants) in the Eastern Duars (Buxa Tiger Reserve and part of Jaldapara), which has good forests can be called a comparatively viable population. The future of over 285 elephants between the Teesta and Torsa Rivers remains uncertain, with the fragmentation of forest areas in Baikunthapur, Kalimpong, Jalpaiguri and

Wildlife Division III due to tea plantations and factories, human settlements, agriculture lands, linear infrastructure elements (roads and railway lines) and mining resulting in increased human-elephant conflict.

The elephant corridor between Mahananda Wildlife Sanctuary and Baikunthapur Forest Division along the Teesta River is vital for elephant movement. The West Bengal Forest Department has notified about 40 hectares of Teesta *chaur* (flood plain) area in the corridor as a wildlife sanctuary, and this will significantly contribute to the protection of the corridor and facilitate elephant movement. There is also a need to re-establish the corridor between the North Diana and Rethi forests, which serves as a link for herds in the Tonda and Titi forests.

In the Terai, the movement of elephants from Mahananda Wildlife Sanctuary to Bahundangi in the Jhapa district of eastern Nepal has been severely affected due to forest fragmentation in the Panighata Range, as well as power fencing of about 18 km along the Mechi River in Nepal. This has abruptly halted the movement of 80-100 elephants beyond Kolabari near the border and has increased human-elephant conflict on the Indian side.

The Buxa-Ripu (Sankosh) elephant corridor linking the population of the Eastern Duars and Buxa Tiger Reserve to Manas Tiger Reserve in Assam needs to be secured. Elephant movement has been severely affected due to large-scale encroachment and tree felling in Kochugaon Forest Division and other areas of Kokrajhar and Bongaigaon districts. The corridor needs to be secured on an urgent basis through protection, removal of encroachments, and restoration of degraded and fragmented habitat to facilitate elephant movement.



Elephant corridors in Northern West Bengal

6.01

APALCHAND - MAHANANDA

Ecological priority: Medium

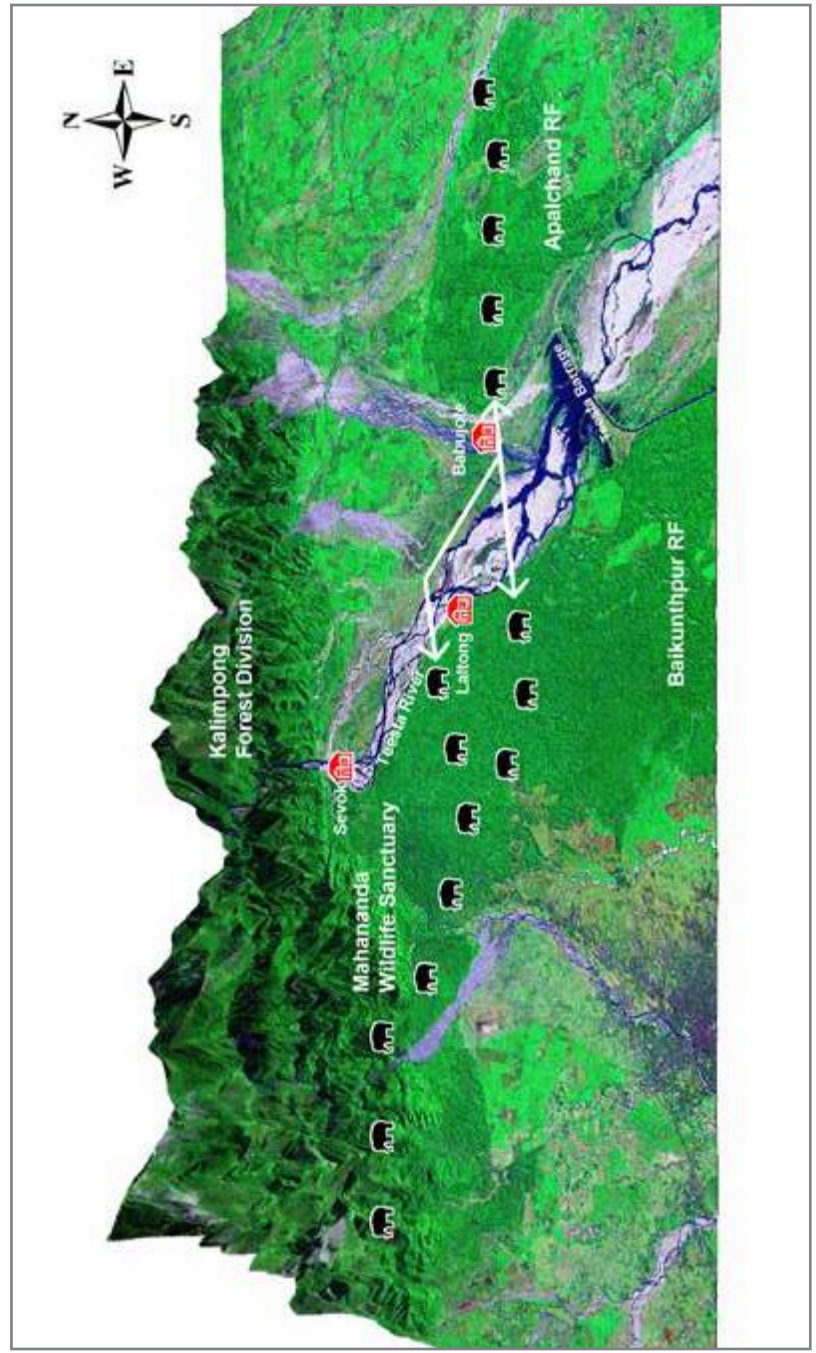
Conservation feasibility: Medium

This corridor connects Apalchand Reserve Forest (Baikunthapur Forest Division) with Mahananda Wildlife Sanctuary. Elephants move from Apalchand Reserve Forest through a narrow patch near Babujote village or the area south of Gajoldoba Beat, then pass through the Gheesh River, Sonali Tea Garden, Leesh River, Saougaon, Sundaribasti, Mongpong River, Totgaon (Teesta *chaur*), Ellenbari Tea Garden and the Teesta River, and enter Mahananda Wildlife Sanctuary between Laltong and Chamukdangi. There is occasional elephant movement between the area south of Gajoldoba Beat (Apalchand Reserve Forest) and Saraswatipur Beat (Mahananda Wildlife Sanctuary) on either side of the Teesta River.

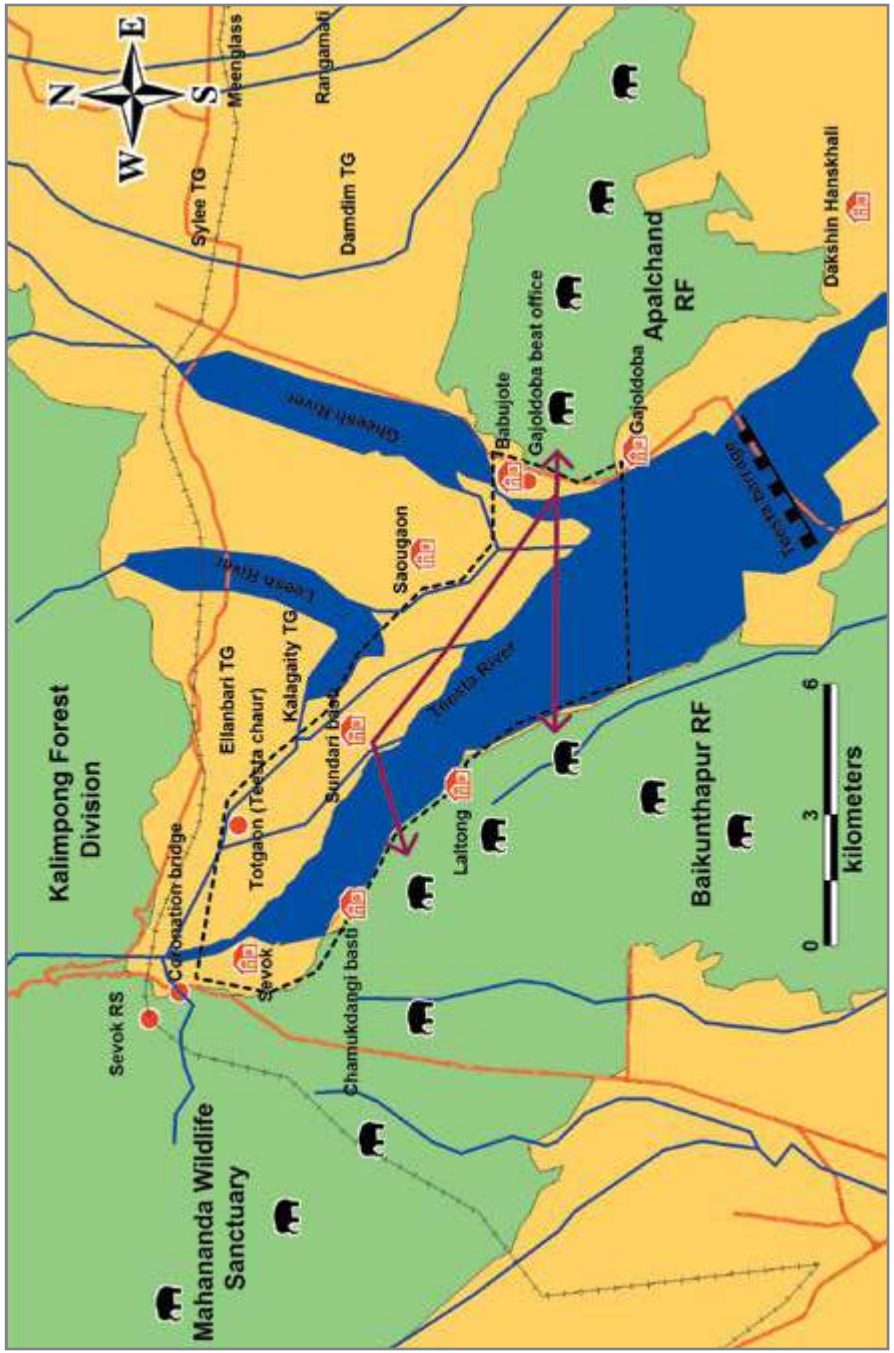
Alternate name	Teesta *chaur*
State	West Bengal
Connectivity	Apalchand RF with Mahananda WLS
Length and Width	0.5-1.5 km and 14-15 km
Geographical coordinates	26° 46′ 58″- 26° 52′ 22″ N 88° 28′ 10″- 88° 35′ 39″ E
Legal status	Reserve Forest and Teesta Wildlife Sanctuary
Major land use	Tea Garden, Revenue Land
Major habitation/settlements	Totgaon, Sundaribasti, Saougaon, Babujote
Forest type	Tropical moist deciduous forest and sal plantation
Frequency of usage by elephants	Regular

FOREST AND ELEPHANTS

Corridor habitat status: Vegetation sampling in Mahananda Wildlife Sanctuary



3D map showing the landscape of the Apalchand – Mahananda Corridor



Map of the Apalchand – Mahananda Corridor

revealed that the predominant tree species is *Lagerstroemia speciosa* (30%), followed by *Tectona grandis* (25%), *Amoora wallichii* (20%), *Dillenia indica* (10%) and *Michelia champaka* (10%). Ground cover was dominated by grasses (70%); barren ground (10%) was at a minimum. The scattered outgrowth of some tree saplings was also observed. Among the ground vegetation, notable elephant fodder species like *Nasturtium officinale*, *Saccharum spontaneum*, *Axonopus compressus*, *Saccharum narenga*, *Alpinia nigra* and bamboo were recorded.

In Apalchand Reserve Forest the predominant species is *Lagerstroemia speciosa* (41.4%), followed by *Michelia champaka* (17.2%), *Anthocephalus chinensis* (10.3%) and *Shorea robusta* (6.9%). Maximum GBH was recorded in *Shorea robusta* (235 cm). Ground cover was mostly barren ground (70%) followed by shrubs (18%), herbs (7%) and grasses (5%).

Estimated elephant numbers in the landscape

Mahananda Wildlife Sanctuary: 100-120
Apalchand Range: 50-60
(West Bengal Elephant Census, 2015)

Forest/Land use

Forest Type: Tropical dry deciduous, tropical moist deciduous, riverine, tropical mixed deciduous and savannah grassland forest
Settlements: Dhumsigara Forest Village, Babujote, Saougaon, Totgaon, Kalagaity, Sundaribasti, Teesta Barrage staff quarters, labour colonies of Sonali and Kalagaity Tea Gardens
Agriculture: Paddy, maize
Tea Estates: Odlabari, Sonali, Ellenbury, Kalagaity
Rivers: Teesta, Mongpong, Leesh and Gheesh
Roadways: NH 31 (Siliguri-Sevok) , Odlabari-Teesta Barrage road
Buildings: Gajoldoba Beat, Teesta Barrage staff quarters

Other ecological importance

Mountain Range: Eastern Himalayas
Elephant Range: Western Duars (Terai) Region

Elephant Reserve: Eastern Duars Elephant Reserve
Protected Area: Mahananda Wildlife Sanctuary and Teesta Wildlife Sanctuary
Biodiversity Hotspot: Eastern Himalayas
IBA: Mahananda Wildlife Sanctuary (IN-WB-07), Eastern Himalayas (EBA 130)

HUMAN DIMENSIONS

Threats

1. Settlements: Encroachment along the Teesta riverbed (Totgaon) blocks the corridor. Expansion of the Babujote and Kalagaity Tea Garden colonies is causing congestion in the corridor. The Teesta Barrage staff quarters are located beside the Apalchand Reserve Forest and also hinder the free movement of elephants.

2. Sand and boulder mining: Mining along the Teesta River and consequent load-carrying vehicular traffic are threats to the corridor.

3. Siliguri-Sevok-Jalpaiguri road along the river and associated vehicular traffic.

Corridor villages: Babujote, Dhumsigara

Corridor dependent villages: Laltong Forest Village, Totgaon, 10th Mile Forest Village, Ellenbury Tea Garden (Basa Line: 200 houses, 4 No. Line: 50 houses), Sonali Tea Garden (Jungle Line: 150 houses, Kothi Line: 100 houses, Dhura Line: 30 houses, Saogaon (150 houses), Totgaon (300 houses), Kalagaity (25 houses), and Chamukdangi Forest Village.

The corridor has a large number of villages within the corridor and on its fringes:

Settlement	Status of Land	Population (Approx.)
Totgaon	Revenue	1400-1600
Sundaribasti	Revenue	150-170
Saogaon	Revenue	700-750
Kothi line (Sonali TG)	Tea Garden	450-550
Jungle Line (Sonali Tea Garden)	Tea Garden	750-850
Ellenbury Tea Garden	Tea Garden	2500-3000
Washabari	Tea Garden	4100-4500
Kalagaity	Revenue	125-150
Kalagaity	Tea Garden	900-1200
Hanskhali	Revenue	650-750
Dumsigara	Forest Village	40-60
Chamukdangi	Forest Village	Not known
Laltong	Forest Village	Not known

A high proportion of the inhabitants of these villages depend on the tea gardens for their livelihood; the rest are dependent on their paddy/maize crops. There is high crop depredation by elephants to the villages east of the Teesta River; some farmers have even stopped cultivating paddy/maize altogether.

Human-Elephant Conflict

Name of the forest range	Elephant deaths (2003 - 2013)	Human deaths (2003 - 2013)	Cases of human injury (2003-2013)	Cases of property damage (2003-2013)	Compen-sation for property damage from 2003 - 2013 (Rs)
Sukna Range	0	9	5	1258	718350
South Range	0	6	2	27	18000
West Range	3	3	1	2208	785905
North Range	3	2		11	45897

CONSERVATION PLAN

1. The West Bengal Forest Department has notified 32 sq km of corridor land on the Teesta *chaur* as the Teesta Wildlife Sanctuary.

2. Construction hindering elephant movement inside the corridor area must be prohibited.

3. Vehicular speeds should be regulated by suitable barriers on NH 31 (Siliguri-Sevok) within the corridor area.

4. Land use change and expansion inside Sonali Tea Garden and Kalagaity Tea Garden should be strictly prohibited.

5. Land use change on either side of the Teesta River, especially on the eastern bank up to Teesta Barrage at Gajoldoba, should be prohibited.

6. Babujote and Dhumsigara Forest Villages could be relocated to increase the corridor width.

7. At least 900 m north of Gajoldoba Beat Office, the area should be cleared (Babujote, Teesta Barrage staff quarters, Dhumsigara Forest Village) to provide safe passage for elephants to Apalchand Reserve Forest.

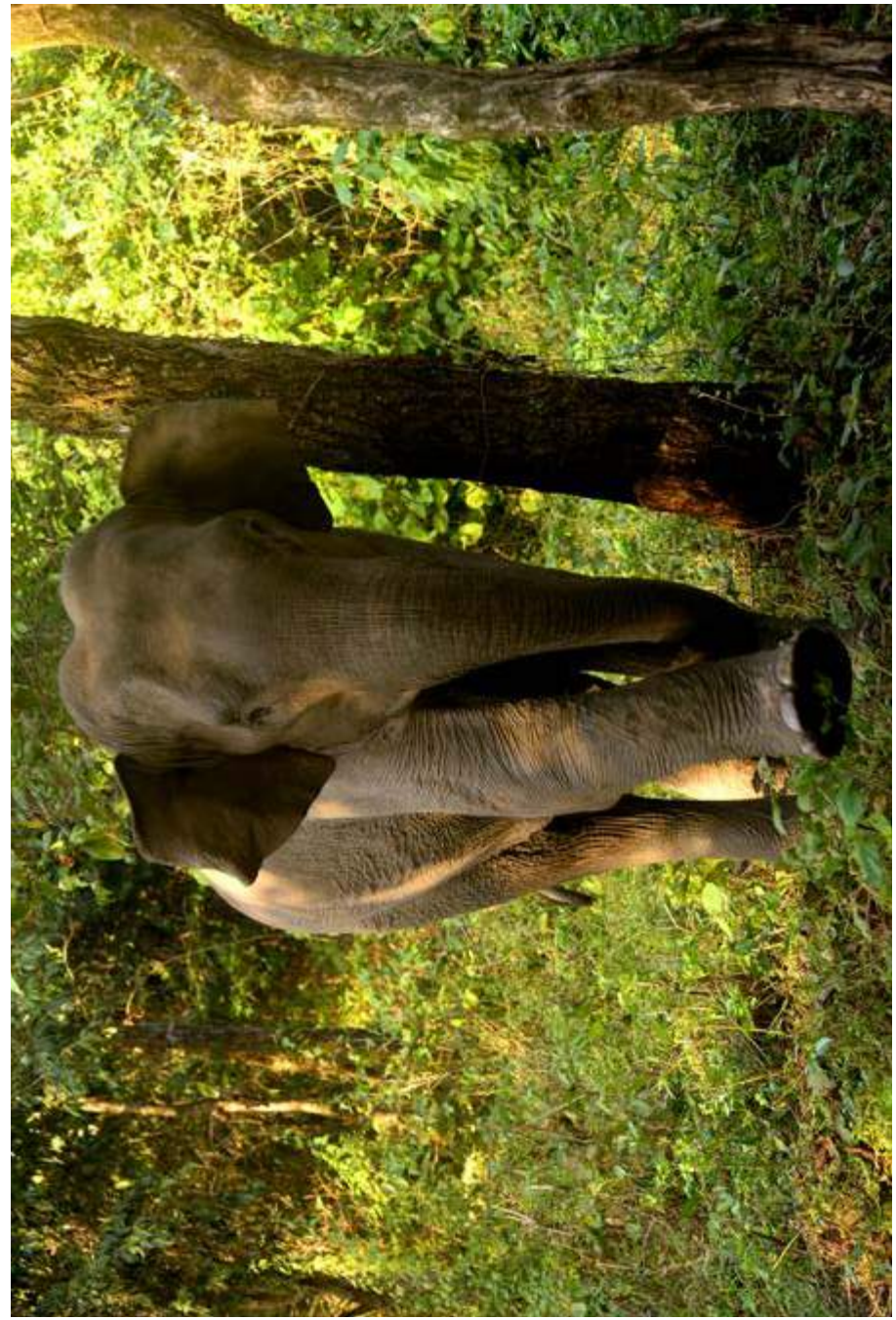


Fig. 6.01: An elephant in the Mahanada corridor

6.02

APALCHAND - GORUMARA

Ecological priority: Medium

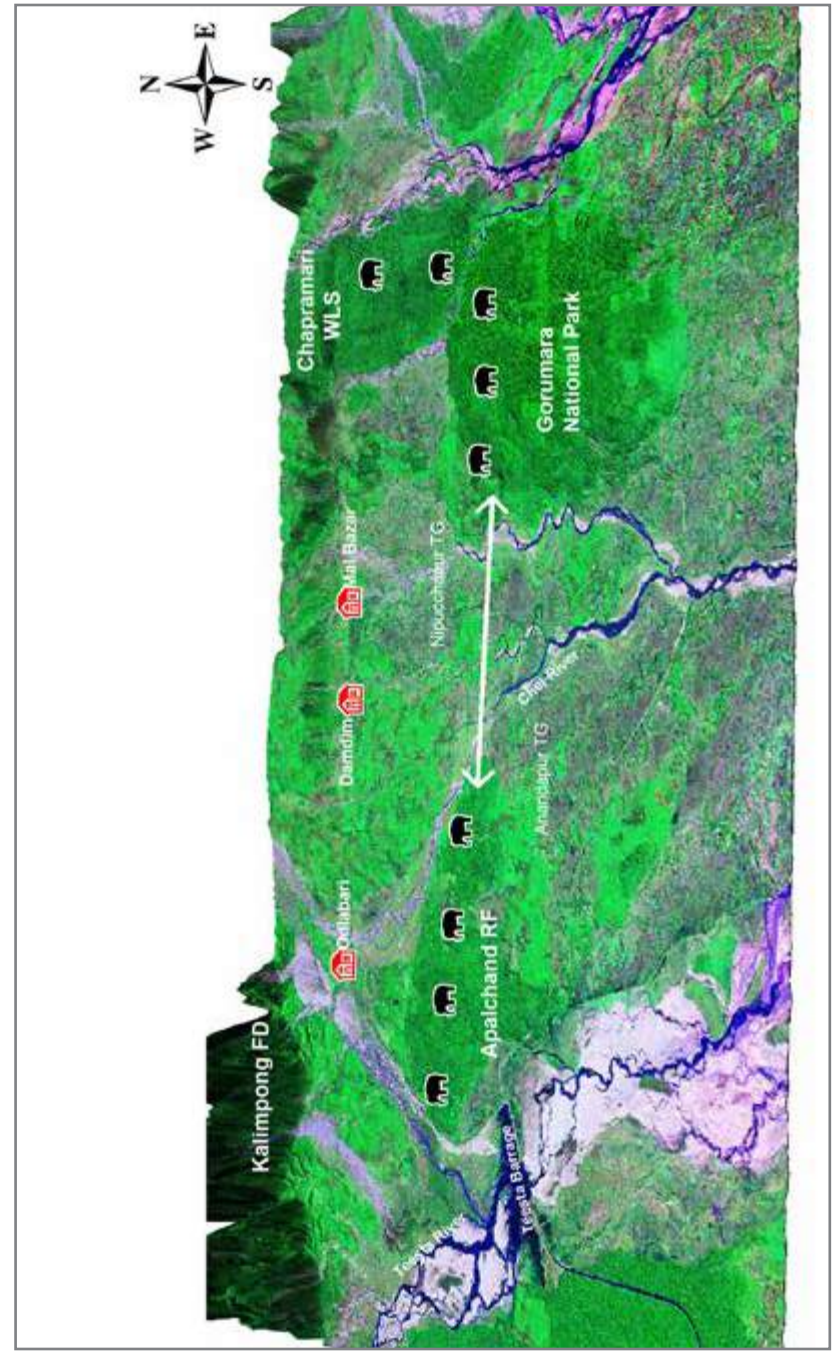
Conservation feasibility: Medium

The Apalchand-Gorumara corridor connects the elephant population of Gorumara National Park with Apalchand Reserve Forest. Elephants pass through Tillabari Division (Baradighi Tea Garden), Neora River, Nichchalsa, Haihaipathar, Nipucchapur, Kumlai River, Baintbari, Damdim Tea Garden and Chel River, and enter Apalchand Reserve Forest mostly to the north of Mechbasty Forest Village. NH 31 is a major impediment to elephant movement. An upcoming railway track (Mal Bazar-Lataguri) also poses a threat to elephant movement.

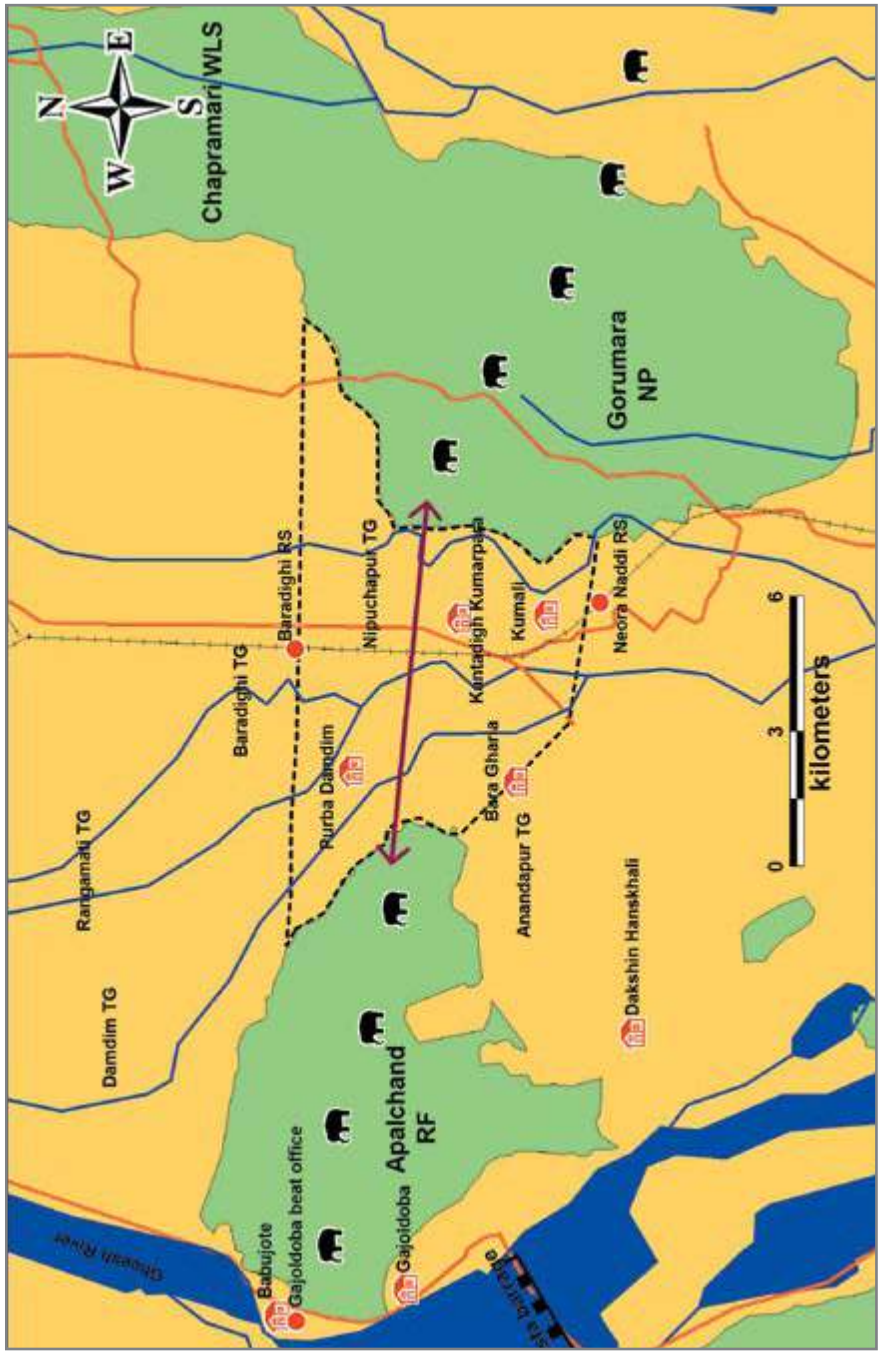
Alternate name	Lower Tondu-Apalchand
State	West Bengal
Connectivity	Apalchand Reserve Forest with Gorumara National Park
Length and Width	13-15 km and 0-2 km
Geographical coordinates	26° 44′ 38″- 26° 48′ 14″ N 88° 40′ 30″-88° 48′ 39″ E
Legal status	Reserve Forest, Forest Land leased to Tea Gardens, Patta Land
Major land use	Tea Garden, agriculture, settlements, road and railway
Major habitation/settlements	Baintbari, Colonies of Baradighi Tea Garden, Damdim Tea Garden
Forest type	Tropical moist deciduous
Frequency of usage by elephants	Regular; peak during May-July and October-March

FORESTS AND ELEPHANTS

Corridor habitat status: Vegetation sampling in the Apalchand Reserve Forest reveals that the predominant tree species are *Shorea robusta* (60%), *Tectona*



3D map showing the landscape of the Apalchand – Gorumara Corridor



Map of the Apalchand – Gorumara Corridor

grandis (15%) and *Lagerstroemia speciosa* (10%). Maximum GBH was recorded in *Shorea robusta* (300 cm). The ground cover in Apalchand comprised shrubs (30%), herbs (40%) and grasses (5%), with about 20% as barren ground.

In Gorumara National Park, the predominant tree species are *Shorea robusta* (75%), followed by *Amoora rohituka* (7%), *Amoora wallichii* (7%) and *Dillenia pentagyna* (4%). Ground cover in Gorumara was dominated by shrubs (60%) followed by grasses (30%) and herbs (8%), with the rest as barren ground.

Estimated elephant numbers in the landscape

Gorumara National Park and Chapramari WIldlife Sanctuary: 50-60
Targhera Range: 20-25
Apalchand Range: 50-60
(West Bengal Elephant Census, 2015)

Forest/Land use

Forest Type: Tropical moist deciduous
Settlements: Nichchalsa, Nipucchapur, Kantadighi Kumarpara, Baintbari, Chhaoaphali, Magurmari Forest Village (FV), Gorumara FV I, Gorumara FV II, Labour colonies of Baradighi Tea Garden (Tillabari Division), Damdim Tea Garden
Agriculture: Maize, paddy
Tea Estates: Baradighi (Tillabari Division), Damdim, Nipucchapur
Rivers: Neora, Chel, Kumlai
Roadways: NH 31 (Chalsa-Lataguri), Mal Bazar-Kranti Road
Railway: Upcoming Mal Bazar-Jalpaiguri broad gauge railway track
Buildings: Factories of Baradighi Tea Garden (Tillabari Division), Damdim Tea Garden, Nipucchapur Tea Garden

Other ecological importance

Mountain Range: Eastern Himalayas
Elephant Range: Western Duars (Terai) Region
Elephant Reserve: Eastern Duars Elephant Reserve
Protected Area: Gorumara National Park
Biodiversity Hotspot: Eastern Himalayas
IBA: Gorumara National Park (IN-WB-03), Eastern Himalayas (EBA 130)

HUMAN DIMENSIONS

Threats

1. *Anthropogenic:* The increasing human population has congested the already narrow corridor. The choice of paddy or maize as the primary crops has increased human-elephant conflict in the area. Labour line colonies and non-elephant friendly practices in the tea gardens are the main causes of disturbance.

2. *People's dependency on corridor forest*: The village communities are highly dependent on the forest for fuelwood and fodder for their cattle.

3. *Railway track*: A broad-gauge railway line connecting Mal Bazar to Jalpaiguri is under construction and a serious threat to elephant movement.

4. *National Highway 31* and associated vehicular traffic.

Corridor villages: Baintbari, labour colonies of Baradighi Tea Garden and Damdim Tea Garden.

Corridor dependent villages: Kantadighi Kumrapara, Mechbasty Forest Village (45-60 houses), Chhaoaphali, Nichchalsa, Nipucchapur, Damdim Tea Garden, Haihaipathar, Odlabari Tea Garden, Kumlai Tea Garden.

Settlement	Status of land	Population (Approx.)
Tillabari Division (Baradighi Tea Garden)	Tea Garden	4000-4500
Damdim Tea Garden	Tea Garden	7300-7700
Haihaipathar	Revenue	5700-6000
Nipucchapur	Revenue	2200-2500
Nipuchhapur Tea Garden	Tea Garden	2700-3000
Nichchalsa	Revenue	3000-3500
Chhaoaphali	Revenue	Not known
Targhera	Revenue	800-1000
Odlabari TG	Tea Garden	4400-4800
Kumlai TG	Tea Garden	4200-4500
Kantadighi Kumarpara	Revenue	3200-3700

The majority of people in these villages depend on the tea gardens for their livelihood. Many of the corridor villages have started cultivating tea instead of paddy or maize due to crop depredation by elephants.

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent encroachment and developmental activities detrimental to animal movement.

2. Elephant movement from the southwest of Gorumara National Park should be restricted and elephant movement from the northern part of Gorumara to Apalchand Reserve Forest channelised through Damdim Tea Garden. Similarly the southeastern part of Apalchand Reserve Forest needs to be blocked so that elephants move from the north.

3. Vehicular speeds should be regulated by the use of suitable physical barriers on NH 31 (Chalsa-Lataguri), which passes through the corridor area. Suitable barriers along the highway (on the western side of Gorumara National Park) south of Kantadighi Kumarpara could prevent conflict and channelise elephant movement from the northern part of Gorumara.

4. Land use change inside Baradighi Tea Garden (Tillabari Division) and Damdim Tea Garden should be strictly prohibited.

5. Relocate the labour quarters of Baradighi Tea Garden (Tillabari Division) and the adjoining forest village near Neora River to facilitate unhindered elephant movement.

6. Artificial water ponds situated south of Tillabari Division need to be relocated deep inside the forest to prevent animals from straying.

7. Local communities from Nichchalsa, Nipucchapur, Baradighi Tea Garden (Tillabari Division), Damdim Tea Garden (Barron Division), Kantadighi Kumrapara, Chhaoaphali and forest villages, as well as the tea garden owners, need to be sensitised about the negative effects of corridor constriction.

8. Appropriate mitigation measures (including an Animal Detection System near the railway track) are needed to minimise the impact that the new railway line passing through corridor will have on animal movement.



Fig. 6.02: Flood plains of the Chel River

6.03

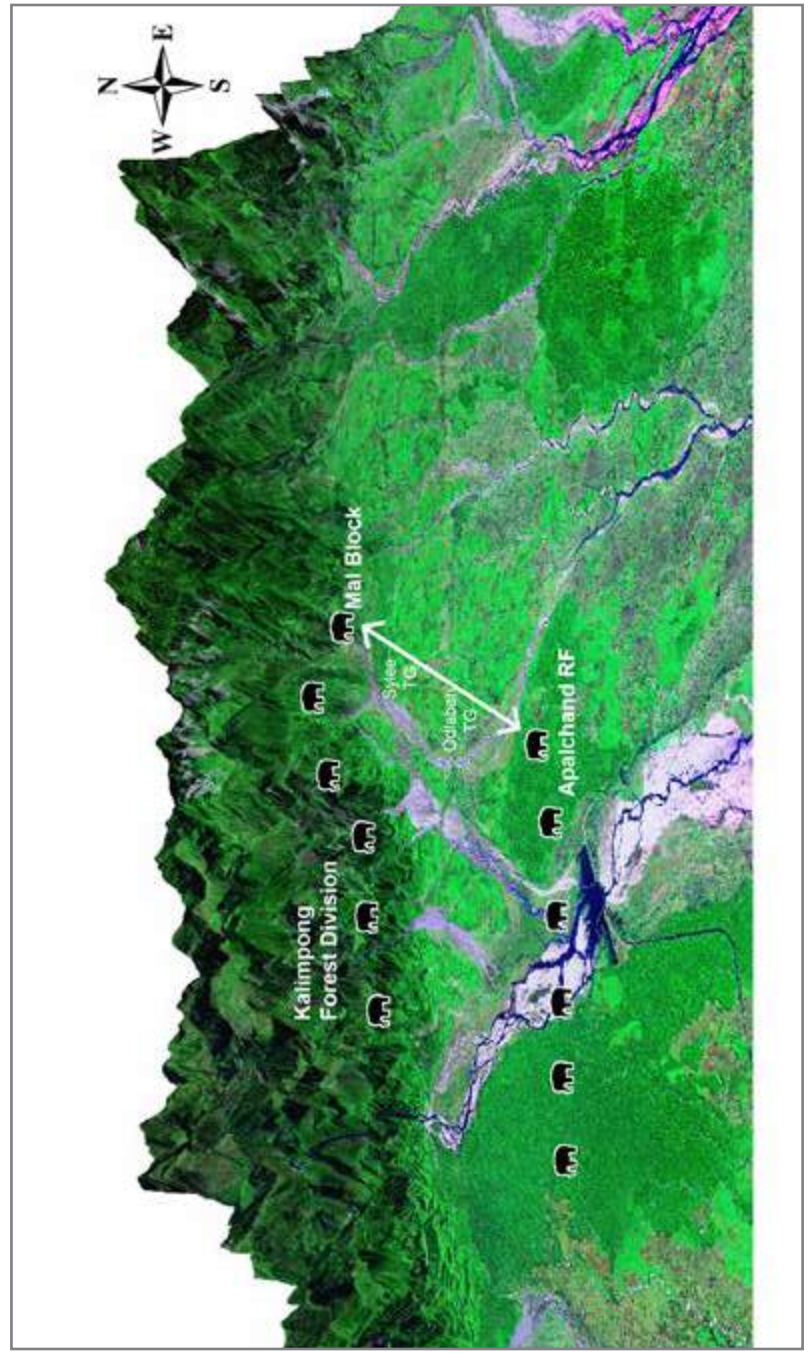
APALCHAND - KALIMPONG AT MAL BLOCK (VIA SYLEE)

Ecological priority: Medium

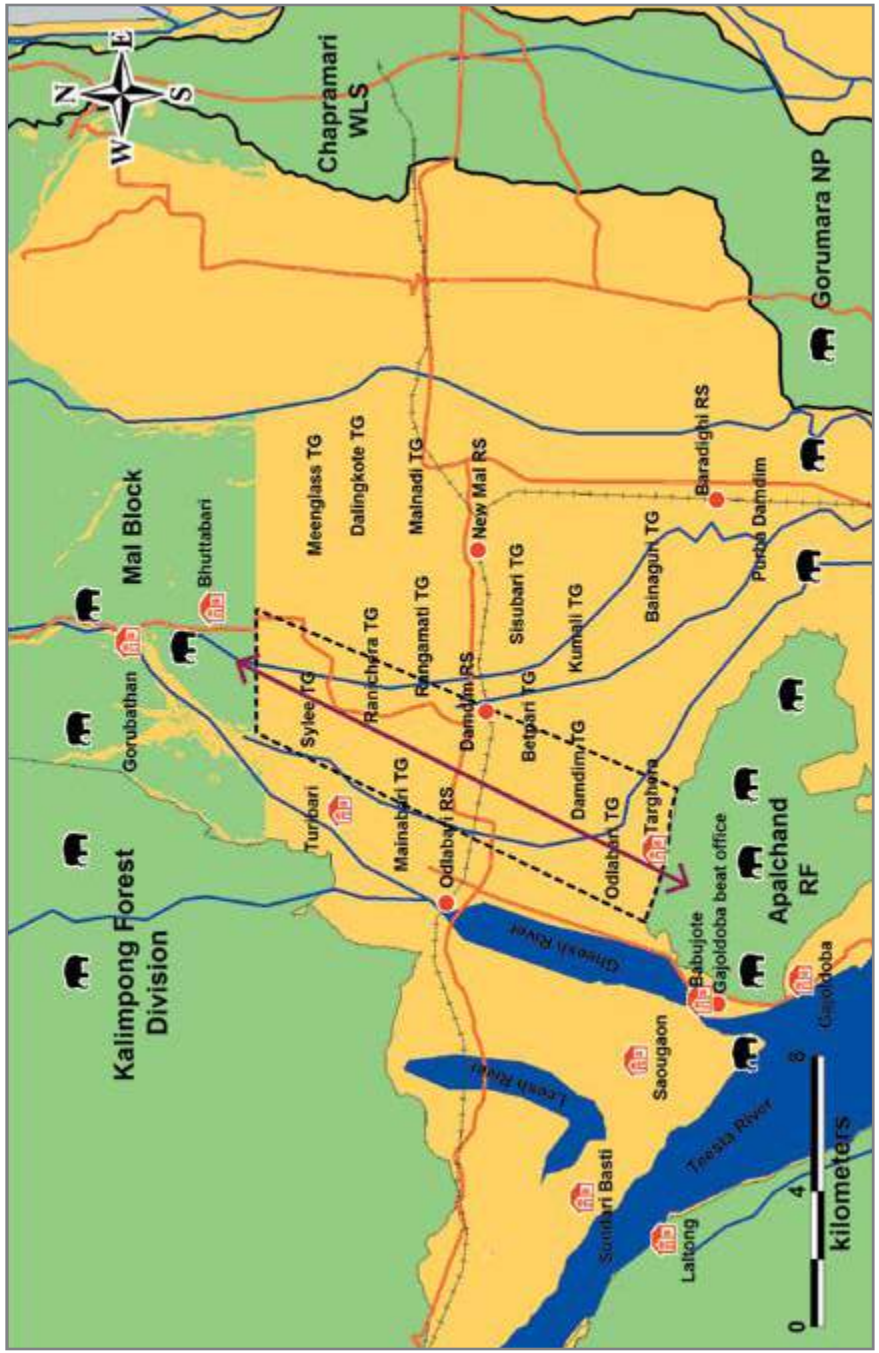
Conservation feasibility: Medium

This corridor connects Apalchand Reserve Forest (Baikanthapur Forest Division) with Mal Block (Kalimpong Forest Division). Elephants from Apalchand Reserve Forest cross the Chel River east of Targhera Forest Beat Office, then move through the Damdim, Kumlai and Baintbari Tea Gardens, the Odlabari-Damdim railway line, NH 31 (Odlabari-Damdim), Ranichera and Sylee Tea Gardens, and enter Mal forest near Bhuttabari Forest Village. The army areas here considerably reduce the width of the corridor. Elephants often use the adjoining Meenglass route to move to Bhuttabari forest due to high disturbance in this corridor.

Alternate name	Apalchand-Bhuttabari
State	West Bengal
Connectivity	Mal Block (Kalimpong Forest Division) with Apalchand Reserve Forest
Length and Width	14-17 km and 0-1.5 km
Geographical coordinates	26° 48′ 53″- 26° 55′ 36″ N 88° 36′ 40″- 88° 42′ 18″ E
Legal status	Revenue Land, Reserve Forest, Tea Gardens
Major land use	Agriculture, tea gardens, roads, railways and settlements
Major habitation/settlements	Damdimhat, Colonies of Sylee Tea Garden, Damdim Tea Garden, Ranichera Tea Garden
Forest type	Moist deciduous forest, plantation forest
Frequency of usage by elephants	Seasonal, during June-July and October-February



3D map showing the landscape of the Apalchand – Kalimpong at Mal Block (via Sylee) Corridor



Map of the Apalchand – Kalimpong at Mal Block (via Sylee) Corridor

FORESTS AND ELEPHANTS

Corridor habitat status: Vegetation sampling in the Bhuttabari Reserve Forest (Kalimpong Forest Division) revealed that the predominant tree species are *Lagerstroemia speciosa* (43.8%), *Tectona grandis* (37.5%), *Canarium sikkimense* (12.5%) and *Anthocephalus chinensis* (6.2%). Maximum GBH and height was observed in *Tectona grandis* (130 cm) and *Canarium sikkimense* (45 m) respectively. In Apalchand Reserve Forest, the predominant tree species are *Shorea robusta* (30.8%), *Lagerstroemia parviflora* (23.8%), *Crataeva unilocularis* (7.7%), *Garuga pinnata* (7.7%), *Stereospermum tetragonum* (7.7%), *Bischofia javanica* (7.7%), *Tetrameles nudiflora* (7.7%) and *Amoora wallichii* (7.7%). Maximum GBH and height was recorded in *Shorea robusta* – 320 cm and 45 m respectively.

Ground cover of Apalchand was dominated by shrubs (30%), herbs (40%), grasses (5%) and barren ground. Ground cover of Bhuttabari was dominated by shrubs (50%), grasses (15%), herbs (10%) and barren ground (25%).

Estimated elephant numbers in the landscape

Gorumara NP & Chapramari WLS: 50-60

Apalchand Range: 50-60

(West Bengal Elephant Census, 2015)

Forest/Land use

Forest Type: Tropical mixed dry deciduous, tropical moist deciduous forest, plantations

Settlements: Bhuttabari Forest Village Targhera, 8 No. Village, Bhuttabari Forest Village, Labour colonies of Odlabari, Baintbari, Sylee, Ranichera and Meenglass Tea Gardens

Agriculture: Maize, ragi, paddy, betel leaf plantations

Tea Estates: Odlabari Tea Garden, Damdim Tea Garden, Baintbari Tea Garden, Ranichera Tea Garden, Sylee Tea Garden, Meenglass Tea Garden

Rivers: Chel River

Railway track: Odlabari-Damdim

Roadways: NH 31 (Odlabari-Damdim), Damdim-Gorubathan road

Other ecological importance

Elephant Range: Western Duars (Terai) Region
Elephant Reserve: Eastern Duars Elephant Reserve
Protected Area: Gorumara National Park and Chapramari Wildlife Sanctuary
Biodiversity Hotspot Region: Eastern Himalayas

HUMAN DIMENSIONS

Threats

1. Anthropogenic pressure: Expansion of tea gardens and their labour quarters constrict the corridor. Villagers are dependent on the forest mostly for fuelwood. These factors have increased human-elephant conflict in the region.

2. Buildings/Artefacts: Targhera Army Camp, Damdim Army Camp, Sylee Tea Garden factory, Ranichera Tea Garden factory, Border Roads Organisation activity area and camp, Bhuttabari saw mill, Bhuttabari forest beat, Ranichera Golf Club

3. Army settlement: Army settlements and their activity areas (eg, a firing range) disturb elephant movement.

4. Railway traffic: On average, 1.6 trains per hour ply from 6 am to 6 pm, and 0.9 trains per hour ply from 6 pm to 6 am.

5. National Highway 31: Heavy vehicular traffic on this highway is a threat to the movement of elephants.

Corridor villages: Damdimhat, Colonies of Sylee Tea Garden, Damdim Tea Garden, Ranichera Tea Garden.

Corridor dependent villages: Damdim Tea Garden (Khagrabasti, BT Line, Barron Division), Damdimhat, Sylee Tea Garden, Ranichera Tea Garden, Baintbari Tea Garden, Chiklabasti, Sailihat.

While most of the inhabitants are tea garden labourers, the rest are engaged in agricultural activities. The Chel Line (250 houses) and Factory Line (320 houses) of Sylee Tea Garden, and the labour quarters of Ranichera Tea Garden block the corridor. People are likely to relocate if they are provided with adequate facilities.

Settlement	Status of Land	Population (Approx.)
Damdim Tea Garden	Tea Garden	7300-7600
Ranichera Tea Garden	Tea Garden	4900-5200
Baintbari	Sylee Tea Garden	1300-1500
Targhera	Revenue	800-900
Odlabari Tea Garden	Tea Garden	4400-4600
Damdimhat	Revenue	2900-3200
Sailihat/ Khasjangal-I	Revenue & Khas	1400-1600
8 No. Basti	Khas Land	350-400
Manpari	Forest Village	45-50
Bhuttabari/ Special	Forest Village	250-350
Chiklabasti/ Khasjangal-II	Khas & Revenue	55-65
Sylee Tea Garden	Tea Garden	4500-5000

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent encroachment and developmental activities detrimental to animal movement.

2. Train frequency should be reduced at least during the night (8 pm to 5 am) by diverting the trains from New Jalpaiguri Junction towards Falakata.

3. Night patrolling of the railway track passing through the corridor is essential during the elephant migratory season (October to March). Installing an Animal Detection System near the track to alert train drivers will also help.

4. Vehicular speeds should be regulated in the corridor area at night by suitable barriers on NH 31 (Odlabari-Damdim) and the Damdim-Gorubathan road.

5. Restore habitat in the Bhuttabari forest fringes, especially between Chel River and Meenglass Tea Garden - Bhuttabari Forest Village to provide canopy cover for the safe passage of elephants.

6. Labour colonies of Ranichera Tea Garden and Sylee Tea Garden, and settlements north of NH 31 could be protected by suitable barriers (fencing, light etc) to reduce human-elephant conflict and prevent retaliation against elephants (pragmatic solution). These colonies and settlements could also be rehabilitated to a safe place in consultation with the respective tea garden owners and inhabitants, with suitable relocation packages provided (ideal solution).

7. Land use change inside Odlabari, Ranichera, Sylee and Damdim Tea Gardens should be strictly prohibited.

8. Sensitise people from Damdimhat and Targhera, and the various tea garden owners, about the negative effects of corridor constriction. Provide do's and don't's in corridor areas as part of an overall campaign for tea garden owners.

9. Expansion of villages, especially ancillary settlements near the Border Roads Organisation camp should be prohibited at the earliest.

10. Sensitise the army about the importance of the corridor and prevent activities that may hinder elephant movement.



Fig. 6.03: Ranichera Tea Garden



Fig. 6.04: Army Compartment at Damdim

6.04

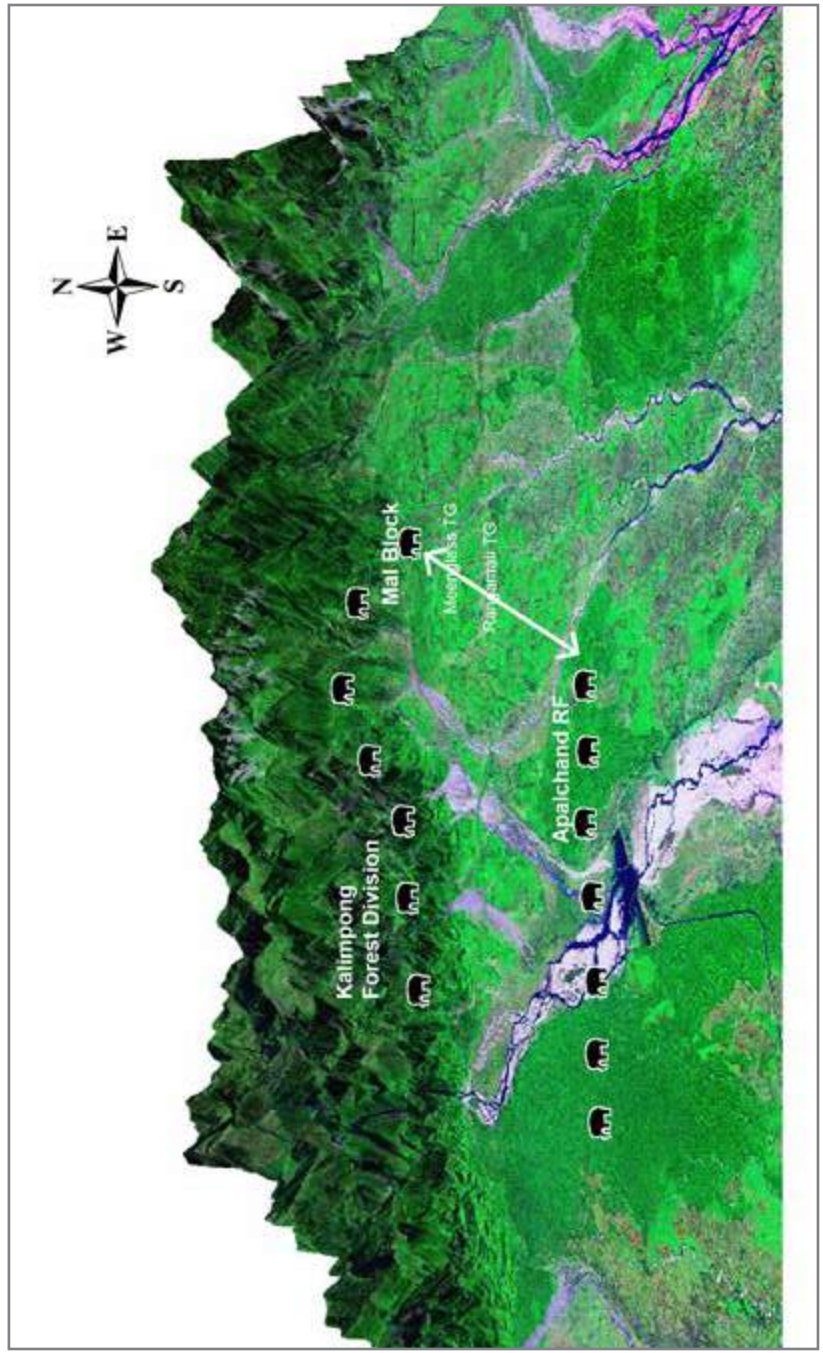
APALCHAND - KALIMPONG AT MAL BLOCK (VIA MEENGLASS)

Ecological priority: Medium

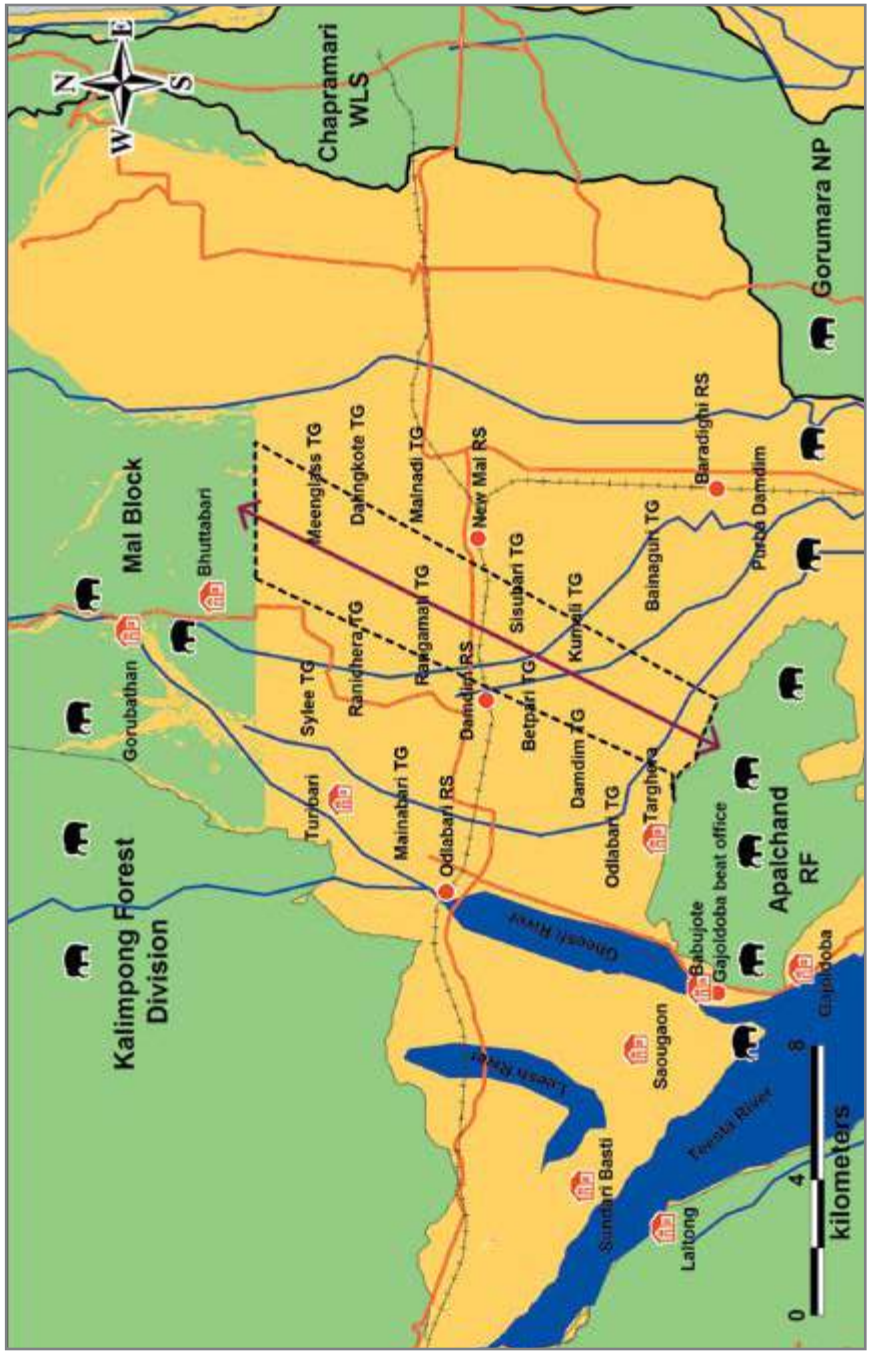
Conservation feasibility: Low

This corridor facilitates elephant movement from Apalchand Reserve Forest (Baikuntapur Forest Division) to Mal Block (Bhuttabari Forest, Kalimpong Forest Division). Elephants pass through the Targhera Forest Range area and cross the Chel River (east of Targhera), and the Damdim, Kumlai, Goodhope, Rungamuttee, Dalingkote and Meenglass Tea Gardens to move between the habitats. National Highway 31 (Odlabari-Mal) and the Siliguri-Alipurduar railway line are the major impediments to elephant movement.

Alternate name	Apalchand-Bhuttabari
State	West Bengal
Connectivity	Mal Block with Apalchand Reserve Forest
Length and Width	14-16 km and 0-2 km
Geographical coordinates	26° 48′ 14″-26° 55′ 37″ N 88° 39′ 7″-88° 45′ 6″E
Legal status	Revenue Land, Forest Land, Tea Garden
Major land use	Forest, plantation, tea garden, army compartment, road and railway line
Major habitation/settlements	Chiklabasti, Sylee Hat and labour colonies of Damdim, Kumlai, Rungamuttee, Dalingkote and Meenglass Tea Gardens
Forest type	Tropical dry to moist deciduous forest
Frequency of usage by elephants	Regular



3D map showing the landscape of the Apalchand – Kalimpong at Mal Block (via Meenglass) Corridor



Map of the Apalchand – Kalimpong at Mal Block (via Meenglass) Corridor

FORESTS AND ELEPHANTS

Corridor habitat status: Vegetation sampling in the Bhuttabari Reserve Forest (Kalimpong Forest Division) revealed that the predominant tree species are *Lagerstroemia speciosa* (43.8%), *Tectona grandis* (37.5%), *Canarium sikkimense* (12.5%) and *Anthocephalus chinensis* (6.2%). Maximum GBH and height was observed in *Tectona grandis* (130 cm) and *Canarium sikkimense* (45 m) respectively. Vegetation sampling in 0.04 ha of Apalchand Reserve Forest revealed that the predominant tree species are *Shorea robusta* (30.8%), *Lagerstroemia parviflora* (23.8%), *Crataeva unilocularis* (7.7%), *Garuga pinnata* (7.7%), *Stereospermum tetragonum* (7.7%), *Bischofia javanica* (7.7%), *Tetrameles nudiflora* (7.7%) and *Amoora wallichii* (7.7%). Maximum GBH and height was recorded in *Shorea robusta*: 320 cm and 45 m respectively.

Ground cover of Bhuttabari Reserve Forest was dominated by shrubs (50%), grasses (15%) and herbs (10%) with the rest as barren ground (25%). Ground cover of Apalchand Reserve Forest was dominated by shrubs (30%), herbs (40%) and grasses (5%), with the rest as barren ground.

Estimated elephant numbers in the landscape

Apalchand Reserve Forest: 50-60
Gorumara National Park & Chapramari Wildlife Sanctuary: 50-60
(West Bengal Elephant Census, 2015)

Forest/Land use

Forest Type: Tropical dry forest, tropical moist deciduous forest and tea garden
Settlements: Khasjungle (Chiklabasti), Damdimhat, and quarters of Damdim, Kumlai, Baintguri, Good Hope, Rungamutte, Meenglass and Dalingkote Tea Gardens
Agriculture: Maize, paddy, betel leaf plantations
Tea Estates: Odlabari, Damdim, Kumlai, Baintbari, Rungamuttee, Goodhope, Dalingkote, Meenglass
Rivers: Chel, Kumlai nullah, Chaiti nullah
Roadways: NH 31, Damdim-Gorubathan road
Railway track: Damdim-New Mal Jn

Other ecological importance

Mountain Range: Eastern Himalayas
Elephant Range: Western Duars (Terai) Region
Elephant Reserve: Eastern Duars Elephant Reserve
Protected Area: Gorumara National Park
Biodiversity Hotspot: Eastern Himalayas

HUMAN DIMENSIONS

Threats

1. *Habitation and settlements*: Expansion of corridor villages, namely Damdimhat and the labour colonies of Rungamuttee Tea Garden, Nedeem Division (Sylee Tea Garden), Barron Division (Sylee Tea Garden), Meenglass Tea Garden and Damdim Tea Garden has narrowed the corridor, hindering elephant movement. The presence of buildings like a Buddhist monastery, Targhera Army Camp and Rungamuttee Army Camp has added to the disturbance.

2. *Grazing and fuelwood*: The increased livestock population and the extraction of fodder and fuelwood from the corridor forest has affected the habitat as well as elephant movement.

3. *High-tension electric lines*: Power lines pass through the corridor and the sagging of these high-tension wires could pose a threat to elephants.

4. *Army compartment*: Army activity areas are an impediment to safe elephant movement.

5. *Railway traffic:* On average, 1.6 trains per hour run from 6 am to 6 pm and 0.9 trains per hour from 6 pm to 6 am, hindering the free movement of elephants.

6. *National Highway 31 (Mal-Siliguri)*: The heavy vehicular traffic on this highway hinders elephant movement.

Corridor villages: Chiklabasti, Sylee Hat, Labour colonies of Damdim, Kumlai, Rungamuttee, Dalingkote and Meenglass Tea Gardens.

Corridor dependent villages: Damdimhat, Damdim Army Camp, Gurjangjhora Tea Garden, Bhuttabari Forest Village Odlabari Tea Garden.

People in the area mostly depend on tea cultivation for their livelihood. A few of the village communities that reside outside the tea garden area are mainly farmers or businessmen. Most people have a favourable disposition towards relocation to safeguard the corridor, as indicated during the initial survey.

Settlement	Status of land	Population
Chayabasa Line	Rungamuttee Tea Garden	1000-1200
Gate Line	Rungamuttee Tea Garden	20-30
Damdim Tea Garden	Tea Garden	7300-7600
Baintbari (Barron Div)	Sylee Tea Garden	1300-1500
Targhera	Revenue Land	800-900
Odlabari Tea Garden	Tea Garden	4400-4600
Damdimhat	Revenue Land	2900-3200
Sailihat / Khasjangal-I	Revenue & Khas	1400-1600
8 No. Basti	Khas Land	350-400
Manpari	Forest Village	45-50
Bhuttabari / Special	Forest Village	250-350
Chikla basti / Khasjangal-II	Khas & Revenue Land	55-65
Sylee Tea Garden	Tea Garden	4500-5000
Rungamuttee Tea Garden	Tea Garden	8000-9000
Kumlai Tea Garden	Tea Garden	4200-4500

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent encroachment and developmental activities detrimental to animal movement.

2. Train frequency should be reduced during the night (8 pm to 5 am) by diverting the trains from New Jalpaiguri Junction towards Falakata.

3. Night patrolling on the railway track passing through the corridor during the elephant migratory season (October to March) will help minimise elephant deaths due to train-hits. Installing an Animal Detection System near the track to alert train drivers will also help.

4. The expansion of the tea garden labour colonies of Damdim, Meenglass, Rungamuttee and Nedeem Division (Sylee Tea Garden) should be prevented. These colonies should be suitably fenced to prevent the entry of elephants and minimise conflict.

5. Vehicular speeds on NH 31 (Odlabari-Damdim) and the Damdim-Gorubathan road should be regulated at night by suitable barriers.

6. The expansion of existing army camps or the construction of new camps must be prohibited inside the corridor area.

7. In consultation with tea estate owners, the labour lines adjoining the Rungamutte Tea Garden factory and the labour colonies of Nedeem Division of Sylee Tea Garden could be relocated to facilitate safe passage of elephants. Alternatives must also be found for 8 No. Basti, which is an encroachment. Until then, the labour lines should be suitably fenced off.

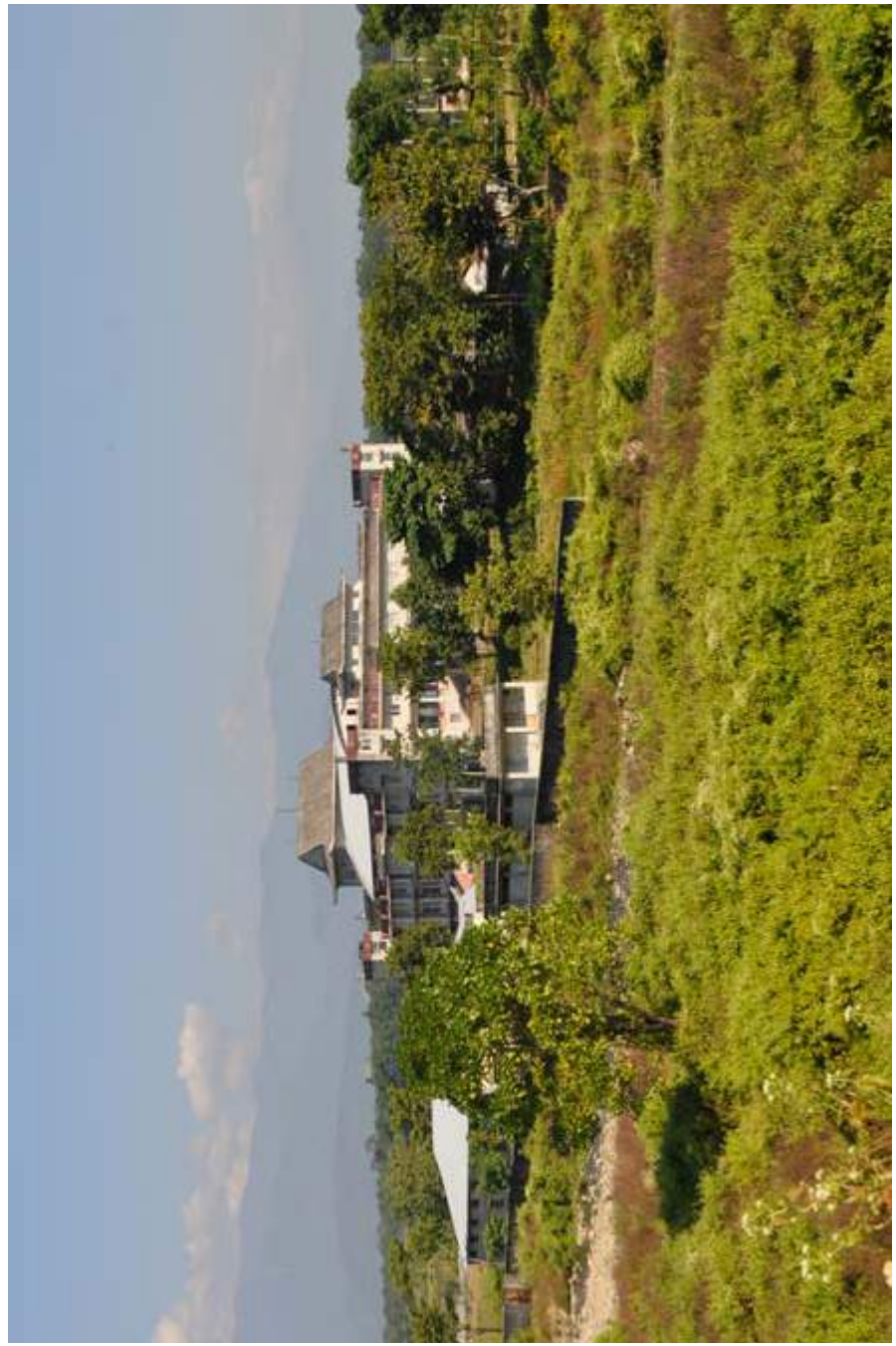


Fig. 6.05: Gumpha and the adjoining Chiklabasti

6.05

CHAPRAMARI - KALIMPONG (MAL BLOCK)

Ecological priority: Medium

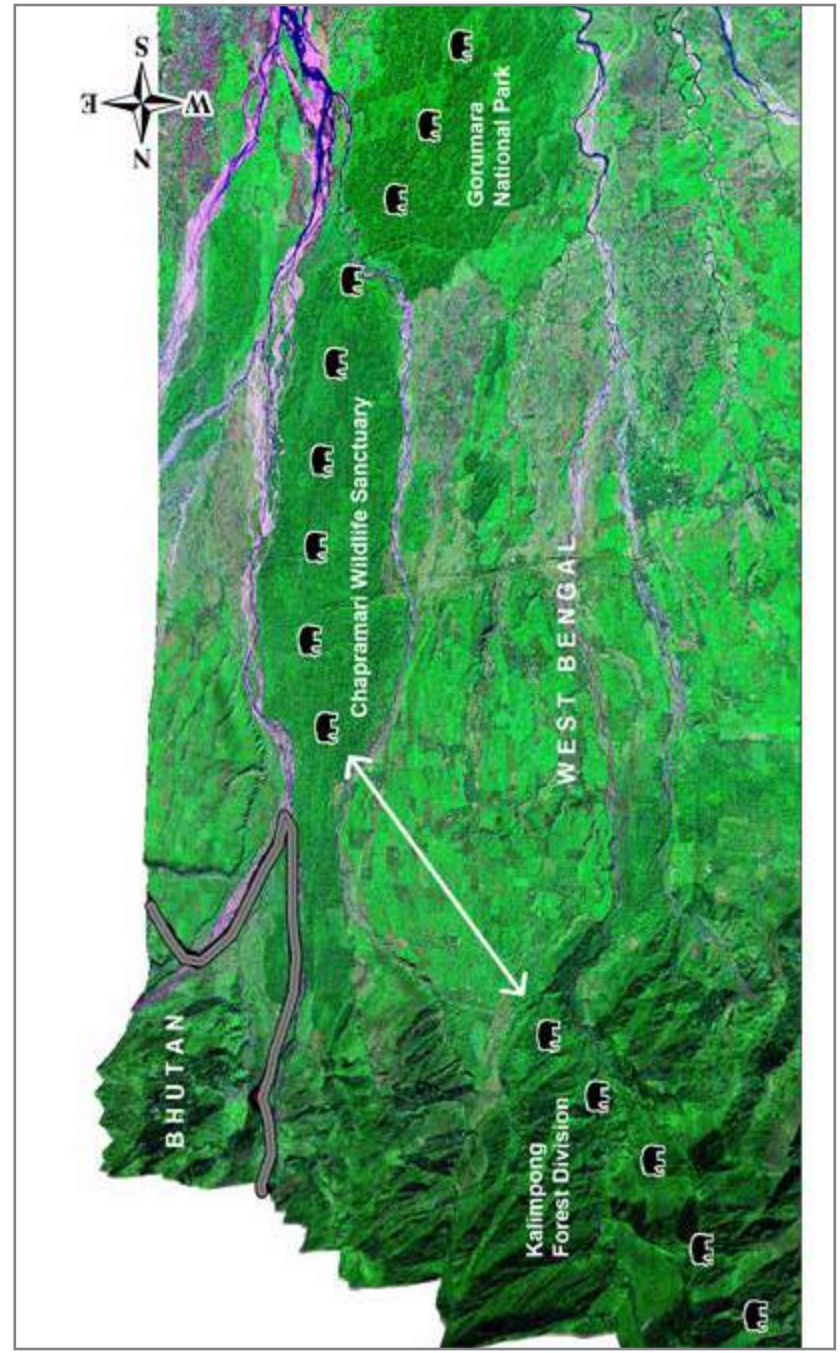
Conservation feasibility: Medium

This corridor facilitates elephant movement between the Mal Block of Kalimpong Forest Division and Chapramari Wildlife Sanctuary of Wildlife Division II. From Chapramari, elephants cross the Murti River near Sardi Line and move between Kilkote and Indong Tea Gardens. After crossing the Chalsa-Matiale road, they pass through the Juranti and Nagaisuree Tea Gardens and cross the Neora River to enter Bhuttabari near Mal-4 Forest Village and Nakti Tea Garden. On occasion they go beyond Nakti and Sonagachi Tea Gardens to Gurjhanjhora and Meenglass Tea Gardens to enter the Mal Block.

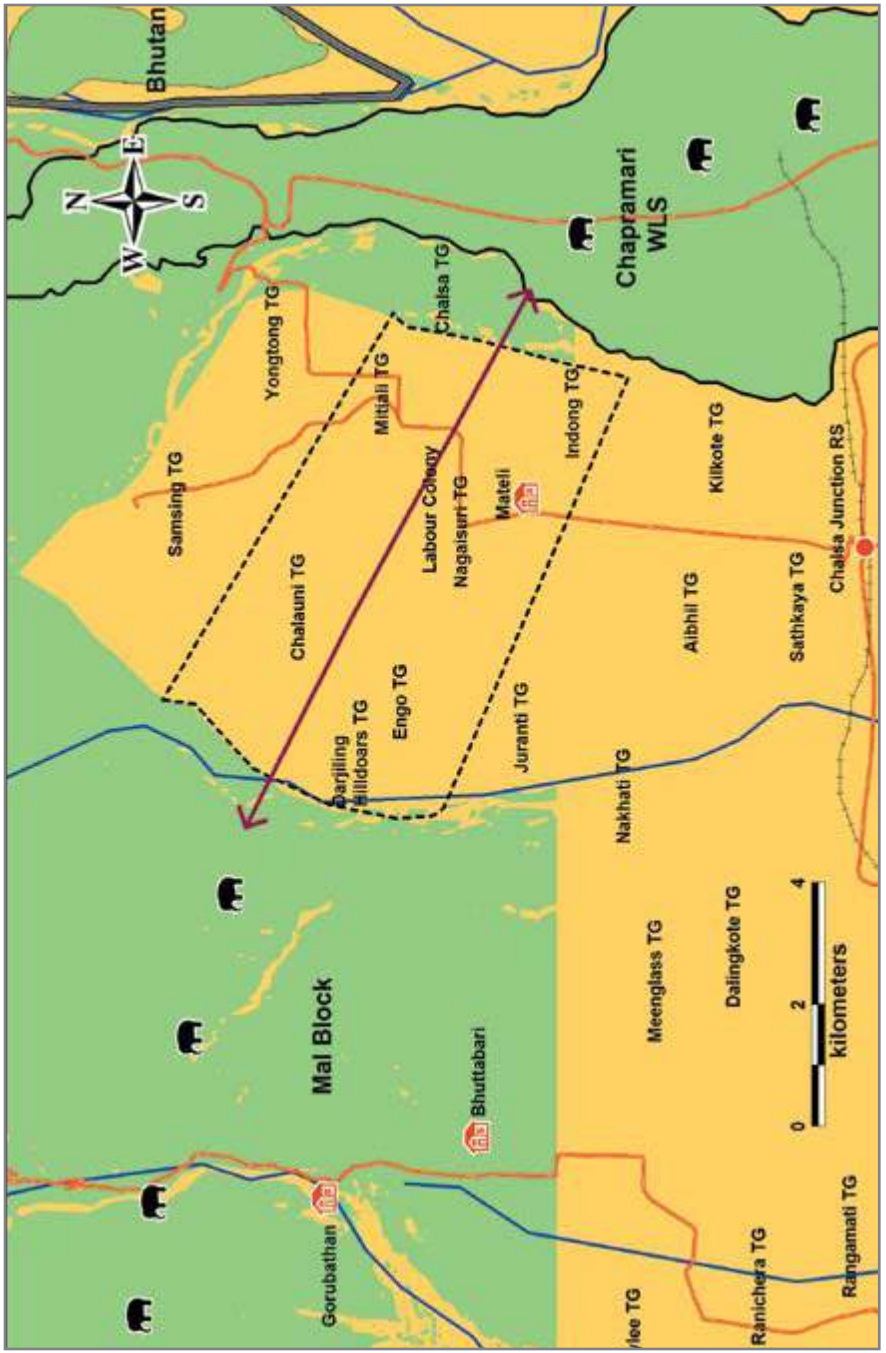
Alternate name	Chapramari-Bhuttabari
State	West Bengal
Connectivity	Chapramari Wildlife Sanctuary with Mal Reserve Forest
Length and Width	8-9 km and 0-2 km
Geographical coordinates	26° 54′ 58″- 26° 59′ 3″ N 88° 45′ 28″- 88° 50′ 28″ E
Legal status	Reserve Forest and Forest Lands leased to Tea Gardens
Major land use	Tea gardens, settlements
Major habitation/settlements	Tea garden colonies of Aibheel, Zurrantee, Nagaisuree
Forest type	Tropical moist deciduous, riparian
Frequency of usage by elephants	Regular

FORESTS AND ELEPHANTS

Corridor habitat status: Tree density was very low (75 trees per ha) in the sampled



3D map showing the landscape of the Chapramari - Kalimpong (Mal Block) Corridor



Map of the Chapramari – Kalimpong (Mal Block) Corridor

areas of Chapramari Wildlife Sanctuary and Kalimpong forest (Bhuttabari Reserve Forest). The predominant tree species are *Amoora wallichii* (33.3%), *Tetrameles nudiflora* (33.3%) and *Terminallia belerica* (33.3%). Maximum GBH and height was recorded in *T nudiflora*: 320 cm and 45 m respectively. Ground cover in Chapramari was dominated by shrubs (50%), grasses (30%), herbs (15%) and barren ground (5%). In Kalimpong (Bhuttabari Forest), ground cover was dominated by shrubs (65%) followed by grasses (30%), herbs (3%) and barren ground (2%).

Estimated elephant numbers in the landscape

Gorumara National Park and Chapramari Wildlife Sanctuary: 68
Kalimpong Forest Division: 8
(West Bengal Elephant Census, 2015)

Forest/Land use

Forest Type: Tropical moist deciduous forest, riparian forest
Settlements: Special Forest Village, tea garden labour colonies of Kilkote, Indong, Nagaisuree, Zurrantee, Aibeel and Nakhati
Agriculture: Paddy, betel nut plantations, maize
Tea Estates: Kilkote, Indong, Nagaisuree, Zurrantee, Aibeel and Nakhati Tea Gardens
Rivers: Murti, Neora, Mal khola
Roadways: Chalsa-Matiali road, Gorubathan road
Buildings: Murti River watch tower, Zurrantee tea garden manager's bungalow, tea garden factories of Kilkote, Aibeel and Zurrantee

Other ecological importance

Elephant Range: Western Duars (Terai) Region
Elephant Reserve: Eastern Duars Elephant Reserve
Protected Area: Gorumara National Park and Chapramari Wildlife Sanctuary
Biodiversity Hotspot region: Eastern Himalayas
IBA: Gorumara National Park (IN-WB-03), Eastern Himalayas (EBA 130)

HUMAN DIMENSIONS

Threats

1. Anthropogenic: Expanding settlements inside the corridor pose a threat. Increased dependency on the forest for fuelwood and cattle fodder has degraded nearby forest areas.

2. Habitat deterioration: Depletion of forest cover is a threat to the corridor as passing elephants doesn't get food or shade.

3. Tea gardens: Tea gardens and labour lines have narrowed down the effective width of the corridor.

Corridor villages: Labour lines of Indong (Amba Chopal), Aibheel (Girja, Gajoldoba, Mongra), Kilkote (Kunja, 11 No. Line), Nagaisuree (Bara Line, 22 No.Line), Nakhati, and Zurrantee (Kaka, Damba, Del, Factory, Neora, Damu) Tea Gardens.

Corridor dependent Villages: Matiali, Chalsa Tea Garden, Indong Tea Garden, Sathkaya Tea Garden, Mal Forest Village.

Settlement	Status of land	Population
Indong	Tea Garden	6500-7000
Aibheel	Tea Garden	4200-4700
Zurrantee	Tea Garden	3000-3500
Nagaisuree	Tea Garden	4800-5500
Kilkote	Tea Garden	4100-4500
Special	Forest Village	500-650
Nakhati	Tea Garden	3900-4300
Matiali	Revenue Land	4200-4600

Settlements inside the corridor depend upon the forest mainly for fuelwood, NTFP, land for agriculture and fodder for their cattle. As most of the corridor lands include tea gardens, the inhabitants here are mainly labourers in the respective tea gardens. High human-elephant conflict is a problem in the area. Farmers have stopped cultivating paddy and maize due to crop depredation.

CONSERVATION PLAN

1. The corridor should be notified by the state forest department and legally protected under an appropriate law to prevent encroachment and developmental activities detrimental to animal movement.

2. Habitat should be restored in the Mal Block of Bhuttabari Reserve Forest between the Mal and Neora Rivers.

3. Expansion of the Kunja (Kilkote Tea Garden) and Amba Chopal (Indong Tea Garden) labour lines as well as Matiali village should be prevented. If possible the corridor area should be declared as an eco-sensitive zone.

4. Special Forest Village, labour lines of Mongra Tea Garden, labour colonies of Aibheel Tea Garden, and the Del and Damu labour colonies of Zurrantee Tea Garden should be protected by suitable barriers. They could also be relocated In consultation with stakeholders.

5. No new construction should be permitted inside the corridor area, especially between the Kunja Line (Kilkote Tea Garden) and Amba Chopal (Indong Tea Garden) labour colonies, and between Special Forest VIllage and Neora Line (Zurrantee Tea Garden).

6.06

RETHI - MORAGHAT

Ecological priority: Medium

Conservation feasibility: Medium

This corridor in Jalpaiguri Forest Division connects Rethi Reserve Forest with Moraghat Reserve Forest and passes mainly through tea gardens (Karbala, Banarhat, Gandrapara and Moraghat). Elephants enter Moraghat Reserve Forest through the Gairkata Range near Totapara Beat. They cross National Highway 31 near the Kalibari railway crossing.

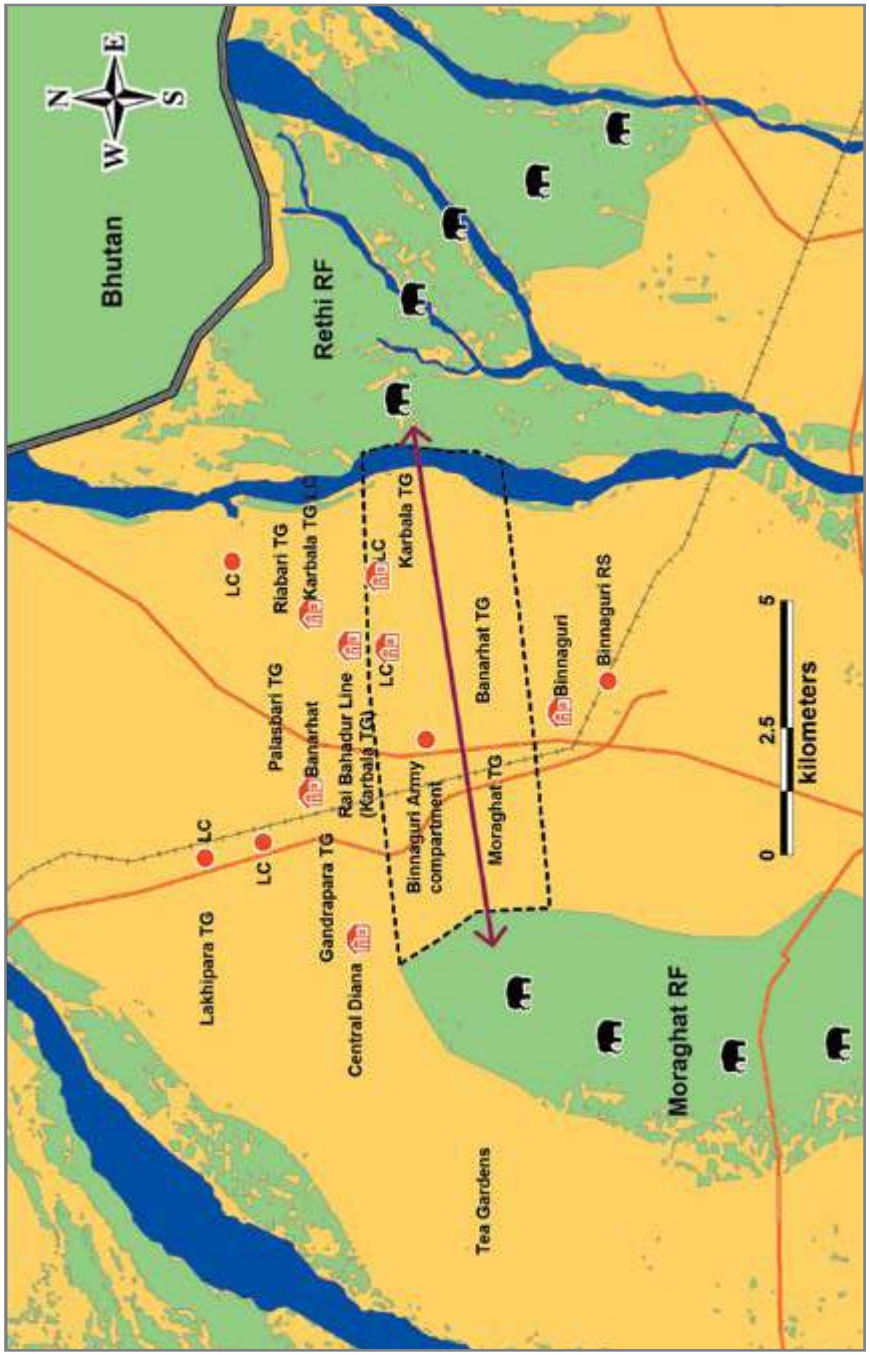
State	West Bengal
Connectivity	Rethi Reserve Forest with Moraghat Reserve Forest under Jalpaiguri Forest Division
Length and Width	12-14 km and 0-1.5 km
Geographical coordinates	26° 45′ 41″- 26° 47′ 41″ N 88° 59′ 56″- 89° 6′ 5″ E
Legal status	Reserve Forest, Revenue Land, Forest Land leased to Tea Gardens
Major land use	Agriculture, tea garden
Major habitation/settlements	Tea garden labour lines of Karbala, Kothi Line (Banarhat), Moraghat
Forest type	Tropical moist deciduous forest and tea gardens
Frequency of usage by elephants	Seasonal and regular

FORESTS AND ELEPHANTS

Corridor habitat status: Vegetation sampling in Rethi Reserve Forest revealed that the predominant species are *Trewia nudiflora* (57.2%), *Amoora wallichii* (21.4%) and *Cassia siamea* (21.4%). Maximum GBH and height was recorded in *Trewia nudiflora*: 400 cm and 45 m respectively. Sampling in Moraghat Reserve



3D map showing the landscape of the Rethi – Moraghat Corridor



Map of the Rethi – Moraghat Corridor

Forest revealed that the predominant tree species is *Shorea robusta* (36.4%), followed by *Tectona grandis* (18.2%), *Lagerstroemia speciosa* (18.2%), *Amoora wallichii* (18.2%) and *Artocarpus chaplasha* (9.1%). Maximum GBH and height was recorded in *Artocarpus chaplasha* and *Shorea robusta* respectively. Ground cover was dominated by shrubs (35%), herbs (15%), grasses (10%) and barren ground (40%). Elephant food species like *Cassia siamea*, *Artocarpus chaplasha* and *Lagerstroemia speciosa* were also recorded in the corridor area.

Estimated elephant numbers in the landscape

Jaldapara National Park: 65-75

Gorumara National Park and Chapramari Wildlife Sanctuary: 50-60

(West Bengal Elephant Census, 2015)

Forest/Land use

Forest Type: Tropical moist deciduous

Settlements: Tea garden labour lines of Karbala, Banarhat, Gandrapara, Moraghat

Agriculture: Maize, wheat, paddy

Tea Estates: Karbala, Banarhat, Gandrapara, Moraghat, Jaybirpara, Dheklapara, Rahimpur, Telepara, Sarugaon

Rivers: Rethi River

Roads & Railways: National Highway 31C (Madarihat-Chalsa), DBITA road, Chamurchi road (Banarhat-Chamurchi-Samtse), Siliguri-Alipurduar ralway line

Buildings: Binnaguri Army Compartment, High School, St. James High School, Duars branch of Indian Tea Association Office, factories of Karbala, Rheabari, Banarhat, Moraghat and Huldibari Tea Gardens.

Other ecological importance

Mountain Range: Eastern Himalayas

Elephant Range: Central Duars (Terai) Region

Elephant Reserve: Eastern Duars Elephant Reserve

Protected Area: Gorumara National Park

Biodiversity Hotspot: Eastern Himalayas

HUMAN DIMENSIONS

Threats

1. An army compartment has partially blocked the elephant corridor and the presence of a firing range has further threatened elephant movement.

2. Tea gardens: The labour lines and factories of Karbala and Moraghat Tea Gardens have reduced the width of the corridor.

3. Railway traffic: Several elephants have died in train-hit incidents in the Banarhat-Carron stretch. On average, 1.6 trains per hour run between 6 am and 6 pm, and 0.9 trains per hour between 6 pm and 6 am, threatening elephant movement.

4. Roadways: Two major roads, NH 31C (Banarhat-Telepara) and the DBITA road (Banarhat-Gairkata), pass through the corridor. Day traffic (6 am to 6 pm) was recorded at 344.8 vehicles per hour, while the traffic between 6 pm and 6 am was 116.2 vehicles per hour.

Corridor villages: Karbala (3500-3800 people), Nepania (1000-1100 people), Kalapani (330-370 people) and Moraghat (3000-3500 people).

Most of the inhabitants find their employment in the tea gardens that dominate the area. The inhabitants of revenue villages are either farmers or businessmen.

Residents of Rheabari, Karbala, Huldibari and Moraghat Tea Gardens are willing to relocate if provided with better facilities. This could be planned in consultation with tea garden owners and managers.

Corridor dependent villages: Huldibari, Binnaguri and Garganda Tea Gardens, Binnaguri Army Compartment, Nepania, Kalapani, Sishu-Jhumra and Sarugaon.

Human-Elephant Conflict: Data from the Jalpaiguri Forest Division between 2005 and 2014 indicates an average of eight to nine human deaths caused annually by elephants, five to six elephant deaths per year, and ex-gratia support of about Rs 19-20 lakh per annum for crop depredation, damage to houses and livestock deaths. More than 50% of the human deaths and property damage caused by elephants have occurred near the periphery of Rethi Reserve Forest.

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent encroachment and developmental activities detrimental to animal movement.

2. The ground surface on either side of the railway track between pole numbers 97/5 and 97/7 should be levelled to facilitate elephant movement. An overpass for the railway line will be the most viable option facilitating elephant movement below.

3. The frequency of trains should be reduced at night (8 pm to 5 am) by diverting the trains from New Jalpaiguri Junction towards the Falakata route.

4. Night patrolling should be initiated on the railway track passing through the corridor during the elephant migratory season (October to March). Installation of an Animal Detection System on the track to alert train drivers will also help.

5. No new construction that obstructs elephant movement should be permitted inside the corridor area, especially between the southern portion of the Bel Line (Karbala Tea Garden) and the Binnaguri Army Compartment and firing range. The labour lines of Karbala, Moraghat and Banarhat Tea Gardens could be power fenced to prevent conflict. The option of voluntary relocation of these settlements could also be explored as a permanent solution.

6. A college is under construction within the corridor, just 400 metres down from the Binnaguri railway level crossing. This will further contrict the corridor, hindering elephant movement. This area should be secured.

6.07

RETHI - CENTRAL DIANA

Ecological priority: Medium

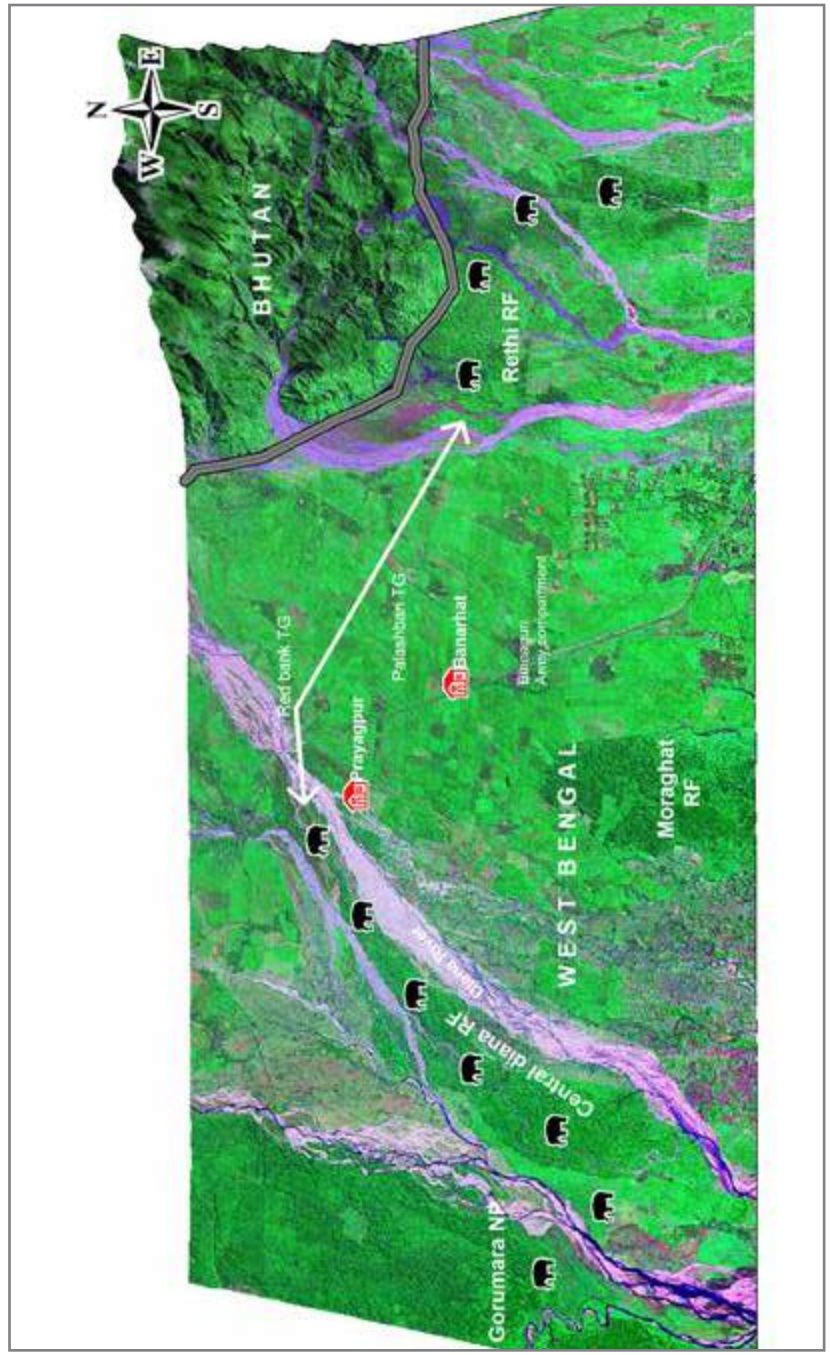
Conservation feasibility: Low

This corridor serves as the major connectivity between Rethi Reserve Forest and Central Diana Reserve Forest, and onwards to Gorumara National Park. Elephants pass through the tea garden areas of Palashbari, Kathalguri, New Dooars, Haritalguri and Choona Bhutti. At Diana River, they take two routes: most of them pass to the north of Red Bank Tea Garden, under the Diana Railway / Roadway Bridge to enter Diana Reserve Forest; others pass to the south of Red Bank Tea Garden, crossing the road between Debpara Tea Garden and Red Bank Tea Garden. Major impediments to elephant movement are the Binnaguri Army Compartment with its nearby firing range, and high vehicular and railway traffic.

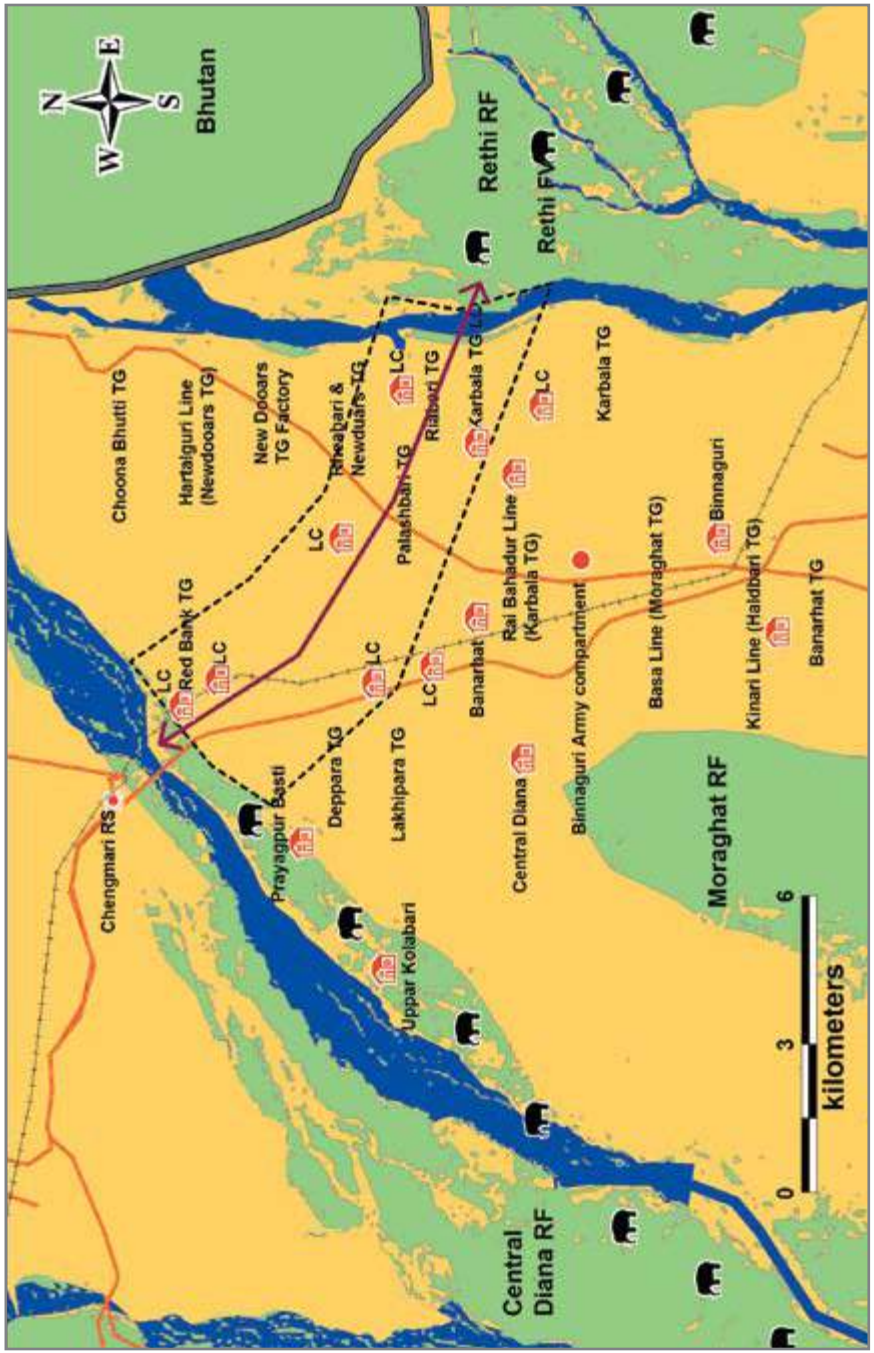
State	West Bengal
Connectivity	Rethi Reserve Forest with Central Diana Reserve Forest
Length and Width	14-16 km and 0-4 km
Geographical coordinates	26° 47’ 25”- 26° 52’ 1” N 88° 59’ 41”- 89° 6’ 3” E
Legal status	Reserve Forest, Forest Lands leased to Tea Gardens, Government-owned
Major land use	Tea gardens, settlements, roads, railways
Major habitation/settlements	Nepania, Kalapani, Prayagpur and tea garden labour colonies
Forest type	Tropical deciduous forest, sal and teak forest
Frequency of usage by elephants	Regular and seasonal

FORESTS AND ELEPHANTS

Corridor habitat status: Tree density was recorded as 350 trees per ha in the



3D map showing the landscape of the Rethi – Central Diana Corridor



Map of the Rethi – Central Diana Corridor

Rethi Reserve Forest. The predominant tree species were *Trewia nudiflora* (57.2%), *Amoora wallichii* (21.4%) and *Cassia siamea* (21.4%). Maximum GBH was recorded in *Tectona grandis* (400 cm).

In the sampled area (0.04 ha) of Diana Reserve Forest, the tree density was estimated as 400 trees per ha. The predominant species were *Tectona grandis* (62.5%), *Bombax ceiba* (18.75%), *Acacia catechu* (12.5%) and *Terminalia muriocarpa* (6.3%). Maximum GBH was observed in *Tectona grandis* (175 cm). Ground cover was dominated by barren ground (40%), followed by shrubs (35%), herbs (15%) and grasses (10%).

Estimated elephant numbers in the landscape

Jaldapara National Park: 65-75
Gorumara National Park & Chapramari Wildlife Sanctuary: 50-60
(West Bengal Elephant Census, 2015)

Forest/Land use

Forest Type: Tropical deciduous, sal forest
Settlements: Nepania Forest Village, Kalapani Forest Village, Prayagpur village, labour colonies of Rheabari, Kathalguri, New Dooars, Palashbari, Diana, and Red Bank Tea Gardens
Agriculture: Maize, paddy, potato, jute
Tea Estates: Rheabari, Kathalguri, Haritalguri, Choona Bhutti, Aambari, New Dooars, Palashbari, Diana, and Red Bank Tea Gardens
Rivers: Rethi River, Diana River
Road: National Highway 31C, Chamurchi road (Banarhat-Chamurchi-Samtse)
Railway Line: Siliguri-Alipurduar
Buildings: Tea garden factories of Rheabari, Kathalguri, New Dooars, Palashbari, Diana and Red Bank

Other ecological importance

Mountain Range: Eastern Himalayas
Elephant Range: Central Duars (Terai) Region
Elephant Reserve: Eastern Duars Elelphant Reserve

Protected Area: Gorumara National Park
Biodiversity Hotspot: Eastern Himalayas

HUMAN DIMENSIONS

Threats

1. Artefacts: Factories and labour lines of Kathalguri, New Dooars, Haritalguri, Red Bank, Aambari and Diana Tea Gardens hinder elephant movement.

2. Army: The firing range of the Binnaguri Army Compartment near the corridor threatens elephant movement due to noise and air pollution.

3. Road traffic: Vehicular traffic is one of the major threats to the free movement of elephants in this corridor. A peak traffic intensity of 366 vehicles per hour was recorded on NH 31C between Binnaguri and Chalsa from 5 pm to 6 pm. On average, 286.1 vehicles per hour plied between 6 am and 6 pm, and 86.3 vehicles per hour plied between 6 pm and 6 am.

4. Railway traffic: Several elephants have been killed due to train-hit incidents in the stretch between Banarhat and Carron in recent years. On average, 1.6 trains per hour run between 6 am and 6 pm, and 0.9 trains per hour run between 6 pm and 6 am, posing a severe threat to free movement of elephants.

Corridor villages: Nepania, Kalapani, Prayagpur; tea garden labour colonies of Red Bank, Rheabari, Palasbari and Karbolla.

Corridor dependent villages: Tea garden labour colonies of Aambari, Debpara and Choona Bhutti.

The forest villages and the revenue villages located inside the corridor are mostly dependent on the nearby forest areas for fuelwood, NTFP, agricultural land and cattle grazing. Most inhabitants are labourers in the tea gardens that dominate the area. Most of them complained of escalating crop depredation by elephants, and some have stopped paddy/maize farming due to the severity of the issue.

Most of the people interviewed expressed their support for any relocation plan in the belief that this would reduce conflict with elephants.

Locality	Status of land	Population
Nepania	Forest Village	1000-1100
Kalapani	Forest Village	330-370
Rheabari	Tea Garden	5200-6000
Haritalguri	Tea Garden	2900-3300
New Dooars	Tea Garden	2600-2800
Prayagpur	Revenue Village	100-150 inside corridor
Kathalguri	Tea Garden	5200-5800
Red Bank	Tea Garden	4000-4500
Diana	Tea Garden	3100-3500

Human-Elephant Conflict: Data from the Jalpaiguri Forest Division between 2005 and 2014 indicates an average of eight to nine human deaths caused annually by elephants, five to six elephant deaths per year, and ex-gratia support of about Rs 19-20 lakh per annum for crop depredation, damage to houses and livestock deaths. More than 50% of the human deaths and property damage caused by elephants have occurred near the periphery of Rethi Reserve Forest.

CONSERVATION PLAN

1. The corridor should be notified by the state forest department and legally protected under an appropriate law to prevent encroachment and developmental activities detrimental to animal movement.

2. The ground surface on either side of the railway track between pole number 86/2 and 86/3 should be levelled to facilitate elephant movement.

3. Train frequency should be reduced at night (8 pm to 5 am) by diverting trains from New Jalpaiguri Junction towards the Falakata route.

4. Night patrolling should be initiated on the railway track passing through the

corridor during the elephant migratory season (October to March). An Animal Detection System (ADS) should be installed along critical sections of the track to detect elephant movement and alert train drivers.

5. Expansion of the Red Bank labour line should be controlled.

6. Vehicular speeds should be controlled at night on NH 31C by suitable physical barriers.

7. In consultation with the stakeholders, labour lines of Palashbari Tea Gardens could be relocated by providing suitable rehabilitation packages.

8. Settlements of the Kathalguri, New Dooars, Haritalguri, Diana and Red Bank Tea Gardens could be fenced off with suitable barriers to prevent conflict as well as expansion in the corridor area. These settlements could also be relocated to alternative sites in consultation with the villagers and tea garden management.

9. Afforestation in the Kathalguri, Palashbari, Aambari, Red Bank, Diana and Choona Bhutti areas would facilitate safe passage for elephants.

10. No new construction should be permitted inside the corridor, especially between the Kathalguri-Rheabari-Karbala Tea Garden settlements.



Fig. 6.06: Diana River



Fig. 6.07: Red Bank Tea Garden Factory

6.08

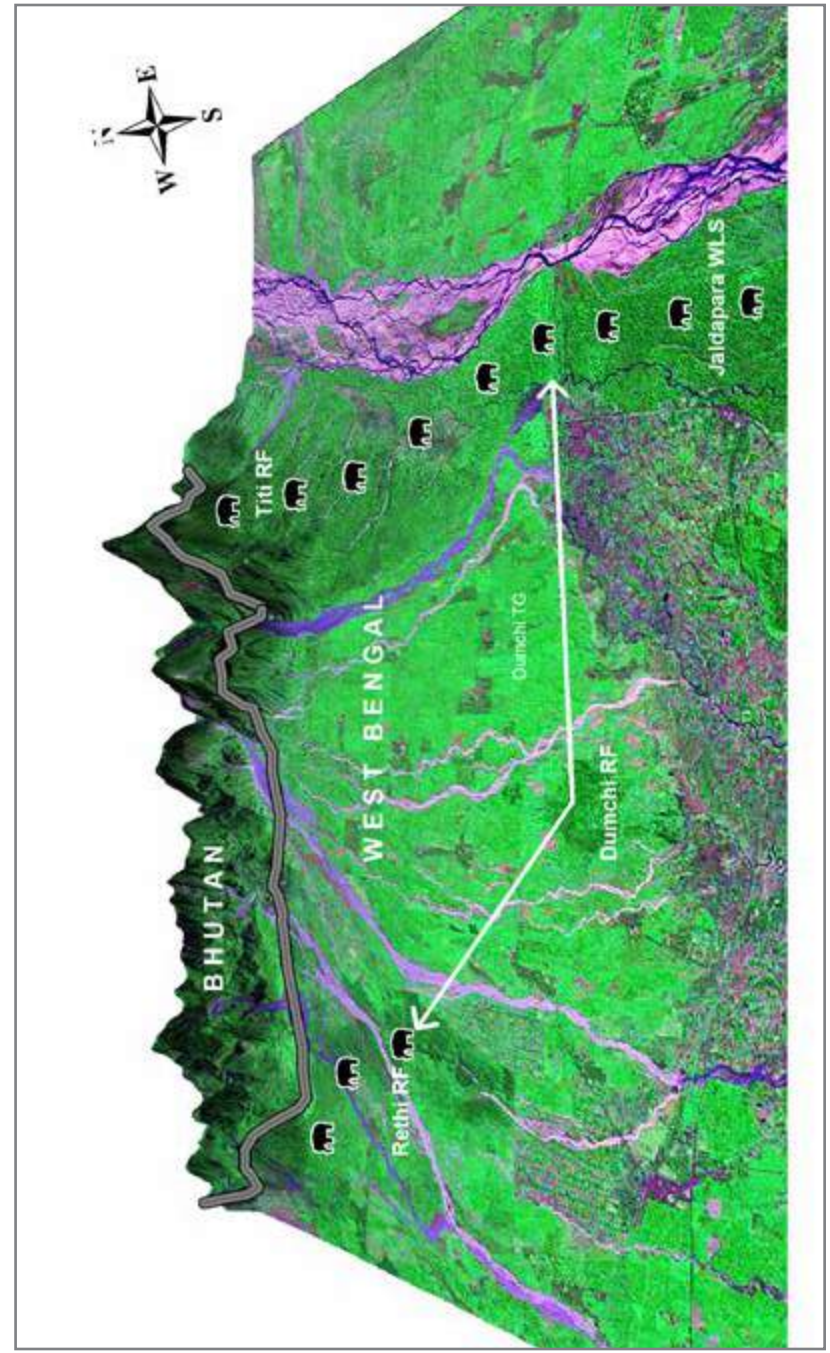
TITI - RETHI VIA DUMCHI

Ecological priority: Medium

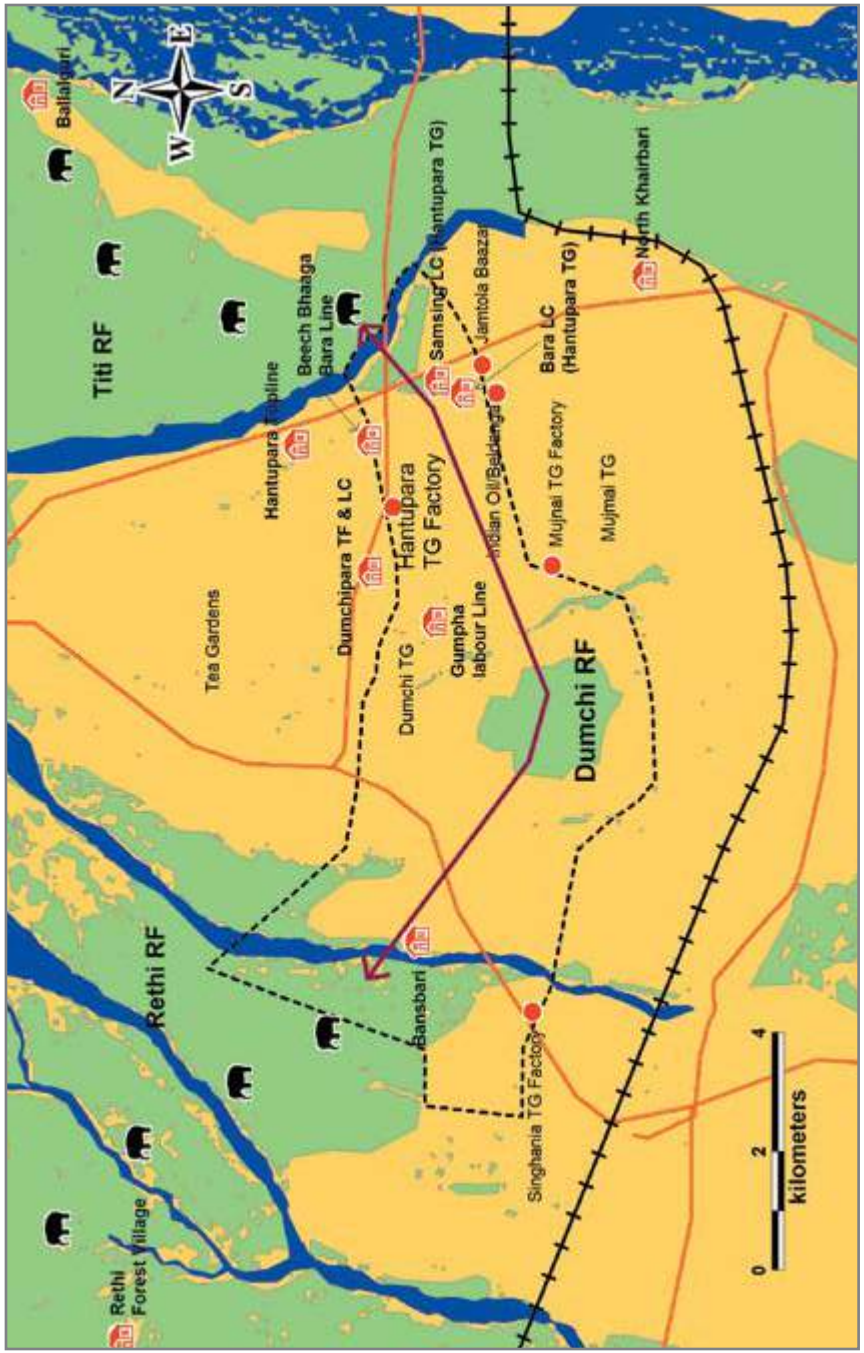
Conservation feasibility: Medium

This corridor links Titi Reserve Forest (the northern part of Jaldapara National Park; Wildlife Division III) with Rethi Reserve forest (Jalpaiguri Forest Division), passing through Dumchi Reserve Forest. Elephants cross the Titi River to enter a small patch of forest (Holong). They cross the Madarihat-Totopara road between Jamtola Bazar and Hantupara Bara Line and reach Dumchi Reserve Forest, passing through Mujnai and Hantupara Tea Gardens. From Dumchi the elephants pass through Gopalpur and Singhania Tea Gardens and enter Rethi Reserve Forest either through the north or the south of Dalmore Garo Basti.

State	West Bengal
Connectivity	Titi Reserve Forest with Rethi Reserve Forest via Dumchi Reserve Forest (Jaldapara National Park with Gorumara National Park)
Length and Width	14-16 km and 1-2 km
Geographical coordinates	26° 42′ 37″- 26° 46′ 39″ N 89° 8′ 34″- 89° 17′ 14″ E
Legal status	Reserve Forest, Revenue Land, Forest Land leased to Tea Gardens
Major land use	Agriculture, tea gardens, forest and settlements
Major habitation/settlements	Dalmore Garo Basti, Hantupara, Samsing and Gumpha Tea Garden labour quarters, Beldanga
Forest type	East Himalayan moist mixed deciduous
Frequency of usage by elephants	Seasonal and regular, but mostly by bulls and small herds



3D map showing the landscape of the Titi – Rethi via Dumchi Corridor



Map of the Titi – Rethi via Dumchi Corridor

FORESTS AND ELEPHANTS

Corridor habitat status: Vegetation sampling in Dumchi Reserve Forest revealed that the predominant tree species were *Shorea robusta* (71%), *Terminalia bellerica* (14%) and *Trewia nudiflora* (14%). Maximum GBH was observed in *Shorea robusta* (245 cm). The ground cover was dominated by shrubs (35%), grasses (35%) and barren ground (30%).

Vegetation sampling in Rethi Reserve Forest reveals that the tree density is as high as 362.8 trees per ha. The predominant tree species were *Tectona grandis* (37.9%), *Trewia nudiflora* (27.6%), *Cassia siamea* (24.1%) and *Amoora rohituka* (10.4%). Maximum GBH and height was recorded in *Trewia nudiflora*: 400 cm and 35 m respectively. The ground cover was dominated by shrubs (40%), barren ground (30%), herbs (20%) and grasses (10%).

Of the total sampled area in Titi Reserve Forest, a total of 12 trees species were recorded. The predominant species were *Shorea robusta* (27.3%), *Castanopsis sp* (18.2%), *Tetrameles nudiflora* (12.1%), *Amoora wallichii* (9.1%). There is a salt lick near the Holapara village area which possibly meets the mineral needs of elephants.

Estimated elephant population in the landscape

Jaldapara National Park: 65-75

Gorumara National Park & Chapramari Wildlife Sanctuary: 50-60

(West Bengal Elephant Census, 2015)

Forest/Land use

Forest Type: East Himalayan moist mixed deciduous, tropical moist deciduous, northern dry deciduous, eastern sub-mountain semi evergreen

Settlements: Dalmore Garo Basti, labour lines of Dalmore, Gopalpur, Ramjhora, Singhania, Hantupara and Dumchipara Tea Gardens, Beldanga village

Agriculture: Maize, wheat, paddy, beetlenut

Tea Estates: Gopalpur, Singhania, Dalmore, Ramjhora, Makrapara, Tulsipara, Hoasinbad, Hantupara, Mujnai and Dumchipara

Rivers: Duti-Sukti Nadi, Pugli River, Garganda River, Birbitti Nadi, Rethi River, Titi Nadi, Bandri Nadi
Roadways: Lankapara road, Makrapara road, Madarihat-Lankapara road, Hat-Totopara road, Garganda road
Buildings: Dalmore Forest Beat Office; tea garden factories of Dalmore, Gopalpur, Ramjhora, Hantupara, Mujnai and Dumchipara; Jamtola Bazaar, Indian Oil filtration unit

Other ecological importance
Mountain Range: Eastern Himalayas
Elephant Range: Central Duars (Terai) Region
Elephant Reserve: Eastern Duars Elephant Reserve
Protected Area: Jaldapara National Park & Gorumara National Park
Biodiversity Hotspot: Eastern Himalayas

HUMAN DIMENSIONS

Threats
1. *People's dependency* on the corridor forest for fuelwood, illegal timber and cattle fodder is high.

2. *Indian Oil filtration unit* and its settlements are bounded by high walls that have blocked part of the corridor.

3. *Settlements* are closer to the major townships of Birpara (North Bengal) and Pugli (Bhutan). Expansion of Dalmore Garo Basti and Ramjhora village settlements has further narrowed down the corridor towards Rethi Reserve Forest.

4. *Trenches* used for drainage inside the tea gardens hinder the free movement of elephants.

5. *Vehicular traffic:* Daytime traffic is high on the Makrapara road due to vehicles carrying finished products from the dolomite mine and cement factory in Bhutan.

A large number of public transport and daily supply vehicles ply on the Lankapara road. Vehicular traffic on the merging point of these roads was 34.3 vehicles per hour from 6 am to 6 pm and 16.8 vehicles per hour from 6 pm to 6 am. The peak frequency from 4 pm to 5pm and 5 am to 6 am was 45-50 vehicles per hour.

Corridor villages: Tea garden labour line colonies of Gumpha, Hantupara, Samsing, Dalmore Garo Basti and Beldanga.

Corridor dependent villages: Labour colonies of Gopalpur, Ramjhora, Singhania, Mujnai and Dumchipara Tea Gardens.

Settlement	Status of land	Population
Dumchi	Forest Village	350-400
Dalmore Tea Garden	Labour Line	8500-9000
Dalmore Garo Basti	Revenue Village	6000-6500
Beech Bhaga	Hantupara Tea Garden	330-380
Bara Line	Hantupara Tea Garden	900-1000
Samsing Line	Hantupara Tea Garden	400-500
Gumpha Line	Hantupara Tea Garden	250-300
Beldanga Village	Revenue Village	125-150
Hantupara Topline	Hantupara Tea Garden	200-220

Most of the inhabitants here are daily wage labourers in the tea gardens. Tea garden labour lines comprise people of multi-ethnic origins with a high percentage belonging to Scheduled Castes and Scheduled Tribes (SC/ST). At least 85% of villagers belong to the ST category and are greatly dependent on forest land for agriculture, firewood and NTFP.

Human-Elephant Conflict: Dumchi Forest Village (Rava Basti) on the fringes of Dumchi Reserve Forest poses a threat to the forest and suffers a lot of damage due to elephants.
Based on figures from the forest department, damage was found to be high in Madarihat Range (WL III Division) and Dalmore Range (Jalpaiguri Division). In

Wildlife III Division (Cooch Behar) alone, an average of seven persons are killed every year (2003-2013) due to conflict. More than rupees nine lakh is spent annually on compensation for crop, house and livestock damage by elephants.

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent encroachment and developmental activities detrimental to animal movement.

2. Habitat restoration needs to be undertaken inside Dumchi Reserve Forest on a priority basis.

3. People from the southern part of the Hantupara Tea Garden labour line (Bara Line) could be voluntarily relocated to increase the corridor width by about 500 m.

4. No new construction obstructing elephant movement should be permitted inside the corridor areas, especially between Bara Line (Hantupara Tea Garden) and Beldanga village, and from the Makrapara Tea Garden area to Dalmore Garo Basti and Sighania Tea Garden factory. The villages should be suitably fenced off to minimise conflict and prevent their expansion in the corridor area.

5. Trenches inside the tea gardens should be filled in.



Fig. 6.08: Dumchi Reserve Forest

6.09

MORAGHAT - CENTRAL DIANA

Ecological priority: Medium

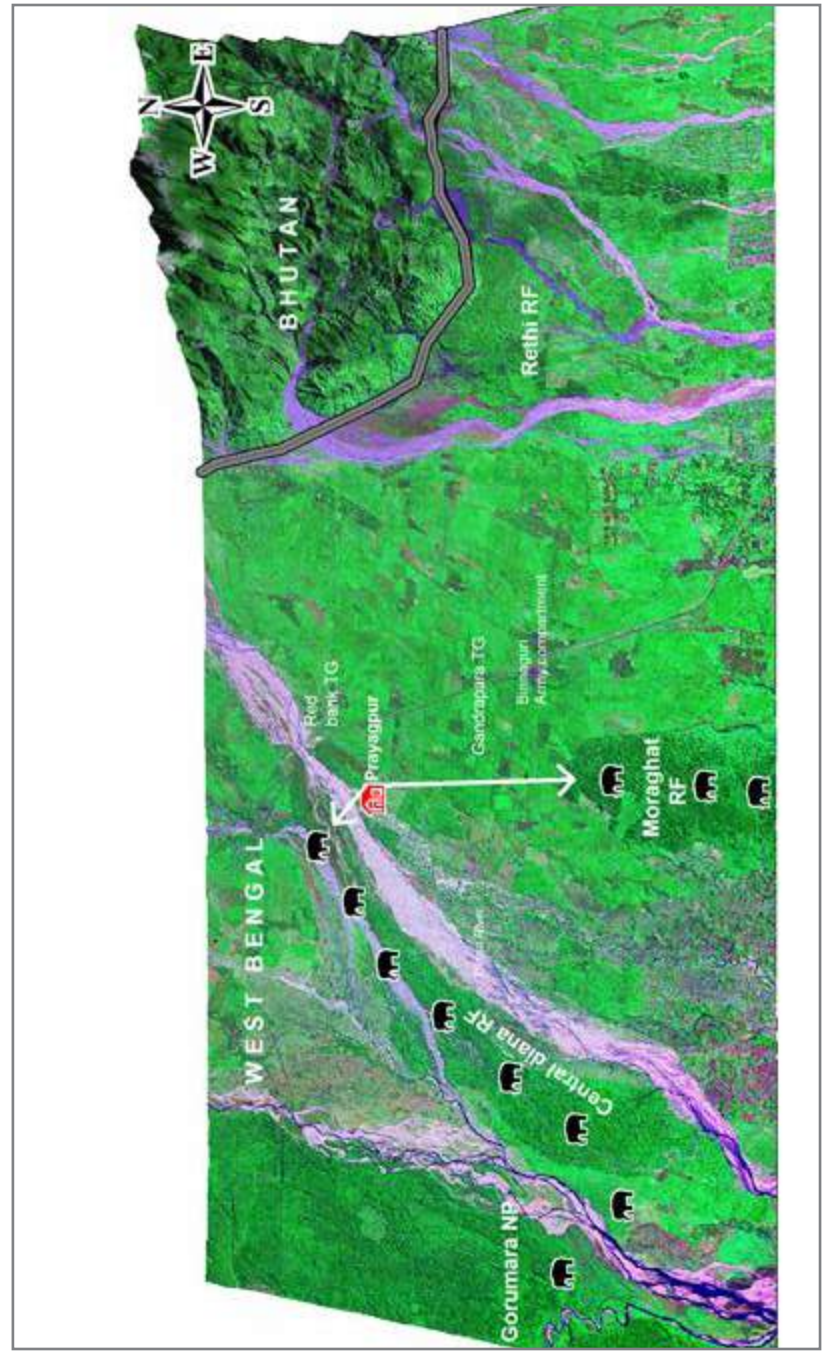
Conservation feasibility: Medium

The Moraghat - Central Diana corridor connects Moraghat Reserve Forest with Diana Reserve Forest of Jalpaiguri Forest Division, leading on to Gorumara National Park. From Moraghat Reserve Forest, elephants move from either side (mostly the north) of Totapara Forest Village and pass through Totapara and Gandrapara Tea Gardens, Jalapara village, Prayagpur, Hridaypur and Upar Kolabari to reach Diana Reserve Forest after crossing the Diana River.

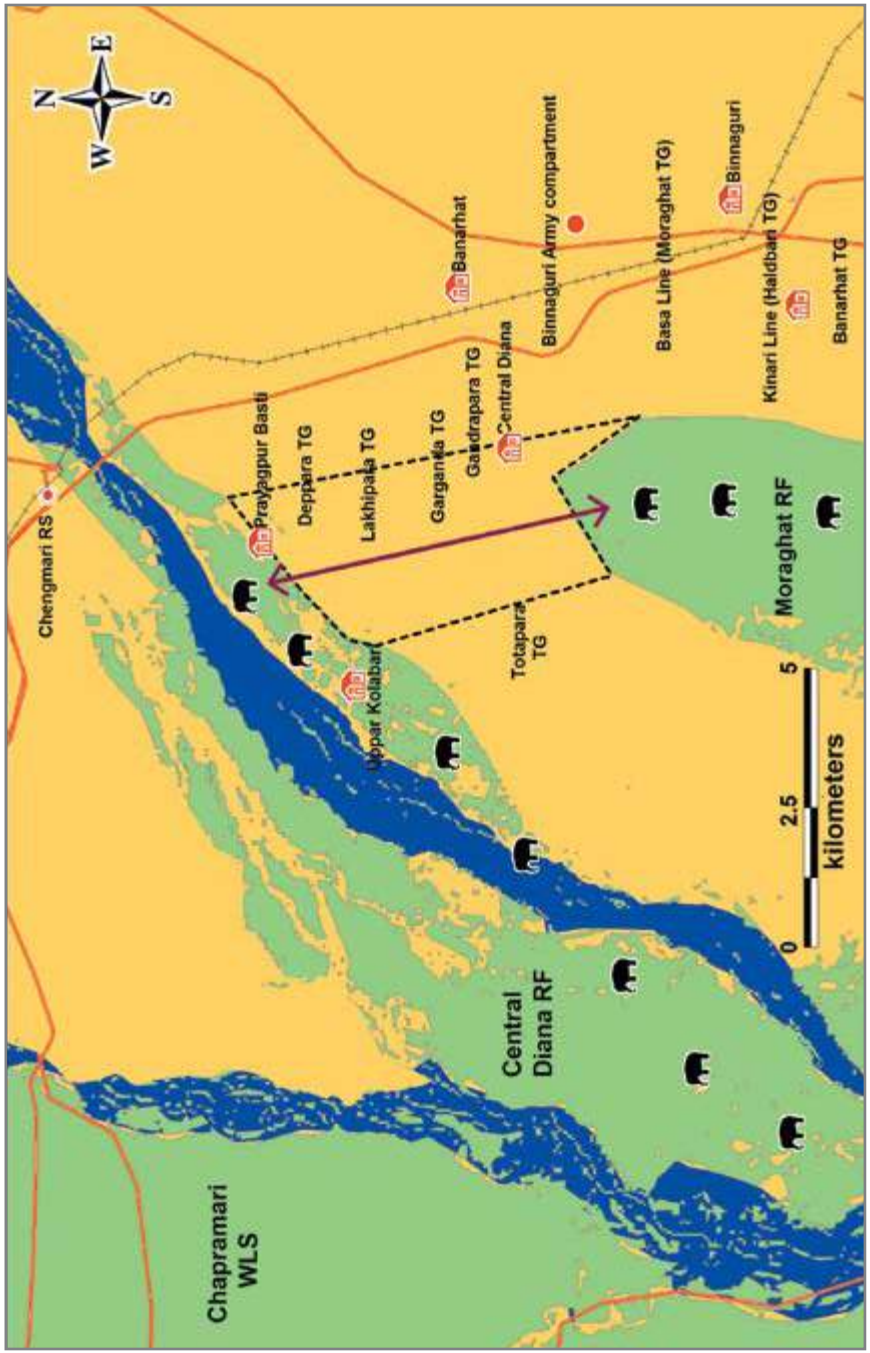
State	West Bengal
Connectivity	Moraghat Reserve Forest with Diana Reserve Forest
Length and Width	7-8 km and 1.5 km
Geographical coordinates	26° 46′ 28″- 26° 50′ 28″ N 88° 58′ 5″- 89° 0′ 35″ E
Legal status	Reserve Forest, Revenue Land, Forest Land leased to Tea Gardens
Major land use	Forest, settlements, tea gardens
Major habitation/settlements	Tea garden labour quarters of Gandrapara and Prayagpur
Forest type	Tropical moist deciduous forest
Frequency of usage by elephants	Regular; used by small herds and bulls mostly between October and January

FORESTS AND ELEPHANTS

Corridor habitat status: The sampled area in Moraghat Reserve Forest revealed that the predominant tree species were *Shorea robusta* (36.4%), *Tectona grandis* (18.2%), *Lagerstroemia speciosa* (18.2%), *Amoora wallichii* (18.2%) and *Artocarpus chaplasha* (9.1%). Maximum GBH and height was recorded in *Artocarpus chaplasha*



3D map showing the landscape of the Moraghat – Central Diana Corridor



Map of the Moraghat – Central Diana Corridor

and *Shorea robusta* respectively. Ground cover was dominated by shrubs (35%), herbs (15%), grasses (10%) and barren ground (40%). Elephant food species like *Cassia siamea, Artocarpus chaplasha and Lagerstroemia speciosa* were also recorded in the corridor area.

Estimated elephant population in the landscape

Jaldapara National Park: 65-75
Gorumara National Park & Chapramari Wildlife Sanctuary: 50-60
(Source: West Bengal Elephant Census, 2015)

Forest/Land use

Forest Type: Tropical moist deciduous
Settlements: Labour quarters of Gandrapara and Totapara Tea Gardens; Jalapara village, Upar Kolabari village, part of Hridaypur village and Prayagpur village
Agriculture: Maize, wheat, paddy, potato, jute
Tea Estates: Gandrapara, Totapara
Rivers: Diana River
Roadways: Khairkata-Prayagpur road, Banarhat-Hridaypur road
Buildings: Totapara market, factories of Gandrapara and Totopara Tea Gardens

Other ecological importance

Mountain Range: Eastern Himalayas
Elephant Range: Central Duars (Terai) Region
Elephant Reserve: Eastern Duars Elephant Reserve
Protected Area: Reserve Forest
Biodiversity Hotspot: Eastern Himalayas

HUMAN DIMENSIONS

Threats

1. Settlements: Totapara Forest Village, Upar Kalabari, Prayagpur and Hridaypur, and the labour lines of Totapara and Gandrapara Tea Gardens exert biotic pressure on the corridor habitat.

2. The low socio-economic status of inhabitants increases their dependency on the neighbouring forest for timber, fruits, fuelwood, cattle fodder etc

3. A large extent of the corridor is occupied by revenue land and crop fields.

4. Apart from tea gardens and settlements, the remainder of the corridor is under cultivation.

Corridor villages: Prayagpur, Gandrapara Tea Garden labour quarters

Corridor dependent villages: Totapara Tea Garden, Jalapara village, Upar Kolabari village, part of Hridaypur village

Name	Status of land	Population
Totapara	Tea Garden	2200-2500
Gandrapara	Tea Garden	2800-3000
Jalapara	Revenue Land	1900-2200
Prayagpur	Revenue Land	500-800
Hridaypur	Revenue Land	800-1000
Upar Kolabari	Revenue Land	600-900
Totapara	Forest Village	150-180

The greater part of the corridor is revenue and agricultural land. The inhabitants occupying the revenue land depend upon agriculture or small-scale businesses. People here mostly belong to the Scheduled Caste or Scheduled Tribe catergory.

Human-Elephant Conflict: Most of the conflict occurs in the fringes of Moraghat Reserve Forest. Other than tea gardens, there are agricultural fields within the corridor area. The villages of Upar Kolabari and Hridaypur face high levels of conflict with elephants. As per data obtained from Jalpaiguri Forest Division, Moraghat Range alone accounts for about 15.6% of the total compensation disbursed by the division.

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent encroachment and developmental activities detrimental to animal movement.

2. No new construction should be permitted inside corridor areas especially between Totapara and Gandrapara Tea Gardens.

3. Farming of crops not palatable to elephants should be encouraged in corridor areas instead of paddy, maize, ragi or potato. The villagers have to be sensitised and provided with support in this regard.

4. Habitat restoration from the north of Moraghat Reserve Forest (Totapara) to the east bank of Diana River would provide cover for the safe movement of elephants.

6.10

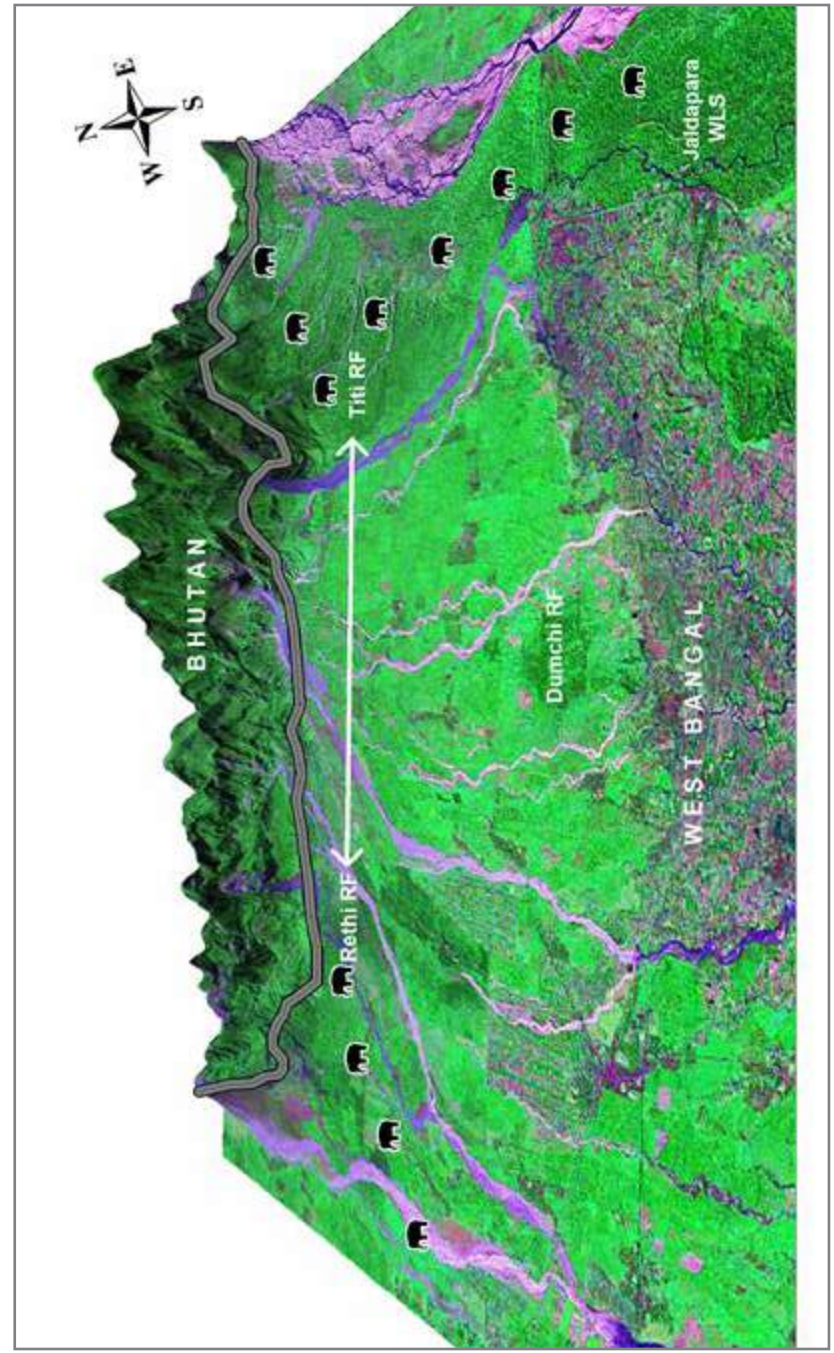
TITI - RETHI

Ecological priority: Medium

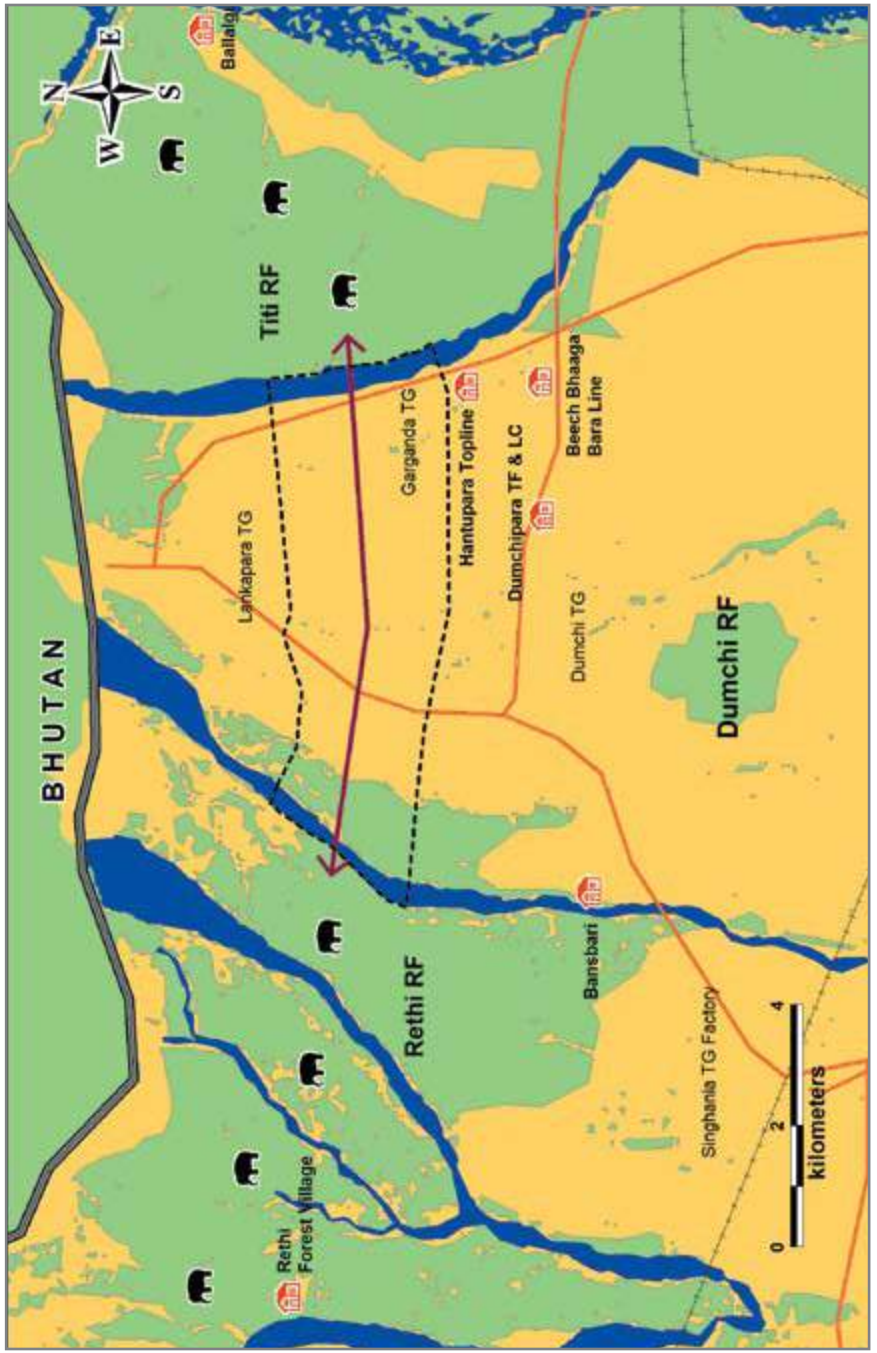
Conservation feasibility: Medium

This corridor links Titi Reserve Forest (the northern part of Jaldapara National Park, Wildlife III Division) with Rethi Reserve Forest (Jalpaiguri Forest Division), leading on to Gorumara National Park. Elephants pass through the Garganda, Lankapara and Tulsipara Tea Gardens, Duti River, Pugli River and the Makrapara Tea Garden area, and enter Rethi Feserve Forest through a narrow stretch of land between Dalmore Garo Basti and Belgachia Line (Makrapara Tea Garden).

Alternate Name	Garganda-Lankapara-Makrapara Corridor
State	West Bengal
Connectivity	Titi Reserve Forest (Lankapara Range) to Rethi Reserve Forest
Length and Width	8-9 km and 700-1300 m
Geographical coordinates	26° 45′ 59″- 26° 47′ 37″ N 89° 10′ 12″- 89° 15′ 49″ E
Legal status	Reserve Forest, Forest Land leased to Tea Gardens
Major land use	Agriculture, tea gardens
Major habitation/settlements	Labour colonies of Garganda and Lankapara Tea Gardens
Forest type	Northern dry deciduous seral sal, eastern sub-mountain semi evergreen, tropical moist deciduous forest
Frequency of usage by elephants	Regular and seasonal



3D map showing the landscape of Titi – Rethi corridor



Map of Titi – Rethi corridor

FORESTS AND ELEPHANTS

Corridor habitat status: Vegetation sampling in Ballalguri (a part of Titi Reserve Forest) revealed that a minimum of eight tree species are found, of which three are elephant food species: *Albizzia lucida* (Patkasiris), *Castanopsis sp* (Bhuise katus), *Strebulus asper* (Sunthale). The highest GBH was measured in *Tetrameles nudiflora* (Chothra/Morungo): 520 cm. A natural salt lick near Lankapara meets the mineral needs of elephants in the area.

The Titi forest fringe mostly had barren ground (75%), followed by shrubs (20%), herbs (4%) and grasses (1%). Ground cover on the fringes of Rethi Reserve Forest was mostly defined by barren ground (60%), followed by shrubs (30%). The rest of the ground was found to be covered by Pteridophytes (10%).

Estimated elephant numbers in the landscape

Jaldapara National Park: 65-75
Buxa Tiger Reserve (West): 118
Gorumara National Park & Chapramari Wildlife Sanctuary: 50-60
(West Bengal Elephant Census, 2015)

Forest/Land use

Forest Type: Tropical moist deciduous, northern dry deciduous, eastern sub-mountain semi evergreen
Settlements: Labour colonies of Garganda and Lankapara Tea Gardens
Agriculture: Paddy, beetlenut
Tea Estates: Garganda, Lankapara, Tulsipara, Makrapara, Hantupara and Dumchipara Tea Gardens
Rivers: Titi, Bandri, Duti–Sukti, Pugli
Roadways: Madarihat-Lankapara Hat road, Lankapara road, Makrapara road
Buildings: Garganda Tea Garden Factory, Lankapara Tea Garden Factory, Makrapara Tea Garden Factory, Lankapara Hat (market)

Other ecological importance

Elephant Range: *Central Duars (Terai) Region*

Elephant Reserve: Eastern Duars Elephant Reserve
Protected Area: Buxa Tiger Reserve and Jaldapara National Park
Biodiversity Hotspot: Eastern Himalayas

HUMAN DIMENSIONS

Threats

1. *Biotic pressure* on the corridor forest is moderate. Local communities mostly belong to the tea gardens and depend on the forest for fuelwood, timber and cattle fodder.

2. *Labour colonies* of Garganda and Lankapara Tea Gardens are located in the corridor.

3. *The expansion of the corridor and dependent villages* severely hinders animal movement and has resulted in high conflict.

4. *Trenches* inside tea gardens, used for water drainage, hinder elephant movement.

5. *Sand and boulder mining* on the Titi River affect the corridor.

6. *Vehicular traffic:* Daytime traffic is high on the Makrapara road due to vehicles carrying material from the dolomite mine and cement factory in Bhutan. A large number of public transport and daily supply vehicles ply on the Lankapara road. Vehicular traffic on the merging point of these roads was 34.3 vehicles per hour from 6 am to 6 pm and 16.8 vehicles per hour from 6 pm to 6 am. The peak frequency from 4 pm to 5pm and 5 am to 6 am was almost 45-50 vehicles per hour.

Corridor villages: Tea garden labour colonies of Garganda and Lankapara.

Corridor dependent villages: Makrapara Tea Garden and Dalmore Garo Basti.

Name	Status of land	Population
Garganda	Tea Garden	4700 - 5000
Lankapara	Tea Garden	12400 - 13000
Makrapara	Tea Garden	3300 - 3700
Dalmore Garo Basti	Revenue Land	6000-6500

The entire area of the corridor passes through various tea gardens. At least 30% of the inhabitants belongs to the SC/ST category and work as labourers in the tea gardens. Settlements experience high human-elephant conflict in terms of damage to property and lives.

Human-Elephant Conflict: In Wildlife III Division (formerly Cooch Behar Forest Division) and Jalpaiguri Forest Division, human-elephant conflict mostly occurs in Madarihat Range (WL III) and Dalmore Range.

On an average, Wildlife III Forest Division and Jalpaiguri Forest Division annually pay over Rs 9 lakh and Rs 13.5 lakh respectively to compensate for property damage (crops, houses and livestock) by elephants.

CONSERVATION PLAN

1. The corridor should be notified by the state forest department and legally protected under an appropriate law to prevent encroachment and developmental activities detrimental to animal movement.

2. Labour lines of Garganda Tea Garden (Babu Line, Factory Line) need to be secured in consultation with the tea garden owners. If a consensus for relocation cannot be reached, these areas could be fenced off to prevent the entry of elephants.

3. Sand and boulder mining on the Titi River should be prohibited inside corridor areas.

4. Several steep trenches running through tea gardens inside the corridor area need to be levelled.

5. No new construction should be permitted inside the corridor area especially between Lankapara and Hantupara Tea Garden settlements and inside the Garganda Tea Garden area. The area could also be notified as an eco-sensitive zone to prevent change in land use.



Fig. 6.09: Lankapara Hat village in the Titi-Rethi Corridor



Fig. 6.10: Rakti River at Lankapara with Jaldapara National Park in the background

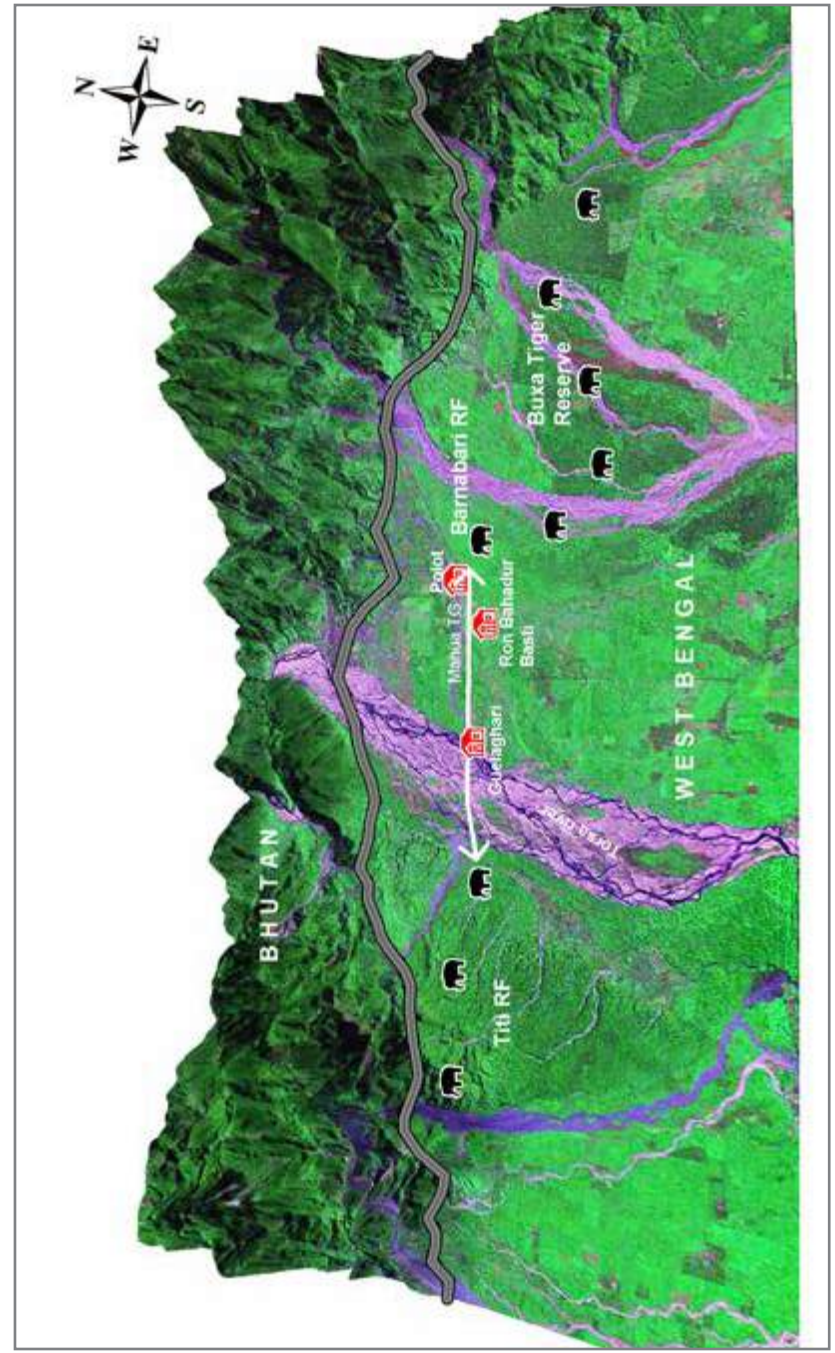
6.11
BUXA-TITI (VIA TORSA)

Ecological priority: Medium

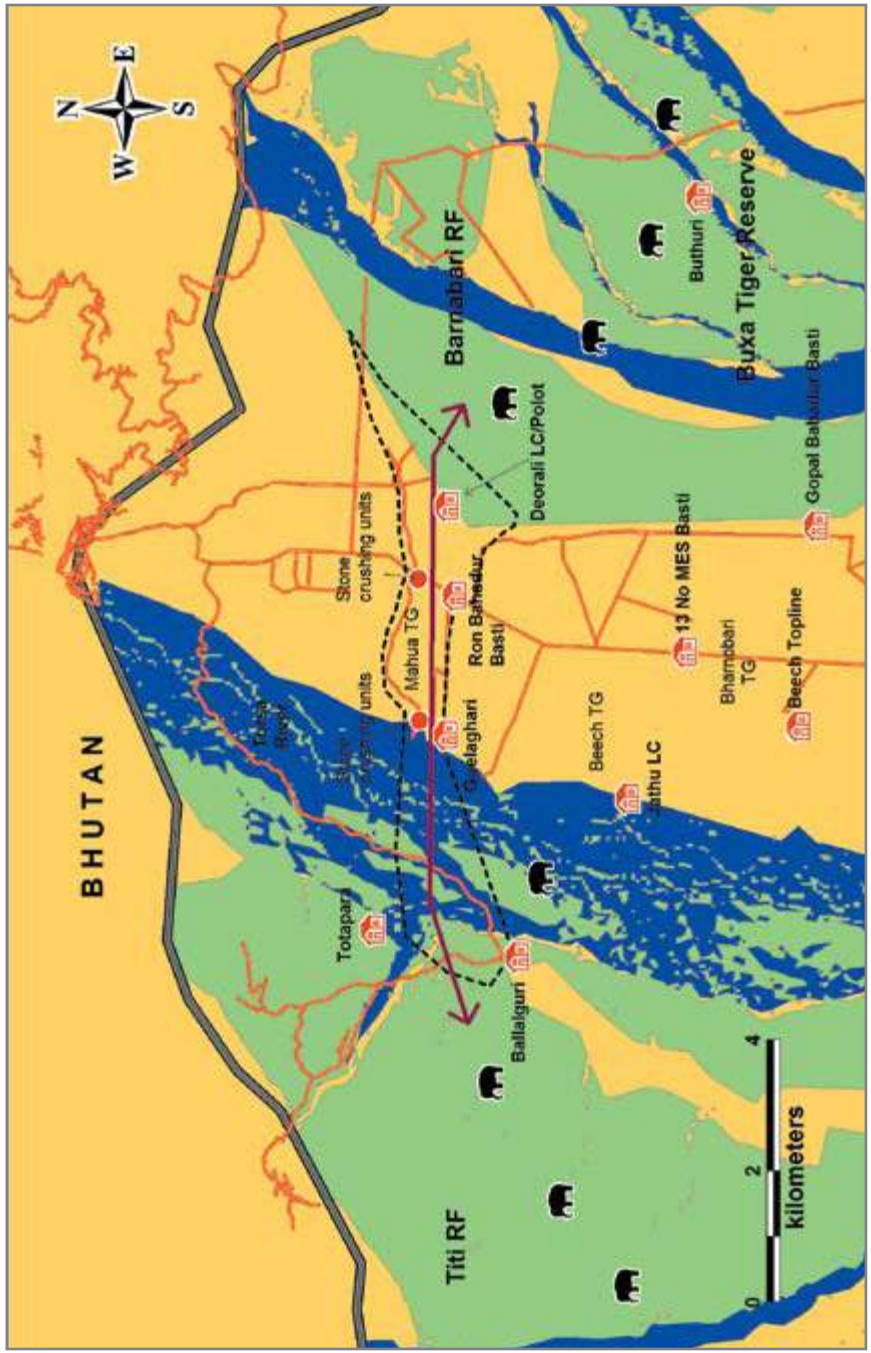
Conservation feasibility: Medium

This corridor connects Buxa Tiger Reserve and Titi Reserve Forest, leading further on to Jaldapara National Park. Elephants move along the Gobarjyoti stream and fringes of Deorali Line, Torsa Tea Garden, Mahua Tea Garden and Ron Bahadur Basti. State Highway 12A intersects the corridor near Mahua Tea Garden. The Deorali Line settlement, clusters of micro-scale sand and stone mining along the Gobarjyoti stream, and high traffic on State Highway 12A are major threats to elephant movement in the area.

Alternate Name	Rangamati
State	West Bengal
Connectivity	Buxa Tiger Reserve (Hamiltonganj Range) and Titi Reserve Forest (Lankapara Range)
Length and Width	12-14 km and 0 - 400 m
Geographical coordinates	26° 48′ 11″- 26° 49′ 34″ N 89° 18′ 43″- 89° 24′ 45″ E
Legal status	Reserve Forest, Revenue Land, Forest Land leased to Tea Gardens
Major land use	Agriculture, tea gardens, settlements, sand and stone mining
Major habitation/settlements	Ron Bahadur Basti, Deorali Line (Polot village)
Forest type	Tropical and eastern sub-mountain semi evergreen forest; northern dry deciduous sal forest; riparian forest; plantation forest
Frequency of usage by elephants	Seasonal and occasional



3D map showing the landscape of the Buxa – Titi (via Torsa) Corridor



Map of the Buxa – Titi (via Torsa) Corridor

FORESTS AND ELEPHANTS

Corridor habitat status: Vegetation sampling in Buxa Tiger Reserve revealed that about 70-80% of area is open forest. The predominant species found in the recent plantation were *Albizzia lucida* (44%) and *Tectona grandis* (50%). The maximum GBH recorded was only 35 cm. Ground cover was dominated by shrubs (50%), followed by grasses (40%) and barren ground (10%).

In the area sampled in Titi Reserve Forest, the predominant tree species were *Castanopsis sp* (30%), *Litsea salicifolia* (10%), *Amoora wallichii* (10%), *Tetrameles nudiflora* (10%) and *Crataeva unilocularis* (10%). The maximum GBH observed was in *Tetrameles nudiflora* (520 cm). Ground cover was dominated by barren ground (75%), followed by shrubs (20%) and herbs (5%).

Estimated elephant numbers in the landscape

Buxa Tiger Reserve: 215
Jaldapara National Park: 65-75
(West Bengal Elephant Census, 2015)

Forest/Land use

Forest Type: Tropical semi evergreen forest, northern dry deciduous sal forest, eastern sub-mountain semi evergreen forest, riparian forest, plantation forest
Settlements: Ron Bahadur Basti, Guelaghari village, Polot/ Deorali Line, Ballalguri village
Agriculture: Maize, ragi, paddy, beetlenut
Tea Estates: Mahua, Torsa, Dalsingpara Tea Gardens
Rivers: Basra River, Gobarjyoti stream, Torsa River
Roadways: Hasimara-Phuentsholing road (SH 12A)
Buildings: Mahua Tea Garden factory, multiple stone crushing and sand mining units

Other ecological importance

Mountain Range: Eastern Himalayas
Elephant Range: Eastern Duars (Terai) Region
Elephant Reserve: Eastern Duars Elephant Reserve

Protected Area: Tiger Reserve, National Park and Reserve Forest
Biodiversity Hotspot: Eastern Himalayas
IBA: Buxa Tiger Reserve (IN-WB-01), Eastern Himalayas (EBA 130)

HUMAN DIMENSIONS

Threats

1. *The expanding settlements* of Ron Bahadur Basti and Deorali Line on either side of SH 12A have constricted the width of the corridor to about 400 m, which has resulted in increased human-elephant conflict.

2. *Sand and stone mining*; Multiple clusters of temporary stone crushing units as well as sand mining activity along the Gobarjyoti stream hinder elephant movement.

3. *Vehicular traffic*: There is a high volume of traffic on SH 12A (Hasimara-Phuentsholing), which is the major road connection between Bengal and Bhutan, connecting Alipurduar, NH 31C with Phuentsholing and Thimpu. About 300 vehicles per hour ply on the road from 6 am to 6 pm, and 59 vehicles per hour ply from 6 pm to 6 am.

4. *A proposed Asian Highway and railway line* between Hasimara and Bhutan are potential threats to the unhindered movement of elephants.

Corridor villages: Ron Bahadur Basti, Deorali Line (Polot Village). The primary occupation of local communities here is as labourers in the tea gardens, though they do practice agriculture as well. Farmers of Deorali Line have, however, stopped agricultural activities due to severe crop depredation by elephants. Beetlenut plantations are abundant throughout Ron Bahadur Basti, providing a secondary source of income to the villagers. A majority of the families living in these villages belong to the SC or ST category.

Corridor dependent villages: Ballalguri and Guelagharia

Village	Households	Population
Deorali Line	200-220	1000-1200
Ron Bahadur Basti	280-300	1200-1600
Guelaghari	380-400	1500-2000
Ballalguri	350-400	1500-2000

Human-Elephant Conflict: The incidence of human-elephant conflict is reasonably high in the corridor area. In the Hamiltonganj Range of Buxa Tiger Reserve, eight elephant deaths and seven human deaths were reported between 2003 and 2013. In Wildlife III Divison (Titi Reserve Forest), around 23 elephant deaths and 49 human deaths were reported during this period.

CONSERVATION PLAN

1. The corridor should be notified by the state forest department and legally protected under an appropriate law to prevent encroachment and developmental activities detrimental to animal movement.

2. Construction hindering elephant movement should not be allowed in the corridor area.

3. Vehicular speed should be controlled by suitable barriers on the Hasimara-Phuentsholing road which passes through the corridor.

4. Adequate mitigation measures for the proposed Asian Highway and railway line between Hasimara and Bhutan must be taken to safeguard elephant movement.

5. The elephant habitats of the Buxa forest fringes, especially between Deorali and the southern part of Gopal Bahadur Basti should be restored to facilitate safe passage of elephants.

6. Land use change inside Mahua, Toorsa, and Dalsingpara Tea Gardens should be strictly prohibited.

7. Sand and stone mining along the Gobarjyoti stream within the corridor area should be banned.

8. Encouraging eco-tourism and fostering plantations for fuelwood and fodder supply would help to decrease the forest dependency of local communities.

9. In Deorali Line, villagers have stopped cultivating their lands with paddy, maize or ragi as elephants damage the entire farmland each year. In dire frustration, villagers are willing to relocate to a safer place, away from elephants. Part of the village (upstream of Gobarjyoti stream from the SH 12A bridge) should be relocated.



Fig. 6.11: Stone mining operation on Gobarjyoti River in Buxa-Titi (Torsa)

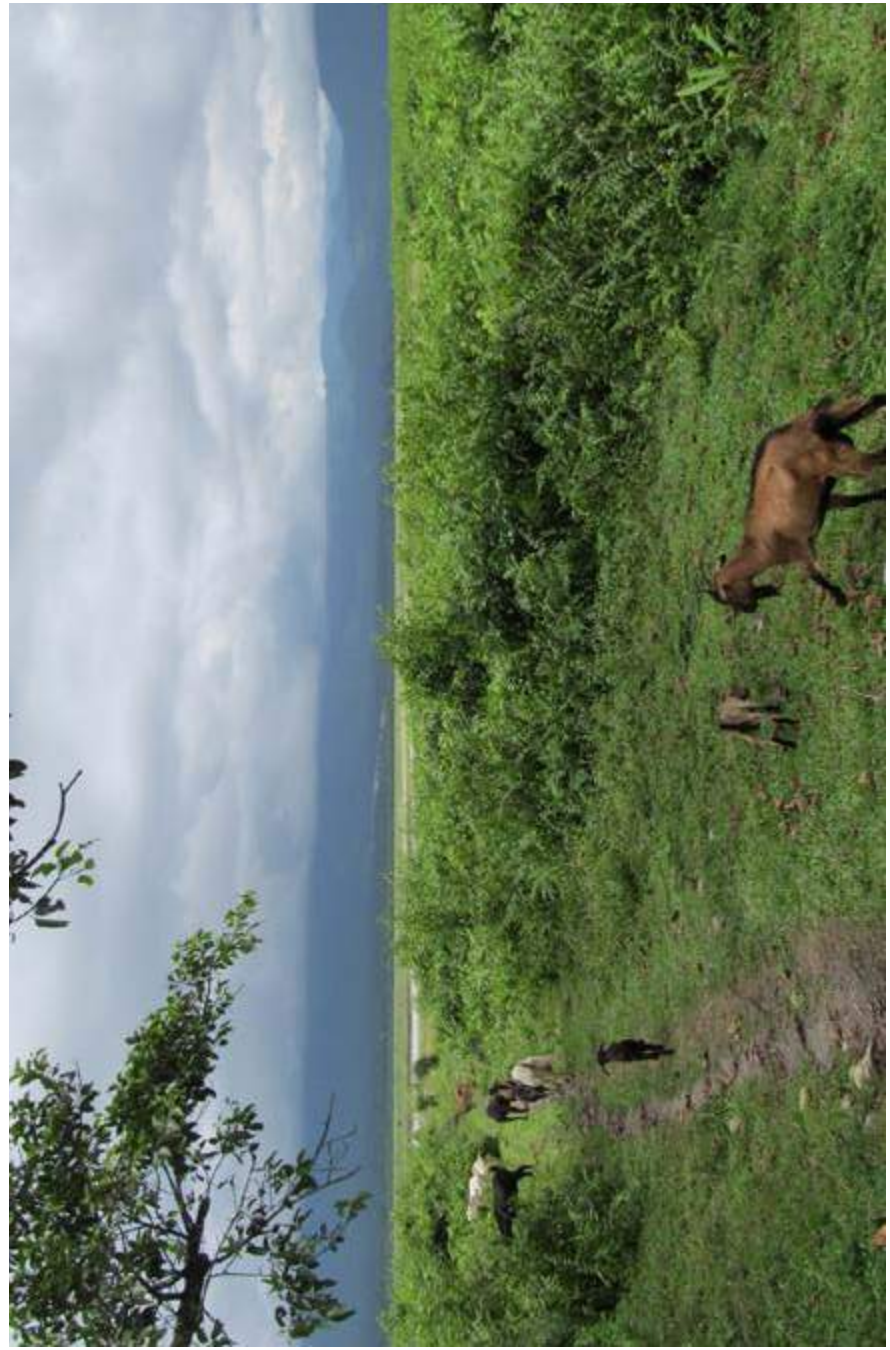


Fig. 6.12: Torsa River plain with Titi Reserve Forest in the background

6.12

BUXA - TITI

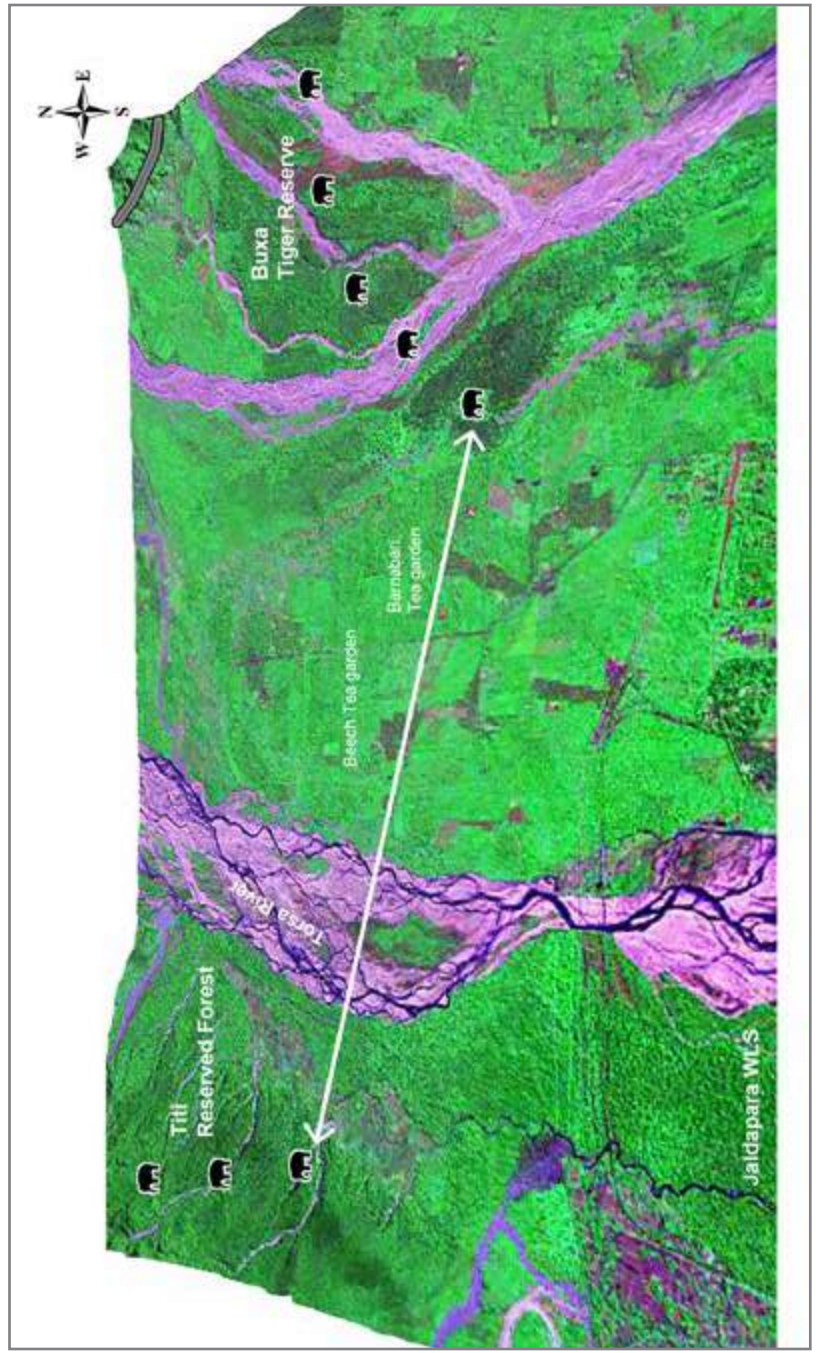
(VIA BEECH & BHARNOBARI TE)

Ecological priority: High

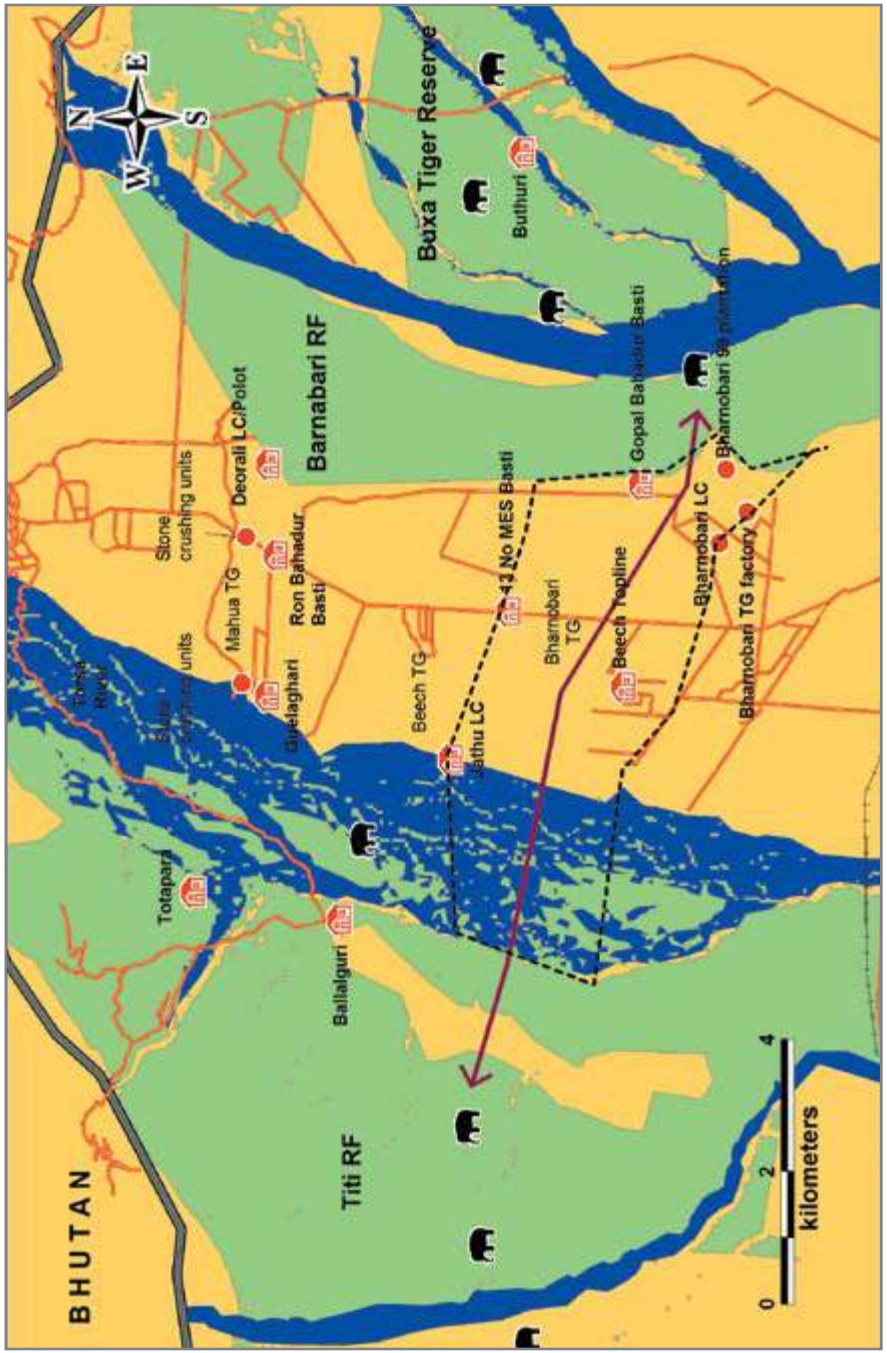
Conservation feasibility: Medium

This is an important corridor which connects Buxa Tiger Reserve and Titi Reserve Forest (Wildlife III Division), thereby connecting the elephant population between Buxa Tiger Reserve and Jaldapara National Park. From Buxa, elephants pass through Gopal Bahadur Basti till Bharnobari Tea Garden, then move between Beech and Dalsingpara Tea Gardens to enter Titi Reserve Forest near Ballalguri. High vehicular traffic on State Highway 12A, which passes through the corridor, and trenches running along this highway hinder animal movement. This is one of the most favoured corridors between Buxa Tiger Reserve and Titi Reserve Forest.

Alternate name	Beech-Bharnobari Tea Estate Corridor
State	West Bengal
Connectivity	Buxa Tiger Reserve (Hamiltonganj Range) and Titi Reserve Forest (Lankapara Range)
Length and Width	5-6 km and 0-1.5km
Geographical coordinates	26° 44′ 22″- 26° 47′ 19″ N 89° 18′ 24″- 89° 23′ 26″ E
Legal status	Reserve Forest and Revenue Land
Major land use	Reserve Forest, patta lands, forest land leased to tea gardens
Major habitation/settlements	Agriculture, tea gardens and settlements. Gopal Bahadur Basti and Beech Garden Topline
Forest type	Tropical and eastern sub-mountain semi evergreen forest; northern dry deciduous sal forests; riparian and plantation forests
Frequency of usage by elephants	Regular



3D map showing the landscape of the Buxa – Titi Corridor



Map of the Buxa – Titi Corridor

FORESTS AND ELEPHANTS

Corridor habitat status: Vegetation sampling in the Buxa forest fringes showed that about 50% of the area was open forest while some trees were found only in a plantation area which is approximately 15 years old. Tree plantation was dominated by *Amoora wallichii* (42%) and *Cassia siamea* (28%), with a maximum GBH of 100 cm and 110 cm and an average maximum height of 26 m and 24 m respectively. The ground cover was dominated by shrubs (50%), followed by grasses (40%) and barren ground (10%).

In the Titi forest fringes, the predominant tree species were *Castanopsis sp* (30%), *Litsea salicifolia* (10%), *Amoora wallichii* (10%) and *Tetrameles nudiflora* (10%), with scattered populations of *Albizzia lucida* and *Strebulus asper*. Maximum GBH was recorded in *Tetrameles nudiflora* (520 cm). Average tree density was estimated as 500 trees per ha. Ground cover was dominated by barren ground (75%), followed by shrubs (20%) and herbs (5%). There is a salt lick near the Holapara village area that could meet the mineral needs of elephants.

Estimated elephant numbers in the landscape

Buxa Tiger Reserve: 215
Jaldapara National Park: 65 -75
(West Bengal Elephant Census, 2015)

Forest/Land use

Forest Type: Tropical semi evergreen forest, riparian forest, plantation forest, northern dry deciduous sal forest, eastern sub-mountain semi evergreen forest
Settlements: Gopal Bahadur Basti, Beech Tea Garden labour line, Bharnobari Tea Garden labour Line, Ballalguri village
Agriculture: Maize, paddy, ragi, betelnut
Tea Estates: Beech Tea Garden, Bharnobari Tea Garden, Dalsingpara Tea Garden
Rivers: Basra, Torsa, Buri Torsa
Roadways: Hasimara-Phuentsholing Road (State Highway 12A)
Building/structures: Bharnobari and Beech Tea Garden factories, boundary wall of the mobile tower (near Beech Tea Garden)

Other ecological importance

Mountain Range: Eastern Himalayas
Elephant Range: Eastern Duars (Terai) Region
Elephant Reserve: Eastern Duars Elephant Reserve
Protected Area: Buxa Tiger Reserve and Jaldapara National Park
Biodiversity Hotspot Region: Eastern Himalayas
IBA: Buxa Tiger Reserve (IN-WB-01), Eastern Himalayas (EBA 130)

HUMAN DIMENSIONS

Threats

1. *Large human settlements in the corridor*: New houses are being constructed in Gopal Bahadur Basti, 13 No. MES Basti, and Dalsingpara Tea Garden. Expansion of these settlements towards the corridor poses further threat to elephant movement.

2. *Habitat* on either side of the Basra River is largely degraded.

3. *Trench (old railway line)* along State Highway 12A hinders animal movement.

4. *High vehicular traffic* on the Hasimara-Phuentsholing road that serves as the major connection between West Bengal and Bhutan. About 300 vehicles per hour ply on the road between 6 am and 6 pm, and 59 vehicles per hour ply between 6 pm and 6 am. Peak vehicular intensity is 275 vehicles per hour, between 11 am and 1 pm.

5. *The proposed Asian Highway and railway line* between Hasimara and Bhutan are potential threats to the free movement of elephants.

Corridor villages: Gopal Bahadur Basti and Beech Garden Topline.

Corridor dependent villages: Dalsingpara Tea Garden labour Line, Bharnobari Tea Garden labour Line, Beech Tea Garden labour Line, and 13 No. MES Basti.

Settlement	Status of land	Households
Gopal Bahadur Basti	Revenue	500-600
Beech Topline (Beech TG)	Tea Garden	400-450
Forest Line (Beech TG)	Tea Garden	200-225
Jathu Line (Beech TG)	Tea Garden	200-225
Holapara Forest Village	Revenue & Forest	220-250
Ballalguri Forest Village	Revenue & Forest	200-220
Bhutri Basti	Forest	120-150
13 No. MES Basti	Revenue	3 houses within corridor
Bharnobari	Tea Garden	2000
Dalsingpara	Tea Garden	1600-1700

People from tea garden labour lines undertake paddy/ragi cultivation in small patches on the corridor. Inhabitants of Gopal Bahadur Basti earn their livelihood through business, agriculture and beetlenut plantations. About 89% of families here belong to the SC/ST category.

Human-Elephant Conflict: The incidence of human-elephant conflict is reasonably high in the corridor area. In the Hamiltonganj Range of Buxa Tiger Reserve, eight elephant deaths and seven human deaths were reported between 2003 and 2013. In Wildlife III Divison (Titi Reserve Forest), around 23 elephant deaths and 49 human deaths were reported during this period.

At least 38.5% and 34.8% of elephant deaths in the Buxa Tiger Reserve (West) Division and Wildlife III Division respectively occur due to human interventions (train-hits, electrocutions and poisonings).

CONSERVATION PLAN

1. The corridor should be notified by the state forest department and legally protected under an appropriate law to prevent encroachment and developmental activities detrimental to animal movement.

2. Vehicular speeds should be controlled by suitable barriers on SH 12A, which passes through the corridor area.

3. Expansion of Gopal Bahadur Basti, Bharnobari Tea Garden, Dalsingpara Tea Garden, Beech Tea Garden and 13 No. MES Basti towards the corridor area should be controlled.

4. The southern section of Gopal Bahadur Basti (about 500 m) needs to be secured in consultation with the villagers.

5. Trenches meant for waste water drainage in tea gardens need to be levelled, especially the one running along the Hasimara-Phuentsholing road (SH 12A) in the corridor area.



Fig. 6.13: Gopal Bahadur Basti

6.13

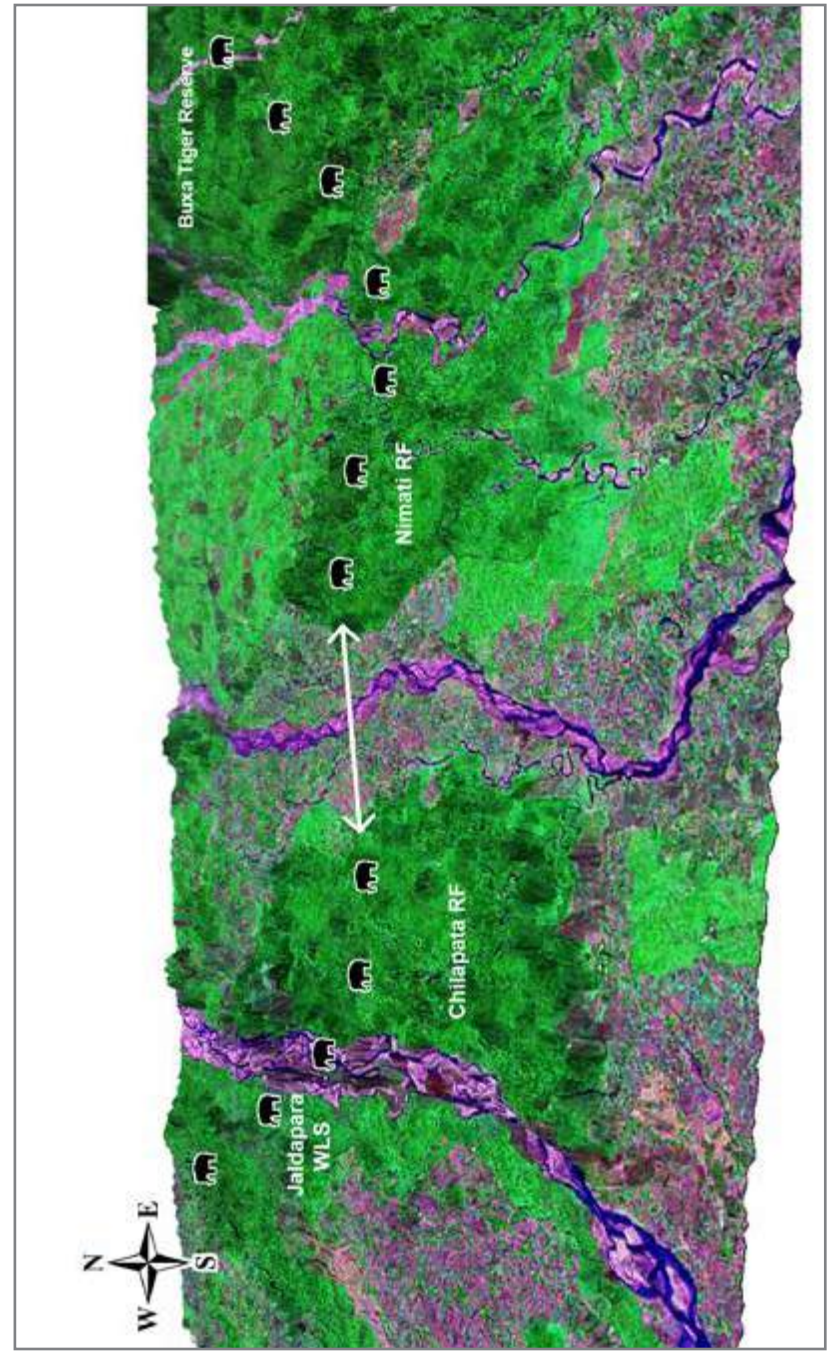
NIMATI - CHILAPATA

Ecological priority: High

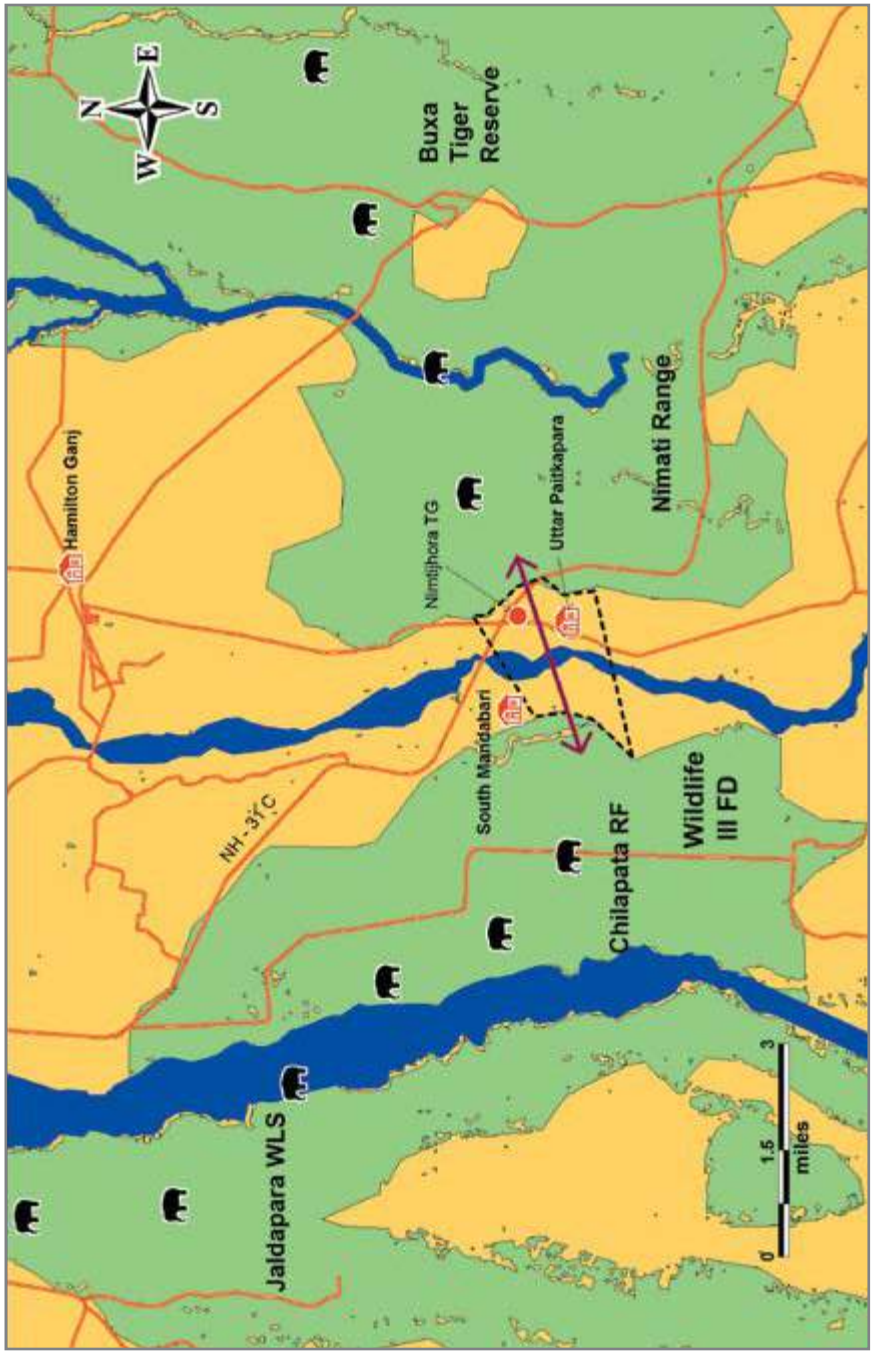
Conservation feasibility: Medium

This corridor facilitates elephant movement between the Nimati Range of Buxa Tiger Reserve and Chilapata Reserve Forest of Wildlife III Division, thereby maintaining elephant movement between Buxa Tiger Reserve and Jaldapara Wildlife Sanctuary. Elephants from Buxa cross National Highway 31C (between the southern limit of Nimti Domohoni village and the Poro River), Nimtijhora Tea Garden, the Nimati-Paitkapara road, Basra River and Dakshin Mendabari village to enter Chilapata Reserve Forest.

Alternate name	Buxa-Chilapata Corridor
State	West Bengal
Connectivity	Buxa Tiger Reserve (Nimati Range) with Chilapata Reserve Forest, finally leading to Jaldapara National Park
Length and Width	3-4.5 km and 0-3 km (of which about 2 km is occupied by the Nimtijhora Tea Garden Labour Line)
Geographical coordinates	26° 34′ 45″- 26° 36′ 41″ N 89° 24′ 15″- 89° 26′ 43″ E
Legal status	Reserve Forest, Revenue Land
Major land use	Forest land leased to tea gardens
Major habitation/settlements	Agriculture, tea gardens, settlements, Dakshin Mendabari, Nimtijhora Tea Garden Labour Line
Forest type	Sub-Himalayan secondary wet mixed forest, eastern Bhabar and Terai sal
Frequency of usage by elephants	Occasional and seasonal (September to February); mostly loners and small herds



3D map showing the landscape of the Nimati – Chilapata Corridor



Map of the Nimati – Chilapata Corridor

FORESTS AND ELEPHANTS

Corridor habitat status: Vegetation sampling in the Nimati Range of Buxa Tiger Reserve revealed that the predominant species was *Lagerstroemia speciosa* (39%), followed by *Bischofia javanica* (17%) and *Terminalia crenulata* (11%). Maximum GBH was observed in *Trewia nudiflora* (150 cm) and *Lagerstroemia speciosa* (148 cm). Tree density was estimated at 225 trees per hectare. An artificial salt lick is available inside this range for animals using the corridor.

Vegetation sampling in Chilapata Reserve Forest showed that the predominant tree species were *Tectona grandis* (25%), *Anthocephalus chinensis* (21%), *Lagerstroemia speciosa* (17%) and *Amoora wallichii* (17%). Maximum GBH was observed in *Michelia champaka* (210 cm) followed by *Lagerstroemia speciosa* (160 cm) and *Amoora wallichii* (135 cm). The ground cover on the fringes of Nimati and Chilapata was dominated by shrubs (45%), followed by barren ground (35%), herbs (17%) and grasses (3%).

Estimated elephants number in the landscape

Buxa Tiger Reserve Elephant Population: 215
Jaldapara National Park Elephant Population: 65-75
(West Bengal Elephant Census, 2015)

Forest/Land use

Forest Type: Sub-Himalayan secondary wet mixed forest, eastern Bhabar and Terai sal
Settlements: Dakshin Mendabari, Uttar Paitkapara, Nimati-Domohoni, labour lines of Nimtijhora Tea Garden
Agriculture: Maize, jute, paddy, ragi
Tea Estates: Nimtijhora Tea Garden, Paitkapara Tea Garden
Rivers: Basra River, Bhandari River
Roadways: National Highway 31C, Paitkapara-Nimti road
Buildings: Nimtijhora Tea Garden Factory, new lodging facility at Istikutum Khamar Bari, Hathkhola Market (12-14 shops), Mendabari Forest Beat Office.

Other ecological importance

Mountain Range: Eastern Himalayas
Elephant Range: Eastern Duars (Terai) Region
Elephant Reserve: Eastern Duars Elephant Reserve
Protected Area: Buxa Tiger Reserve, Jaldapara National Park
Biodiversity Hotspot: Eastern Himalayas
IBA: Buxa Tiger Reserve (IN-WB-01), Jaldapara National Park (IN-WB-04) & Eastern Himalayas (EBA 130)

HUMAN DIMENSIONS

Threats

1. Settlements: The Nimtijhora Labour Line settlement along with the expanding Uttar Paitkapara and Nimti-Domohoni settlements hinder elephant movement through the corridor.

2. The expansion of Dakshin Mendabari village to the west of the Basra River, and the consequent increase in agricultural activities, has increased conflict and hindered elephant movement.

3. A new resort (a lodge at Ishtikutum Khamar Bari) just inside the corridor is a potential threat.

4. Vehicle traffic: Two roads pass through the corridor: NH 31C (the Nimati-Samuktala stretch) and the Nimati-Paitkapara road. A peak vehicular intensity of 229 vehicles per hour was observed from 1 pm to 2 pm on the highway, with a daily average of 99.54 vehicles per hour. On average 39.5 vehicles per hour, mostly goods vehicles, move on the highway between 6 pm and 6 am. Night traffic decreases after 10 pm.

Corridor villages: Dakshin Mendabari, Nimtijhora Tea Garden Labour Line.

Corridor dependent villages: Uttar Paitkapara (southern part), Bongbasti.

Village Name	Status of land	Population
Dakshin Mendabari (Southern Part)	Revenue	1800-2200
Bongbasti	Forest	300-400
Uttar Paitkapara (Northern part)	Revenue	170-200
Bania Basti	Forest	180-200
Nimtijhora	Tea Garden	4400-4800

Most people in these villages work as labourers in the neighboring tea garden, while some are farmers. Paddy, maize, jute and ragi are the crops of choice. Dakshin Mendabari and Uttar Paitkapara are mostly dependent on jute plantations. Elephants often trample paddy, ragi, maize in an attempt to raid the fields.

Human-Elephant Conflict: The incidence of human-elephant conflict is reasonably high in the corridor area. In the Nimati Range of Buxa Tiger Reserve (W), 15 elephant deaths and 15 human deaths were reported between 2003 and 2013. Some 23 elephant deaths and 49 human deaths were reported in Wildlife III (Cooch Behar) Division during the same period.

At least 38.5% and 34.8% of elephant deaths in the Buxa Tiger Reserve (W) Division and Wildlife III Division respectively occur due to human interventions (train-hits, electrocutions and poisonings).

CONSERVATION PLAN

1. The corridor should be notified by the state forest department and legally protected under an appropriate law to prevent encroachment and developmental activities detrimental to animal movement. An identified area in the corridor has been proposed for inclusion as an eco-sensitive zone by the forest department.

2. A 500-metre section of the southern part of the Nimtijhora Tea Garden Labour Line towards Uttar Paitkapara needs to be secured to increase the effective width

of the corridor. The northern part of Uttar Paitkapara and the southern part of Dakshin Mendabari could also be considered for relocation on a priority basis.

3. Afforestation should be carried out especially inside Nimati Reserve Forest and the adjoining Nimtijhora Tea Garden.

4. Vehicular speeds should be controlled using suitable barriers on National Highway 31C passing through the corridor.

5. The new lodge at Ishtikutum Khamar Bari could be relocated outside the corridor.



Fig. 6.14: Nimtijhora Labour Line Quarters



Fig. 6.15: Dakshin Mendabari Village

6.14

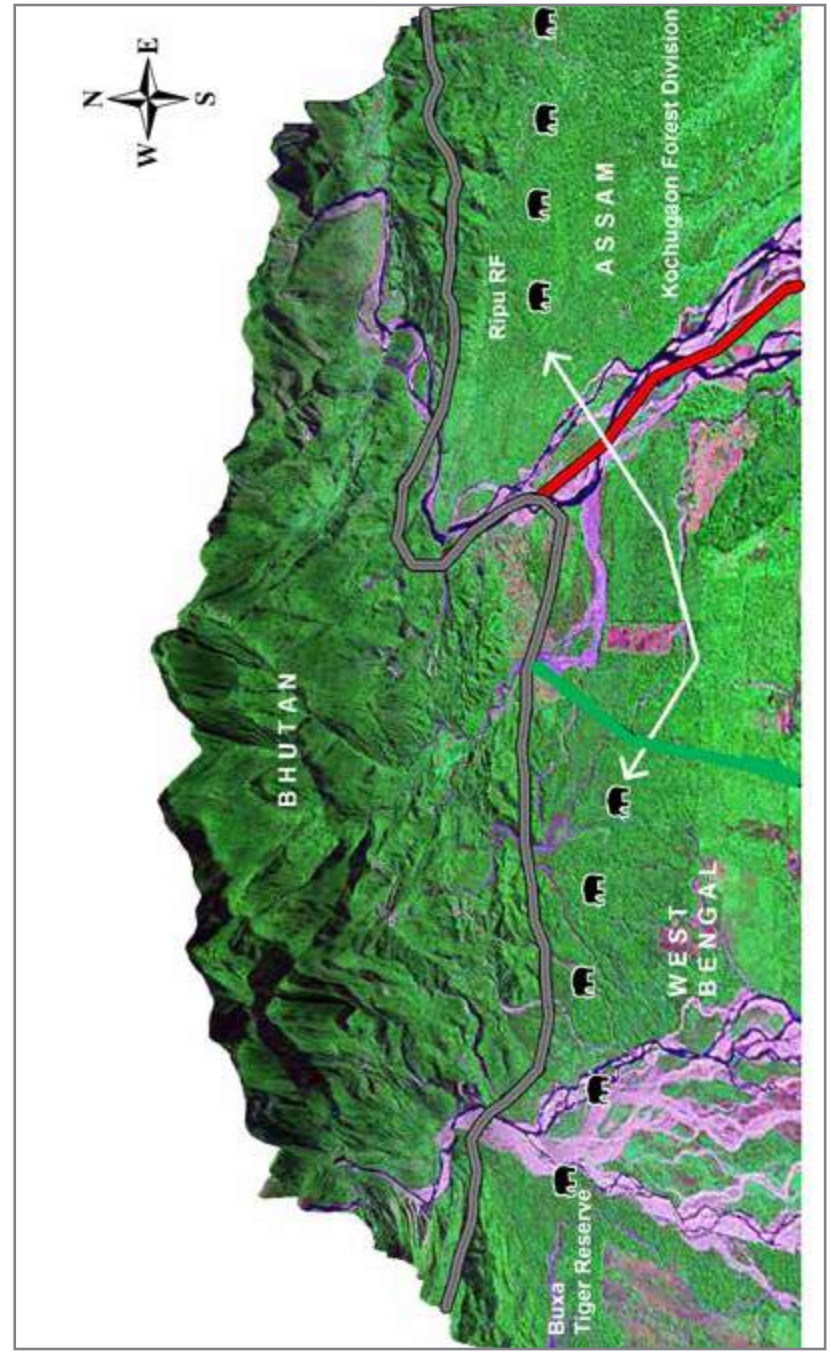
BUXA-RIPU AT SANKOSH

Ecological priority: High

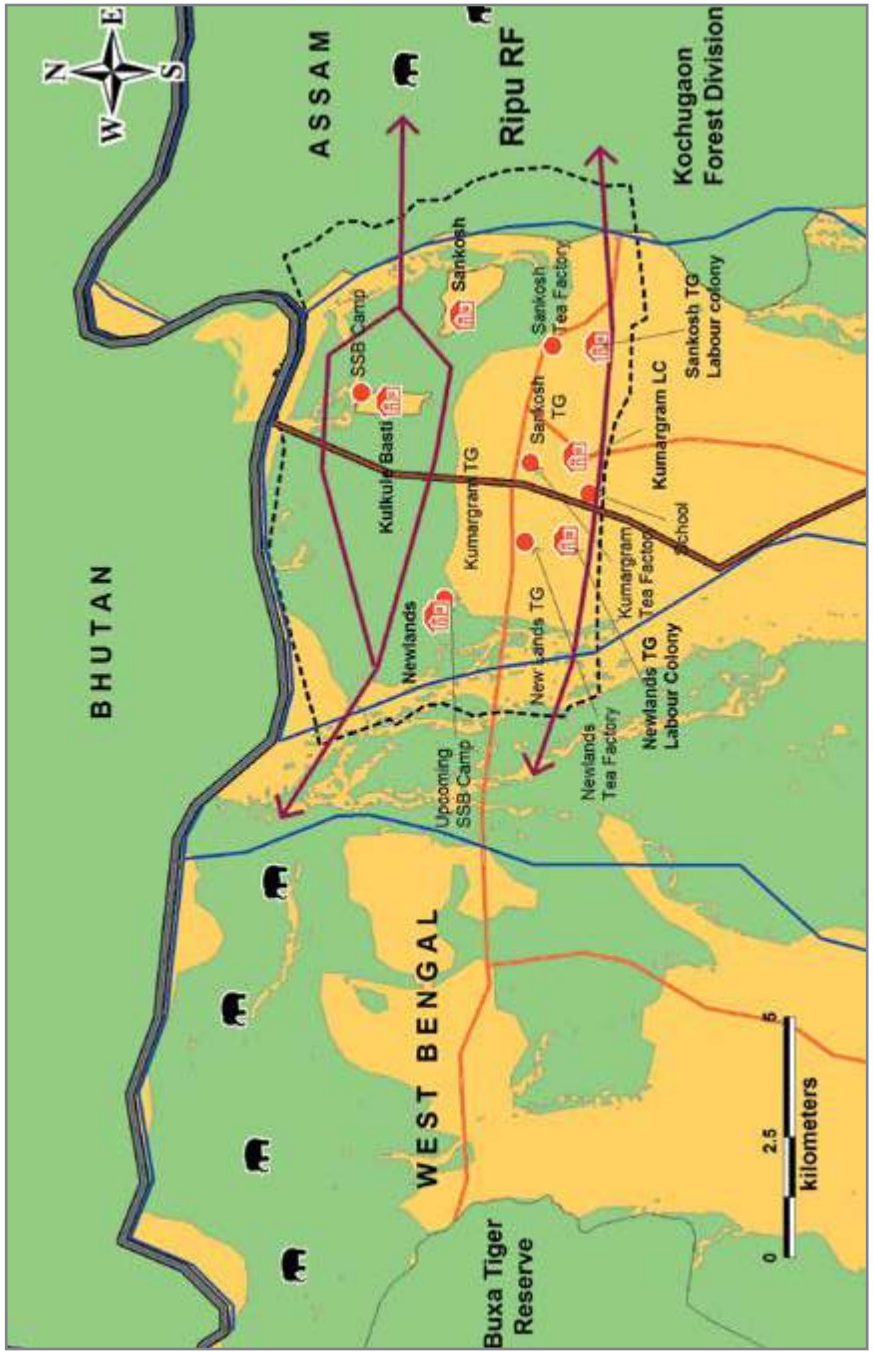
Conservation feasibility: Medium

This corridor connects Buxa Tiger Reserve (West Bengal) with the Ripu forest in Kochugaon Forest Division (Assam). The corridor passes through the Sankosh and Kalikhola Rivers, tea gardens (Sankosh, Kumargram and Newlands), and human settlements (Sankosh Forest Village, Kulkule Forest Village, Newlands Forest Village). Small elephant herds oocasionally move through the Nouthale forest and the neighbouring Lhamoyzingkha settlement areas of Bhutan. Power fencing around the Kulkule Forest Village significantly blocks the corridor.

Alternate name	Sankosh Corridor
State	West Bengal and Assam
Connectivity	Kumargram Forest (Buxa Tiger Reserve-East) with Ripu forest (Assam)
Length and Width	10-11 km and 0-3.5 km
Geographical coordinates	26° 38′ 37″- 26° 42′ 50″ N 89° 46′ 10″- 89° 53′ 26″ E
Legal status	Reserve Forest, Revenue Land, Forest Land leased to Tea Gardens
Major land use	Forest, agriculture, tea gardens, settlements
Major habitation/settlements	Kulkule Forest Village, Sankosh Forest Village, Newlands Forest Village
Forest type	Northern dry deciduous sal forest, Sub-Himalayan secondary wet mixed forest, East Himalayan moist mixed deciduous forest
Frequency of usage by elephants	Regular and seasonal



3D map showing the landscape of the Buxa–Ripu at Sankosh Corridor



Map of the Buxa–Ripu at Sankosh Corridor

FORESTS AND ELEPHANTS

Corridor habitat status: Vegetation sampling in the corridor forest revealed that the predominant tree species were *Lagerstroemia speciosa* (30.8%), *Shorea robusta* (27%), *Terminalia crenulata* (21.6%) and *Michelia champaka* (8.1%). Maximum GBH was recorded in *Terminalia crenulata* (240cm). Ground cover was dominated by barren ground (62%), followed by shrubs (30%) and herbs (8%).

Estimated elephant numbers in the landscape

Buxa Tiger Reserve: 215 (2011 census)

Kachugaon Forest Division (Assam): 193 (2011 census)

Forest/Land use

Forest Type: Northern dry deciduous sal forest, sub-Himalayan secondary wet mixed forest, east Himalayan moist mixed deciduous forest

Settlements: Kumargram Forest Village, Sankosh Forest Village, Newlands Forest Village, Kulkule

Agriculture: Maize, wheat, paddy, bamboo

Tea Estates: Kumargram Tea Garden, Newlands Tea Garden, Sankosh Tea Garden

Rivers: Ryadak, Kalikhola, Sankosh

Roadways: Barobisa-Sankosh-Bhutan road

Artefacts: Kumargram Tea Garden factory, Sankosh Tea Garden factory, Newlands Tea Garden factory, electric fencing around Kulkule Forest Village, Kalijhora SSB Camp, Newlands SSB Camp, Kulkule Basti

Other ecological importance

Mountain Range: Eastern Himalayas

Elephant Range: Eastern Duars (Terai) Region

Elephant Reserve: Eastern Duars Elephant Reserve

Protected Area: Buxa Tiger Reserve

Biodiversity Hotspot: Eastern Himalayas

IBA: Buxa Tiger Reserve (WB-01), Eastern Himalayas (EBA 130)

HUMAN DIMENSIONS

Threats

1. Settlements: Electric fencing around the Kulkule (Kumargram Forest Village) and Kalikhola Sashastra Seema Bal (SSB) camps inhibits elephant movement. The labour lines of the Sankosh, Kumargram and Newlands Tea Gardens further restrict elephant movement. Encroachment in the Ripu Reserve Forest area is another hindrance.

2. Habitat degradation in Ripu Reserve Forest and Kachugaon Forest Division (Assam) due to illegal felling of trees and encroachment.

3. Cattle grazing in the corridor forests and fringe areas has degraded the habitat quality.

4. Traffic: Although 51.2 vehicles per hour move on the Barobisa-Sankosh-Lhamoyzingkha road between 6 am and 6 pm on average, the vehicular movement is only about 5.6 vehicles per hour between 6 pm and 6 am. Hence, this is currently not a major threat.

Corridor villages: Kulkule Forest Village, Sankosh Forest Village, Newlands Forest Village.

Corridor dependent villages: Sankosh Tea Garden, Newlands Tea Garden and Kumargram Tea Garden labour lines.

Village Name	Status of land	Population	Cows, goats and sheep
Sankosh Tea Garden	Labour Line	850-950	873
Newlands Tea Garden	Labour Line	1800-1900	1886
Kumargram Tea Garden	Labour Line	750-800	777
Kulkule	Forest Village	425-450	392
Newlands	Forest Village	200-230	167
Sankosh	Forest Village	750-800	623

About 5200 people inhabit these places. Most earn a living as tea garden labourers, or through farming.

Human-Elephant Conflict: About four elephant deaths and seven human deaths per year were reported from Buxa Tiger Reserve (East) Division between 2003 and 2013. Seventeen percent of elephant deaths and 8.3% of property damage occurred within the Kumargram Range alone. Cases of human death/injury due to elephants were negligible in this range.

CONSERVATION PLAN

1. The corridor should be notified by the state forest department and legally protected under an appropriate law to prevent encroachment and developmental activities inimical to animal movement.

2. In consultation with villagers, Kulkule Forest Village could be relocated with the provision of suitable relocation packages. A few shops located along the side of Sankosh River need to be shifted outside the corridor.

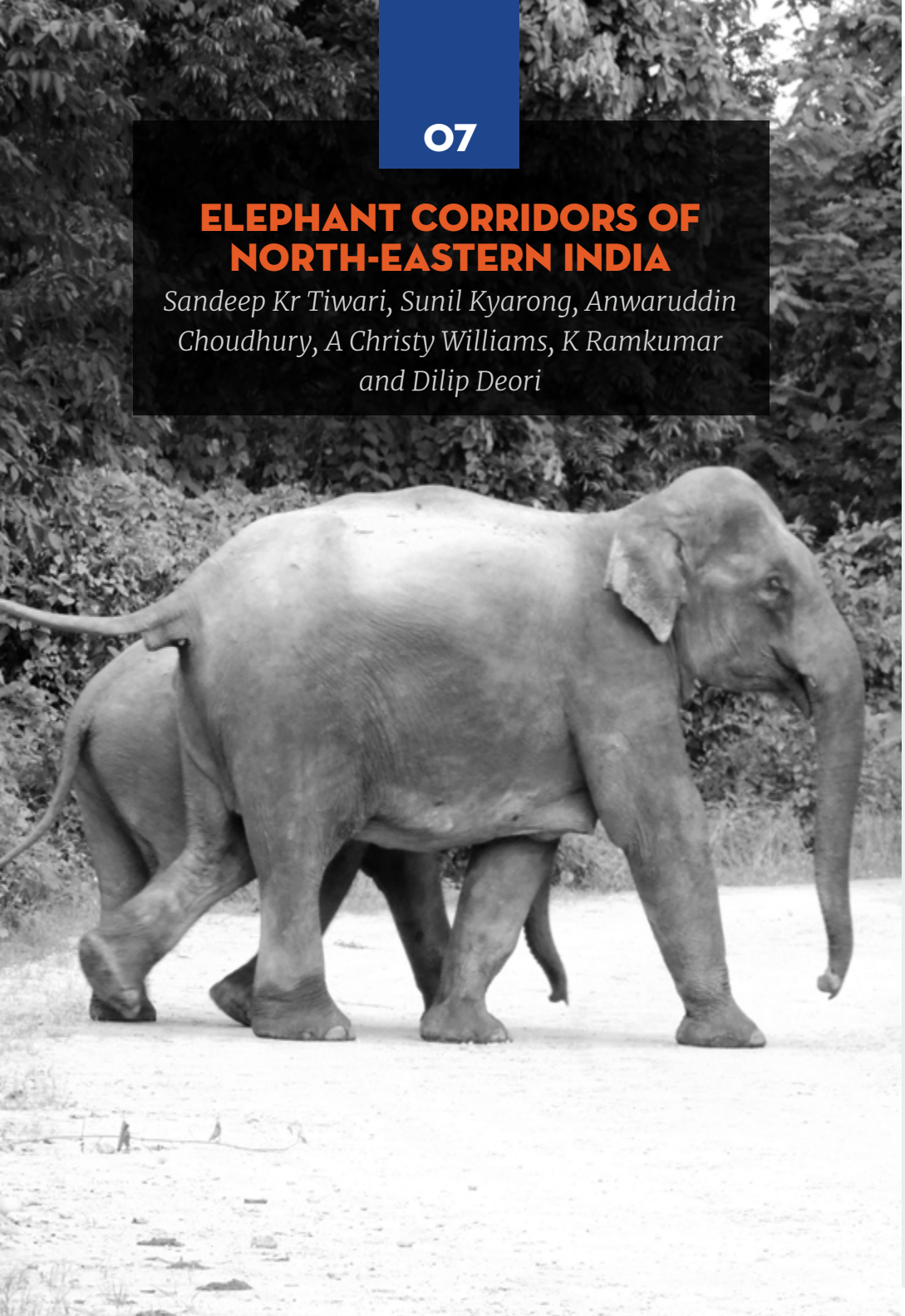
3. Better protection of habitat as well as habitat restoration should be taken up on a priority basis in Ripu Reserve Forest.

4. Expansion of the tea garden labour lines of Sankosh, Newlands and Kumargram towards the corridor area should be prevented.

07

ELEPHANT CORRIDORS OF NORTH-EASTERN INDIA

Sandeep Kr Tiwari, Sunil Kyarong, Anwaruddin Choudhury, A Christy Williams, K Ramkumar and Dilip Deori



<< Elephants crossing the Kalapahar-Daigrung Corridor in Karbi Anglong, Assam

THE ELEPHANTS OF NORTH-EASTERN INDIA had an almost contiguous distribution with the populations of Bhutan, Bangladesh, Nepal and Myanmar in the past. However, due to degradation and fragmentation of the habitat, these elephants are now confined to certain discrete areas. They are now distributed in four distinct populations and a few scattered populations in the Barak Valley (*Choudhury, 1999*). The major elephant populations are as follows:

(A) North Bank of the Brahmaputra: This population extends from northern West Bengal (this has been dealt with separately in this publication) through the Himalayan foothills and Duars covering southern Bhutan, northern Assam and Arunachal Pradesh along the north bank of the Brahmaputra River. In eastern Assam, the range also covers part of the flood plains of the Brahmaputra and the Lohit River. In 1970, due to the clearing of a strip of about 20 km in the Dibang Valley of Arunachal Pradesh for cultivation and habitation, the elephant population of the north and south bank (eastern areas) became separated from each other (*Choudhury, 1995*).

The elephant habitats of the north bank are under severe biotic pressure, resulting in degradation and fragmentation. Due to large-scale encroachment and tree felling in Kochugaon Forest Division and other areas of Kokrajhar district, elephant movement between Buxa Tiger Reserve (northern West Bengal) and Manas National Park (Assam) has been severely affected. Between 1977

and 2007, Kokrajhar lost 692.76 sq km of forest cover of which 228.16 sq km was lost between 1997 and 2007 (*Nath and Mwchahary, 2012)*. Between 1991 and 1998, more than 1500 sq km of forest area came under encroachment in the north bank (*Talukdar and Barman, 2003*).

The Sonitpur district of Assam has been the worst affected: between 1994 and 1999 it lost 86.75 sq km (1.7%) of forest area, and between 1999 and 2001 it lost 145.44 sq km (2.86%) of forest area (*Srivastava et al., 2002*). Thus, 229.64 sq km of moist deciduous forest and 2.55 sq km of semi evergreen forest have been lost between 1994 and 2001. As of 2016, the Gohpur Reserve Forest (133 sq km) in Sonitpur is totally encroached with no sign of the forest remaining. Similarly, other Reserve Forests such as Balipara (100 sq km out of 188 sq km under encroachment), Charduar (130 sq km under encroachment), Nauduar (130 sq km under encroachment), Biswanath (76 sq km under encroachment), Behali and Singri in this district are under heavy encroachment. Although Sonitpur district has about 1200 sq km of forest cover in official records, what is left on the ground and under the forest department's control accounts for less than 400 sq km. Of these, 200 sq km is in Nameri National Park, 128 sq km in Sonai-Rupai Wildlife Sanctuary (satellite core of Nameri National Park) and about 60 sq km in Behali Reserve Forest. The rest is either degraded or is being rapidly lost. Between 2013 and 2015, the district has lost 11 sq km of forest cover (*FSI, 2015*). This has resulted in severe human-elephant conflict leading to large-scale crop depredation and loss of human and elephant lives.

The conflict in Sonitpur district reached its peak between 1998 and 2002, culminating in the mass poisoning of elephants and the death of 22 elephants. In just these four years, 62 elephants died in Sonitpur East and West Division, Rowta Reserve Forest and West Assam Wild Life Division (Nameri Tiger Reserve). Between 2005 and 2015, about 145 wild elephant deaths and 245 human deaths related to human-elephant conflict were reported in Sonitpur district, mainly in the tea estate areas. Elephants from Sonai Rupai Wildlife Sanctuary and Charduar Reserve Forest have traditionally been visiting the degraded Singri Hills Reserve Forest through tea gardens and agricultural fields. However, due to degradation and shrinkage of habitat in Sonai Rupai Wildlife Sanctuary, Charduar Reserve Forest and Balipara Reserve Forest, the movement of elephants has been severely affected and the human-elephant conflict is on the rise.

Movement of elephants has also been affected between Pakke Tiger Reserve and Papum Reserve Forest in Arunachal Pradesh due to human encroachment and agricultural activities. Elephants mainly use riverbeds to move between these two areas. Seijosa nullah and a small plantation area near Longka nullah serve as a movement path between the two habitats due to the complete clearing of forest in Nauduar Reserve Forest in Assam. Elephant movement between Drupong Reserve Forest and Doimukh Reserve Forest of Banderdewa Forest Division has also been severely affected by encroachment along National Highway 52A and construction of railway lines and other developmental activities. The hydro-electric project in Lower Subansiri has also affected the elephant movement in the area. The elephant movement between Pakke Tiger Reserve and Doimara Reserve Forest has been severely affected by encroachment of land, expansion of human settlements, industry and other structures that have come up on either side of NH 229. The elephant movement through the Tippi corridor is almost impaired and the Dezling corridor is also severely threatened due to slash and burn cultivation and encroachment.

The elephant habitats of the North Bank of the Brahmaputra have been placed under severe biotic pressure, resulting in degradation and fragmentation.

(B) South Bank of the Brahmaputra: As already mentioned in Chapter One, the elephant population on the southern bank of the Brahmaputra can be divided into three distinct populations – those of the eastern, central and western areas.

(1) Despite the fragmentation of the eastern range, elephants still move through tea gardens and cultivated areas. This range became separated from the north bank population during the 1970s and from the south bank-central areas in the

early 1980s. The separation from the south bank-central areas was due to large scale felling and encroachment in Doyang Reserve Forest, Nambor (South Block) Reserve Forest, Diphu Reserve Forest and Rengma Reserve Forest, totaling about 990 sq km of forest area (*Choudhury, 1999*). The range is spread over lower Dibang Valley and Lohit, Changlang and Tirap districts in Arunachal Pradesh; Tinsukia, Dibrugarh, Sibsagar, Charaideo, Jorhat and Golaghat districts in Assam; and Mon, Tuensang, Mokokchung and Wokha districts in Nagaland.

This range has been fragmented at many places, the most notable being the area along the Dhansiri River (Doyang Reserve Forest, Nambor South Reserve Forest, Rengma Reserve Forest and Diphu Reserve Forest), thereby severely hindering the movement of elephants between this part of Assam and Nagaland. Till the 1980s elephant movement was reported between Rengma Reserve Forest (Assam) and Baghty Valley (Nagaland), between the villages of Sungkha and Lishuya. Similarly, elephant movement from Desoi Reserve Forest and Hollongapahar (Assam) to adjacent elephant habitat in Nagaland has been severely hindered by habitat degradation in Assam and Nagaland.

As a result of the large-scale destruction of forest cover in the Golaghat district in the last three decades, elephants move to National Highway 37 and nearby agricultural land in search of food. This area had dense forest cover till the mid 1980s. Between 2013 and 2015, the district lost 5 sq km of forest cover (*FSI, 2015*). Recently, Numaligarh Refinerary Limited (NRL) excavated around 12.5 acres (five hectares) of forested land near Deopahar proposed Reserve Forest to develop a golf course. A large area was fenced off, hindering elephant movement. The National Green Tribunal has since ordered that the fence be removed and the area reforested.

At present, about 40% of the northern part of Nambor Reserve Forest has been encroached (*Talukdar and Burman, 2003*). The movement of elephants from Digboi and Doom Dooma Forest Divisions to forest areas of the Changlang district of Arunachal Pradesh has been severely hindered. A part of the elephant population of the Changlang district is continuous with that of Myanmar through a corridor in Namdhapa National Park. However, all the other probable migration routes through Tirap and Changlang districts of Arunachal Pradesh and Mon and Tuensang districts of Nagaland are no longer available due to heavy poaching by the Konyak and the Wancho Nagas and clearance for *jhum* (*Choudhury, 1999*). Movement between Upper Dihing (East and West Block) and Doom Dooma takes place mainly through tea gardens and agricultural land. This has been severely affected along the Golai-Powai corridor due to settlements, an Indian Oil Ltd depot and other structures that have come up on both sides of the national highway. Movement of elephants between Lakkipathar Range of Upper Dihing (West Block) Reserve Forest (Digboi Forest Division) and Tokowani Reserve Forest (Doom Dooma Forest Division) used to occur through Langkasi and Anandbari Tea Gardens. Due to encroachment and the expansion of settlements on both sides of the Tinsukia-Digboi highway (NH 37) in the last decade, elephants are only using the corridor area for crop raiding and the connectivity is totally broken.

(2) The central range is one of the most important habitats for the elephant in north-eastern India and extends from Kaziranga National Park across the Karbi plateau, parts of the central Brahmaputra plains and the basin of the Diyung River to the foot of the Meghalaya plateau in Assam and Meghalaya. This population has become separated from the south bank-western population due to expansion of Guwahati city, clearing of forests, *jhum* cultivation and settlements along National Highway 40 (Shillong-Guwahati) in the Rhi-Bhoi district of Meghalaya. Elephants from the eastern Karbi plateau move down regularly to the plains of Kaziranga National Park at the beginning of winter, ascending once again at the advent of the floods (*Choudhury, 1999*). Movement between these two forests takes place mainly through tea gardens and cultivated lands. Heavy traffic on National Highway 37, which passes through the corridor, is one of the major barriers for animal movement, especially during the rains. There is occasional movement between this population and the south bank-western area population through Nongkhyllem Reserve Forest and the degraded habitat of Rhi-Bhoi district (through the Nongwah Mawphar village area established in 1999), but this has also been severely affected in recent years.

(3) The habitat in the western range supports a significant population of elephants in parts of Assam and Meghalaya. It extends from near Guwahati through the

foothills of the Meghalaya plateau (Garo and Khasi Hills) including the districts of Kamrup (Metropolitan) and Goalpara in Assam, and Rhi-Bhoi, West Khasi Hills, East Garo Hills, West Garo Hills, Southwest Garo Hills and South Garo Hills in Meghalaya. Elephants also occasionally move to the forests of Bangladesh from the forest areas of Baghmara in Meghalaya.

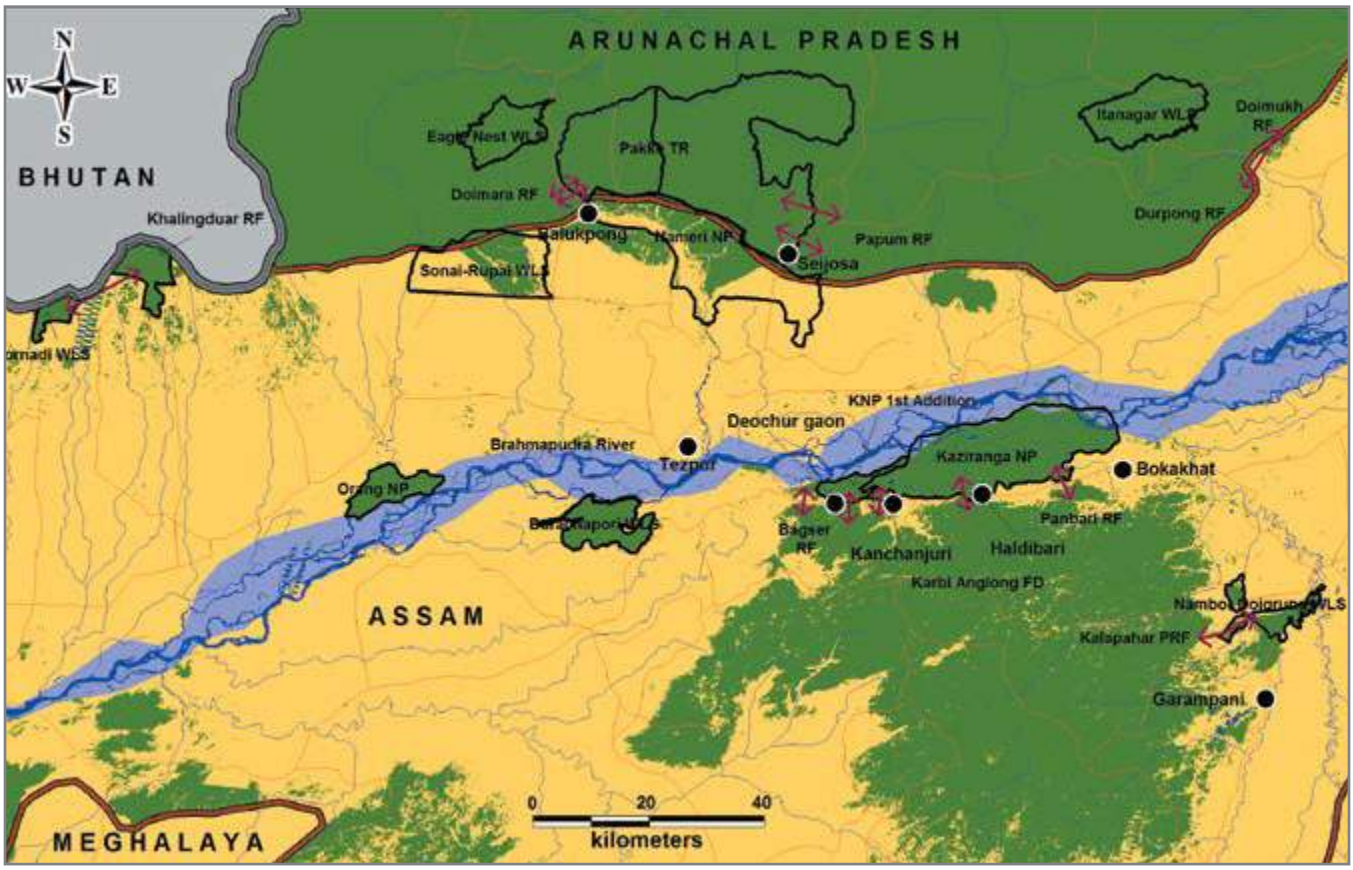
The majority of the habitat comprises tropical moist deciduous and tropical semi evergreen forests. Tropical wet evergreen forest occurs along the narrow river valleys. The terrain is mainly hilly in this region and the movement of elephants was mostly unhindered until very recently. This area also includes the Garo Hill Elephant Reserve spread over 3500 sq km and supports approximately 1200 elephants. However, developmental activities and clearing of forest for *jhumming* (slash and burn cultivation) has resulted in the degradation and fragmentation of habitat. The problem has been compounded due to the fact that most of the forest area is under community or local control; only 410 sq km is under the control of the forest department and the rest is private forest. Further, due to large deposits of coal and limestone in the Garo Hills, many elephant areas are in danger. Coal and limestone mining in the Darengiri area has led to fragmentation of the habitat and hindered the movement of elephants between Angratoli Reserve Forest and Emangre Reserve Forest, increasing human-elephant conflict. Between 2007-08 and 2015, 48 human deaths due to elephants were reported. The fencing of the international border between India and Bangladesh has further affected elephant movement. Wildlife Trust of India, in collaboration with the Garo Hills Autonomous District Council and the state forest department, and with the participation of the local communities, has secured the elephant corridors between Balpakram National Park, Siju Wildlife Sanctuary and Rewak Reserve Forest, and Imangre Reserve Forest leading to Nokrek National Park, by getting areas notified as Village Reserve Forests. Human settlements, the new North-Eastern Hill University campus, the Garo Hills Student Union building, fishery ponds, the 2nd Police Battalion camp, heavy traffic on the Guwahati-Tura road and agricultural activities have almost barred elephant movement between the West Garo Hills and Nokrek National Park.

Apart from the above four major populations, there are a few isolated habitats that support a sizeable elephant population as mentioned in Chapter One. The forest cover of north-eastern India is disappearing at a very alarming rate due to a host of factors that include the growing human population and the consequent increase in agriculture, settlements and encroachments; the construction of roads, railway lines and hydro-electric projects; and massive bamboo extraction, mining and oil exploration in prime elephant habitats. More than 1000 sq km of forest were being destroyed annually (*Choudhury,1999*). Between 2013 and 2015, north-east India lost 628 sq km of forest cover of which about 270 sq km was in the state of Assam (48 sq km), Arunachal Pradesh (73 sq km), Meghalaya (71 sq km) and Nagaland (78 sq km) (*FSI 2015*).

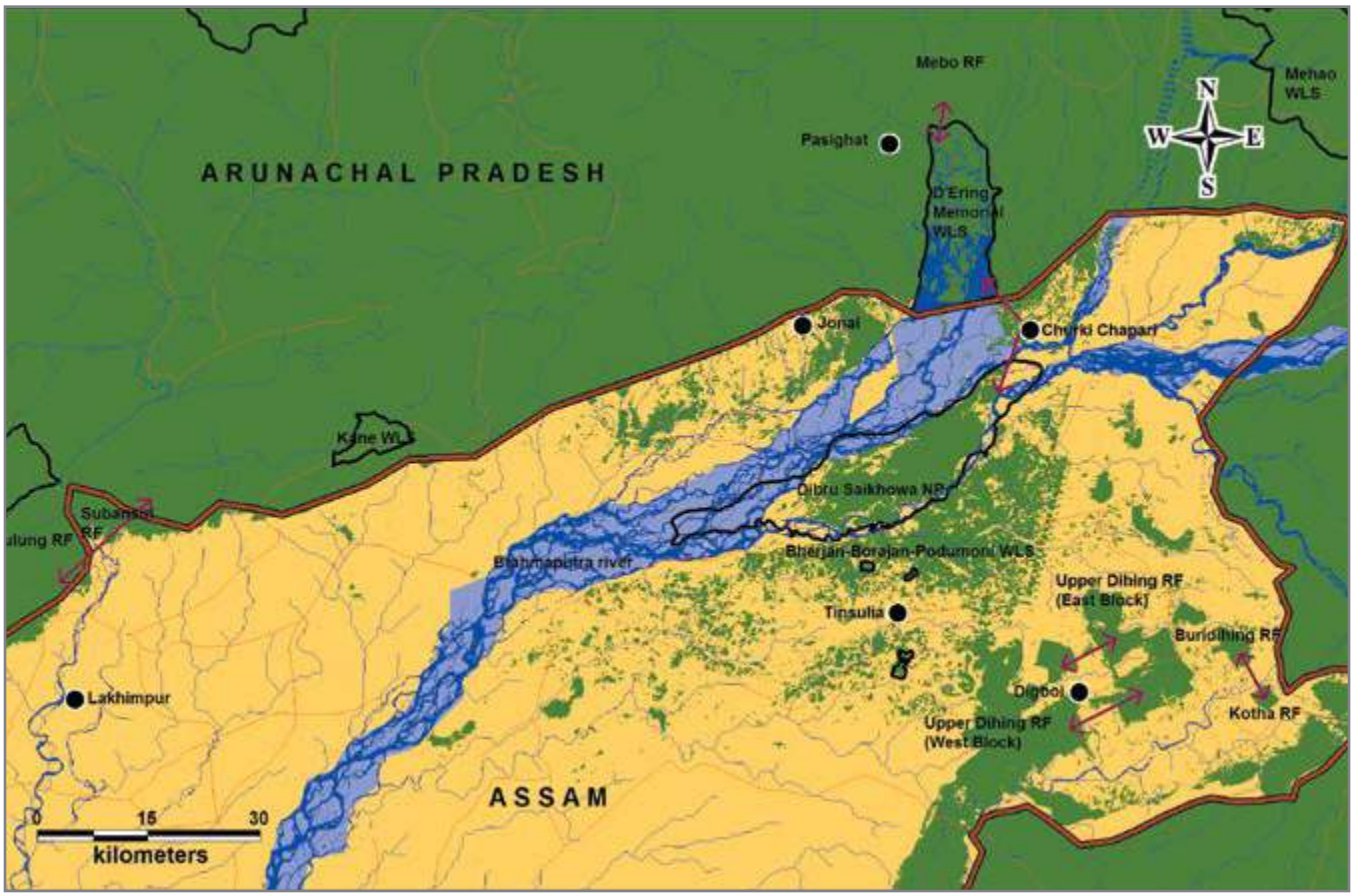
The ultimate cause of habitat shrinkage is the rapid growth of the human population. Around 450,000 families in north-eastern India annually cultivate 10,000 sq km, with the total area affected by *jhumming* amounting to approximately 44,000 sq km. Due to reduced fallow periods, the regeneration of young secondary forest is halted by crop planting, changing the landscape extensively. Degraded forests, bamboo thickets and weeds dominate these areas. As a high percentage of people live in rural areas (85%) with farming as the main occupation, the large-scale destruction of forests and wetlands seems inevitable.



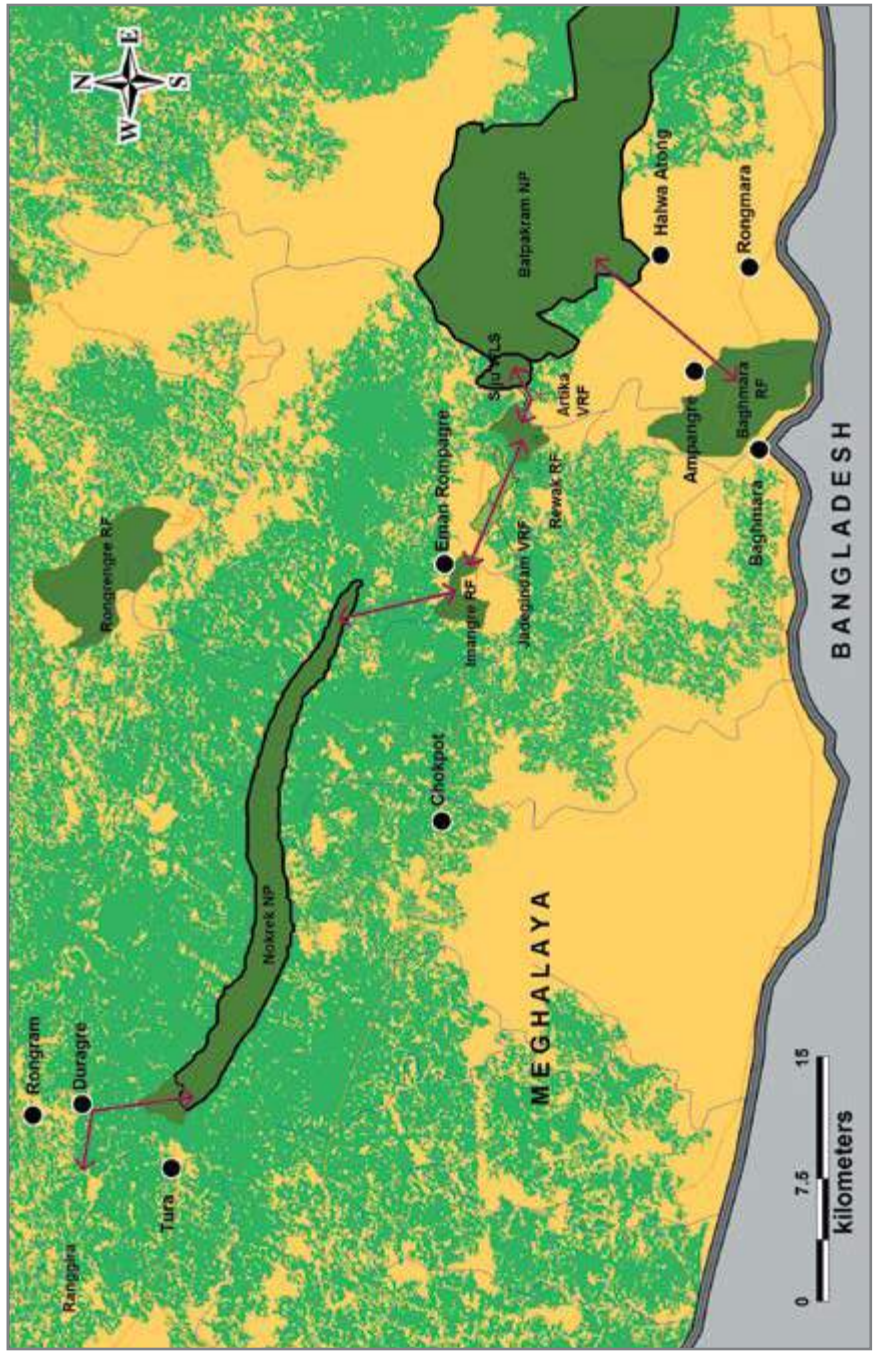
Fig. 7.01: A view of New Ram Terang, the inhabitants of which were relocated from a site in the middle of the Kalapahar-Daigrung Corridor



Elephant corridors in North-East India – Part I



Elephant corridors in North-East India – Part II



Elephant corridors in North-East India – Part III



Fig. 7.02: A herd of elephants in the old Ram Terang village

7.01

PAKKE - DOIMARA AT TIPPI

Ecological priority: Medium

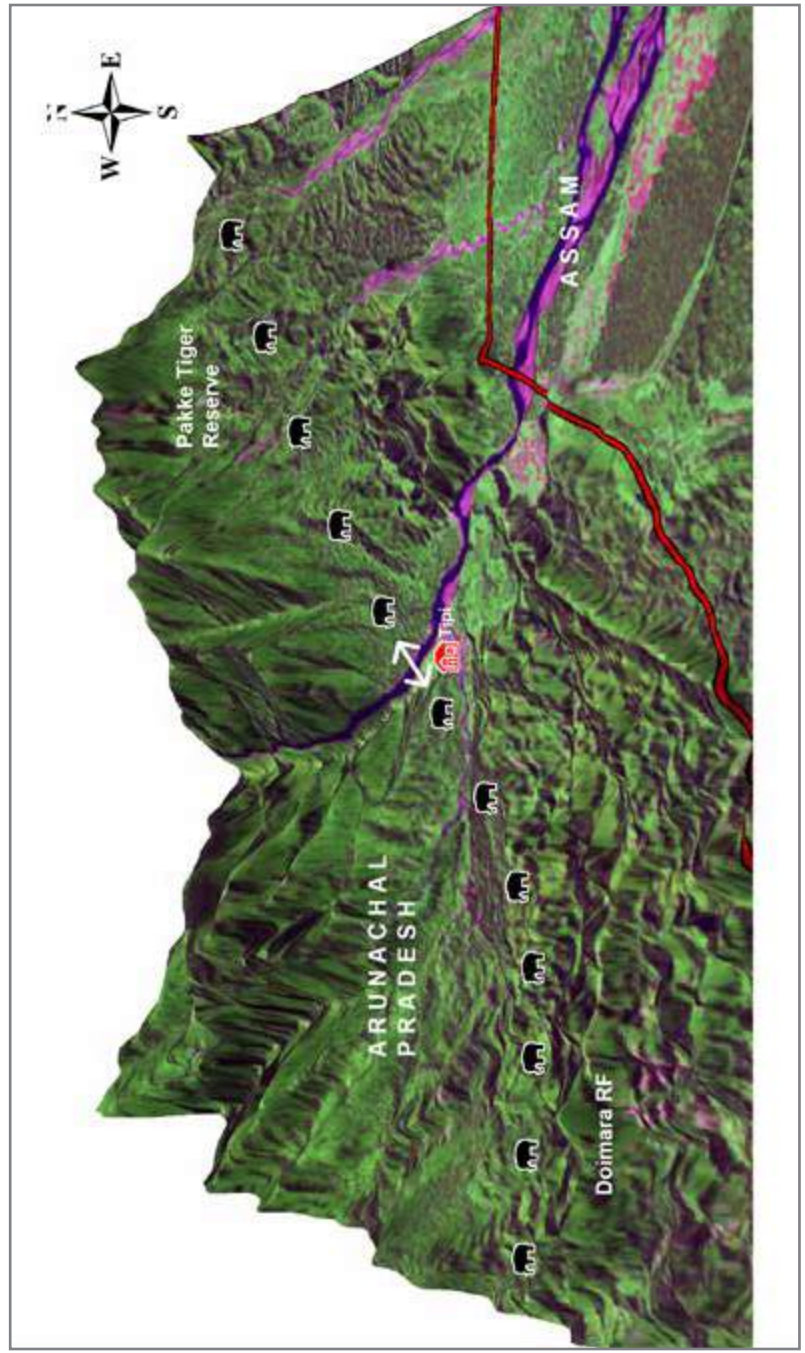
Conservation feasibility: Medium

This corridor connects Pakke Tiger Reserve with Doimara Reserve Forest of Khellong Forest Division. Earlier, elephants used to cross the Kameng River near Tippi village, Tippi Forest Range Office and the Orchid Research Centre. This route has almost been blocked by encroachments and other physical barriers and the elephants, since the last five years, cross the highway near the nullah and the upcoming Tippi Tourism guest house (about two kilometres from the earlier location towards Eagle Nest).

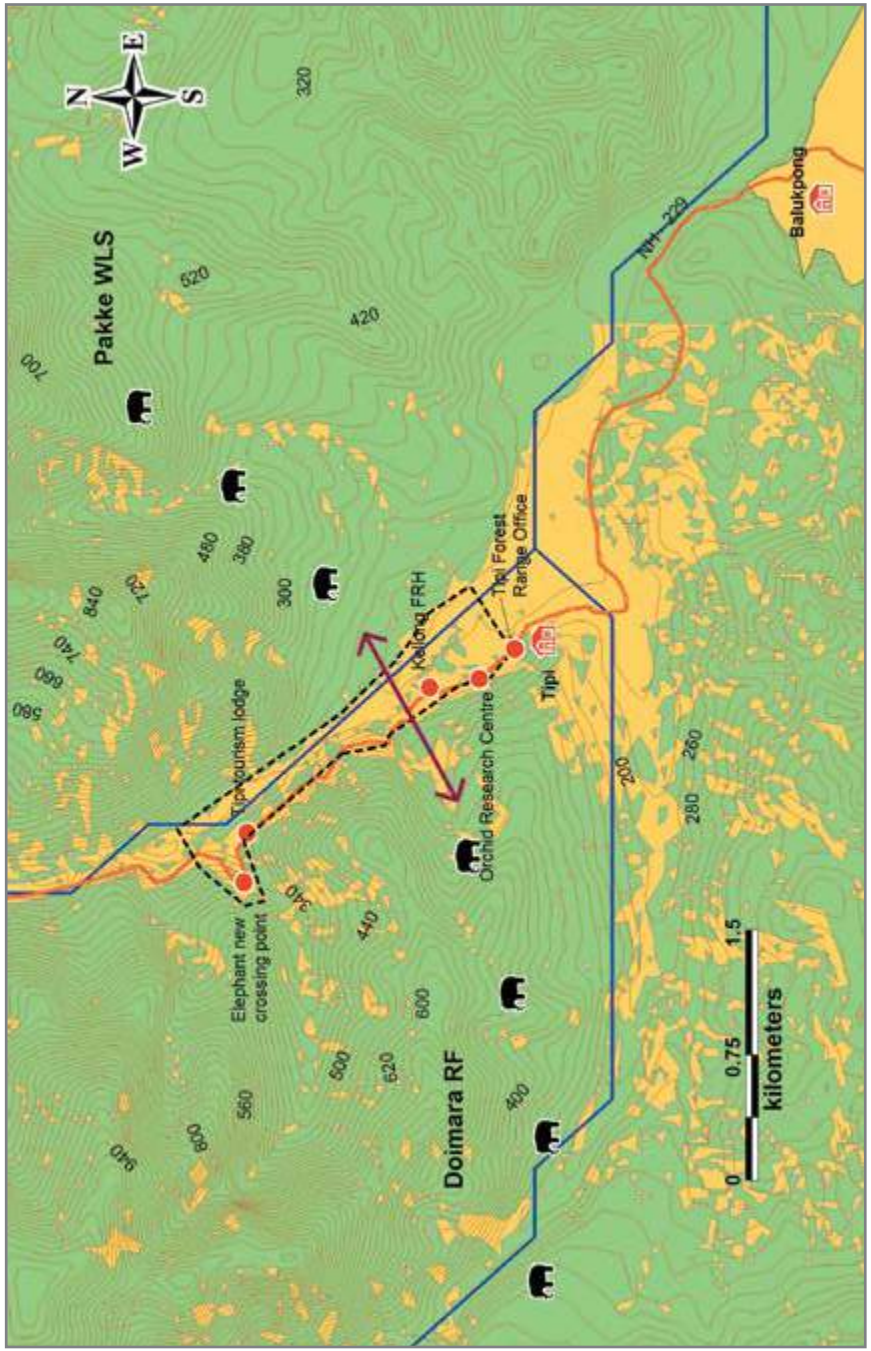
Alternate name	Tippi Corridor
State	Arunachal Pradesh
Connectivity	Pakke Tiger Reserve with Doimara Reserve Forest
Length and Width	1 km and 0.2 km
Geographical coordinates	27° 1′ 57″- 27° 3′ 2″ N 92° 35′ 35″- 92° 36′ 44″ E
Legal status	Reserve Forest
Major land use	Forest, Kameng River, settlement
Major habitation/settlements	Tippi
Forest type	Tropical evergreen forest and semi evergreen forest
Frequency of usage by elephants	Rare

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 13 tree species were recorded in the sampled area of 0.08 ha. The predominant tree species were *Duabanga grandiflora* (36%), *Sterospermum chelonoides* (11%), *Artocarpus lakoocha* (11%) and *Canarium*



3D map showing the landscape of the Pakke–Doimara at Tippi Corridor



Map of the Pakke–Doimara at Tippi Corridor

grandiflora (8%). Of these, 10 tree species are elephant food species. Ground cover vegetation was dominated by grasses (46 %), shrubs (24%), herbs (20 %) and barren ground (10%). Bamboo patches (*Bambusa spp*) were available in plenty in this corridor forest.

Estimated elephant numbers in the landscape

Pakke Tiger Reserve: 134

Khellong Forest Division: 115

(Elephant Census Arunachal Pradesh, 2015).

Forest/Land use

Forest Type: Tropical evergreen and semi evergreen forest

River: Kameng River

Roadways: NH 229 (Bhalukpong-Bomdila)

Encroachment: Huts along the road

Other ecological importance

Mountain Range: Eastern Himalayas

Elephant Reserve: Kameng Elephant Reserve

Protected Area: Pakke Tiger Reserve

Biodiversity Hotspot: Eastern Himalayas

IBA: Pakke Tiger Reserve (IBA criteria A1, A2)

HUMAN DIMENSIONS

Threats

1. Settlements and developmental activities: Expansion and developmental activities in and around Tippi village, Orchid Research Centre, the General Reserve Engineer Force (Border Roads Organisation) office and the BSNL office, and encroachments along NH 229 have severely threatened the corridor and almost blocked elephant movement. Hence, elephant movement is also happening north of this area near the Tippi Tourism guest house.

2. Cultivation: Cultivation of paddy in the corridor is another threat to the habitat.

3. Concrete wall: A crash barrier along NH 229, as well as the boundary walls of the Orchid Research Centre and Tippi Tourism guest house have severely hindered elephant movement.

4. High vehicular traffic: There is heavy traffic on NH 229 (Bhalukpong-Bomdila), which bisects this corridor. On average, 64.20 vehicles per hour ply on this road, with 47.2 vehicles per hour plying between 6 pm and 6 am.

Corridor dependent villages: There are 235 permanent houses at Tippi village, with a human population of about 966. There are also encroachments (80 temporary houses) along NH 229 near the Orchid Research Centre. Most of the inhabitants here are road construction labourers and have been staying here for over five years. Because of these settlements and encroachments, elephants now move from about two kilometres north of the Orchid Research Centre, near the upcoming Tippi Tourism guest house.

Human-Elephant Conflict: Two human deaths caused by elephants were recorded in 2004 and 2005. In 2013, the steel gate of the Orchid Research Centre was damaged by elephants. Since then no cases of conflict have been reported in the corridor area.

CONSERVATION PLAN

1. The corridor should be legally protected by the state forest department under an appropriate law, and action should be taken to prevent encroachment of the corridor forest, illegal tree felling and developmental activities hindering elephant movement.

2. The Tippi Tourism guest house should be shifted away from the corridor as it is in the direct path of elephant movement.

3. The construction of concrete walls should not be allowed on either side of NH 229 in the stretch passing through the corridor.

4. All temporary houses that have emerged due to road construction work along the national highway could be removed.

5. Construction, developmental activities and land use change should be strictly prohibited in the corridor area. No LPC (Land Possession Certificate) should be provided by the district administration on forest land.



Fig. 7.03: Settlements and developmental activities in corridor areas hinder free elephant movement

7.02

PAKKE- DOIMARA AT DADZU-LUMIA

Ecological priority: High

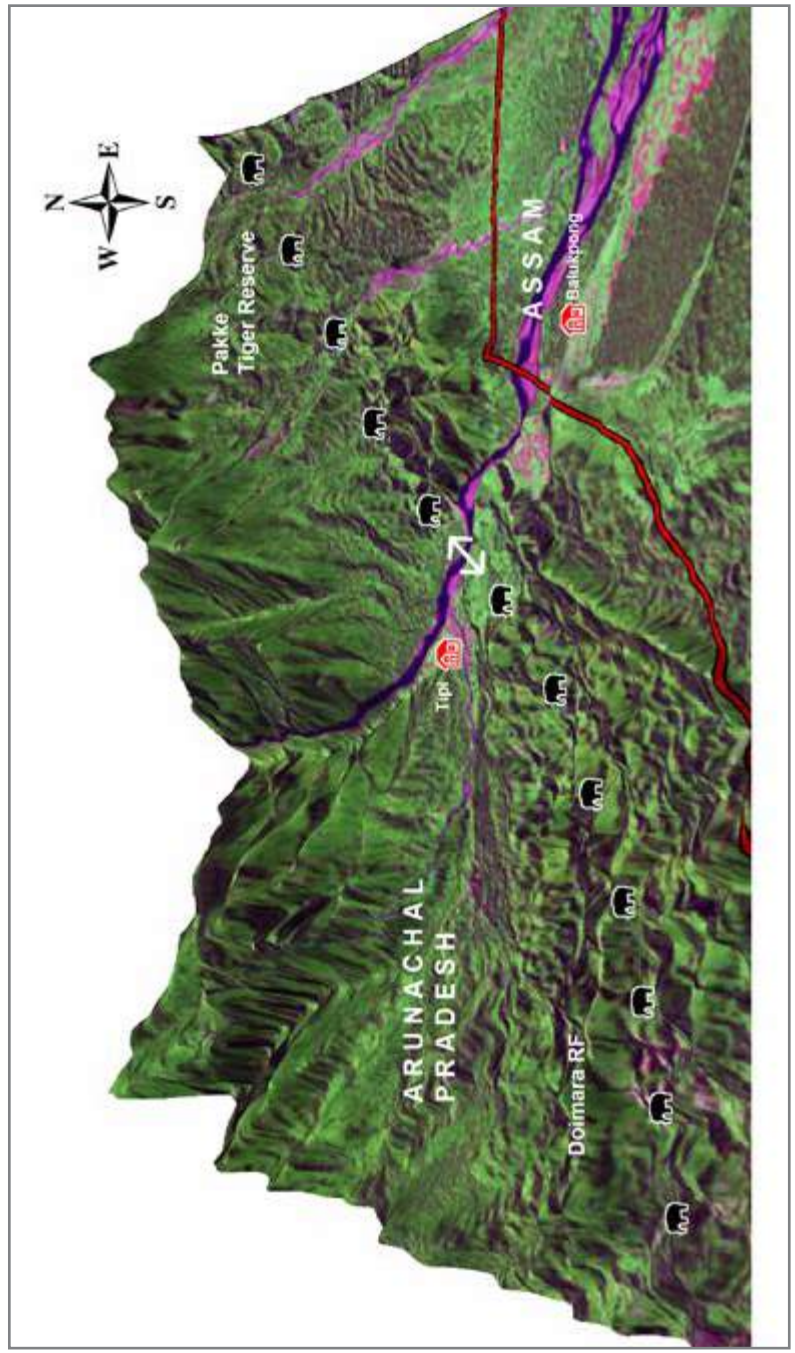
Conservation feasibility: High

This corridor connects the elephant habitats between Pakke Tiger Reserve and Doimara Reserve Forest of Khellong Forest Division. Elephants cross the Kameng River near Dhuwang nullah which extends up to 600 metres towards Tippi. The area is relatively plain and seasonally used by elephants. The corridor has been threatened by encroachment and shifting cultivation, as well as the construction of a small structure as part of the proposed ITBP camp in the corridor.

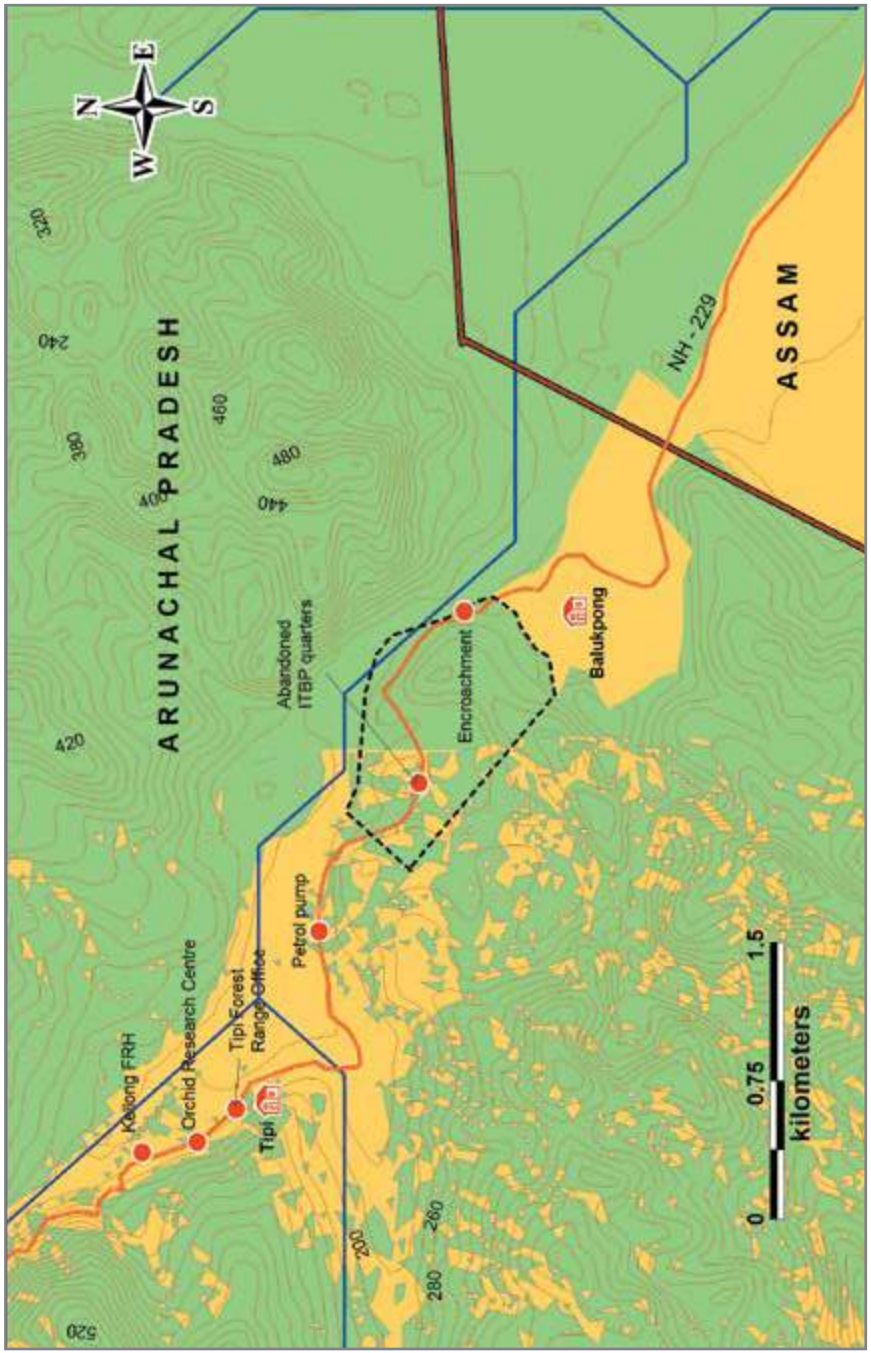
Alternate name	Pakke-Doimara at Dezling
State	Arunachal Pradesh
Connectivity	Pakke Tiger Reserve with Khellong Forest Division
Length and Width	1 km and 0.4 km
Geographical coordinates	27° 1′ 1″- 27° 1′ 37″ N 92° 37′ 17″- 92° 38′ 11″ E
Legal status	Reserve Forest and/or Community Land
Major land use	Forest, agriculture, river
Major habitation/settlements	Nil
Forest type	Tropical evergreen and semi evergreen forest
Frequency of usage by elephants	Regular; seasonal

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 14 tree species were recorded in the sampled area of 0.16 ha in the corridor forest, of which 10 are palatable to elephants. The predominant species were *Duabanga grandiflora* (30%), *Altingia excels* (11%),



3D map showing the landscape of the Pakke–Doimara at Dadzu–Lumia Corridor



Map of the Pakke–Doimara at Dadzu–Lumia Corridor

Gmelina arborea (11%), *Oroxylum indicum* (L) (13%). Other species included *Terminalia bellerica, Dillenia indica, Bauhinia spp, Emblica officinalis* etc. Grasses (40%) dominated the ground cover, followed by herbs (35%), shrubs (20%) and barren ground (5%).

Estimated elephant numbers in the landscape

Pakke Tiger Reserve: 134
Khellong Forest Division: 115
(*Elephant Census Arunachal Pradesh, 2015*)

Forest/Land use

Forest Type: Tropical evergreen and semi evergreen forest dominated by *Tectona grandis* and *Eucalyptus*
River: Kameng
Road: National Highway 229
Agriculture: Shifting cultivation (*jhumming)*

Other ecological importance

Mountain Range: Eastern Himalayas
Elephant Range: Kameng Elephant Reserve
Protected Area: Pakke Tiger Reserve
Biodiversity Hotspot: Eastern Himalayas
IBA: Pakke Tiger Reserve (IBA criteria A1, A2)

HUMAN DIMENSIONS

Threats

1. Settlements and encroachment: Expansion of the Upper Bhalukpong and Tippi villages and emerging temporary settlements (encroachments) towards the corridor area are major threats to the corridor.

2. Cultivation inside the corridor forest is a severe threat to the elephant habitat and the connecting corridor forest. A large part of the corridor area, especially at its bottleneck (on both sides of NH 229) is under cultivation .

3. High vehicular traffic on NH 229 (Bhalukpong-Tawang) is a threat to the free movement of elephants. On average, 64 vehicles per hour ply on this road during the day. About 47 vehicles per hour ply between 6 pm and 6 am. Concrete side walls (crash barriers) along NH 229 in the corridor also hinder elephant movement.

4. ITBP camp: There is a proposal to set up an ITBP camp in a 35-hectare area of the corridor, which will further threaten the movement of elephants and other wild animals. A small structure has already been constructed along the highway.

5. Boulder extraction from the Kameng River near the corridor is another issue.

Corridor dependent villages: Upper Bhalukpong and Tippi.

There is no village located inside the corridor. Upper Bhalukpong is located very close to the corridor and has about 348 households with a population of 1551 individuals. Tippi has about 235 permanent houses and 80 temporary houses (encroached).

Human-Elephant Conflict: Not high. Crop depredation by elephants in and around the corridor area is reported every year. However, no incidents of human death or injury have been reported in the last five years.

CONSERVATION PLAN

1. The corridor should be legally protected by the state forest department under an appropriate law, and action should be taken to prevent the encroachment of corridor forest, illegal tree felling and developmental activities hindering elephant movement. In consultation with villagers, the corridor area can be notified as a Community Conserved Area.

2. All encroachments upon corridor land could be removed at the earliest in consultation with the community members (tribes and others). Cultivation in the corridor is a major threat and this has to be regulated and stopped, especially in the bottleneck portion near Kameng River.

3. No LPC (Land Possession Certificate) should be provided by the district administration on corridor forest land.

4. Construction and developmental activities that hinder elephant movement in the corridor should be strictly prohibited. Illegal tree felling for personal and commercial purposes should be controlled in the corridor forest.

5. Boulder extraction should be banned along the Kameng River in the corridor area.

6. Concrete walls (crash barriers) constructed on either side of NH 229 should be removed in the area passing through the corridor. Vehicle speeds also need to be regulated by appropriate speed-breakers in the corridor.



Fig. 7.04: Crash barriers on NH 229 restrict the free movement of elephants

7.03

PAKKE - PAPUM AT LONGKA NULLAH

Ecological priority: High

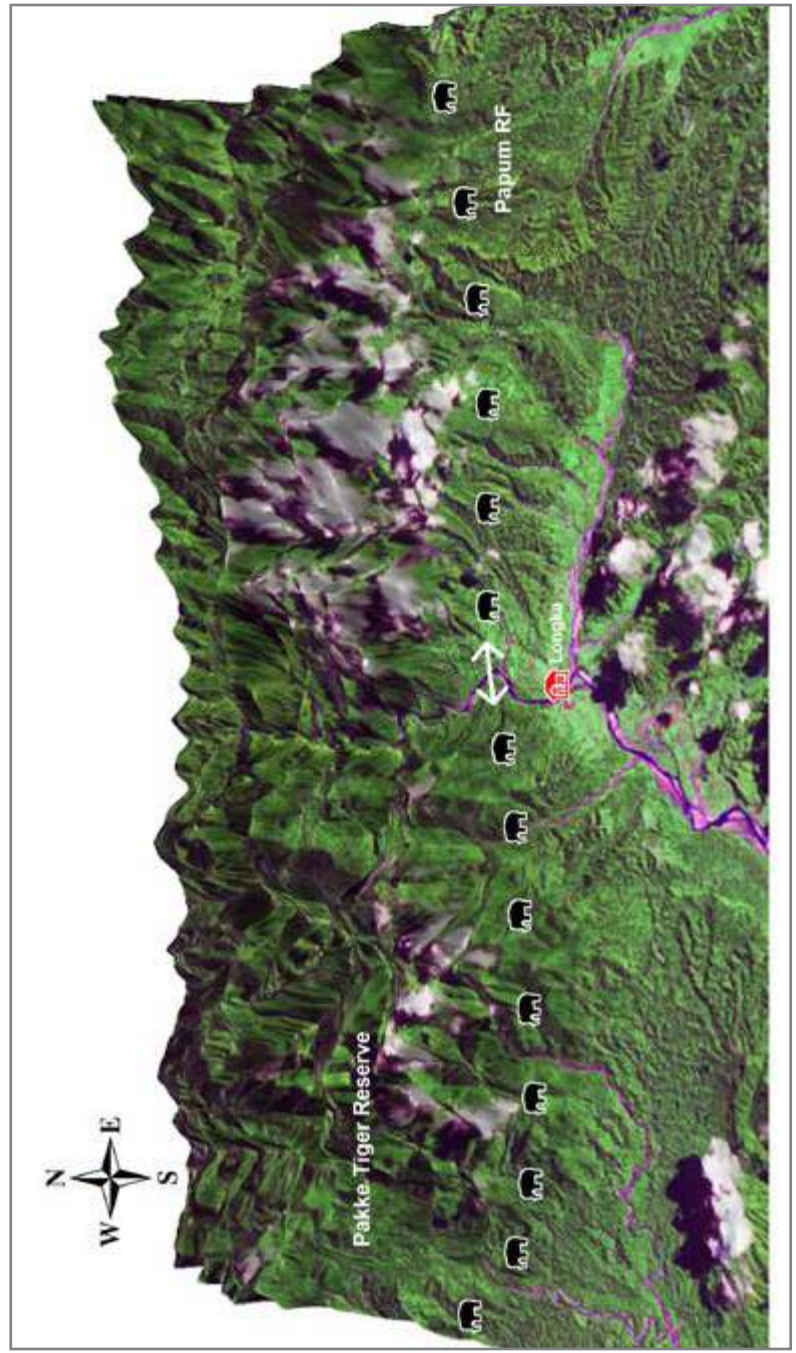
Conservation feasibility: High

This narrow corridor connects the elephant habitats within Papum Reserve Forest of Pakke Tiger Reserve. Elephants cross the Pakke River near the Longka nullah forest guest house. This movement path is regularly used by elephants.

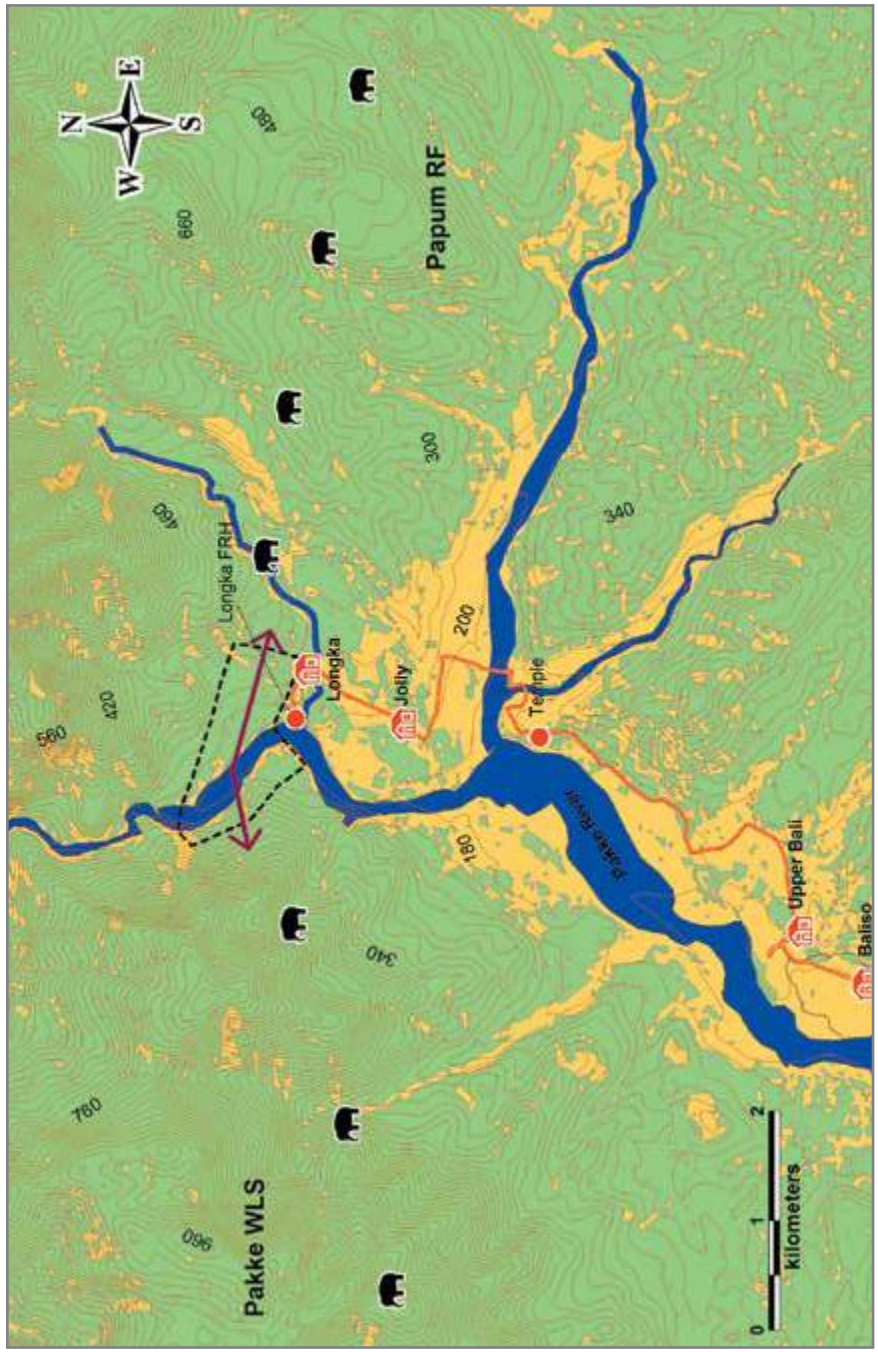
Alternate name	Longka nullah
State	Arunachal Pradesh
Connectivity	Western and Eastern side of Papum Reserve Forest
Length and Width	0.5 km and 0.8 km
Geographical coordinates	27° 1′ 2″- 27° 1′ 39″ N 93° 1′ 44″- 93° 2′ 51″ E
Legal status	Reserve Forest
Major land use	Forest, forest plantation
Major habitation/settlements	Longka village and Longka forest guest house
Forest type	Tropical evergreen and semi evergreen forest
Frequency of usage by elephants	Regular

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 10 tree species were recorded in the sampled area of 0.08 ha in the corridor forest, of which four species are palatable to elephants. The predominant tree species were *Duabanga grandiflora* (34%), *Dillenia indica* (12%), *Gmelina arborea* (14%) and *Altingia excels* (12%). *Imperata cylindrica* (L) grass was abundant especially along the nullahs. The ground cover was found to consist of grasses (40%), shrubs (25%), herbs (25%) and barren ground (10%).



3D map showing the landscape of the Pakke –Papum at Longka nullah Corridor



Map of the Pakke –Papum at Longka nullah Corridor

Estimated elephant numbers in the landscape

Pakke Tiger Reserve: 134

Khellong Forest Division: 115

(Elephant Census Arunachal Pradesh, 2015)

Forest/Land use

Legal status of corridor forest: Reserve Forest

Forest: Tropical evergreen and semi evergreen forest, mostly forest plantation

Settlement: Longka village

River: Pakke River and Longka nullah

Agriculture: Jhum cultivation of paddy

Artefacts: Forest guest house

Other ecological importance

Mountain range: Eastern Himalayas

Elephant Reserve: Kameng Elephant Reserve

Protected Area: Pakke Tiger Reserve

Biodiversity Hotspot: Eastern Himalayas

IBA: Pakke Tiger Reserve (IBA criteria A1, A2)

HUMAN DIMENSIONS

Threats

1. Settlements: The number of houses in Longka and Jolly villages has been increasing and so has the biotic pressure exerted on the corridor forest. In the last five years about 12 new houses have been built in this area.

2. Cultivation: Shifting cultivation of paddy has fragmented the elephant habitat.

3. Illegal felling: Illegal felling of trees for timber and fuelwood near the old plantation area of Papum Reserve Forest will affect the diurnal movement of elephants apart from decreasing the quality of the corridor forest.

Corridor villages: Longka

Longka is located in the corridor area. It has eight families with a population of about 92 people.

Corridor dependent villages: Jolly

Jolly village is located on the corridor fringe and has about 37 families and a population of 208. A majority of the population depends on agriculture for sustenance. Four families from Longka have moved to Jolly village.

Human-Elephant Conflict: Crop depredation by elephants happens every year during the cropping season. Five cases of human injury and two elephant deaths were reported between 2002-03 and 2011-12.

CONSERVATION PLAN

1. The corridor should be legally protected by the state forest department under an appropriate law, and action should be taken to prevent the encroachment of the corridor forest, illegal tree felling and developmental activities hindering elephant movement.

2. Longka village needs to be fenced off.

3. Cultivation should be controlled in the corridor area and Papum Reserve Forest.

4. Illegal tree felling for commercial purposes should be strictly prohibited in the corridor forest. The Gore Abbe Society could be involved for protection of forests and sensitisation of people.

5. The Grain-for-Grain initiative could be provided as ex-gratia support to manage human-elephant conflict.



Fig. 7.05: Groundtruthing of the corridor by a WTI team member



Fig. 7.06: Longka village within the corridor

7.04

PAKKE- PAPUM AT SEIJOSA NULLAH

Ecological priority: High

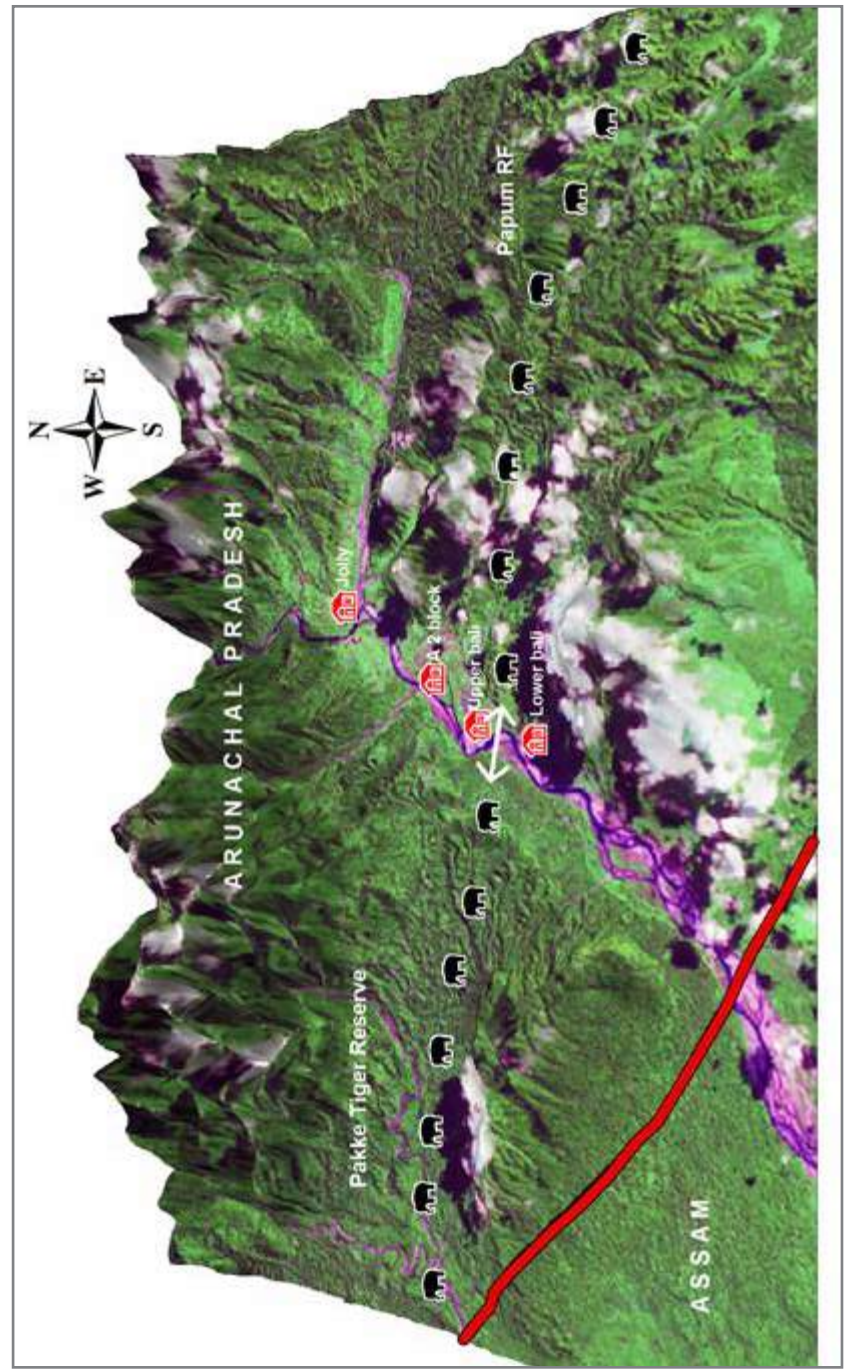
Conservation feasibility: High

This corridor connects Pakke Tiger Reserve with Papum Reserve Forest. Elephants cross the Pakke River and move to Papum Reserve Forest through the Seijosa nullah near Lower Bali village, and also through A2 / Yarason nullah near A2 block and Mebuso 2. Elephants mostly pass through the two nullahs in the corridor.

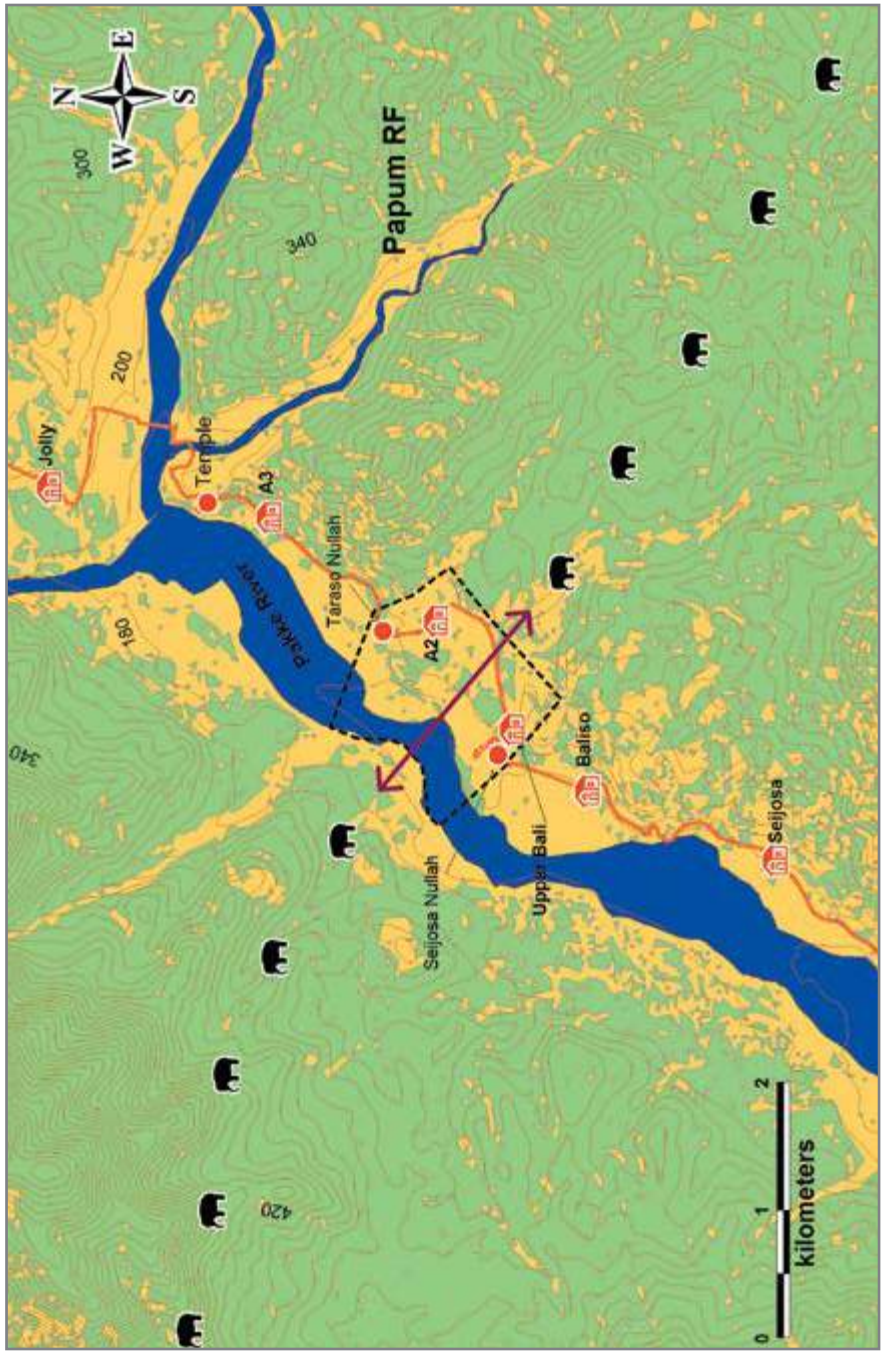
Alternate name	Seijosa nullah
State	Arunachal Pradesh
Connectivity	Pakke Tiger Reserve with Papum Reserve Forest
Length and Width	1 km and 0.6 km
Geographical coordinates	26° 58′ 23″- 26° 59′ 22″ N 93° 0′ 49″- 93° 2′ 2″ E
Legal status	Community Land, Forest
Major land use	Forest, agriculture and settlement
Major habitation/settlements	Lower Bali, Upper Bali and Mebuso 2
Forest type	Tropical evergreen forest
Frequency of usage by elephants	Regular; through the year

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 13 tree species were recorded in the sampled area of 0.08 ha. The predominant tree species were *Duabanga grandiflora* (36%), *Sterospermum chelonoides* (11%), *Artocarpus lakoocha* (11%,) and *Canarium grandiflora* (8%). Of these, 10 species are elephant food species.



3D map showing the landscape of the Pakke–Papum at Seijosa Nullah Corridor



Map of the Pakke–Papum at Seijosa Nullah Corridor

Estimated elephant numbers in the landscape

Pakke Tiger Reserve: 134

Khellong Forest Division: 115

(Elephant Census Arunachal Pradesh, 2015)

Forest/Land use:

Forest Type: Tropical evergreen forest

Settlement: Lower Bali, Upper Bali, Mebuso 2

Agricultural land

River: Pakke River, Seijosa nullah and A2/ Yarason nullah

Other ecological importance

Mountain range: Eastern Himalayas

Elephant Reserve Name: Kameng Elephant Reserve

Protected Area: Pakke Tiger Reserve

Biodiversity Hotspot: Eastern Himalayas

IBA: Pakke Tiger Reserve (IBA criteria A1, A2)

HUMAN DIMENSIONS

Threats

1. Settlements: The increasing population of Mebuso 2, Lower Bali and Upper Bali villages and their biotic pressure (NTFP and fuelwood collection) is a threat. Bamboo is collected from the forest in large quantities.

2. Cultivation: Cultivation near the corridor area degrades the corridor and also attracts elephants near human settlements.

3. Electric fencing around Pakke Jungle Camp adjacent to the corridor hinders animal movement.

4. Illegal felling of trees inside Papum Reserve Forest and along the Seijosa nullah.

5. Seijosa Road Bridge: An upcoming road bridge over the Seijosa nullah will increase vehicular traffic and other biotic pressure.

6. Rubber and tea plantations in the Papum Reserve Forest

Corridor villages: Lower Bali, Upper Bali, Mebuso 2

Corridor dependent villages: Part of Lower Bali and Mebuso 2

Human-Elephant Conflict: Crop depredation by elephants is a major concern for the villagers as well as the forest department. Seven human injuries and two elephant deaths were reported between 2002 and 2010 near the corridor.

CONSERVATION PLAN

1. The corridor should be legally protected by the state forest department under an appropriate law, and action should be taken to prevent encroachment of the corridor forest and developmental activities hindering elephant movement. The possibility to declare this as a Community Reserve/CCA could be explored with the Ghora Abhe Society.

2. Illegal tree felling in the corridor forest for commercial purposes should be strictly prohibited. Illegal bamboo extraction should also be controlled in the corridor area.

3. Habitat restoration in degraded areas of Papum Reserve Forest has to be undertaken on a priority basis. The Ghora Abhe Society could be involved to facilitate this process.

4. Institutional and capacity-building support should be provided to Eco-Development Committees (EDC) to empower them and garner their support for conservation.

4. Shifting cultivation and rubber and tea plantations inside the Papum Reserve Forest should be controlled with the assistance of the Ghora Abhe Society.

5. Prevent further expansion of the Pakke Jungle Camp within the corridor area.

6. Grain-for-Grain initiative could be provided as ex-gratia support to manage human-elephant conflict.

7. Support for the Paga Festival could be provided as a confidence-building measure.



Fig. 7.07: A view of the corridor landscape

7.05

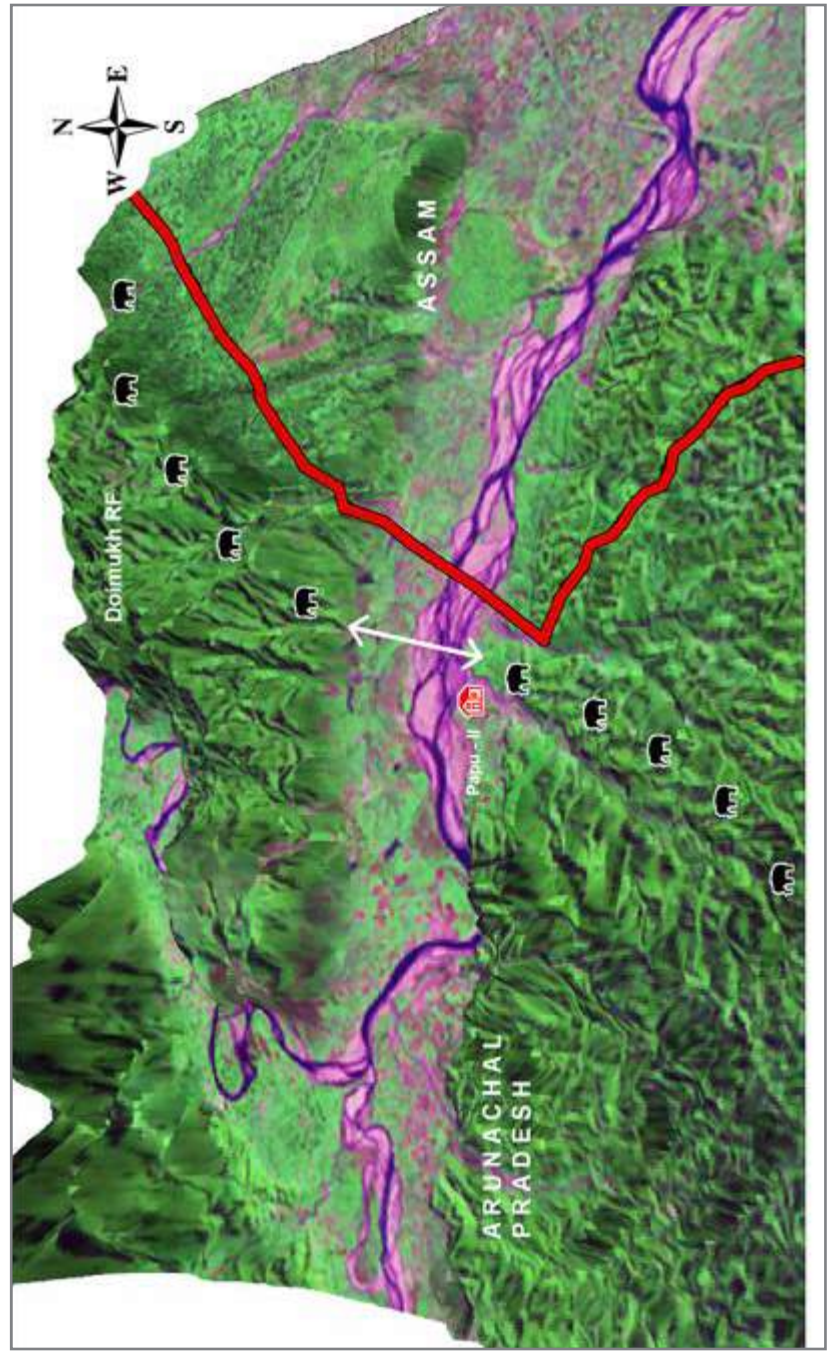
DURPONG - DOIMUKH AT KHUNDAKUWA

Ecological priority: Medium

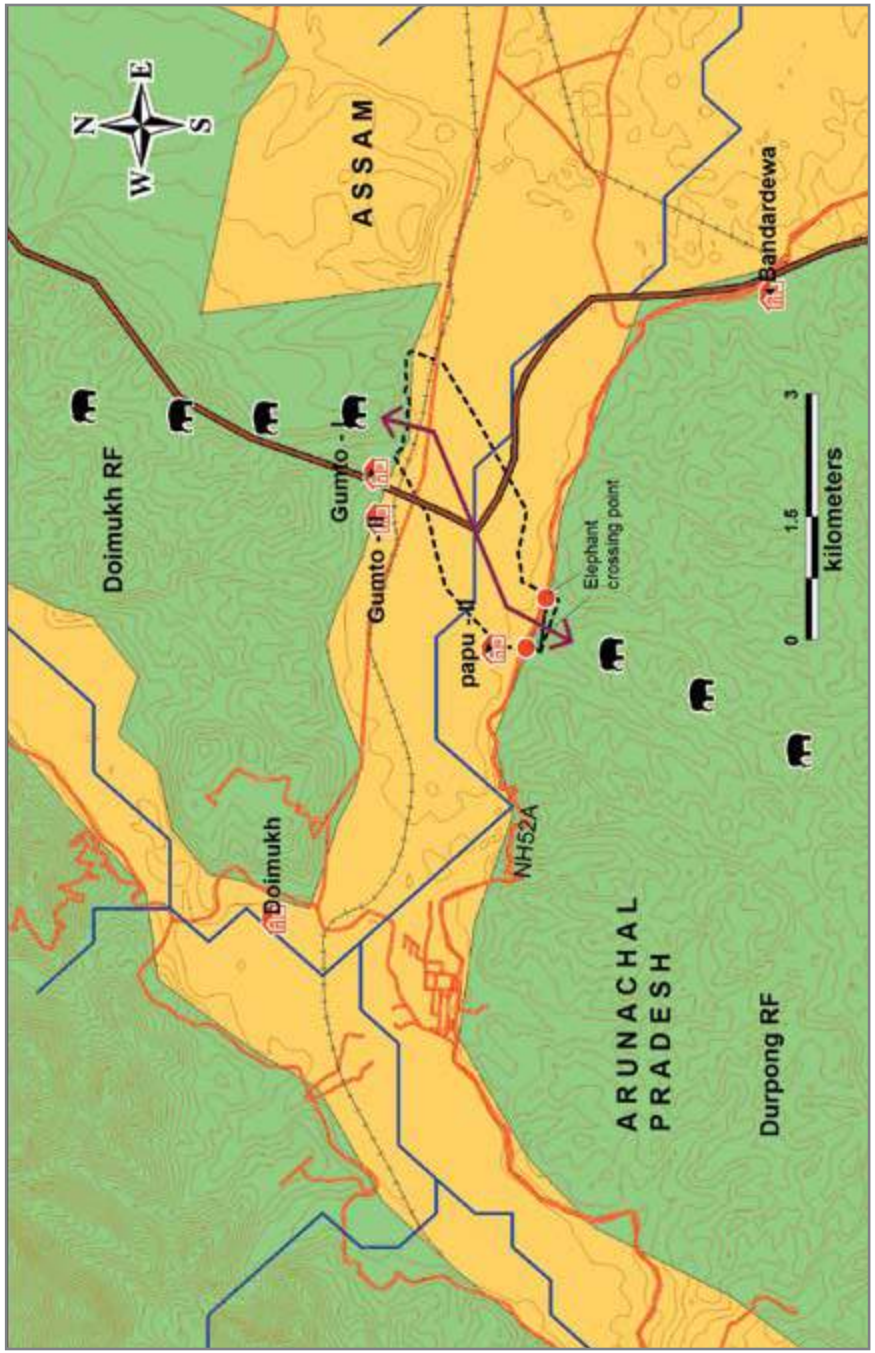
Conservation feasibility: Medium

This corridor connects Durpong Reserve Forest with Doimukh Reserve Forest of Banderdewa Forest Division. Elephants generally cross the Dikrong River through Khundakuwa nullah to move between these forest areas. National Highway 52A connecting Banderdewa to Itanagar, a railway track connecting Harmooty (Assam) to Naharlagun (Arunachal Pradesh), and the Harmooty-Doimukh road pass through the corridor. Ranga and Golajuli villages and their agricultural lands are also located within the corridor.

Alternate name	Karsinga
State	Arunachal Pradesh
Connectivity	Durpong Reserve forest and Doimukh Reserve forest of Banderdewa Forest Division
Length and Width	1 km and 0.6 km
Geographical coordinates	27° 7′ 4″- 27° 8′ 10″ N 93° 47′ 0″- 93° 49′ 14″ E
Legal status	Reserve Forest and Private Land
Major land use	Forest, agriculture, settlements and river
Major habitation/settlements	Khundakuwa and Naobhanga (encroachments), Ranga and Golajuli
Forest type	Tropical evergreen forest
Frequency of usage by elephants	Rare



3D map showing the landscape of the Durpong – Doimukh at Khundakuwa Corridor



Map of the Durpong – Doimukh at Khundakuwa Corridor

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 20 tree species and a bamboo species (*Bambusa balcooa*) were recorded in the sampled area of 0.08 ha. Of these, seven species are palatable to elephants. The predominant tree species were *Gmelina arborea* (12%), *Dillenia indica* (9%), *Oroxylum indicum* (L) (9%) and *Terminalia sp* (9%). The proportion of ground cover vegetation was: grasses (37%), shrubs (27%), herbs (24%) and barren ground (12%).

Estimated elephant numbers in the landscape

Banderdewa Forest Division: 192

Ranga Reserve Forest of Lakhimpur Forest Division: 77

(Elephant Census Arunachal Pradesh, 2015 and *Elephant Census Assam 2011)*

Forest/Land use

Forest Type: Tropical evergreen forest

Settlements: Khundakuwa nullah and Naobhanga nullah (encroachments), Golajuli and Ranga villages

Agriculture: Paddy

Road: NH 52A and Harmooty-Doimukh road

Railway track: Harmooty to Naharlagun

River: Dikrong River

Other ecological importance

Mountain range: Eastern Himalayas

Elephant Reserve Name: Kameng Elephant Reserve

HUMAN DIMENSIONS

Threats

1. Settlements: Khundakuwa nullah, Naobhanga nullah, Golajuli and Ranga villages. Two new church settlements have come up in Khundakuwa nullah.

2. Encroachment: There are 16 houses on encroached land at Khundakuwa nullah, established about five years back. Another encroachment with 25 houses is at Naobhanga nullah in the corridor area.

3. Concrete wall: The concrete wall constructed to check water flow in the nullahs and create space for houses is hindering elephant movement.

4. Cultivation: Cultivation practices in and around the Durpong Reserve Forest.

5. Mining: Boulder mining along the Naobhanga nullah and sand mining at Dikrong River.

6. High vehicular traffic: National Highway 52A passes through the corridor. On average, 51.20 vehicles per hour ply on this road during the day. About 38.85 vehicles per hour ply between 6 pm and 6 am. Widening of the highway has further affected the corridor.

7. Railway track: A new railway track connects Harmooty and Naharlagun towns. The elevated railway line has hindered elephant movement.

Corridor villages: Khundakuwa nullah (16 households), Khundakuwa (38 households), Naobhanga (48 households), Golajuli (65 households) and Ranga (55 households).

Corridor dependent villages: Khundakuwa, Naobhanga, Golajuli and Ranga villages.

Human-Elephant Conflict: The incidence of human-elephant conflict has reduced as corridor usage by elephants is now rare. About 12 human deaths caused by elephants were reported between 2007 and 2014 in the region.

CONSERVATION PLAN

1. The corridor should be legally protected by the state forest department under an appropriate law, and action should be taken to prevent encroachment of the corridor forest, illegal tree felling and developmental activities hindering elephant movement.

2. Illegal tree felling and bamboo extraction for commercial purposes should be strictly prohibited inside Durpong Reserve Forest, Doimukh Reserve Forest and Ranga Reserve Forest. Habitat restoration needs to be undertaken in these reserves.

3. Encroachments in Khundakuwa nullah (16 families) should be removed on a priority basis by Banderdewa Forest Division.

4. Vehicular speeds on NH 52 should be regulated by the use of suitable physical barriers at night.

5. Cultivation should be controlled inside corridor areas.

6. The concrete wall constructed by the sides of the Khundakuwa and Naobhanga nullahs should be modified to facilitate elephant movement along the riverbed.

7. Illegal sand and boulder mining along the Dikrong River and Naobhanga nullah in the corridor area should be stopped immediately by Banderdewa Forest Division.

7.06

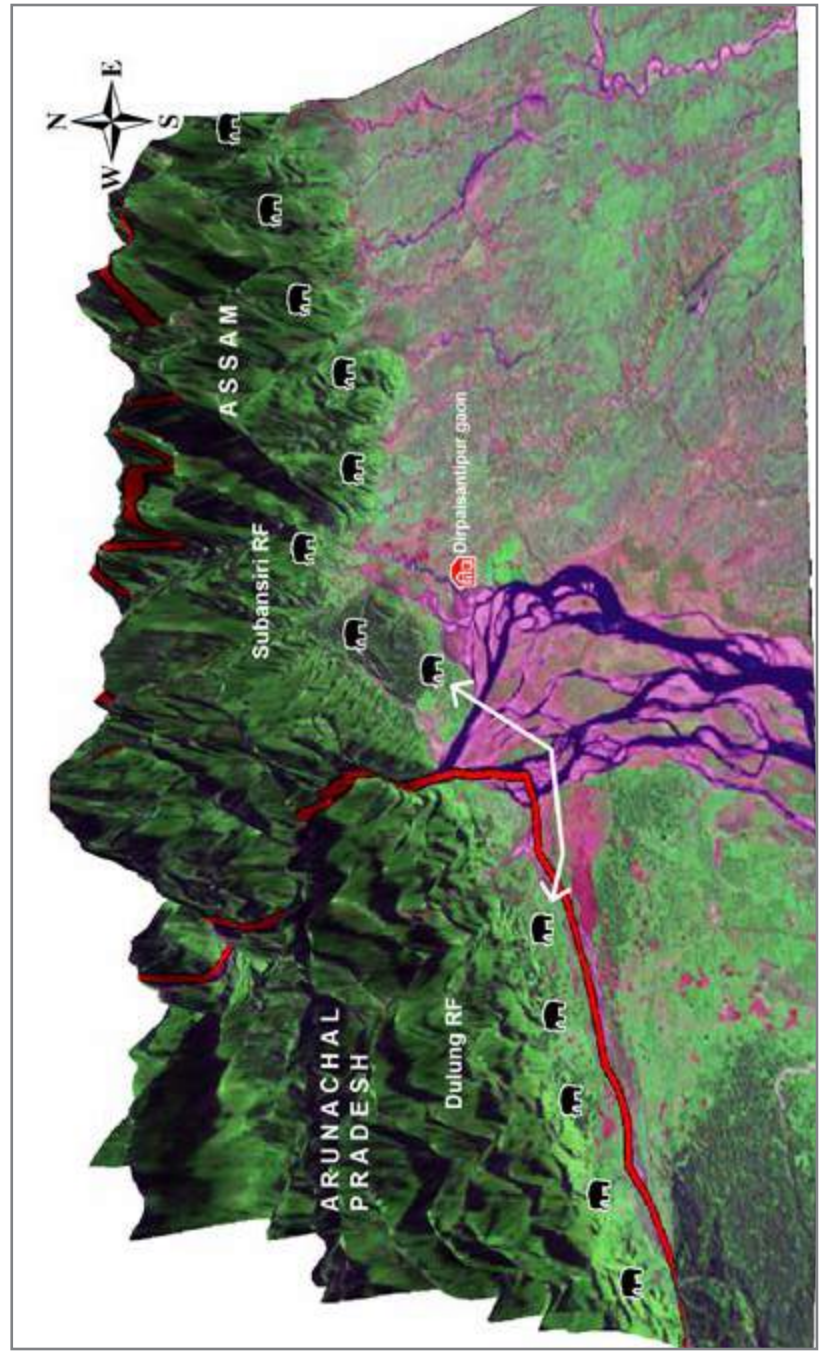
DULUNG - SUBANSIRI

Ecological priority: Medium

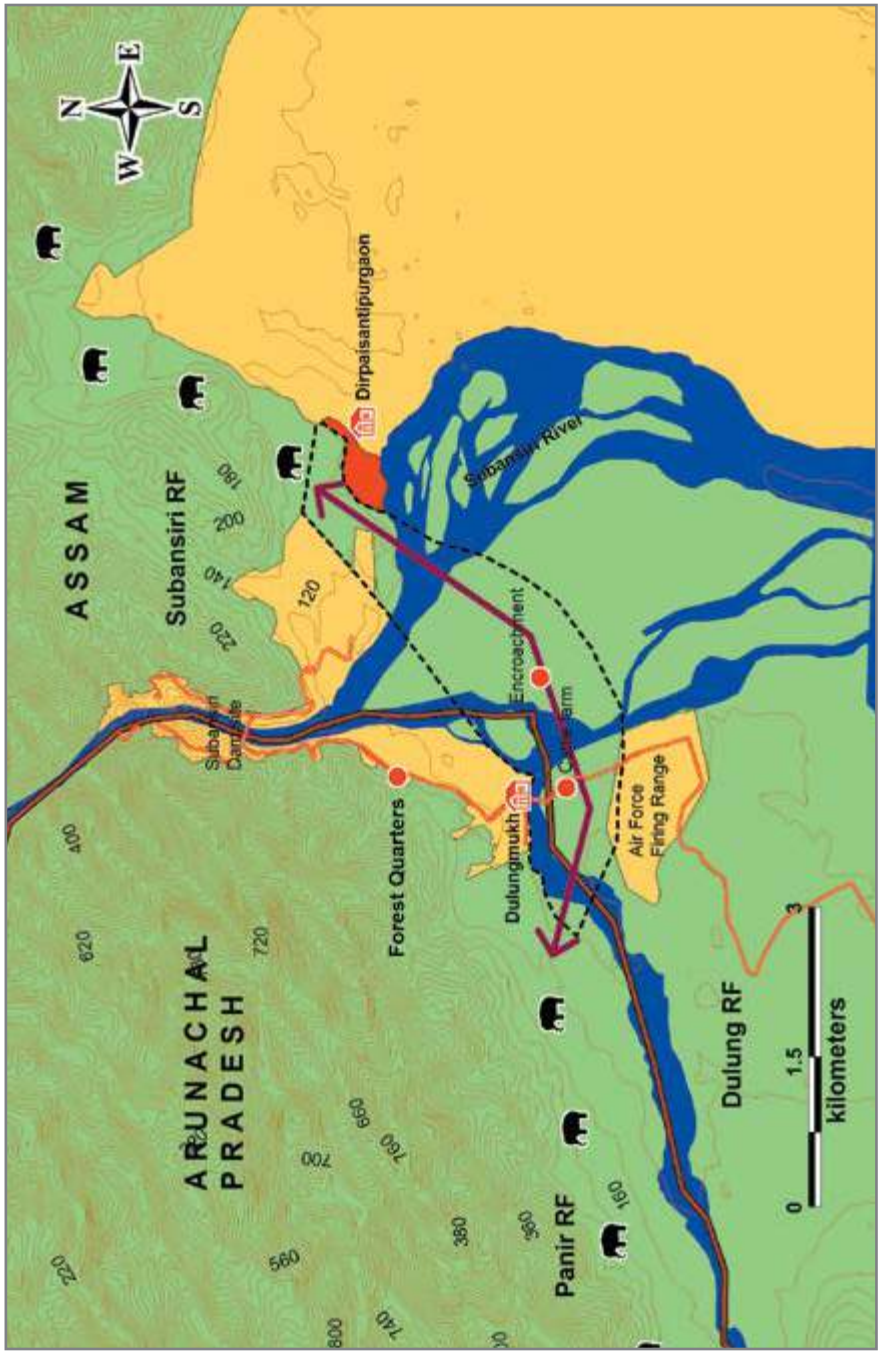
Conservation feasibility: Medium

The Dulung-Subansiri corridor connects Panir Reserve Forest (Banderdewa Division, Arunachal Pradesh) and Dulung Reserve Forest with Subansiri Reserve Forest (Lakhimpur Forest Division, Assam). It is situated just south of the Subansiri hydro-electric site near Gerukamukh. It is a vital link between the elephant habitats of the east and west banks of the Subansiri River. Due to the steep and rough terrain, there is little chance of elephant movement to the north of this corridor (towards Tale Valley Wildlife Sanctuary). Elephants move to Subansiri Reserve Forest through Dulung village, Subansiri River, Jababari Island and Ghora Island. Elephant movement has drastically reduced over the years.

Alternate name	Dulung
State	Assam and Arunachal Pradesh
Connectivity	Panir Reserve Forest and Dulung Reserve Forest with Subansiri Reserve Forest
Length and Width	3.5 km and 0.5-1 km
Geographical coordinates	27° 30’ 18”- 27° 32’ 15” N 94° 14’ 11”- 94° 17’ 20” E
Legal status	Reserve Forest
Major land use	Agriculture, forest, settlement, river, island and Air Force firing range
Major habitation/settlements	Jababari island
Forest type	Tropical evergreen and semi evergreen forest
Frequency of usage by elephants	Occasional; during cropping season



3D map showing the landscape of the Dulung- Subansiri Corridor



Map of the Dulung- Subansiri Corridor showing the land to be secured

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 11 tree species were recorded in the sampled area of 0.08 ha in the corridor forest. Of these, five tree species are palatable to elephants. The predominant species were *Ziziphus jujuba* (31%), *Dillenia indica* (15%), *Gmelina arborea* (12%) and *Oroxylum indicum* (9%).

Ground cover was found to consist of grasses (43%), shrubs (20%), herbs (24%) and barren ground (13%).

Estimated elephant numbers in the landscape
Banderdewa Forest Division: 192
Subansiri Range of Lakhimpur Forest Division: 40
Lakhimpur Forest Division: 121
(Elephant Census Arunachal Pradesh, 2015 and *Elephant Census Assam, 2011)*

Forest/Land use
Legal status: Reserve Forest
Forest type: Tropical semi evergreen forest
Settlement: Jababari island
Agriculture land: Dulungmukh
River: Subansiri River and Dulung River

Other ecological importance
Mountain Range: Eastern Himalayas

HUMAN DIMENSIONS

Threats
1. Settlements: Eight houses at Jababari island and a cattle shed are in the corridor.

2. Agriculture: Agricultural activities in Jababari island and Dulungmukh village hinder the free movement of elephant.

3. Tree felling: Tree felling in Ghora and Jababari islands.

4. Boulder collection: Boulder collection from the Dulung River.

5. An Air Force firing range in Dulung Reserve Forest is located in the corridor, hindering elephant movement.

6. Tea garden: Ananda Tea Garden and its labour colonies are located in the corridor area.

7. Dam: The upcoming Subansiri hydro-electric dam near Gerukamukh.

Corridor villages: Jababari Island (eight households)

Corridor dependent Villages: Kalaptakur (65 households), Ananda Tea Garden colony (100 households) and Dulungmukh (125 households)

CONSERVATION PLAN

1. The corridor should be legally protected by the state forest department under an appropriate law, and action should be taken to prevent encroachment of the corridor forest, illegal tree felling and developmental activities hindering elephant movement.

2. About eight houses (encroachments) in Jababari island should be removed by Bandardewa Forest Division.

3. Illegal timber felling inside Ghora and Jababari islands for personal and commercial purposes should be strictly prohibited.

4. In consultation with the Air Force, bombing practice should be stopped during the elephant migratory season (October to February).

5. Boulder collection in the Dulung River should be prohibited inside the corridor area.

6. Overgrazing should be controlled near corridor areas. Habitat restoration needs to be undertaken in the barren land located in the islands.

7. Hydrologic regulation: plan to be made with National Hydroelectric Power Corporation (NHPC).



Fig. 7.08: Dulung - Subansiri corridor landscape

7.07

D'ERING - MEBO AT SIGAR NULLAH

Ecological priority: High

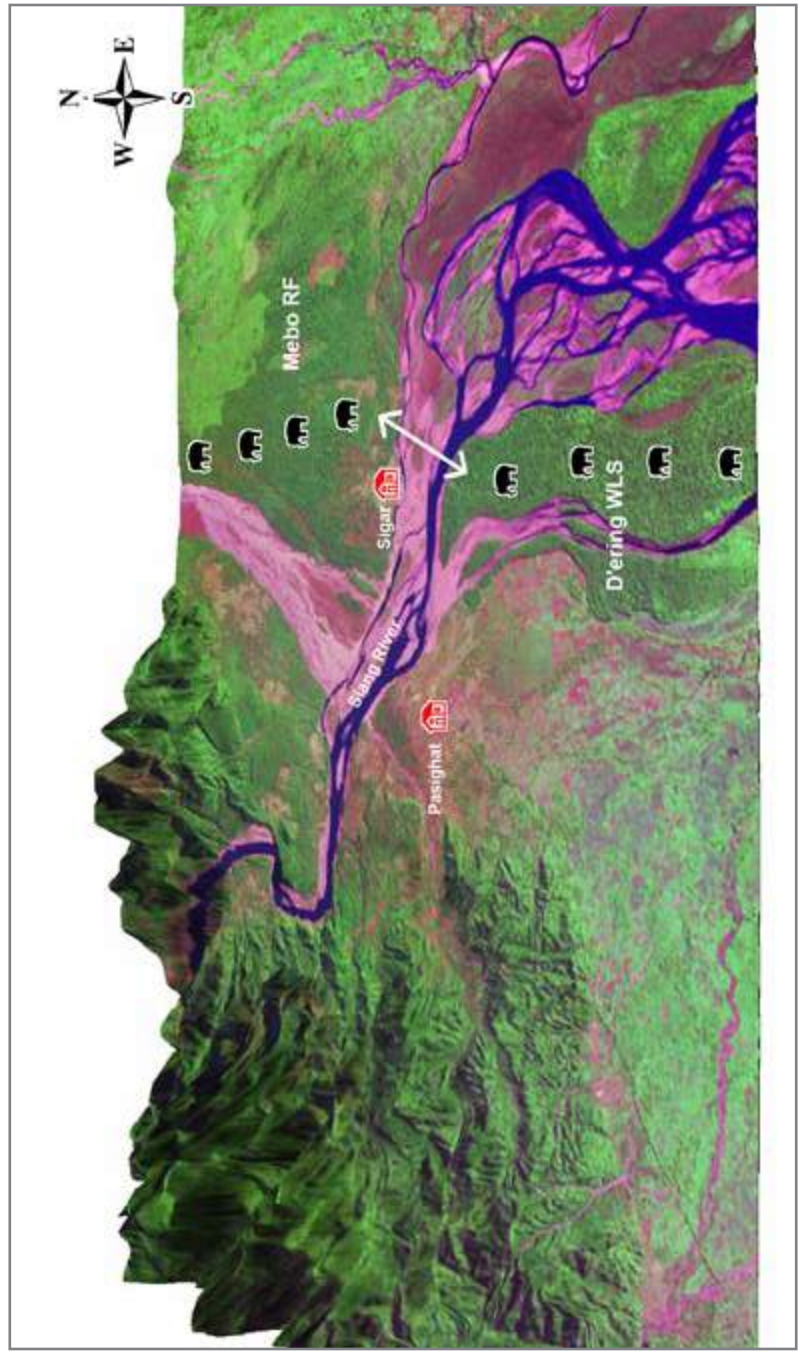
Conservation feasibility: High

This corridor connects the D'ering Memorial Wildlife Sanctuary and Mebo Reserve Forest of Pasighat Forest Division on either side of the Siang River. Elephants move adjacent to Sigar village and many private forest lands, to Dibang Forest Division through Aohali village. The corridor is extensively used by elephants.

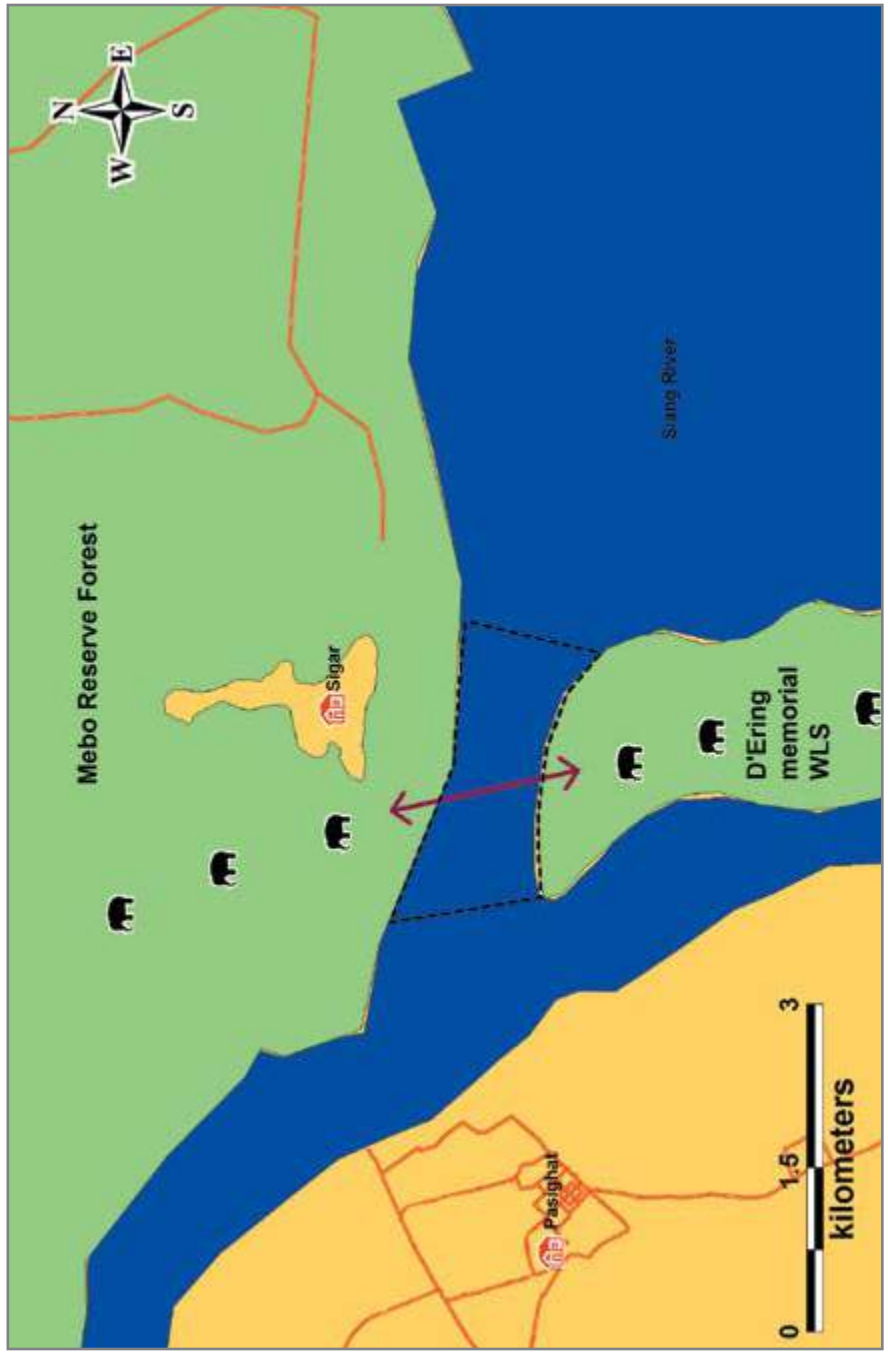
Alternate name	Sigar nullah
State	Arunachal Pradesh
Connectivity	D'Ering Memorial Wildlife Sanctuary and Mebo Reserve Forest
Length and Width	3 km and 1-1.5 km
Geographical coordinates	28° 3' 28"- 28° 4' 31" N 95° 21' 25"- 95° 23' 6" E
Legal status	Reserve Forest, Community Land
Major land use	Forest, river and agricultural
Major habitation/settlements	Sigar
Forest type	Tropical evergreen forest
Frequency of usage by elephants	Regular and seasonal

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 11 tree species were recorded in the sampled area of 0.08 ha. Of these, five are elephant food species. The predominant species were *Anthocephalus chinensis* (35%), *Albizzia procera* (23%), *Oroxylum indicum* (L) (15%) and *Dillenia indica* (11%). Other species include *Pterospermum acerifolium*, *Terminalia myriocarpa*, *Kydia calycina, Bombax ceiba, Gymnema arborea, Mallotus philippensis* and *Aesculus assamica.*



3D map showing the landscape of the D'Ering-Mebo at Sigar Nullah Corridor



Map of the D'Ering –Mebo at Sigar Nullah Corridor

The ground cover was dominated by grasses (*Saccharum longisetosum, S Spontaneum,* 37%), shrubs (27%), herbs (24%) and barren ground (12%).

Estimated elephant numbers in the landscape

Pasighat Forest Division: 144
D'Ering Wildlife Sanctuary: 61
Dibang Forest Division: 113
(Elephant Census Arunachal Pradesh, 2015)

Forest/Land use

Forest type: Tropical Evergreen Forest
River: Siang
Agricultural land
Settlement: Sigar village

Other ecological importance

Mountain Range: Eastern Himalayas
Protected Area: D'Ering Memorial Wildlife sanctuary

HUMAN DIMENSIONS

Threats

Settlements and agricultural practices: The expansion of settlements at Sigar village in the corridor as well as the encroachment of certain other areas, and an increase in agricultural activity near the corridor.

Corridor village: Sigar with about 64 households and a population of 400.

Corridor dependent villages: Ralling (38 households with a population of 350) and New Borghuli (36 households with a population of 150).

Human-Elephant Conflict: Conflict occurs mainly due to crop depredation by elephants and is a major issue for the villagers.

CONSERVATION PLAN

1. The corridor should be legally protected by the state forest department under an appropriate law, and action should be taken to prevent encroachment of the corridor forest, illegal tree felling and developmental activities hindering elephant movement.

2. Prevent encroachment and new settlements in the corridor area and control the expansion of agricultural practices near the corridor area.

3. Efforts should be made to prevent illegal felling of trees in the corridor area and in the community forest.



Fig. 7.08: Meeting with community members of corridor and corridor-dependent villages



Fig. 7.09: Agricultural activity in the village of Sigar, located within the corridor area

7.08

D'ERING - DIBRU SAIKHOWA

Ecological priority: High

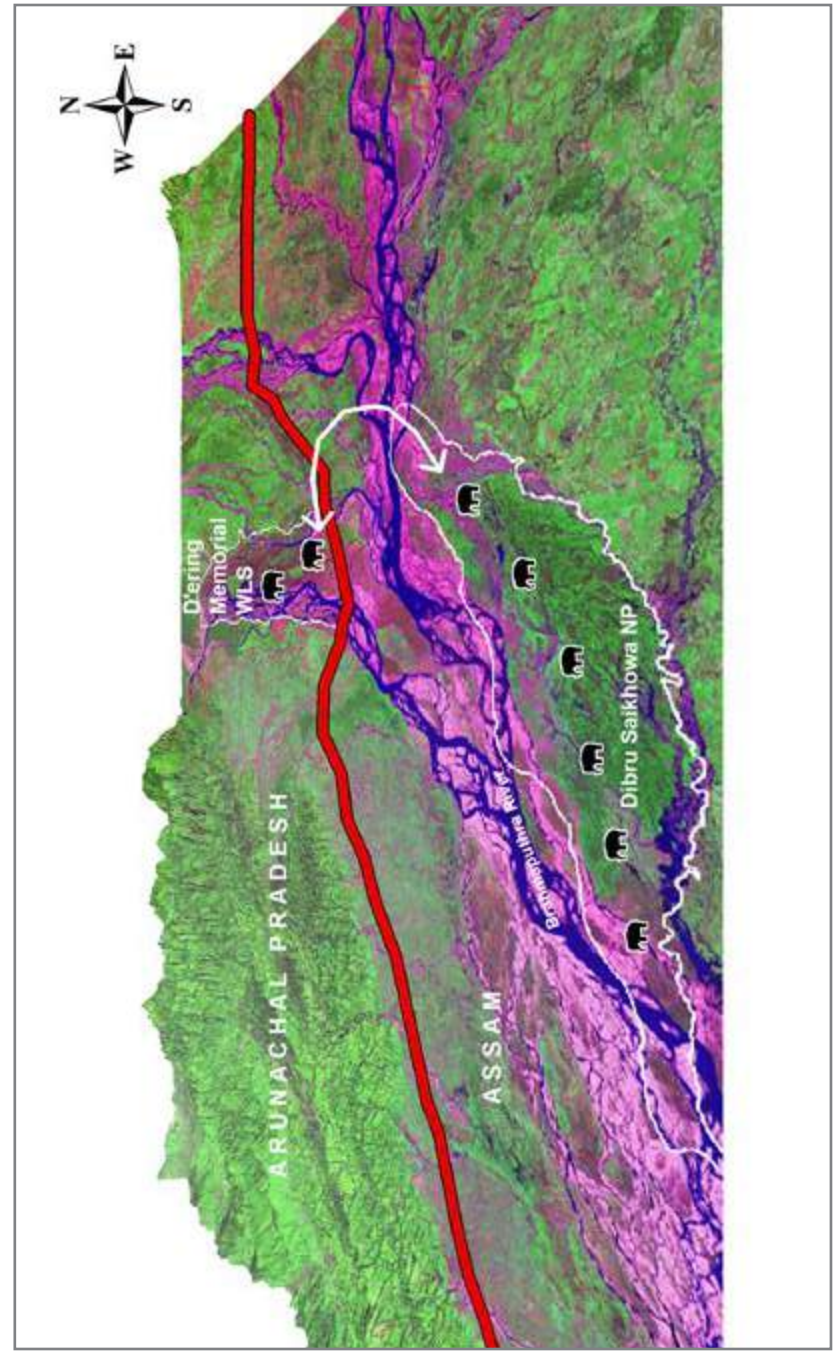
Conservation feasibility: High

This corridor connects the D'ering Memorial Wildlife Sanctuary (Arunachal Pradesh) with Dibru Saikhowa National Park (Assam) via the forest patches of the Sadiya Forest Range of Doom Dooma Forest Division. Elephants move through community lands, settlements (some encroached), agricultural lands, and the flood plains of the Siang, Dibang and Lohit Rivers, which lie between these two Protected Areas.

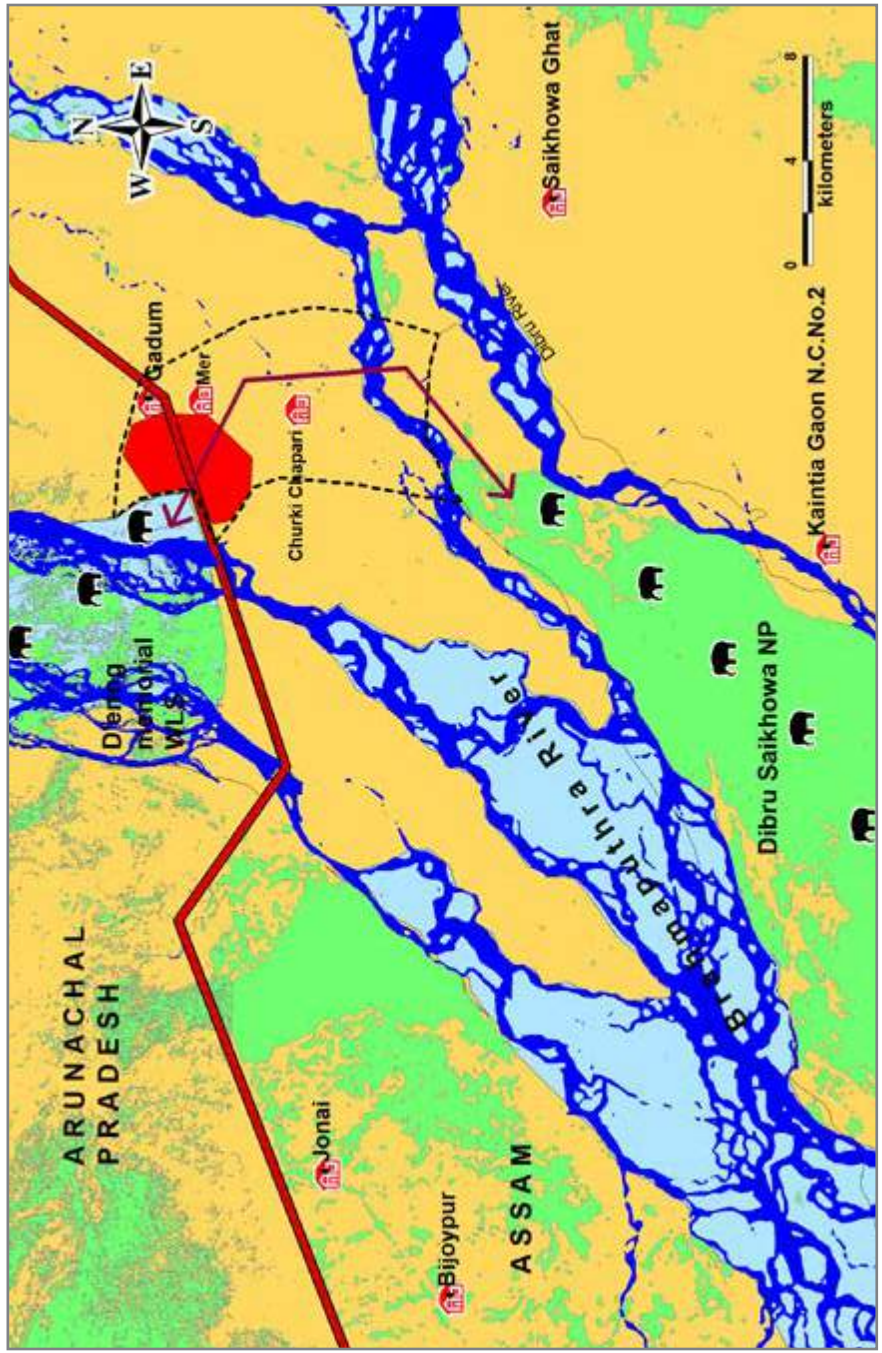
State	Arunachal Pradesh and Assam
Connectivity	D'Ering Memorial Wildlife Sanctuary and Dibru Saikhowa National Park
Length and Width	16 km and 1-2 km
Geographical coordinates	27° 46' 51"- 27° 54' 2" N 95° 27' 50"- 95° 33' 15" E
Legal status	Reserve Forest, Community Land, Private Land
Major land use	Forest, flood plain, river, agricultural land, settlements
Major habitation/settlements	Mer, Gadum, Paglam, Laimukri, Amorpur, Chilling No 2
Forest type	Assam alluvial plain semi evergreen forest and riverine forest
Frequency of usage by elephants	Regular; seasonal (October- February)

FORESTS AND ELEPHANTS

Corridor habitat status: The corridor forest is in the flood plains of the Siang, Dibang and Lohit Rivers. The vegetation is mostly grassland (*Phragmites karka, Saccharum spontaneum, S arundinaceum, Erianthus ravannae*). Tree species towards



3D map showing the landscape of the D'Ering – Dibru Saikhowa corridor



Map of the D'ering – Dibru Saikhowa corridor

D'ering Wildlife Sanctuary are generally represented by *Albizzia procera* and *Zizyphus Mauritania*. The grass species towards Dibru Saikhowa are represented by *Imperata cylindrical, Phragmaties karka, Erianthus ravanea* and *saccharum*.

Estimated elephant numbers in the landscape

Pasighat Forest Division: 144
D'Ering Wildlife Sanctuary: 61
Dibru Saikhowa National Park: 115
(Elephant Census Arunachal Pradesh, 2015 and *Assam, 2011-12)*

Forest/Land use

Forest type: Assam alluvial plain semi evergreen forest and riverine forest
River: Siang, Dibang and Lohit Rivers
Agricultural land
Settlement: Mer, Gadum, Paglam, Laimekuri, Amorpur and Chilling No 2

Other Ecological importance

Mountain Range: Eastern Himalayas
Protected Area: D'Ering Wildlife Sanctuary and Dibru Saikhowa National Park

HUMAN DIMENSIONS

Threats

1. Settlements: Mer, Gadum, Paglam, Laimekuri, Amorpur and Chilling No 2 settlements, as well as some encroached land in Assam. Biotic pressure results from the collection of grasses for thatching in houses and fodder for livestock, as well as fuelwood collection. This has degraded the corridor habitat and threatened elephant movement.

2. Increased human-elephant conflict: Two elephants were killed in 2013 in retaliation for crop depredation in the Siang area.

Corridor dependent villages: Mer (120 households), Gadum (60 households), Namsing (299 households) and Paglam (200 households) in Arunachal Pradesh.

Laimekuri (28 households), Estum (130 households), Amorpur (138 households), Chilling No 2 (11 households), Kaling, Ghospuri, Kheroni, Baro-Ghoria (120 households) in Assam.

Human-Elephant Conflict: Conflict occurs every year in the corridor area, both in Arunachal Pradesh and Assam. According to reports from the Sadiya Range of Doomdooma Forest Division, in 2015-16 there were two human deaths due to elephants, 105 hectares of crop depredation, and about 30 houses damaged by elephants in the corridor. In the Mebo Forest Division in Arunachal Pradesh, four people lost their lives due to elephants between 2011 and 2015, and an average of 50 hectares of crops are damaged annually by elephants in the region.

CONSERVATION PLAN

1. The corridor should be legally protected by the state forest department under an appropriate law, and action should be taken to prevent encroachment of the corridor forest, illegal tree felling and developmental activities hindering elephant movement.

2. At least 400 hectares of corridor land needs to be declared as a Community Reserve in consultation with villagers.

3. Prevent encroachment and new settlements in the corridor area, especially towards Assam.

4. Provide support to local communities to improve their livelihood, and minimise human-elephant conflict through appropriate measures in corridor and fringe villages.

5. Control the expansion of agricultural practices in and near the corridor area.

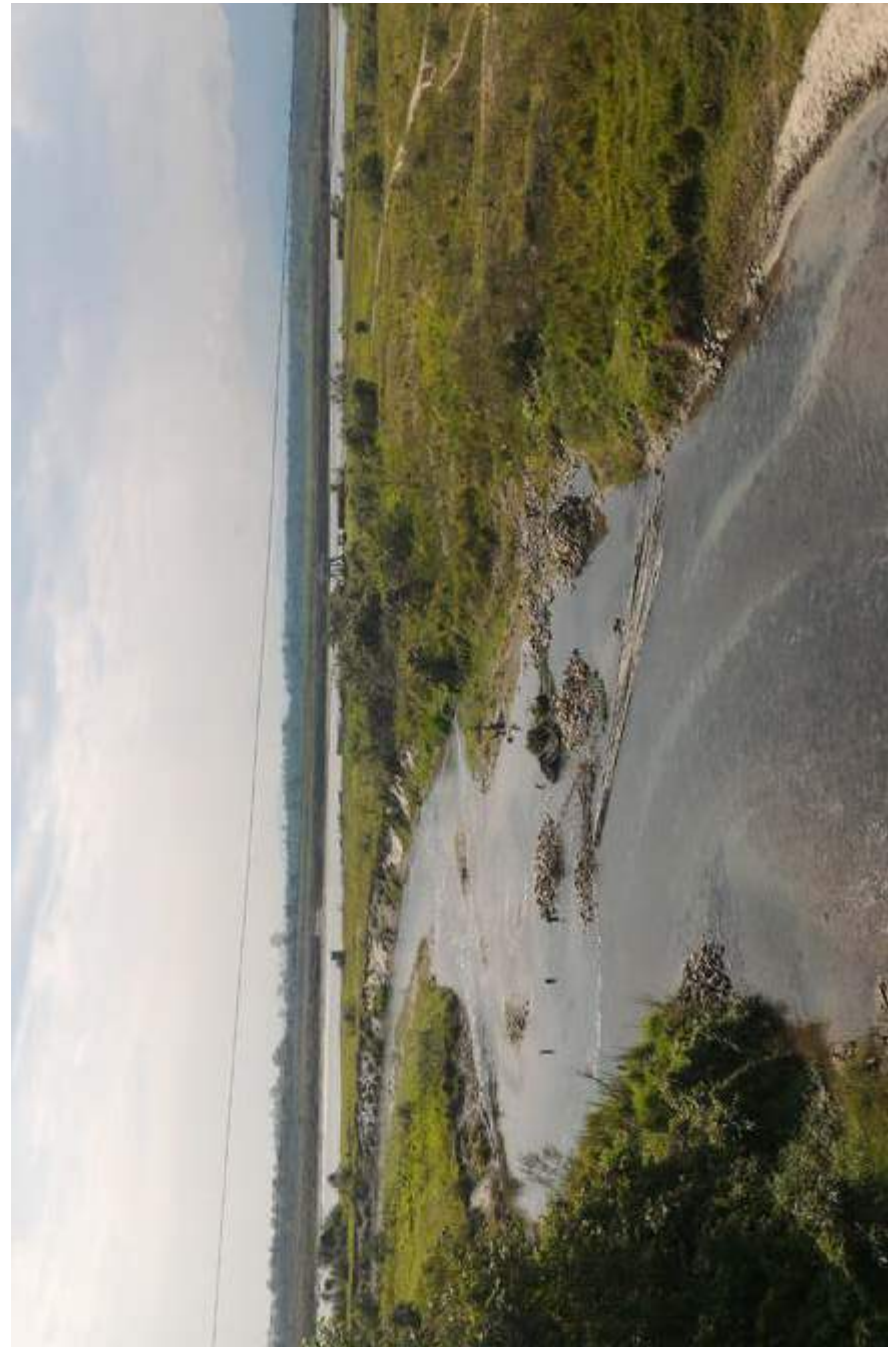


Fig. 7.10: The corridor landscape and river system

7.09

KOTHA - BURIHIDING

Ecological priority: Medium

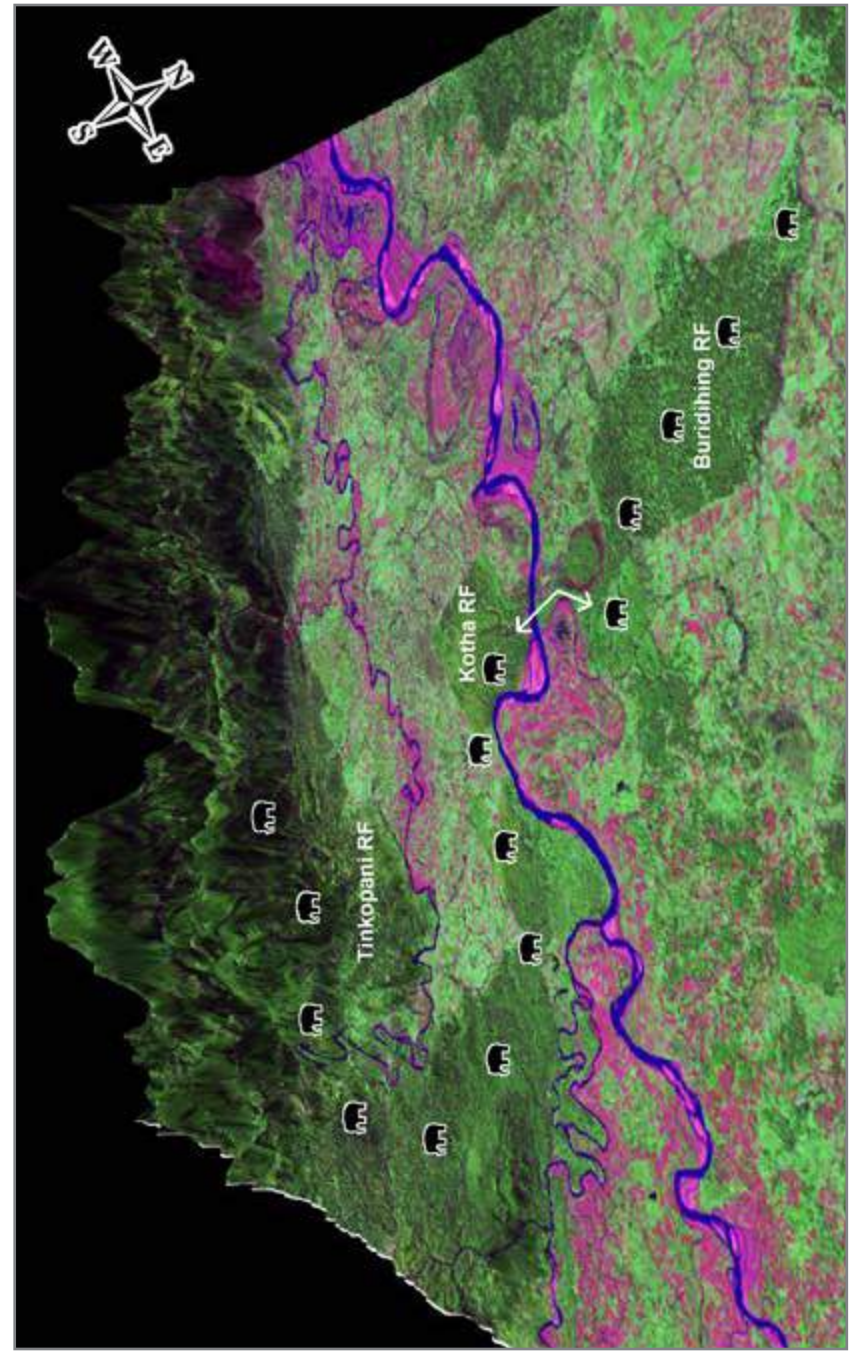
Conservation feasibility: Medium

This corridor connects the Kotha Reserve Forest (Digboi Forest Division) and adjacent elephant populations of Changlang district of Arunachal Pradesh with the Burihiding Reserve Forest (Doomdooma Forest Division), thereby maintaining a linkage with the Terai Reserve Forest, Kakojan Reserve Forest and Nalani Reserve Forest. Elephants cross the Burihiding River near the Kotha Kakharani settlement and pass through small tea gardens and agricultural land to enter Burihiding Reserve Forest.

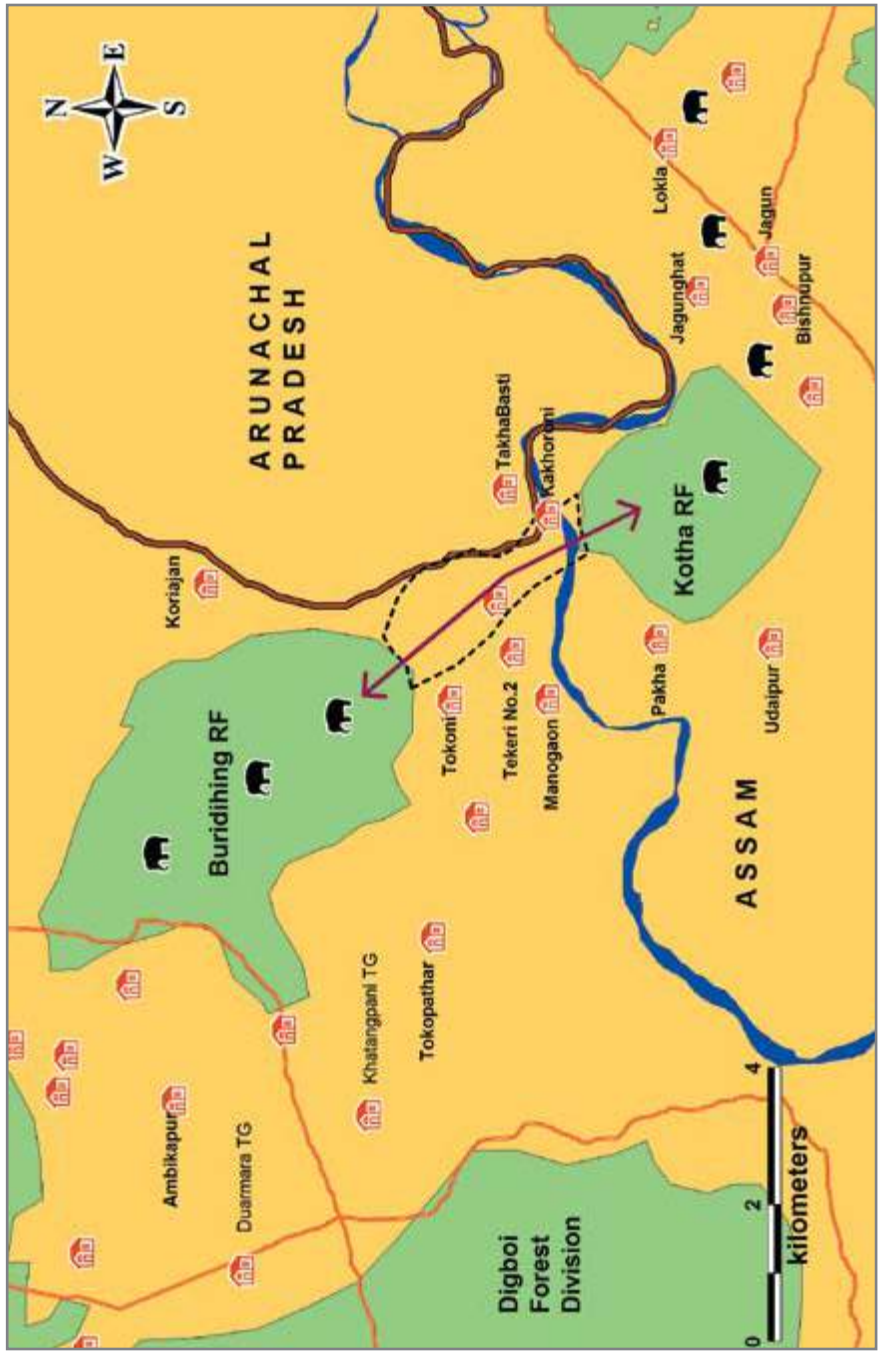
State	Assam
Connectivity	Digboi Forest Division with Doomdooma Forest Division
Length and Width	3 km and 1-1.5 km
Geographical coordinates	27° 24' 22"- 27° 25' 58" N 95° 50' 15"- 95° 51' 56" E
Legal status	Private Land, Reserve Forest and land leased to Tea Gardens
Major land use	Tea gardens, forest, settlements and agriculture
Major habitation/settlements	Encroached settlements - Tekerigaon, Kotha Kakharani, Ahompathar
Forest type	Tropical semi evergreen forest
Frequency of usage by elephants	Occassional

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 14 tree species were recorded in the corridor forest. Of these, five were palatable to elephants. The predominant species found in this area were *Lagerstroemia reginae* (17%), *Dillenia indica* (12%), *Gmelina arborea*



3D map showing the landscape of the Kotha–Burihiding Corridor



Map of the the Kotha-Burihiding Corridor

(14%) and *Canarium resiniferum* (9%). Ground cover consisted of grasses (40%), shrubs (23%), herbs (23%) and barren ground (14%).

Estimated elephant numbers in the landscape

Digboi Forest Division: 124
Doomdooma Forest Division: 175
(Elephant Census Assam, 2011)

Forest/Land use

Forest type: Tropical semi evergreen forest.
Tea gardens: Kotha Tea Garden, and fragmented tea gardens in Kotha, Udaypur, Ahompathar
Settlements: Tekerigaon, Kotha Kakharani, Ahompathar
River: Kharam, Deodubi nullah
Roads: Village roads
Buildings and Artefacts: Brick kilns

Other ecological importance

Mountain Range: Himalayas
Elephant Reserve Name: Dihing-Patkai Elephant Reserve
Nearest Protected area: Dihing Patkai Wildlife Sanctuary
Biodiversity Hotspot: (Indo-Burma)

HUMAN DIMENSIONS

Threats

1. Settlements: Encroachment of corridor areas towards Buridihing Reserve Forest. Expansion and biotic pressure (fuelwood and timber extraction and cattle grazing) from adjacent villages of Kotha Reserve Forest (Kotha Kakharani, Rampur, Ahompathar, Tekerigaon and Kothaa Darkho) has affected the corridor forest and hindered elephant movement.

2. Deforestation: Deforestation of habitat in both the reserve forests, especially

Buridihing Reserve Forest, due to extraction of fuelwood, timber and cattle grazing.

3. Factories: Indiscriminate growth of brick kilns in the corridor area is hindering elephant movement.

4. Tea gardens: There is a possibility of encroachment upon forest areas in future by the small tea planters and their labour colonies, which are located close to forest areas.

5. Agriculture: Increased cultivation of paddy and other crops in the corridor area.

Corridor villages: The corridor has Tekerigaon, Kotha Kakharani (36 families), Ahompathar (33 families) and tea garden labour lines within its area. It is also surrounded by other villages (Kotha, Udaypur, Rampur) and labour lines of tea gardens.

Corridor dependent villages: Kotha Tea Garden labour colony, Kotha village, Udaypur village, Rampur village.

Human-Elephant Conflict: Most cases of conflict are due to crop depredation by elephants. Three human deaths were reported between 2009 and 2013.

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent encroachment, illegal felling of trees and developmental activities detrimental to animal movement.

2. Further encroachment of corridor forest should be prevented and the already encroached land in Buridihing Reserve Forest cleared by the forest department.

3. Agricultural practices near the corridor area need to be controlled and regulated.

4. Cattle grazing should be prohibited inside the Kotha Reserve Forest to improve habitat.

5. Brick kilns in the corridor area should be closed and the habitat restored.

6. Land use change should be strictly prohibited in tea gardens located in and around the corridor area.

7.10

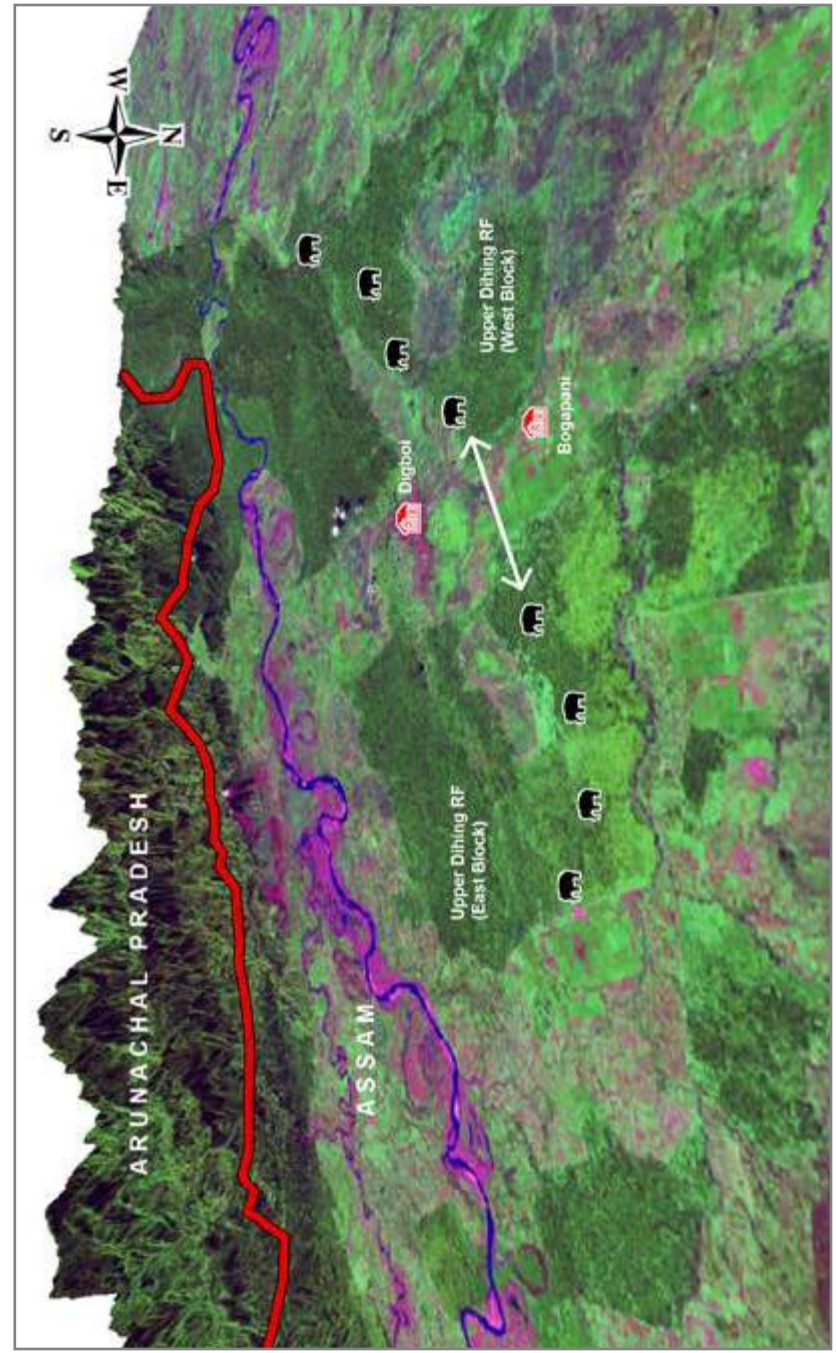
UPPER DIHING EAST - UPPER DIHING WEST BLOCK AT BOGAPANI

Ecological priority: Medium

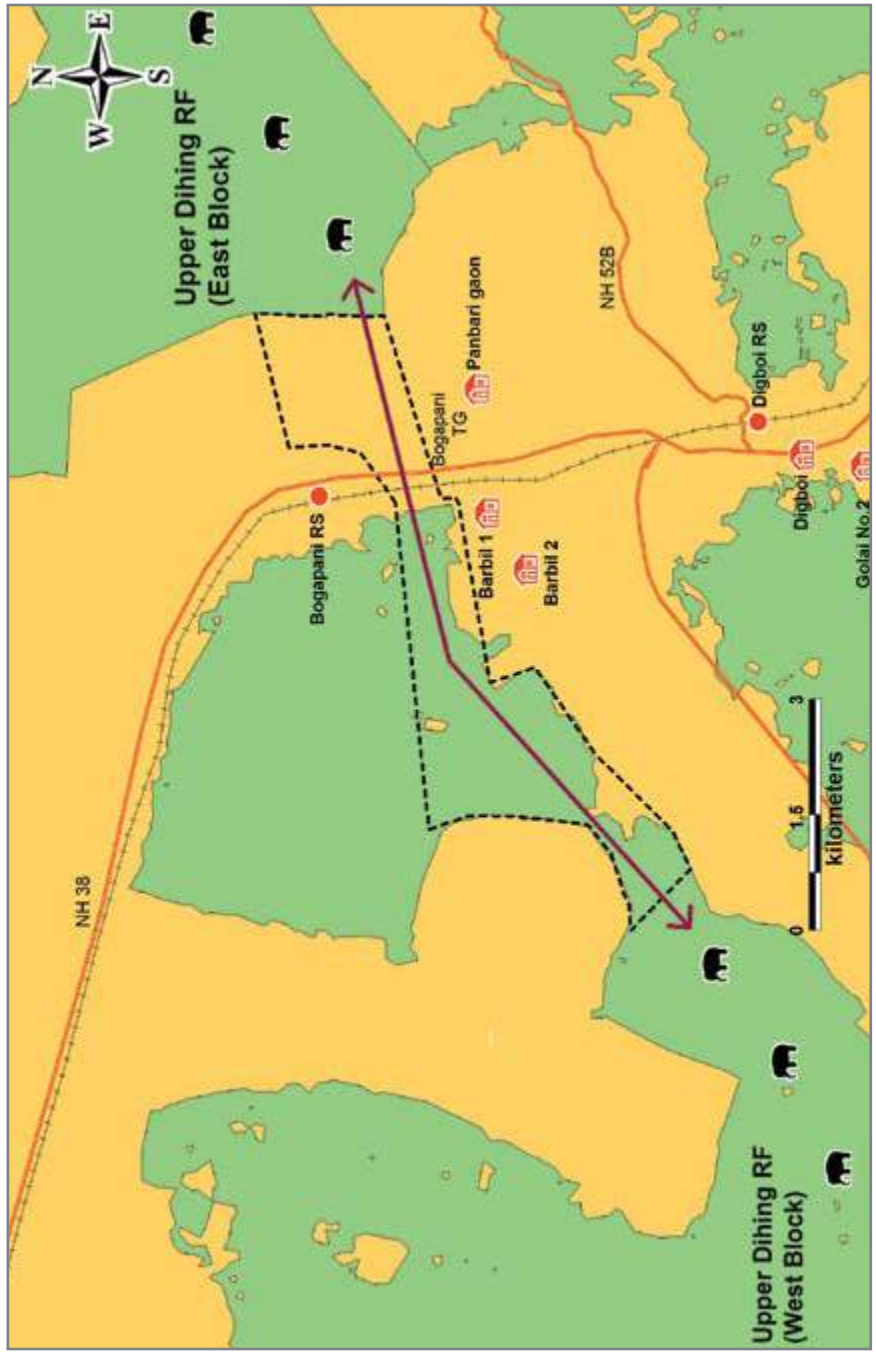
Conservation feasibility: Medium

This corridor connects the East and West Blocks of Upper Dihing Reserve Forest in Digboi Forest Division. Elephants move through Bogapani Tea Gardens, agricultural fields and human habitations once they have crossed NH 38 and the railway track near Ramnagar village. This railway track has caused the death of nine elephants between 2001 and 2015 and, along with the national highway, is a major impediment to elephant movement in the corridor.

Alternate Name	Bogapani
State	Assam
Connectivity	Upper Dihing East - Upper Dihing West block
Length and Width	2.5-3 km and 0.5-1 km
Geographical coordinates	27° 23′ 26″- 27° 26′ 31″ N 95° 33′ 13″- 95° 38′ 5″ E
Legal status	Reserve Forest, land leased to Tea Garden and Patta Land
Major land use	Tea garden, forest, settlement and agriculture
Major habitation/settlements	Bogapani, Borbil-1 and 2, Panbari
Forest type	Tropical semi evergreen, plantation and agriculture land
Frequency of usage by elephants	Regular (Seasonal; September to February)



3D map showing the landscape of the Upper Dihing East– Upper Dihing West Block at Bogapani Corridor



Map of the Upper Dihing East– Upper Dihing West Block At Bogapani Corridor

FORESTS AND ELEPHANTS

Corridor habitat status: A major part of the corridor passes through Bogapani Tea Garden. About ten species of plants were recorded in the sampled area of 0.08 ha. The common ones include *Dipterocarpus macrocarpus*, *Shorea assamica*, *Ailanthus integrifolia*, *Castanopsis indica*, *Mallotus philippinensis* etc.

Estimated elephant numbers in the landscape

Digboi Forest Division: 124

(Elephant Census Assam, 2011)

Forest/Land use

Tea garden: Bogapani

Settlements: Bogapani, Borbil-1 and 2, Panbari

Railway: Dibrugarh-Tinsukia-Dimapur

Highway: NH 38 (Digboi-Margherita)

Artefacts: High-voltage power line

Other ecological importance

Mountain Range: Patkai

Elephant Reserve: Dihing-Patkai Elephant Reserve

Nearest Protected area: Dihing-Patkai Wildlife Sanctuary

Biodiversity Hotspot: Indo-Burma

IBA: The Upper Dihing West Complex (IBA Site No. IN-AS-45)

HUMAN DIMENSIONS

Threats

1. Settlements and development activities: Expansion and development activities in and around Bogapani, Ramnagar and Borbil-1. Encroachments along NH 38 and the railway line near the corridor pose a severe threat to the corridor and are a hindrance to the free movement of elephants.

2. Vehicular traffic: National Highway 38 bisects the corridor at Bogapani Tea Garden. On average, 85-90 vehicles per hour ply on this road. The average between 6 pm and 6 am is 45-50 vehicles per hour. There is a plan to route a bypass through the corridor area, which will further fragment the corridor.

3. Railway track: A track of the North Frontier Railway connecting Tinsukia and Lidu passes through the corridor. A total of nine elephants have died in train-hits in three different incidents in the corridor between 2001 and 2015.

4. Encroachment along the railway track (between the railway track and the national highway) has further fragmented the corridor, hindering elephant movement.

5. Tea garden: Barbed wire fencing along the boundary of Bogapani Tea Garden hinders elephant movement.

6. High-voltage terminal located inside Bogapani Tea Garden is a potential threat to elephant movement.

Corridor villages: Bogapani (875 families), Borbil-1 (549 families) and Borbil-2, Panbari and encroachment along the railway track are present within the corridor. Ramnagar and Borbilgaon 3 are on the fringes.

Corridor dependent villages: Bogapani labour colony, Panbari, Ramnagar and encroached areas, Borbilgaon 1 and Borbilgaon 3 (696 families).

Human-Elephant Conflict: Crop depredation by elephants is a major concern in the corridor area and fringe villages. Four human deaths caused by elephants were reported from the region between 2001 and 2012.

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent encroachment, illegal felling of trees and developmental activities detrimental to animal movement. The corridor area could be notified as Ecologically Fragile Land (EFL) for legal protection and to prevent further fragmentation.

2. Prevent further encroachment of land between NH 38 and the railway line and other parts of the corridor. Existing encroachments in elephant crossing points should be removed on a priority basis.

3. Regulating the speed of trains passing through the corridor, especially between 6 pm and 6 am, is essential.

4. The construction of a flyover (about 1.2 km long) for vehicles on NH 38 is required. Till this is constructed, vehicular speeds should be restricted by suitable physical barriers in the corridor area from 6 pm to 6 am. No realignment of the road should be allowed through the corridor forest.

5. Fencing along the fringes of Bogapani Tea Garden in the corridor area should be removed.

7.11

UPPER DIHING EAST - UPPER DIHING WEST BLOCK BETWEEN GOLAI-PAWAI

Ecological priority: Medium

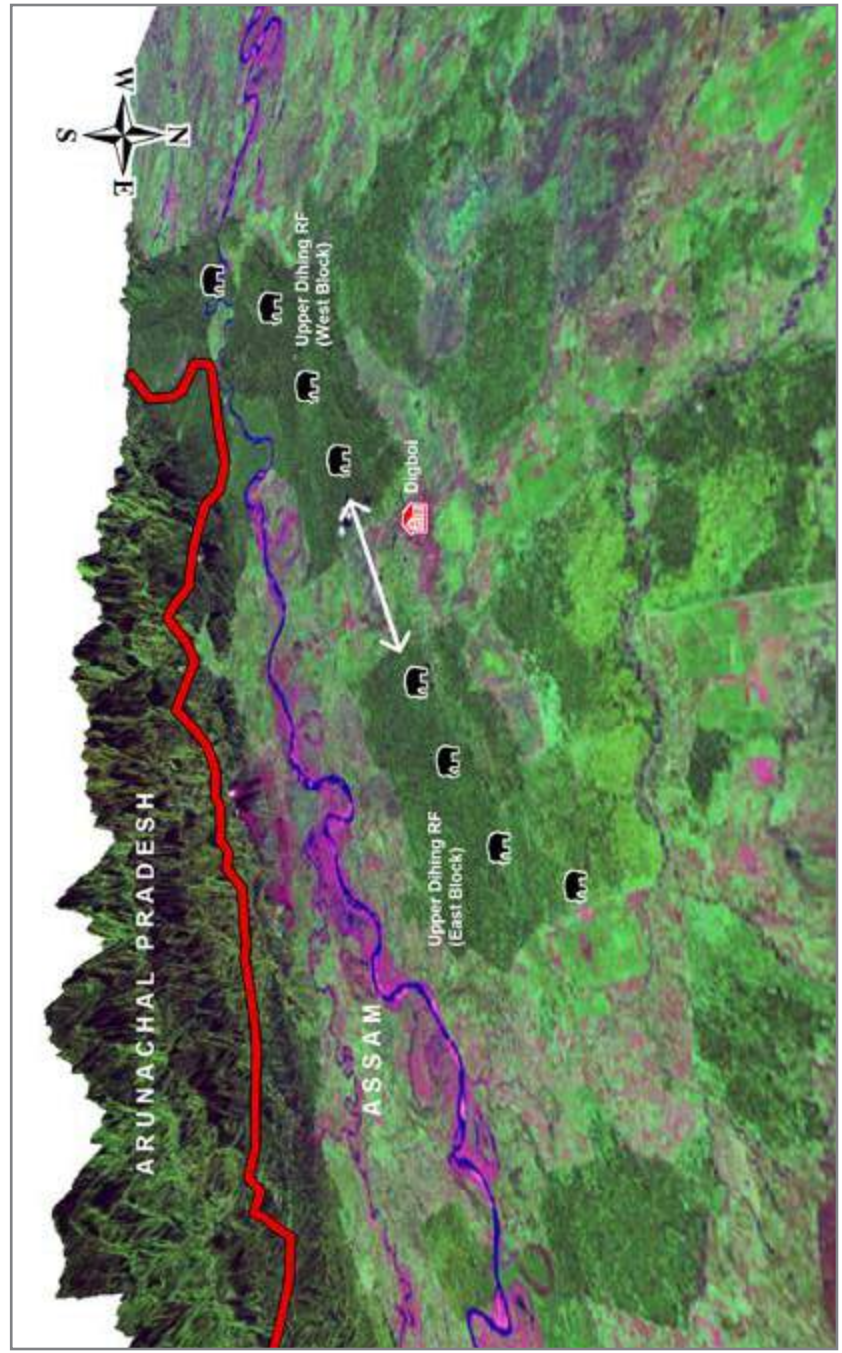
Conservation feasibility: Medium

The corridor connects the East and West Blocks of Upper Dihing Reserve Forest of Digboi Forest Division. Elephants move through tea gardens, agriculture fields and human habitations once they have crossed NH 38 and the railway track between Golai Basti No.1 and No.2 villages. The construction of houses, the boundary wall of the Indian Oil Corporation (IOC) terminal and other artefacts have severely hindered elephant movement.

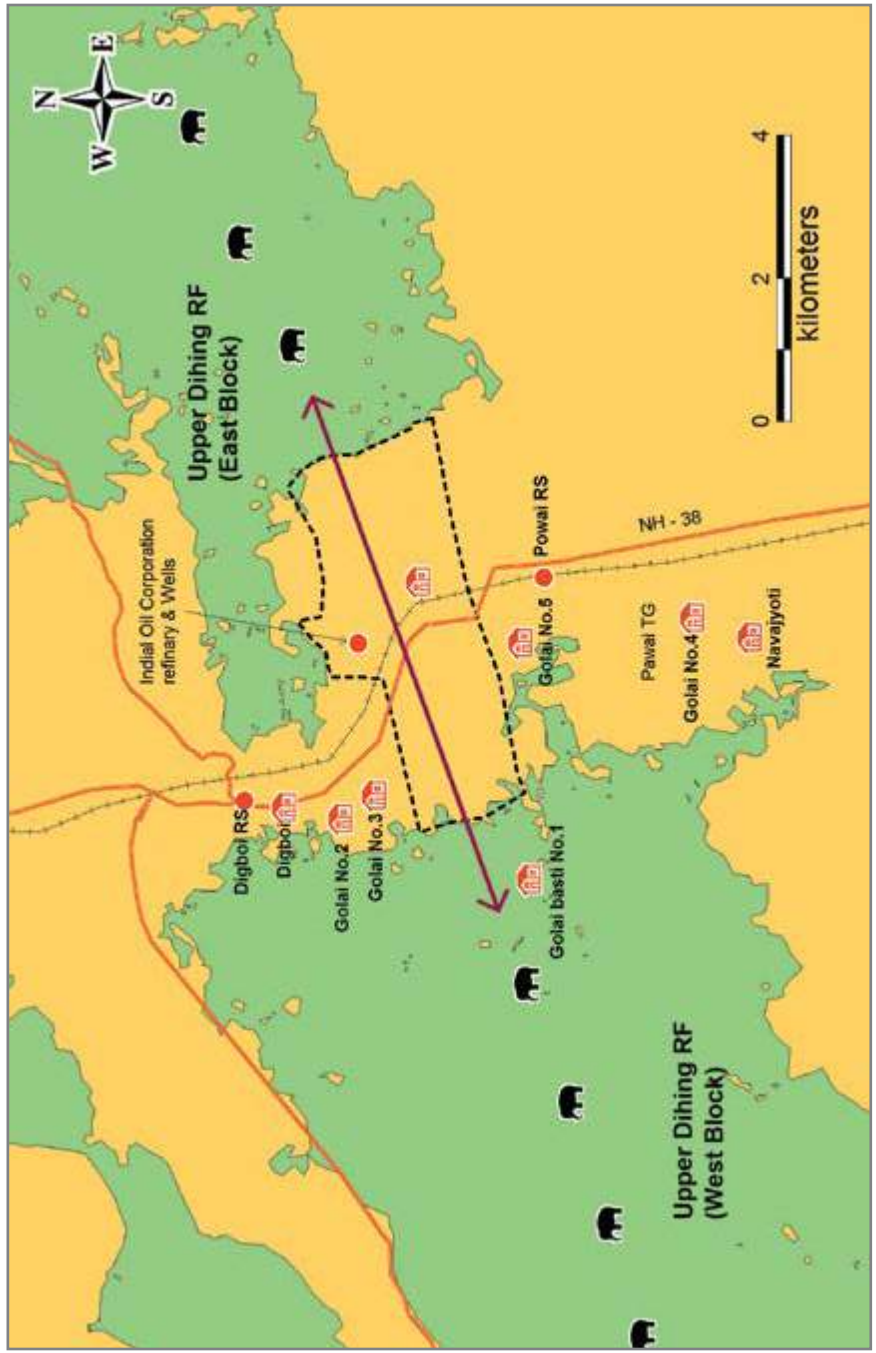
State	Assam
Connectivity	Upper Dihing East and West block
Length and Width	3 km and 0.5 km
Geographical coordinates	27° 20' 51"- 27° 22' 37" N 95° 36’ 45”- 95° 40’ 17” E
Legal status	Patta Land and Reserve Forest
Major land use	Tea garden, settlement and agriculture field
Major habitation/settlements	Golai No.2, Baruphotia, Navajyoti
Forest type	Tropical evergreen forest
Frequency of usage by elephants	Regular but minimised, Bulls and herds

FORESTS AND ELEPHANTS

Corridor habitat status: A major part of the corridor is devoid of natural vegetation and passes through tea gardens, human settlements, agricultural land and degraded lands.



3D map showing the landscape of the Upper Dihing East–Upper Dihing West Block between Golai–Pawai Corridor



Map of the Upper Dihing East- Upper Dihing West Block between Golai-Pawai Corridor

Estimated elephant numbers in the landscape

Digboi Forest Division: 124

(Elephant Census Assam, 2011)

Forest/Land use

Forest type: Tropical evergreen forest

Tea Garden: Amalgamated Tea Company and small tea gardens

Settlements: Part of Golai No.2, Baruphotia, Navajyoti

Railway: Dibrugarh-Tinsukia-Dimapur

Highway: NH 38 (Digboi-Margherita)

Other ecological importance

Mountain range: Patkai

Elephant Reserve: Dihing-Patkai Elephant Reserve

Nearest Protected Area: Dihing-Patkai wildlife Sanctuary

Biodiversity Hotspot: Indo-Burma

IBA: The Upper Dihing West Complex (IBA Site No. IN-AS-45)

HUMAN DIMENSIONS

Threats

1. Settlements and developmental activities: Expansion and developmental activities in and around the corridor, encroachments along the NH 38 and the railway line passing through the corridor all pose a severe threat and have almost blocked the elephant movement.

2. Vehicular traffic: National Highway 38 connecting Tinsukia to Margherita bisects the corridor at Bogapani Tea Garden. On average, 85-90 vehicles per hour ply on this road. The average between 6 pm and 6 am is 45-50 vehicles per hour.

3. Railway track: A track of the North Frontier Railway connecting Tinsukia and Lidu passes through the corridor.

4. Tea gardens: Amalgamated Tea Company and smaller tea gardens are located in the corridor.

5. A boundary wall had been constructed for the Indian Oil Corporation (IOC) terminal adjacent to the corridor. The wall inside the corridor area was later demolished to facilitate elephant movement after the state and central governments, locals and NGOs raised objections.

6. New dhabas/hotels have come up along the road in the corridor, catering to the needs of tea garden and refinery workers as well as travellers.

Corridor villages: The corridor has parts of Golai No.2, Baruphotia and Navajyoti (new settlement) within its area.

Corridor dependent villages: Golai No.3 (160 families), Golai No.4 (52 families), Golai No.5 (223 families), Baruphotia, Navajyoti (new settlement).

Human-Elephant Conflict: Conflict has reduced over the years; elephants and other wild animals use the corridor less due to the large human population in and around the corridor area. Two human deaths and six elephant mortality cases were reported between 2002 and 2006.

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent encroachment, illegal felling of trees and developmental activities detrimental to animal movement.

2. Construction of houses within the corridor should be stopped. A few families that are in the direct path of elephant movement could be relocated.

3. The corridor conservation plan suggested by the forest department and experts should be properly implemented in the IOC land within the corridor.

4. Fencing should be prohibited in Powai Tea Garden located in the corridor area.

5. The construction of a flyover for vehicles on NH 38 is required. Till this is done, vehicular speeds should be restricted by suitable physical barriers in the corridor area from 6 pm to 6 am.



Fig. 7.11: Indian Oil Corporation boundary wall in the corridor

7.12

KALAPAHAR - DAIGRUNG

Ecological priority: High

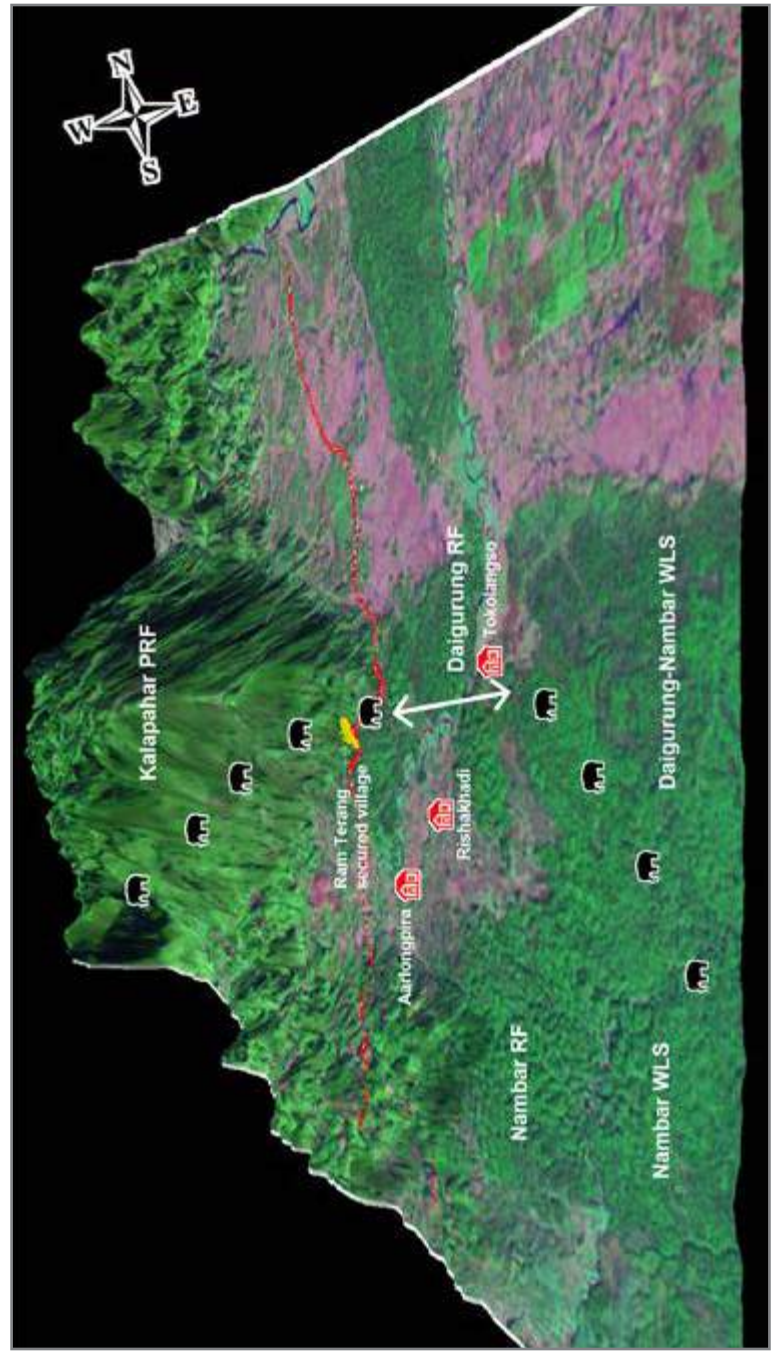
Conservation feasibility: High

This corridor connects Kalapahar Proposed Reserve Forest and Nambor West Block of East Karbi Anglong Division with Nambor-Daigrung Wildlife Sanctuary (Nambor North Block in Golaghat District). Elephants move to Kaziranga National Park from the Daigrung-Nambor Wildlife Sanctuary via Kaliani Reserve Forest after crossing the corridor near Ram Terang and Tokolangso villages.

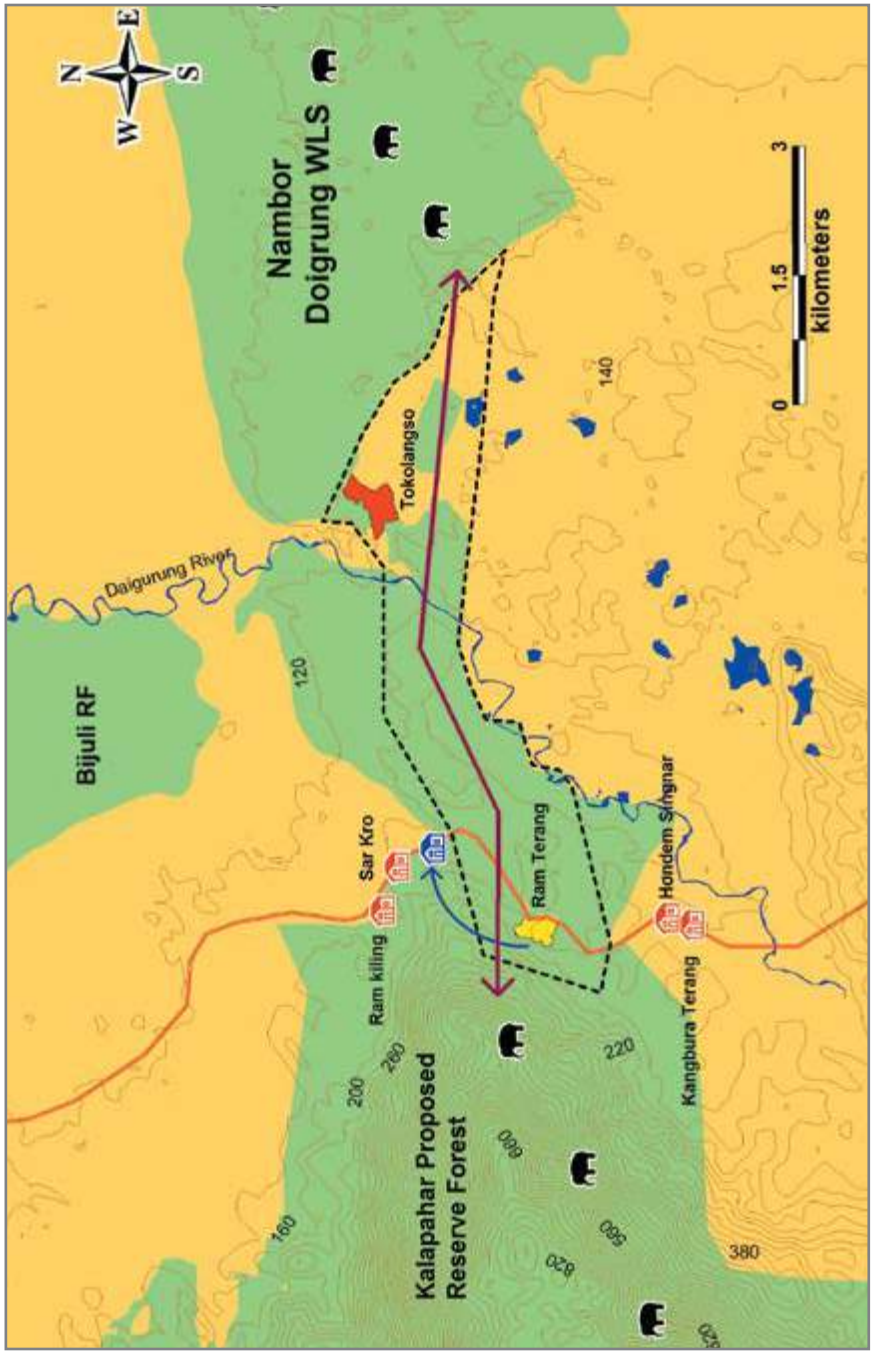
State	Assam
Connectivity	Kalapahar Proposed Reserve Forest of East Karbi Anglong Division with Nambor-Daigrung Wildlife Sanctuary
Length and Width	6.5 km and 0.15 – 2.2 km
Geographical coordinates	26° 23′ 3″- 26° 24′ 53″ N 93° 46′ 30″- 93° 51′ 41″ E
Legal status	Proposed Reserve Forest
Major land use	Forest, settlements and agriculture
Major habitation/settlements	Tokolangso (Ram Terang has been relocated outside the corridor)
Forest type	Tropical semi evergreen forest
Frequency of usage by elephants	Regular; throughout the year

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 38 plant species were recorded from the corridor forest. The dominant plant species were *Litsea monopetala*, *Tetrameles nodiflora*, *Erythrina indica*, *Alstonia scholaris*, *Syzigium cumini*, *Toona ciliate* etc. *Clemates cadimia*, *Paederia foetida*, *Mimosa pudica*, *Mikenia* etc were common non-tree species found in the corridor area. Ground vegetation was dominated by grasses and shrubs.



3D map showing the landscape of the Kalapahar–Daigrung Corridor



Map of the Kalapahar–Daigrung Corridor

Estimated elephant numbers in the landscape

Karbi Anglong Forest Division: 614
Nambor-Daigrung Wildlife Sanctuary: 68
Kaziranga National Park: 1165
(Elephant Census Assam, 2011)

Forest/Land use

Forest type: Tropical semi evergreen forest
Settlement: Tokolangso
Agriculture: Slash and burn, seasonal paddy
Road: Silonijan-Chokihola, village roads
River: Daigrung

Other ecological importance

Mountain range: Mikir Hills (Karbi Plateau)
Elephant Reserve: Kaziranga-Karbi Anglong Elephant Reserve
Protected Area: Daigrung-Nambor Wildlife Sanctuary
and Garampani Wildlife Sanctuary
Biodiversity Hotspot: Indo-Burma

HUMAN DIMENSIONS

Threats

1. Human settlements and expansion of villages: Two villages, namely Ram Terang and Tokolangso, were situated inside the corridor. Ram Terang was voluntarily relocated out of the corridor forest in early 2016. Expansion of the corridor and fringe villages has increased biotic pressure due to timber and fuelwood collection, apart from agricultural activities. Encroachment of the forest area in Daigrung Reserve Forest is a major concern.

2. Deforestation: Extraction of timber and firewood from the forest is a major threat. This has severely degraded the forest cover, especially in the corridor area.

3. Agriculture activities: Most villagers undertake *jhum* (slash and burn) cultivation (paddy, pineapple etc) in the corridor area. This has degraded the habitat. Some of the villagers have also begun planting tea and rubber, clearing the virgin forest towards the Tokolangso side of the corridor.

4. Road traffic: The widening of the Silonijan-Chokihola road has increased the flow of traffic and is a potential threat.

Corridor villages: Ram Terang, with 19 families, was located in the middle of the corridor and has now been shifted to New Ram Terang outside the corridor. Its inhabitants had shifted to Ram Terang from the Murpholoni area some 25 years ago due to religious reasons and high elephant depredation. Most of them were engaged in *jhumming* and cultivating paddy. Tokolangso village lies on the Daigrung and Nambor side of the forest. The village is under the Nilip constituency of Nilip Block under the Bokajan Subdivision of Karbi Anglong district. The part of the village within the corridor comprises 23 households with a population of 140.

Corridor dependent villages: Sar Kro (34 families), Hondem Singnar (33 families), Kangbura Terang (28 families), Gudam Kro village, Ram Killing (9 families), Gudam Terrang, Borjan, part of Tokolangso (40 families), Rishakhidi (200 families) and Alukhunda (17 families).

Human-Elephant Conflict: Conflict is quite severe in the region. Elephants visit the corridor almost throughout the year to raid crops and other agricultural produce. There have been no human deaths or retaliatory killings of elephants in the corridor area, although 33 human deaths due to elephants were reported from the Silonijan Range between 2001 and 2013.

CONSERVATION PLAN

1. The corridor should be notified by the state forest department and Karbi Anglong Autonomous Council (KAAC), and legally protected under an appropriate law to prevent encroachment and developmental activities detrimental to animal movement.

2. The 19 families of Ram Terang village were voluntarily relocated to New Ram Terang on the fringes of the corridor in early 2016. The inhabitants of Tokolangso village (23 families) within the corridor also have to be voluntarily relocated outside the corridor, through the provision of suitable rehabilitation packages.

3. Prevent slash and burn cultivation in corridor villages by providing land for permanent agriculture.

4. Undertake habitat restoration in the corridor and forest fringes on a priority basis. The Karbi Anglong Forest Department and Wildlife Trust of India have already initiated the restoration of the corridor land vacated by Ram Terang village.

5. Undertake suitable eco-development support in the corridor and fringe villages to strengthen livelihoods and minimise dependency on corridor forests.

Note: *In Phase-I, Wildlife Trust of India and Elephant Family rehabilitated Ram Terang village in consultation with the villagers, Karbi Anglong Autonomous Council (KAAC) and Assam administration. The villagers were provided with 0.35 acres of land per family for housing, 1.3 acres of land per family for agriculture, a Karbi traditional house, a Community Hall and other basic amenities at the relocation site. Rehabilitation of part of Tokolangso village will be undertaken in Phase-II of the project.*

7.13

KAZIRANGA - KARBI ANGLONG AT PANBARI

Ecological priority: High

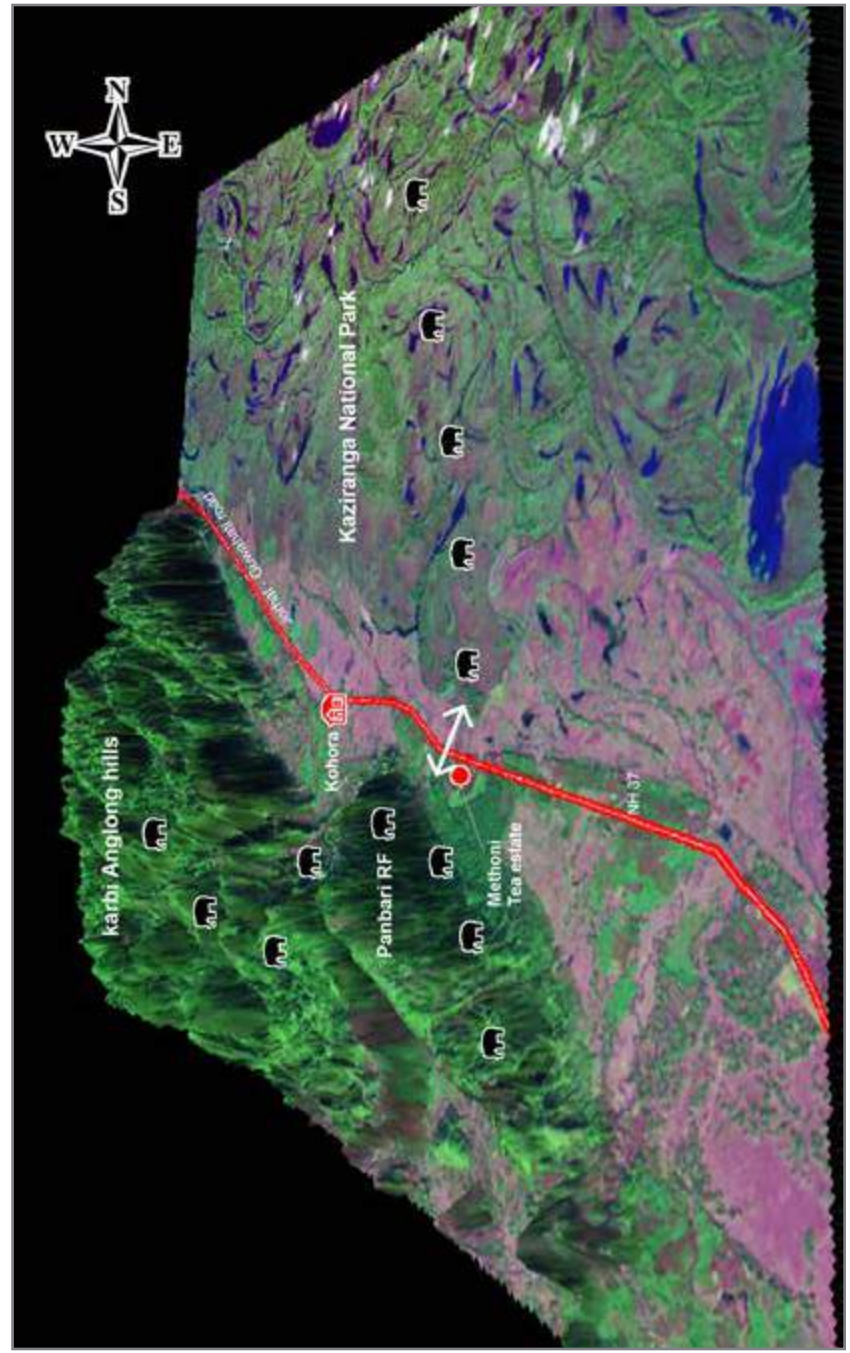
Conservation feasibility: High

This corridor connects the elephant habitats of Kaziranga National Park with the Karbi Anglong Forest Division through Panbari Reserve Forest. The corridor is disconnected due to agricultural land for about 500 m between NH 37 and Kaziranga National Park. Elephants move from Kaziranga to the Karbi Anglong Hills through agricultural fields and cross the busy NH 37 between Methoni Tea Estate and Panbari forest quarters to enter Panbari Reserve Forest and Karbi Anglong.

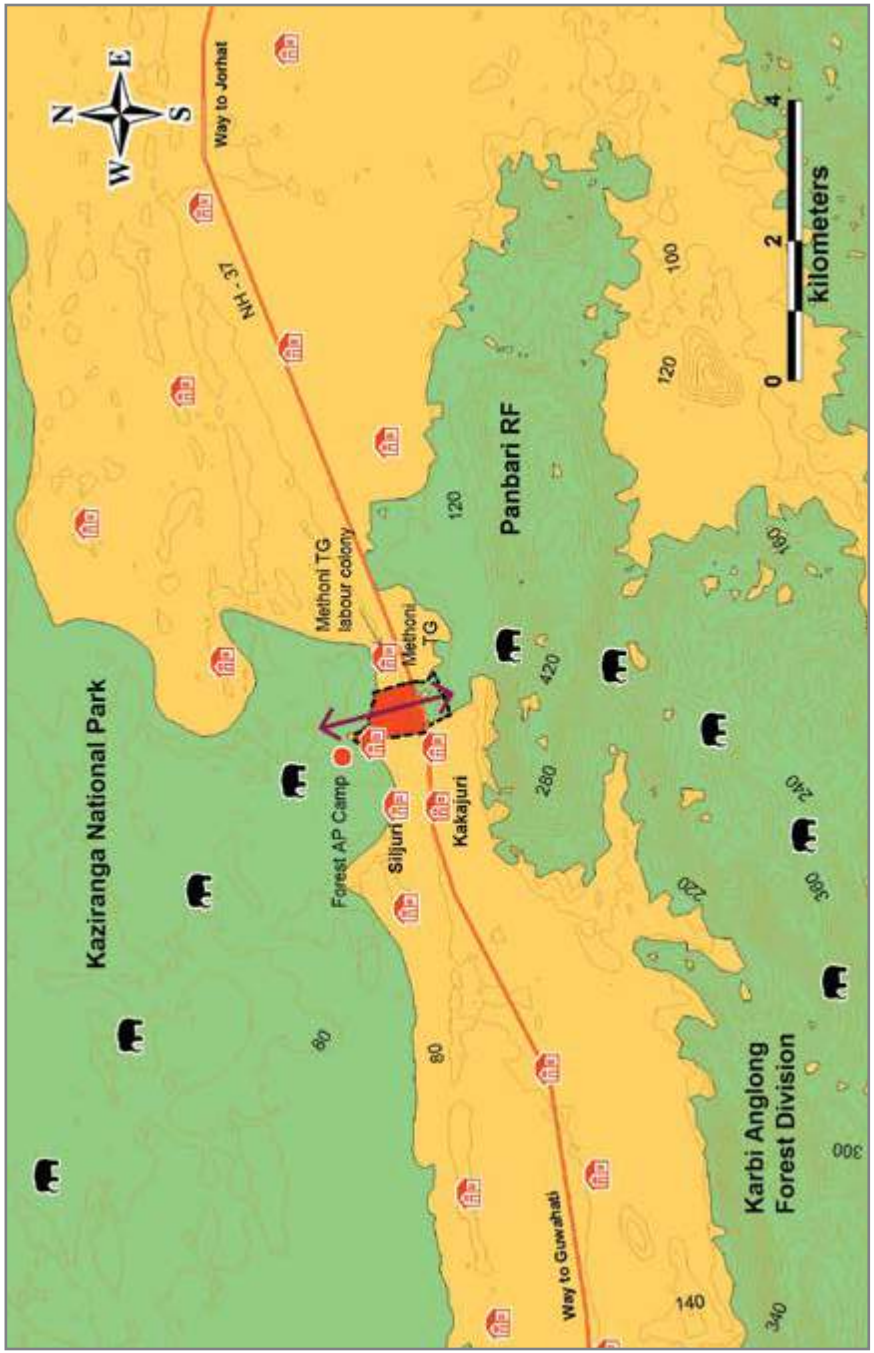
Alternate name	Panbari
State	Assam
Connectivity	Kaziranga National Park with Karbi Anglong Forest
Length and Width	1 km and 0.75 km
Geographical coordinates	26° 36′ 43″- 26° 37′ 18″ N 93° 29′ 36″- 93° 30′ 8″ E
Legal status	Reserve Forest and Revenue Land (3rd Addition to Kaziranga National Park)
Major land use	Agriculture and forest
Major habitation/settlements	Temporary houses of Siljuri-Kakojuri and Methoni villages
Forest type	Tropical semi evergreen forest
Frequency of usage by elephants	Regular; more during cropping season (October to December)

FORESTS AND ELEPHANTS

Corridor habitat status: There are no forest patches in the corridor area between Kaziranga and NH 37 except Panbari Reserve Forest on the southern side of NH 37. A major part of the corridor is agriculture land. Panbari Reserve Forest has



3D map showing the landscape of the Kaziranga – Karbi Anglong at Panbari Corridor



Map of the Kaziranga – Karbi Anglong at Panbari Corridor

about 112 species of plants of which 65 are tree species, dominated by *Shorea robusta, Duabanga grandiflora, Tectona grandis, Gmelina arborea, Lagerstroemia myriocarpa, Diptereocarpus macrocarpus, Erythrina indica, Terminalia myriocarpa, Phyllantus emblica, Sterospermum chelonoides, Syzygium cumini, Michelia champaca, Bauhinia variegata, Pterospermum acerifolium* etc. The shrub and herb species include *Laportea crenulata, Debregeasia wallichiana, Lasia spinosa, Justicia adhatoda, Sagittarias agittifolia, Alpinia allughas* etc. Ground vegetation is dominated by grasses and shrubs.

Estimated elephant numbers in the landscape

Karbi Anglong Forest: 614
Kaziranga National Park: 1165
(Elephant Census Assam, 2011)

Forest/Land use

Forest type: Tropical semi evergreen forest
Agriculture: Seasonal paddy
Highway: NH 37 (Guwahati-Jorhat)
Artefacts: High-voltage power line
Settlements: About 20 temporary houses of Siljuri-Kakojuri village

Other ecological importance

Mountain Range: Karbi Plateau (Mikir Hills)
River: Brahmaputra
Elephant Reserve: Kaziranga-Karbi Anglong Elephant Reserve
Protected Area: Kaziranga National Park and Tiger Reserve
Biodiversity Hotspot: Indo-Burma
IBA: Kaziranga National Park (IBA category A1, A2, A4i, A4iii)

HUMAN DIMENSIONS

Threats

1. Heavy traffic on National Highway 37 passing through the corridor has

severely affected elephant movement. On average, 229.5 vehicles per hour ply on the highway; an average of 5500 vehicles per day, increasing to over 6000 vehicles on weekends. The movement of heavy and six-wheel vehicles is comparatively higher than that of four-wheelers. This is due to the movement of goods vehicles and buses.

2. Agricultural land between the boundary of Kaziranga National Park and National Highway 37 covers about 72.5 hectares, of which about 57.5 hectares is under the control of villagers.

3. Illegal extraction and felling of trees in Panbari Reserve Forest.

4. New houses (about 20 temporary houses) have been established by villagers from Siljuri-Kakojuri in the agricultural land of the corridor.

5. A stone quarry lies on the Karbi Anglong side of the corridor (behind Panbari Reserve Forest).

Corridor villages: Earlier only two or three temporary houses were found in the corridor area. Now about 20 temporary houses have been established inside the corridor, essentially by settlers from Siljuri-Kakojuri village to show their presence on their land and complicate its acquisition by the government. The southern side of the corridor has a few staff quarters of the Panbari Beat, as well as Kakajuri village which is inhabited by Karbi people.

Corridor dependent villages: Kakojuri Karbi Gaon towards the south, Siljuri village towards the west, Methoni village towards the east.

Human-Elephant Conflict: Only a few instances of property damage and human deaths caused by elephants have been reported in and around the corridor. Crop damage by elephants in this corridor village is moderate and occurs during the elephant migratory season.

CONSERVATION PLAN

1. The corridor should be legally protected under an appropriate law to prevent encroachment and developmental activities detrimental to animal movement.

2. All the temporary houses on agricultural land within the corridor need to be vacated following consultations with villagers.

3. An overpass should be constructed in the corridor area for vehicles plying on NH 37. Till then, traffic on the road should be regulated with suitable barriers between 6 pm and 6 am.

4. The stone quarry on the Karbi Anglong side of the corridor should be shut down immediately. Protection to Panbari Reserve Forest and the adjoining forest areas of Karbi Anglong should be strengthened.

Land identified to secure the corridor: The total area of the corridor is about 72.5 hectares, of which about 15 hectares have been acquired by the government and are now part of the 3rd Addition to Kaziranga National Park. About 4.4 hectares were secured by the Bokakhat Revenue Department, Kaziranga National Park and Wildlife Trust of India in 2009-10. In consultation with villagers, the remaining 53.1 hectares under the possession of people from Methoni Tea Estate and Siljuri-Kakojuri village need to be secured.

7.14

KAZIRANGA – KARBI ANGLONG AT KANCHANJURI

Ecological priority: High

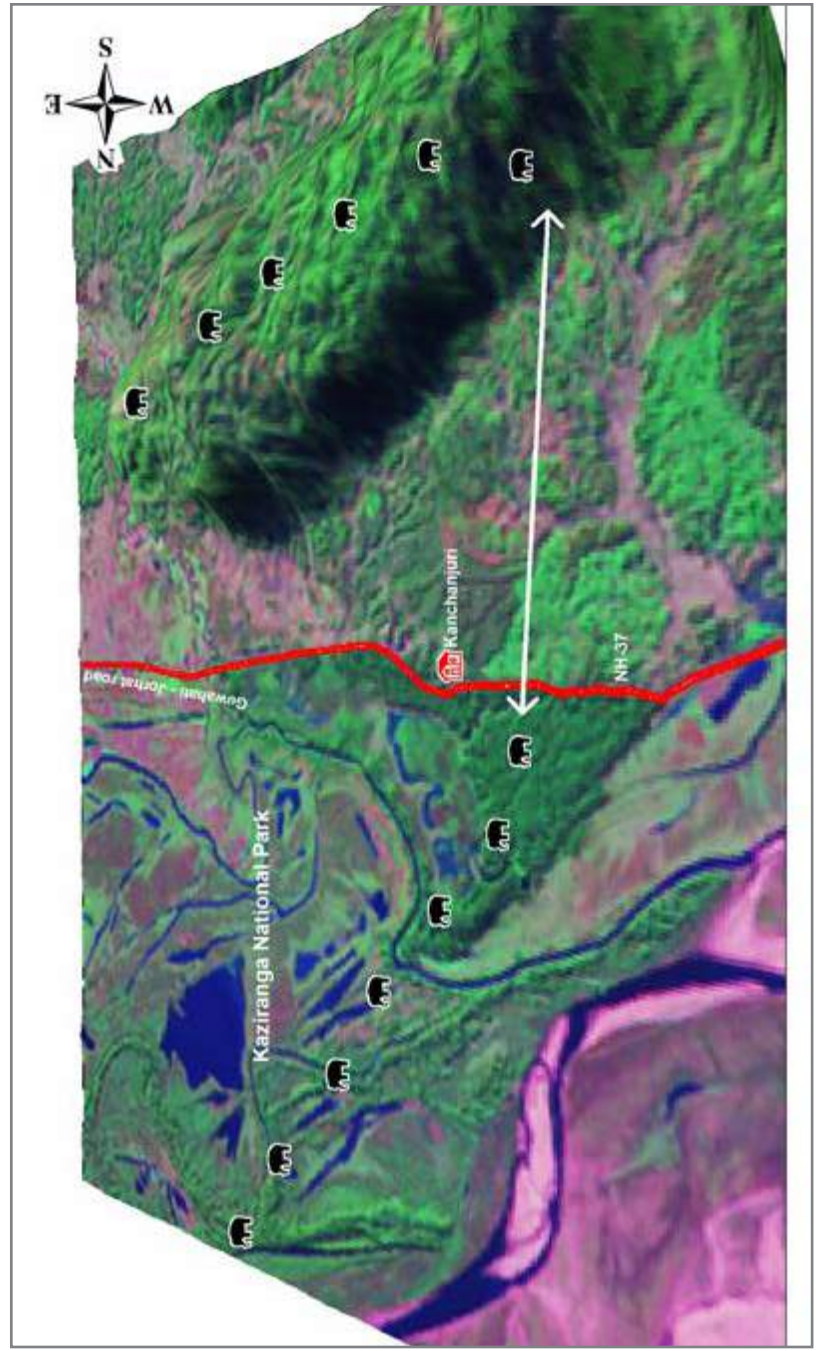
Conservation feasibility: High

This corridor connects the elephant habitats of Kaziranga National Park with Ruthepahar forest of East Karbi Anglong Division (towards the northeast) and Bagser Reserve Forest of Nagaon Forest Division (to the southwest). The corridor passes through Burapahar Tea Garden, a rubber plantation and settlements on the southern side of National Highway 37. A part of Burapahar Tea Garden has been declared as the 4th Addition to Kaziranga National Park.

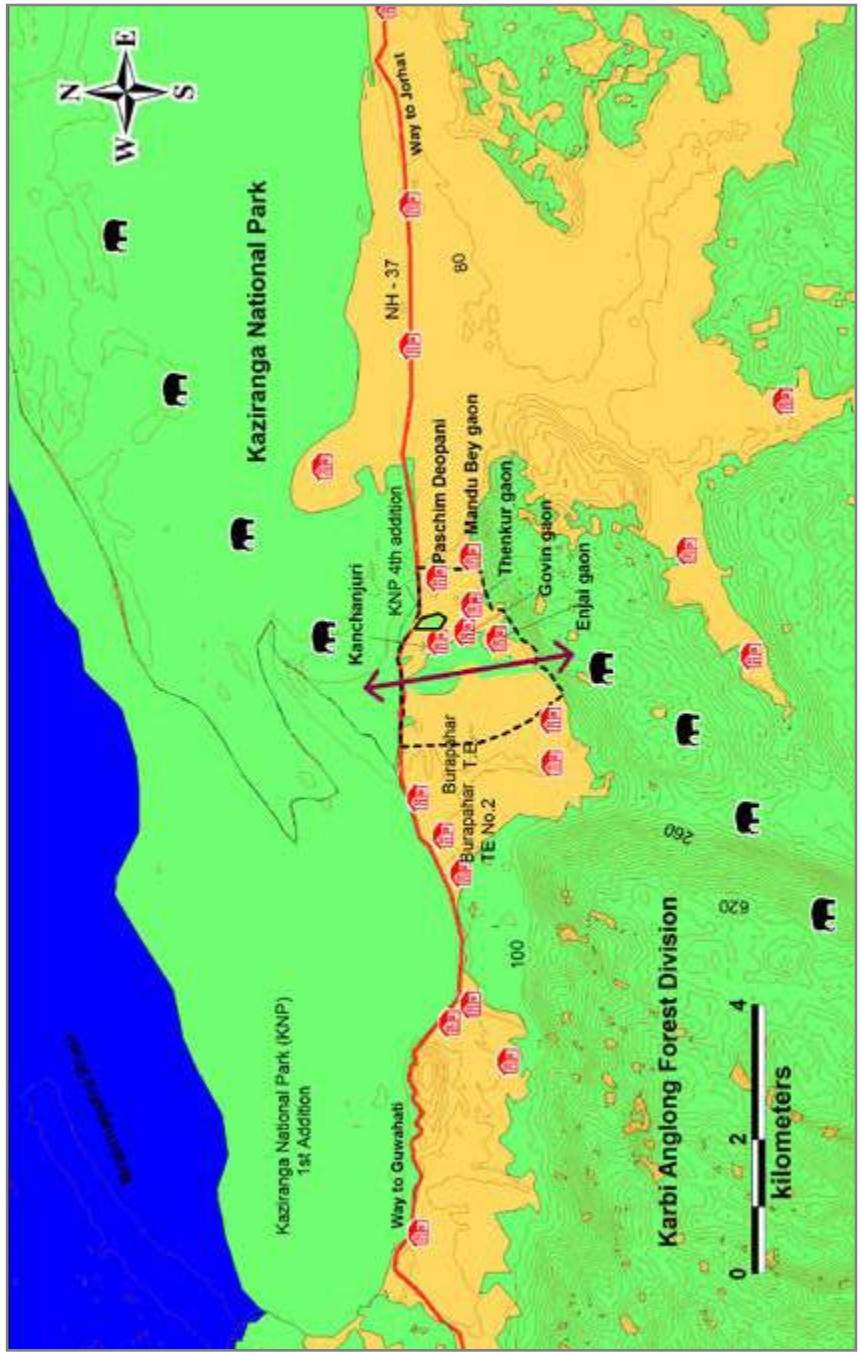
Alternate name	Kanchanjuri
State	Assam
Connectivity	Kaziranga National Park with East Karbi Anglong Forest Division and Nagaon Forest Division
Length and Width	0.9 – 2.6 km and 3 km
Geographical coordinates	26° 33’ 16”- 26° 34’ 36” N 93° 9’ 30”- 93° 11’ 7” E
Legal status	Reserve Forest and Private Land
Major land use	Forest, Tea plantation and settlement
Major habitation/settlements	Kanchanjuri, Mandu Bey, Govingaon, Enjaigaon and Paschim Deopani
Forest type	Tropical moist deciduous
Frequency of usage by elephants	Regular; throughout the year

FORESTS AND ELEPHANTS

Corridor habitat status: Almost half of the corridor is located in the Burapahar Tea Garden area and the remainder in Bagser Reserve forest. The corridor forest has about 70 species of plants, of which 70% are tree species.



3D map showing the landscape of the Kaziranga – Karbi Anglong at Kanchanjuri Corridor



Map of the Kaziranga – Karbi Anglong at Kanchanjuri Corridor

The important species include *Shorea robusta, Tectona grandis, Gmelina arborea, Lagerstroemia myriocarpa, Diptereocarpus macrocarpus, Cassia fistula, Terminalia myriocarpa, Phyllantus emblica, Michelia champaca, Bauhinia variegata, Pterospermum acerifolium, Spondia spinnata, Toon ciliate* etc.

Estimated elephant numbers in the landscape

Karbi Anglong Forest: 614
Kaziranga National Park: 1165
(Elephant Census Assam, 2011)

Forest/Land use

Forest type: Tropical moist deciduous
Settlements: Kanchanjuri, Enjaigaon, Thenkurgaon, Mandu Bey, Govingaon and Paschim Deopani
Agriculture: Seasonal paddy
Plantations: Burapahar Tea Garden, smaller tea gardens, Karbi Anglong Autonomous Council rubber plantation
Highway: NH 37 (Guwahati-Jorhat)
Buildings and Artefacts: Resorts and *dhabas*

Other ecological importance

Mountain Range: Karbi Plateau
River: Brahmaputra
Elephant Reserve: Kaziranga-Karbi Anglong Elephant Reserve
Protected Area: Kaziranga National Park and Tiger Reserve
Biodiversity Hotspot: Indo-Burma
IBA: Kaziranga National Park (IBA category A1, A2, A4i, A4iii)

HUMAN DIMENSIONS

Threats

1. *Heavy traffic on National Highway 37 passing through the corridor:* On average, of 207.6 vehicles per hour ply through the corridor stretch, a majority of them

being four-wheel (105.8 vehicles per hour) and six-wheel (58.5 vehicles per hour) vehicles. The movement of heavy vehicles and six-wheel vehicles is comparatively higher than that of four-wheelers on this highway. The expansion of the highway will add to the traffic volume and speed, making animal movement difficult.

2. *Barbed-wire fencing* along the road in Burapahar Tea Garden and a few other small tea gardens in the corridor area.

3. *Human settlements* (six villages) on the western side of Burapahar Tea Garden are in the corridor area. The expansion of these settlements is increasing biotic pressure. The collection of fuelwood from Bagser Reserve Forest has deteriorated the corridor forest.

4. *Agricultural land* and rubber plantation.

5. *Resorts and dhabas are* coming up in and around the corridor.

Corridor dependent villages: Kanchanjuri (70 households), Enjaigaon (25 households), Thenkurgaon (68 households) , Mandu Bey (76 households), Govingaon (60 households) and Paschim Deopani (80 households). All are revenue villages.

Human-Elephant Conflict: Elephant movement is reported throughout the year and increases from October to December. No human or elephant deaths have been reported due to conflict in the corridor area in the last five years. However, instances of crop damage by elephants are reported on the agricultural land in the settlements.

CONSERVATION PLAN

1. The corridor should be legally protected under an appropriate law to prevent encroachment and developmental activities detrimental to animal movement.

2. Land use change in the remaining part of Burapahar Tea Garden needs to be prevented to facilitate elephant movement, by working closely with the tea garden's management.

3. Vehicular traffic at night on NH 37, especially during the monsoon floods, needs to be regulated. Speed breakers are needed to control vehicular speed. Widening of the highway within the corridor area should be stopped.

4. The collection of minor forest produce, timber and fuelwood from the corridor and Karbi Anglong forests needs to be controlled and regulated.

5. Setting up of new resorts in the corridor areas need to be prevented and the activities of existing resorts regulated.

Secured Corridor Land

1. Part of Burapahar Tea Garden (89.75 ha) has been included as the 4th Addition to Kaziranga National Park (vide letter No.FRS. 104/85/41). Habitat restoration needs to be undertaken here.

2. It is important that land use change in remaining part of the tea garden is prevented.

7.15

KAZIRANGA – KARBI ANGLONG AT HALDIBARI

Ecological priority: High

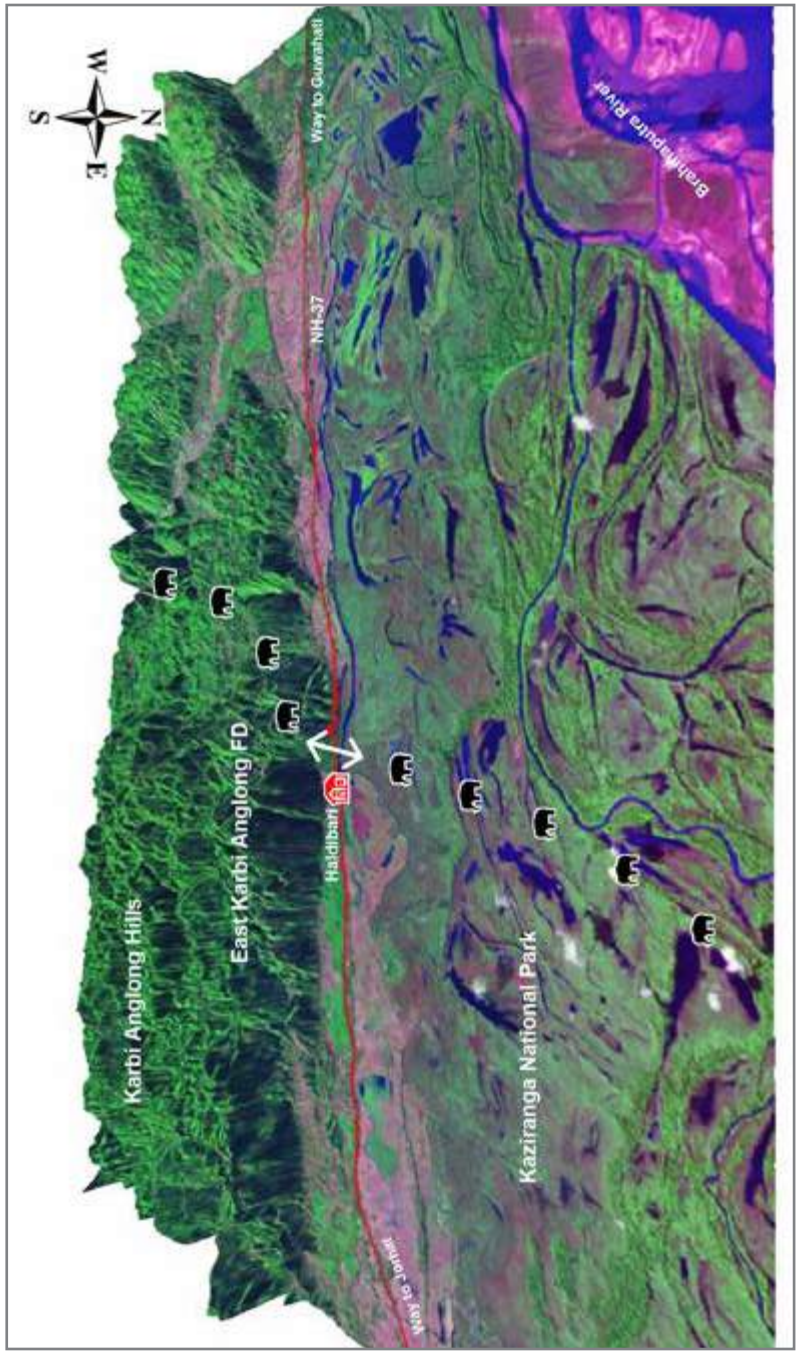
Conservation feasibility: High

This corridor connects the elephant habitats of Kaziranga National Park in the north with North Karbi Anglong Wildlife Sanctuary and the adjoining community forests of the Karbi Anglong Hills in the south. National Highway 37 passes through both the habitats in the corridor. The corridor starts from the end of Hathikuli Tea Estate (2nd Addition of Kaziranga National Park) in the northeast and extends till the 5th Addition of Kaziranga National Park in the west.

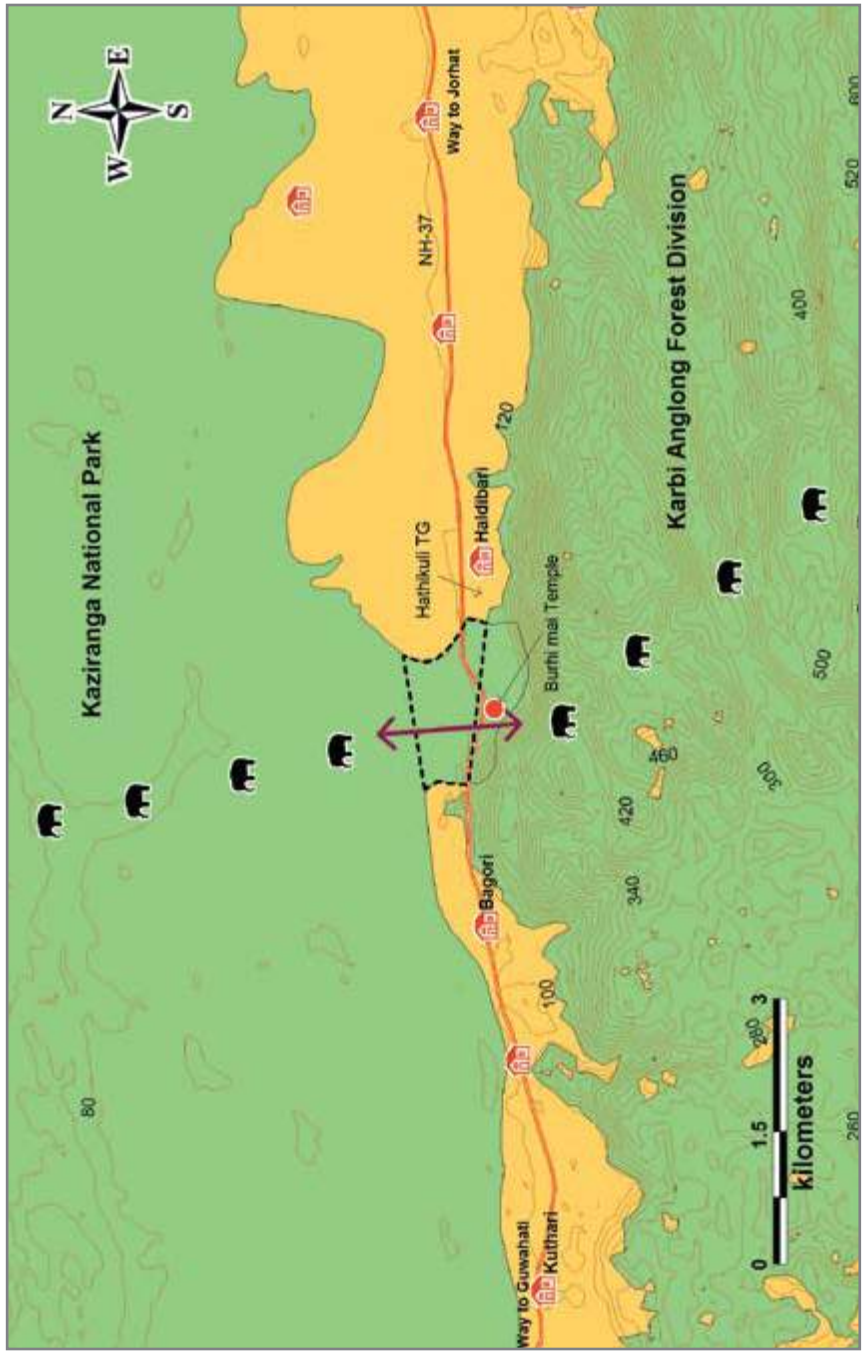
Alternate name	Haldibari
State	Assam
Connectivity	Kaziranga National Park with North Karbi Anglong Wildlife Sanctuary
Length and Width	0.1 km and 2.2 km
Geographical coordinates	26° 35′ 2″- 26° 35′ 33″ N 93° 19′ 33″- 93° 20′ 44″ E
Legal status	Reserve Forest and Protected Area
Major land use	Forest and a few settlements towards the Karbi Anglong Hills on the fringe
Major habitation/settlements	Nil
Forest type	Tropical moist deciduous
Frequency of usage by elephants	Occasional; June to August

FORESTS AND ELEPHANTS

Corridor habitat status: The corridor has good habitat on both sides of NH 37. Prominent plant species include *Shorea robusta*, *Tectona grandis*, *Bauhinia*



3D map showing the landscape of the Kaziranga – Karbi Anglong at Haldibari Corridor



Map of the Kaziranga – Karbi Anglong at Haldibari Corridor

variegata, *Bauhinia purpurea*, *Cassia fistula*, *Diptereocarpus macrocarpus, Duabanga grandiflora, Delonix regia, Erythrin aindica, Ficus lapidosa, Gmelina arborea, Garcinia pendiculata, Lagerstroemia myriocarpa, Litsea monopetala, Phyllantus emblica, Michelia champaca, Terminalia myriocarpa, Pterospermum acerifolium, Spondia spinnata, Sterospermum chelonoides, Toon ciliate* etc. Bamboo species in the corridor forest are *Bambusa pallid, Dendrocalamus giganteus* and *Bambusa tulda*.

Estimated elephant numbers in the landscape

Karbi Anglong Forest: 614
Kaziranga National Park: 1165
(Elephant Census Assam, 2011)

Forest/Land use

Forest type: Tropical moist deciduous
Highway: NH 37 (Guwahati-Jorhat)

Other ecological importance

Mountain Range: Karbi Plateau
River: Brahmaputra
Elephant Reserve: Kaziranga-Karbi Anglong Elephant Reserve
Protected Area: Kaziranga National Park and Tiger Reserve
Biodiversity Hotspot: Indo-Burma
IBA: Kaziranga National Park (IBA category A1, A2, A4i, A4iii)

HUMAN DIMENSIONS

Threats

1. *Heavy traffic on National Highway 37 passing through the corridor:* On average, 207.6 vehicles per hour ply through the corridor stretch, a majority of them being four-wheel (105.8 vehicles per hour) and six-wheel (58.5 vehicles per hour) vehicles. The movement of heavy vehicles and six-wheel vehicles is comparatively higher than that of four-wheelers on this highway. The expansion of the highway will add to the traffic volume and speed, making animal movement difficult.

2. *The eastern part of the corridor has settlements* of Hathikuli Tea Estate and Chingthong Togbi village at the foothills of Karbi Anglong. A few other villages are also located at the foothills. Biotic pressure in terms of fuelwood and NTFP collection has impacted the forest.

3. Burhi Mai Temple in the middle of the corridor: Although this is a small temple, several small structures, shops and commercial activities have mushroomed in and around the corridor because of it, affecting elephant movement. Further expansion will add to the problem.

4. Hotels and resorts have come up on both the western and eastern parts of the corridor. This could further affect the habitat and elephant movement.

Corridor dependent villages: Hathikuli Tea Estate, Chingthong Togbi (72 households), Hemai Rangpi (27-28 households), Sarmen Sygner (65-68 households), Haliram Engleng (60 households), Kamchan Rangi (18-20 households) and Basim Sygner (18-20 households).

The corridor does not have any settlement within its area. However, on its eastern side on the foothills of Karbi Anglong, lie the staff quarters of Hathikhuli Tea Estate, as well as Chingthong Togbi, Hemai Rangpi, Sarmen Sygner, Haliram Engleng, Kamchan Rangi and Basim Sygner settlements.

CONSERVATION PLAN

1. The corridor should be legally protected under an appropriate law to prevent encroachment and developmental activities detrimental to animal movement. The entire corridor are should be declared as a 'No Development Zone' and its land use monitored.

2. Vehicular traffic at night on NH 37, especially during the monsoon floods, needs to be regulated. Speed breakers are needed to control vehicular speed. Widening of the highway within the corridor area should be stopped. An overpass could be constructed in the corridor area for vehicle movement.

3. The expansion of activities around the Burhi Mai Temple has to be stopped and the temple area strictly demarcated. No other activities should be allowed along the road near the temple and existing structures should be removed.



Fig. 7.12: NH 37 passing through the Haldibari Corridor

7.16

KAZIRANGA – EAST KARBI ANGLONG AT DEOSUR

Ecological priority: High

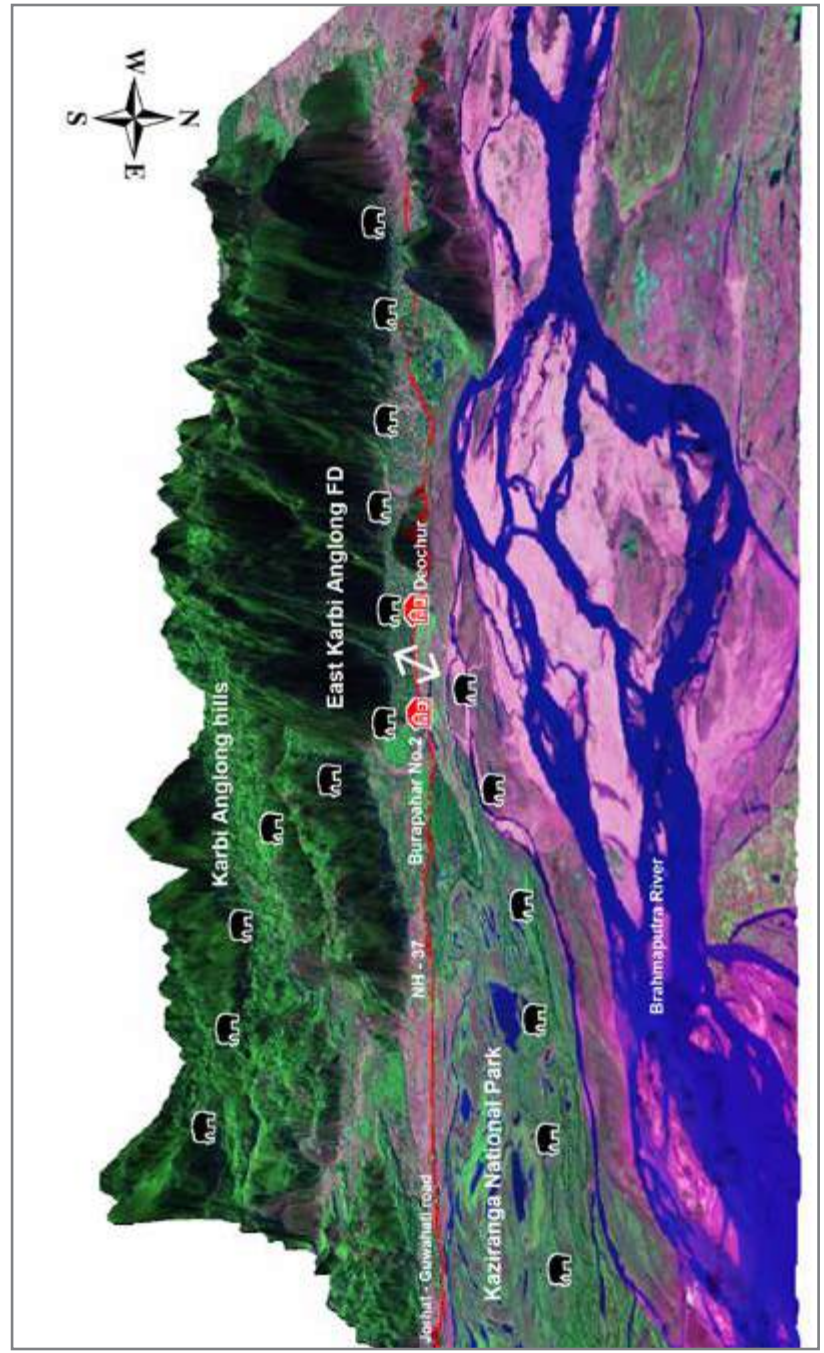
Conservation feasibility: High

This corridor connects the Porcupa Range of East Karbi Anglong Forest Division with the Burapahar Range of Kaziranga National Park. Elephants move from the Karbi Anglong Hills to Kaziranga through encroached agriculture land between the Burapahar No.2 and Deosur villages located along NH 37, which the forest department has recently evicted and cleared for the free movement of elephants.

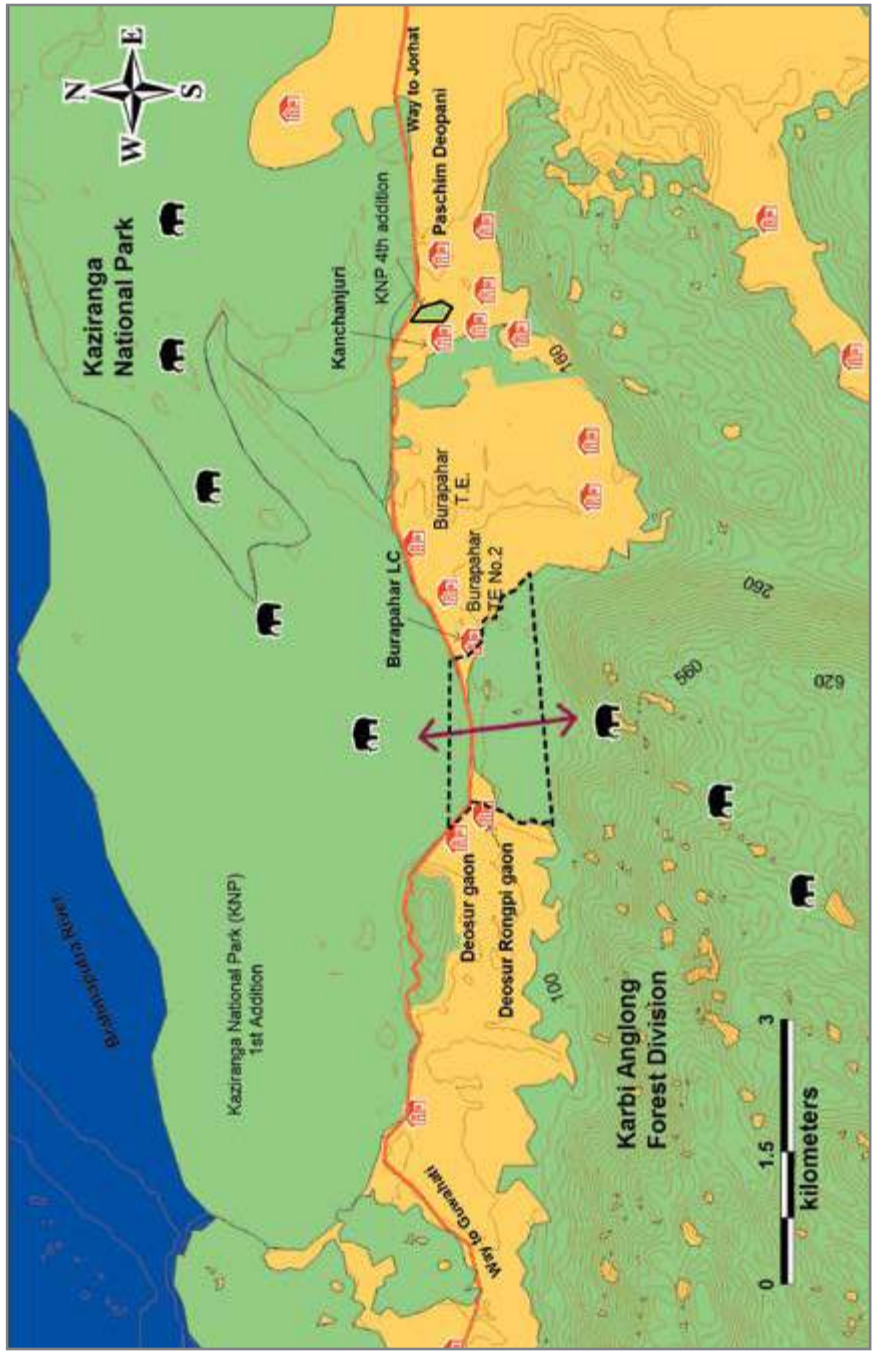
Alternate name	Deosur
State	Assam
Connectivity	Kaziranga National Park with East Karbi Anglong Forest Division
Length and Width	Length 0.8 km and Width 1.6 km
Geographical coordinates	26° 33' 36"- 26° 34' 14" N 93° 7' 6"- 93° 8' 52" E
Legal status	Reserve Forest
Major land use	Forest and agriculture
Major habitation/settlements	Nil
Forest type	Tropical moist deciduous forest
Frequency of usage by elephants	Regular; throughout the year especially during floods

FORESTS AND ELEPHANTS

Corridor habitat status: The corridor consists of agricultural land and the forests of East Karbi Anglong Forest Division. The main plant species present in the forest include *Shorea robusta*, *Tectona grandis*, *Diptereocarpus macrocarpus*, *Cassia fistula*, *Terminalia myriocarpa*, *Phyllantus emblica*, *Michelia champaca*, *Bauhinia variegata*, *Pterospermum acerifolium*, *Gmelina arborea* etc.



3D map showing the landscape of the Kaziranga – East Karbi Anglong at Deosur Corridor



Map of the Kaziranga – East Karbi Anglong at Deosur Corridor

Estimated elephant numbers in the landscape

Karbi Anglong Forest: 614

Kaziranga National Park: 1165

(Elephant Census Assam, 2011)

Forest/Land use

Forest type: Tropical moist deciduous

Settlements: Burapahar Tea Estate colony, Deosur Rongpi Gaon and Deosur Gaon (adjacent to the corridor)

Agriculture: Seasonal paddy (encroachment on government land)

Highway: NH 37 (Guwahati-Jorhat)

Buildings and Artefacts: Electric sub-station

Other ecological importance

Mountain Range: Karbi Plateau

River: Brahmaputra

Elephant Reserve Name: Kaziranga-Karbi Anglong Elephant Reserve

Protected Area: Kaziranga National Park and Tiger Reserve

Biodiversity Hotspot: Indo-Burma

IBA: Kaziranga National Park (IBA category A1, A2, A4i, A4iii)

HUMAN DIMENSIONS

Threats

1. *Encroachment* between Burapahar No.2 and Deosur villages and a part of Bagser Reserve Forest had completely impaired the structural connectivity of elephant habitats between Kaziranga National Park and the Karbi Anglong hills. This encroachment has recently been cleared by the forest department but needs to be periodically monitored.

2. Heavy traffic on National Highway 37 passing through the corridor: On average, 207.6 vehicles per hour ply through the corridor stretch, a majority of them

being four-wheel (105.8 vehicles per hour) and six-wheel (58.5 vehicles per hour) vehicles. The movement of heavy vehicles and six-wheel vehicles is comparatively higher than that of four-wheelers on this highway. The expansion of this highway will add to the traffic volume and speed, making animal movement difficult.

3. *Biotic pressure* from the fringe villages of Burapahar Tea Estate, Deosur Rongpi Gaon and Deosur has affected the quality of the habitat. Shops and illegal hamlets have come up in the last one decade.

Corridor dependent villages: There is no settlement located inside the corridor. Corridor dependent villages include the Burapahar Tea Estate colony (80 households), Deosur Rongpi Gaon and Deosur (106 households).

CONSERVATION PLAN

1. The corridor should be legally protected by the state forest department under an appropriate law, and action should be taken to prevent agricultural activities on government land, encroachment of forest land, illicit felling, slash and burn agriculture, and developmental activities detrimental to the corridor.

2. The expansion of human settlements, shops and hotels along NH 37 needs to be prevented.

3. Restoration of the degraded Bagser Reserve Forest should be undertaken on a priority basis.

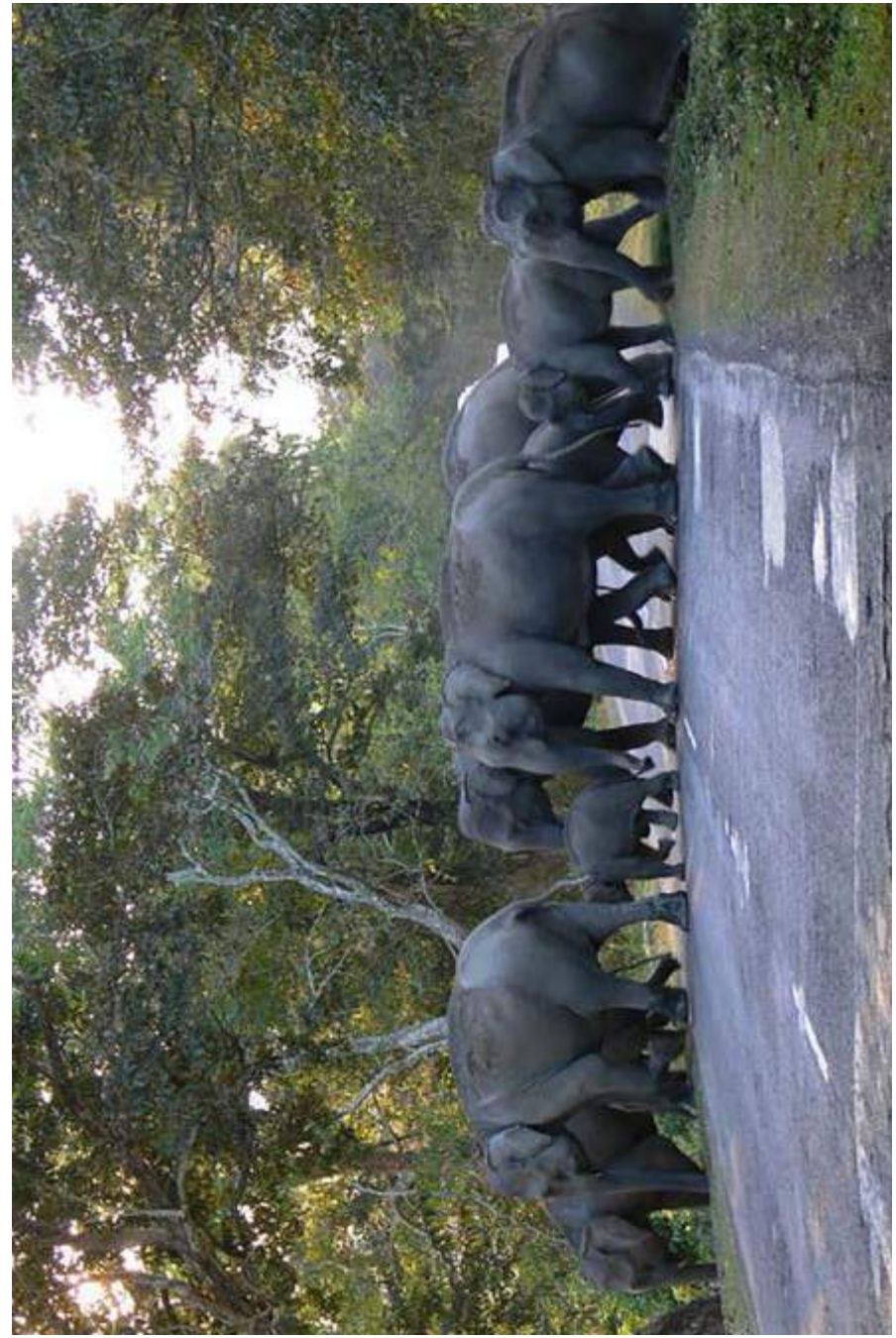


Fig. 7.13: Elephants crossing the highway through the the Kaziranga – East Karbi Anglong Corridor at Deosur

7.17

KUKURAKATA - BAGSER AT AMGURI

Ecological priority: Medium

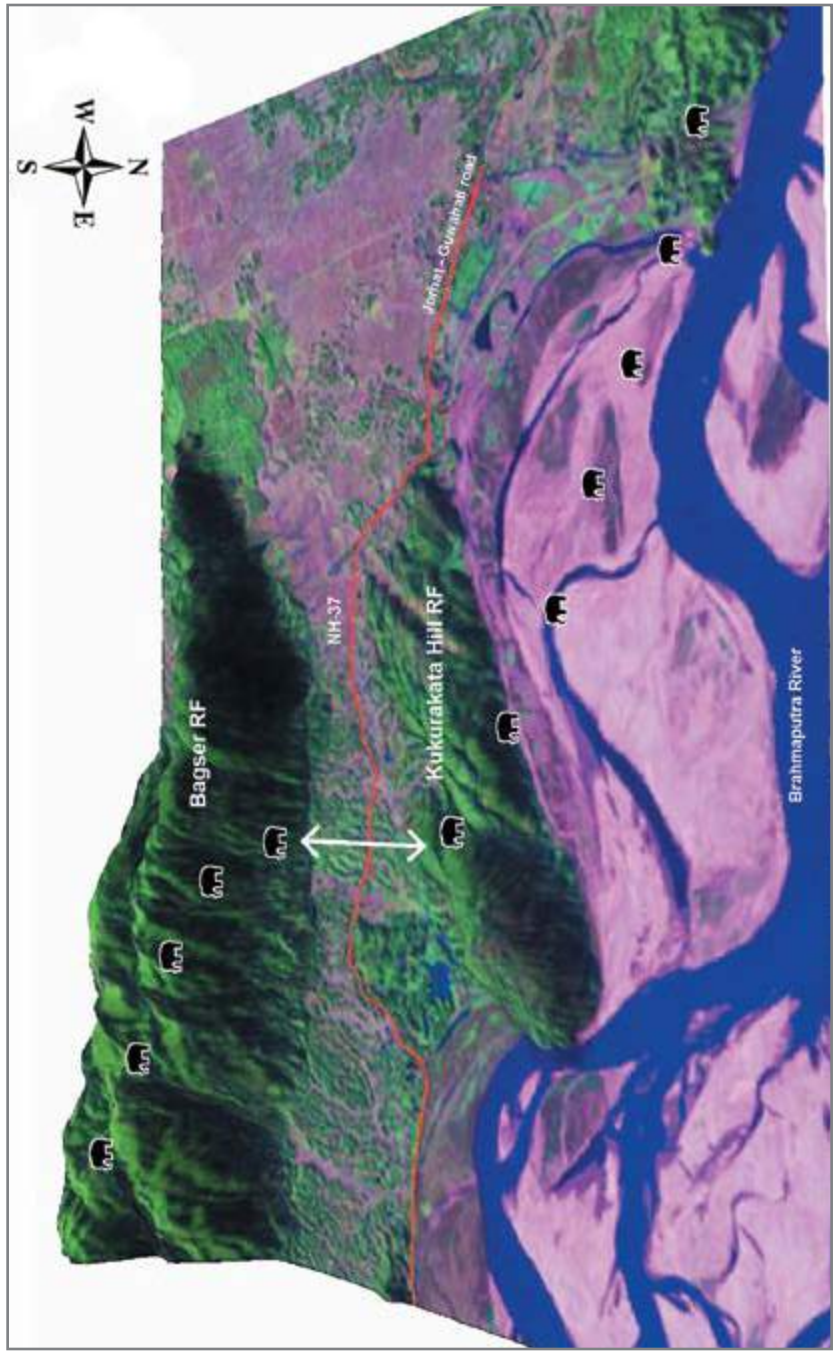
Conservation feasibility: Medium

This corridor connects the Kukurakata Reserve Forest of Kaziranga National Park with Bagser Reserve Forest of Nagaon Forest Division and the forests of Karbi Anglong. Elephants pass through the tea gardens, settlements and forest patches between Amguri Chang and Kalapani Timung villages. This movement has drastically reduced due to the presence of a large number of settlements, restaurants and hotels near NH 37.

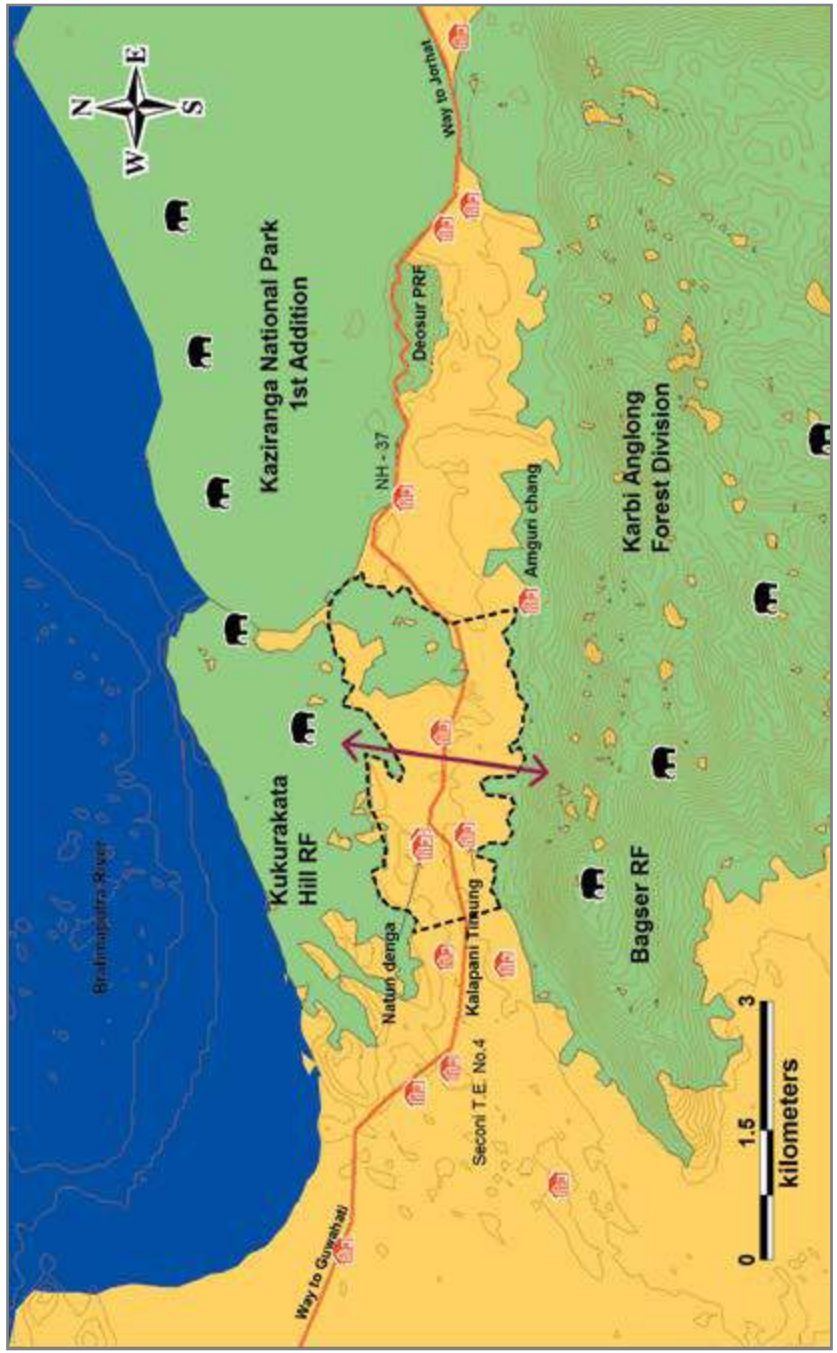
State	Assam
Connectivity	Kaziranga National Park with Karbi Anglong Forest Division
Length and Width	0.5-2 km and 2 km
Geographical coordinates	26° 33' 40"- 26° 34' 54" N 93° 2' 7"- 93° 4' 37" E
Legal status	Private Land, Reserve Forest and land leased to Tea Gardens
Major land use	Agriculture, tea garden, settlement and forest
Major habitation/settlements	Amguri Chang, Natundenga, Kalapani Timung Gaon
Forest type	Tropical semi evergreen forest and grassland
Frequency of usage by elephants	Low

FORESTS AND ELEPHANTS

Corridor habitat status: Most of the corridor area is under paddy cultivation or occupied by human settlements.



3D map showing the landscape of the Kukurakata – Bagser at Amguri Corridor



Map of the Kukurakata – Bagser at Amguri Corridor

Estimated elephant numbers in the landscape

Karbi Anglong Forest: 614

Kaziranga National Park: 1165

(Elephant Census Assam, 2011)

Forest/Land use

Forest type: Tropical semi evergreen forest and grassland

Settlements: Amguri Chang, Natundenga, Kalapani Timung Gaon

Agriculture: Seasonal paddy

Plantation: Tea and rubber

Highway: NH 37 (Guwahati-Jorhat)

Other ecological importance

Mountain Range: Karbi Plateau

River: Brahmaputra

Elephant Reserve: Kaziranga-Karbi Anglong Elephant Reserve

Protected Area: Kaziranga National Park and Tiger Reserve

Biodiversity Hotspot: Indo-Burma

IBA: Kaziranga National Park (IBA category A1, A2, A4i, A4iii)

HUMAN DIMENSIONS

Threats

1. *Heavy traffic on National Highway 37* passing through the corridor. More than 5000 vehicles ply per day on this highway. The expansion of NH 37 will increase traffic volume and speed, further hindering animal movement.

2. *Tea gardens and the expansion* of Kalapani Timung Gaon, Amguri Chang and Natundenga villages in and around the corridor area, and the resulting biotic pressure (fuelwood and timber collection), has affected elephant movement.

3. *Collection of fuelwood* from Bagser Reserve Forest and Kukurakata Reserve Forest has severely degraded the habitat.

4. *Expansion of agricultural land* in the corridor area.

5. *Restaurants, resorts and an amusement park* located along NH 37 in and around the corridor have hindered animal movement, with vehicles halting at these places.

Corridor villages: The corridor has three revenue villages being used for settlement and agriculture under the jurisdiction of Kaliabor subdivision of Nagaon district: Amguri Chang (96 households), Natundenga (65 households) and Kalapani Timung Gaon (38 households). Chikoni Tea Garden lies on the south side of the corridor.

Human-Elephant Conflict: No mortality of humans or elephants has been reported due to conflict in the last five years, though one person was injured by an elephant in August 2013. Crop damage increases during the paddy season from October to December.

CONSERVATION PLAN

1. The corridor should be notified by the state forest department and legally protected under an appropriate law to prevent encroachment and developmental activities detrimental to animal movement.

2. New restaurants/resorts in the corridor area need to be prohibited. The activities of existing establishments should be regulated. The corridor area needs strict monitoring to prevent land use change affecting elephant movement.

3. Vehicular traffic at night on NH 37, especially during the monsoon floods, needs to be regulated by maintaining a time card system. Speed breakers are needed to control vehicular speed. Widening of the highway within the corridor area should be stopped.



Fig. 7.14: A view of Amguri village inside the corridor

7.18

BORNADI - KHALINGDUAR

Ecological priority: Medium

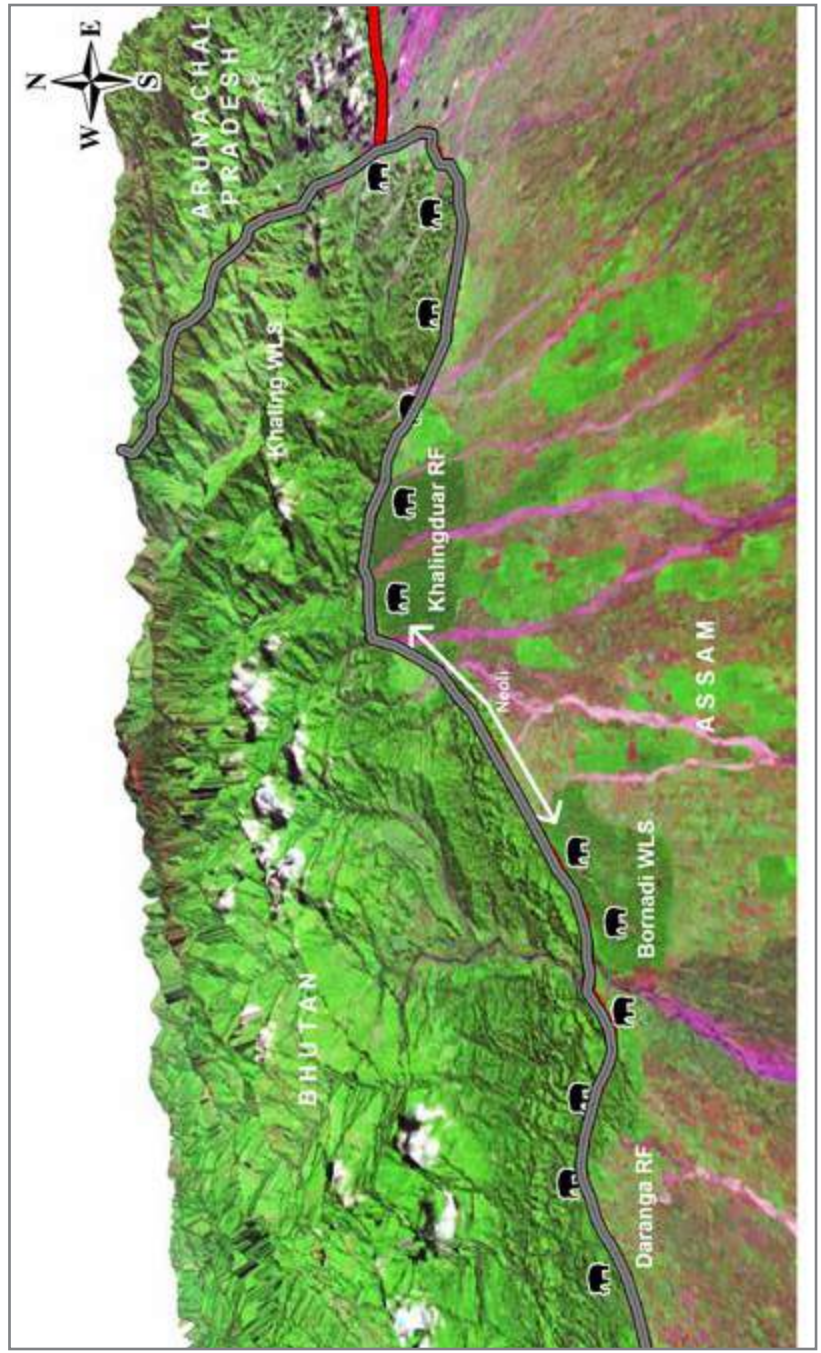
Conservation feasibility: Medium

This corridor connects Bornadi Wildlife Sanctuary with Khalingduar Reserve Forest. The corridor is located on the international border of India and Bhutan in the north of Udalguri district. Elephants move from Khalingduar Reserve Forest of Dhansiri Forest Division to Bornadi Wildlife Sanctuary and Daranga Reserve Forest, through the foothills of undulating mountains, the Neoli Proposed Reserve Forest (PRF), tea gardens and human habitations.

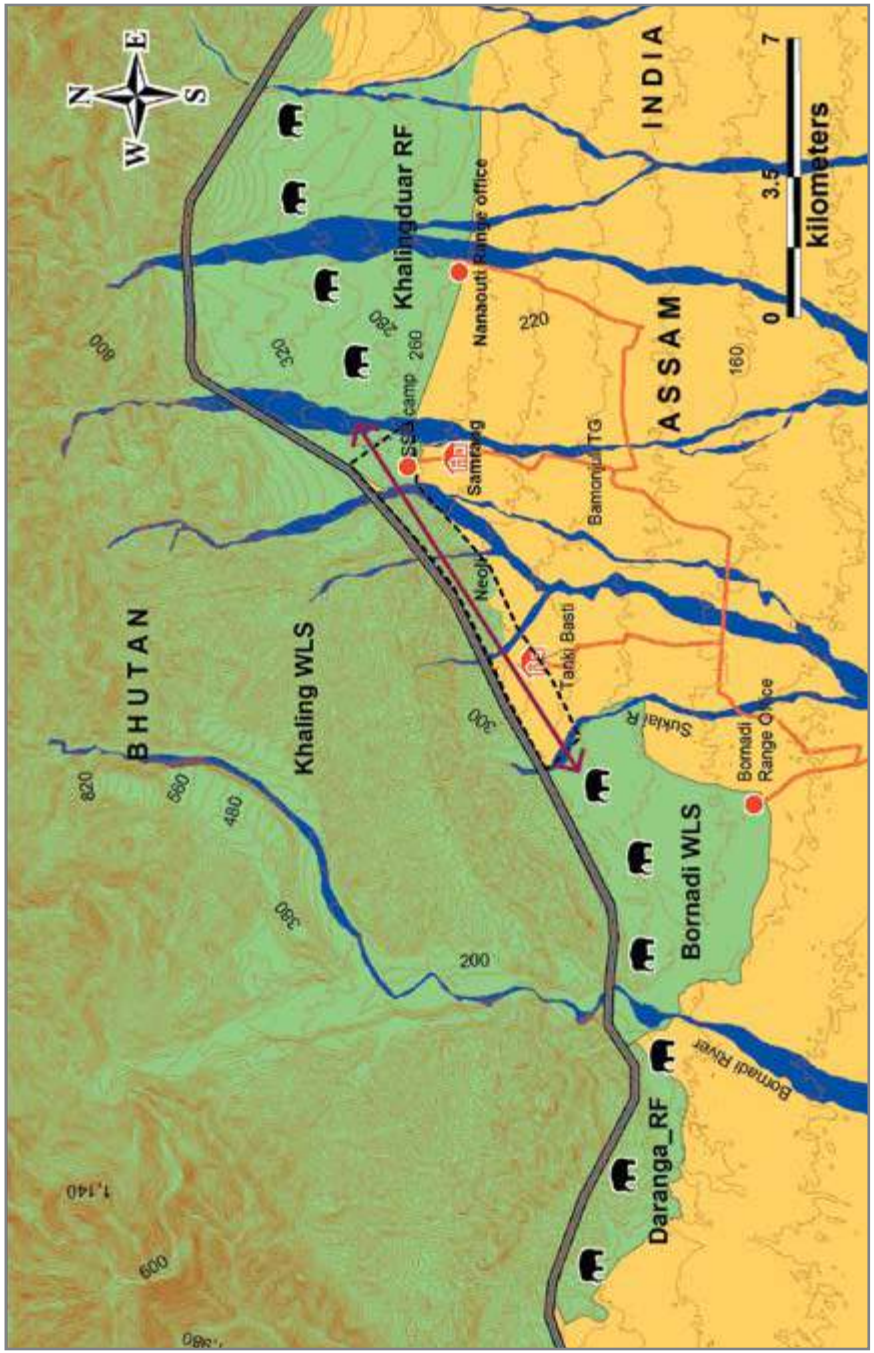
Alternate name	Neoli
State	Assam
Connectivity	Bornadi Wildlife Sanctuary and Dhansiri Forest Division Bornadi WLS – Khalingduar RF
Length and Width	8 km and 0.9–1.5 km
Geographical coordinates	26° 49′ 19″- 26° 52′ 38″ N 91° 45′ 37″- 91° 50′ 46″ E
Legal status	Private Lands, Reserve Forest
Major land use	Agriculture land, human habitation and tea garden
Major habitation/settlements	Tankibasti and Samrang
Forest type	Semi evergreen and mixed dry deciduous
Frequency of usage by elephants	Regular

FORESTS AND ELEPHANTS

Corridor habitat status: The forest in the corridor area has suffered massive deforestation between 1991and 2001 and is quite degraded. The grassland is getting converted into mixed dry deciduous forest in many parts.



3D map showing the landscape of the Bornadi-Khalingduar Corridor



Map of the Bornadi – Khalingduar Corridor

Plant species recorded in the area include *Dillenia pentagyna, Bombax ceiba, Terminalia chebula, Holarrhenaanti dysenterica, Hydnocarpus kurzii, Sterculia villosa, Bridellia stipularis, Gmelina arborea, Phyllanthus emblica, Randia spinosa, Malotus philippinensis* and *Butea menosperma*. Weeds (*Mikenia macrantha, Lantana camara, Ageratum conyzoides, Eupatorium odoratum, Leeacrispa,* and *Mimosa invisa)* have taken over large areas of the corridor forest.

Estimated elephant numbers in the landscape

*Bornadi Wildlife Sanctuary:*102
Khalingduar Reserve Forest: 50
Daranga Reserve Forest – Bornadi Wildlife Sanctuary – Khalingduar Reserve Forest complex: 150 - 200
(Elephant Census Assam, 2011)

Forest/Land use

Forest type: Semi evergreen and mixed dry deciduous
Settlements: Tankibasti, Samrang
Agriculture: Paddy, areca nut
Tea Estates: large numbers
Highway: Mungaldoi-Bhutiachang

Other ecological importance

Mountain Range: Eastern Himalayas
Elephant Reserve: Ripu-Chirang Elephant Reserve
Protected Area: Bornadi WLS, Manas Tiger Reserve
Biodiversity Hotspot: Eastern Himalayas

HUMAN DIMENSIONS

Threats

1. Encroachment in the Neoli Proposed Reserve Forest as well as in Bornadi Wildlife Sanctuary and Khalingduar Reserve Forest for tea plantation, agriculture and settlements threatens the future structural connectivity as well as quality of forest in the corridor and the habitats being connected.

2. *Expansion of settlements and agricultural practices* in and around the area from Neoli Proposed Reserve Forest till Bornadi Wildlife Sanctuary has disconnected the structural connectivity of the corridor.

3. *Deforestation and biotic pressure* exerted by the villages of Tankibasti and Samrang has severely degraded the corridor habitat. A large area is infested with weeds, affecting the quality of the forest and consequently the availability of food for animals.

4. *Grazing of thousands of domestic cattle* inside the Neoli Proposed Reserve Forest and surrounding habitats poses a severe threat to the quality of the corridor forest and disturbs the free movement of elephants.

5. *Expansion of agriculture*, apart from the large number of tea gardens and settlements, is affecting the free movement of elephants and has severely increased human-elephant conflict in this region.

6. *A Sashastra Seema Bal (SSB) camp* is located in the corridor area and hinders the movement of elephants.

Corridor villages: Bodo, Nepali and Adivasi tribes are the major communities living in the corridor villages. Most are daily wage labourers, though they earn a secondary income from paddy cultivation and cattle rearing. They depend on the corridor forest for fodder and NTFP collection, and bamboo extraction.

Tankibasti, Samrang and few encroached settlements lie within the corridor.

Corridor dependent villages: Nonaipara Basti and other encroached villages.

Human-Elephant Conflict: Conflict is very high in the Bornadi-Khalingduar corridor landscape and is a major threat to the conservation of elephants. More than 50 people lost their lives due to elephants in the Udalguri district between 2003 and 2014. During the same period, 28 elephants were also killed due to conflict. Many houses are damaged and a large extent of crop is destroyed every year by elephants.

CONSERVATION PLAN

1. The corridor should be legally protected by the state forest department under an appropriate law, and action should be taken to prevent agricultural activities on the goverment land, encroachment of forest land, illicit felling of trees and developmental activities detrimental to the corridor.

2. Expansion of human settlements and agriculture in Tankibasti and Samrang villages must be prevented.

3. The encroachment of corridor forest and habitat has to be prevented; the eviction of existing encroachments from critical parts of the corridor and surrounding habitat should be taken up on a priority basis.

4. Habitat restoration has to be undertaken in the entire corridor forest in Neoli Proposed Reserve Forest as well as the habitats of Bornadi Wildlife Sanctuary and Khalingduar Reserve Forest. Illegal extraction of bamboo and NTFP needs to be regulated.

5. The SSB camp should be shifted outside the corridor.

6. Neoli Proposed Reserve Forest needs to be declared as a Reserve Forest at the earliest.

7.19

RANGGIRA - NOKREK

Ecological priority: Medium

Conservation feasibility: Low

Elephants from Ranggira, Sanchangiri and Galwang Reserve Forest area use this corridor to move to Nokrek National Park. Earlier, they moved via Bismagre, Bibragre, Sakalgre and Mandalgre private forests. However, the establishment of human settlements, construction of the North-Eastern Hill University (NEHU) campus, the Garo Students Union building, a fishery pond, the 2nd Police Battalion campus and other artefacts along the Tura-Rongram road have almost blocked the corridor. At times the elephants move north of the NEHU Campus (near the boys hostel) and cross the road close to the Garo Students Union building.

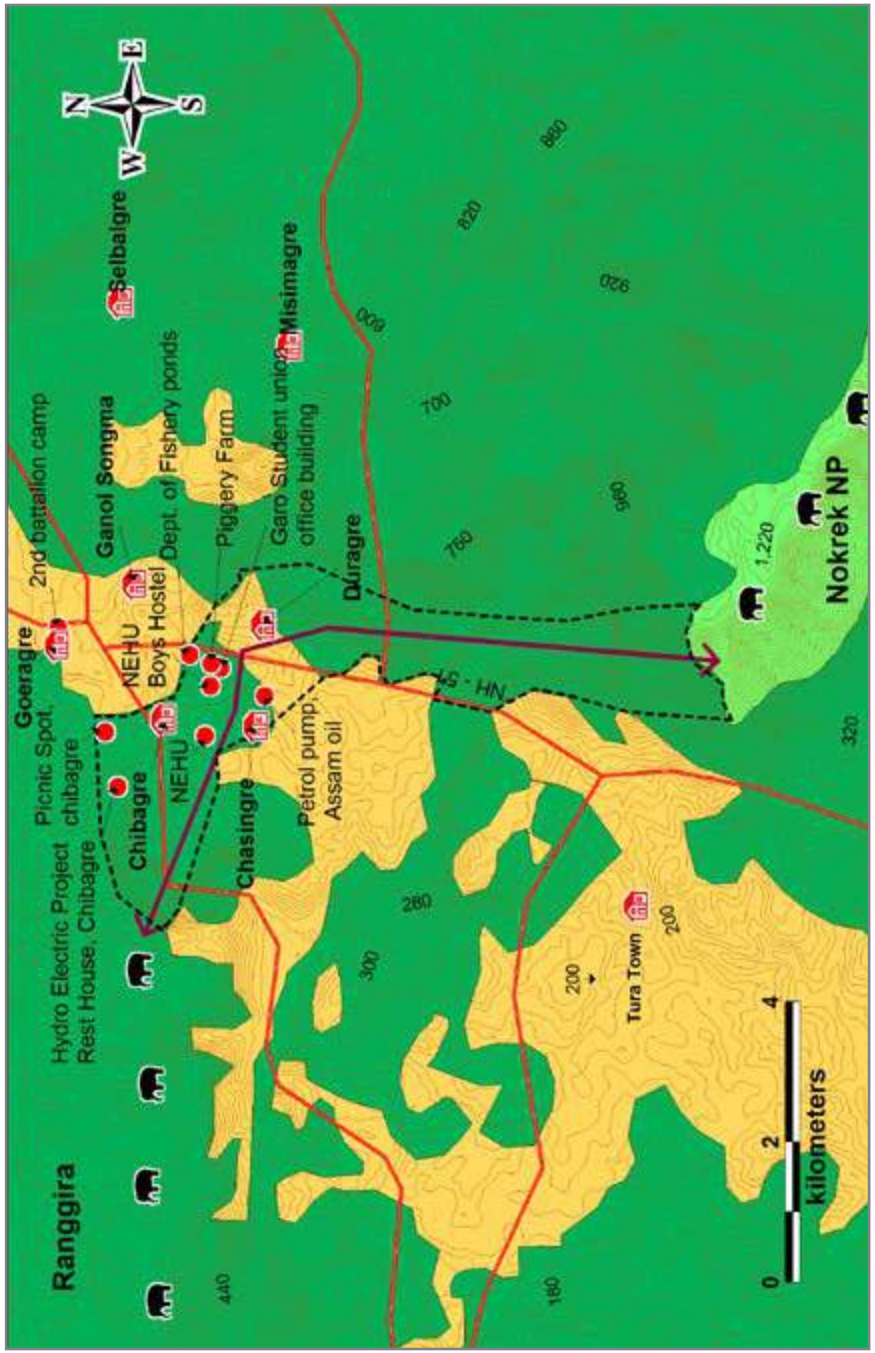
State	Meghalaya
Connectivity	West Garo Hills with Nokrek National Park
Length and Width	7-8 km and 0.1 – 1.5 km
Geographical coordinates	25° 30′ 5″- 25° 34′ 59″ N 90° 12′ 3″-90° 15′ 10″ E
Legal status	Aking Land and Private Land
Major land use	Forest, plantation, settlement, agriculture and NEHU campus
Major habitation/settlements	Chasingre, Phagugre, Chibragre, Ganol Sangma, 2nd Police Battalion campus and Boldorenggre
Forest type	Tropical evergreen and moist deciduous with *jhum* patches
Frequency of usage by elephants	Rare

FOREST AND ELEPHANTS

Corridor habitat status: The corridor consists of tropical evergreen forest along



3D map showing the landscape of the Ranggira – Nokrek Corridor



Map of the Ranggira – Nokrek Corridor

the southern boundary of Nokrek National Park and Ranggira Reserve Forest. The terrain is highly undulating.

Estimated elephant numbers in the landscape

This region has about 40-50 elephants.

Forest/Land use

Legal Status: Community Land and land under NEHU campus
Forest Type: Tropical evergreen forest
Agriculture: Slash and burn cultivation
Settlements: Chibragre village, Ganolapal and Garo Student Union building
Aloe vera processing factory (Ganol Songma) and fishery pond
Highway: Tura-Guwahati (NH 51)

Other ecological importance

Elephant Reserve Name: Garo Hills Elephant Reserve
Protected Area: Nokrek National Park and Biosphere Reserve
IBA: Nokrek National Park

HUMAN DIMENSIONS

Threats:

1. The NEHU campus that has come up in the middle of the corridor has drastically affected the movement of elephants and other wildlife.

2. The Garo Students Union building located on other side of the road (opposite the NEHU campus) has also hindered elephant movement.

3. Human settlements are coming up around the NEHU campus and along the road in and around the corridor area.

4. Community land on the other side of the road towards Nokrek is also a threat. Several pieces of land have been purchased for business and other use.

Corridor villages: Chibragre and its community land towards Nokrek and Ganolapal (new settlements that have come next to the NEHU campus on the other side of the road). Aloe vera processing factory (Ganol Songma).

Corridor dependent Villages: Settlements and community land of Duragre.

CONSERVATION PLAN

1. Declaration, demarcation and legal protection of the corridor under various laws appropriate for the state.

2. Negotiation with NEHU authorities to spare about 44 hectares of land near the hostel area for elephant movement.

3. Relocate the Garo Students Union building to an alternate site outside the corridor.

4. Prevent the establishment of new settlements in the corridor area.

5. State forest department and Garo Hills Autonomous District Council to secure land on other side of road (opposite the NEHU Campus) to provide 500 m width to the corridor.

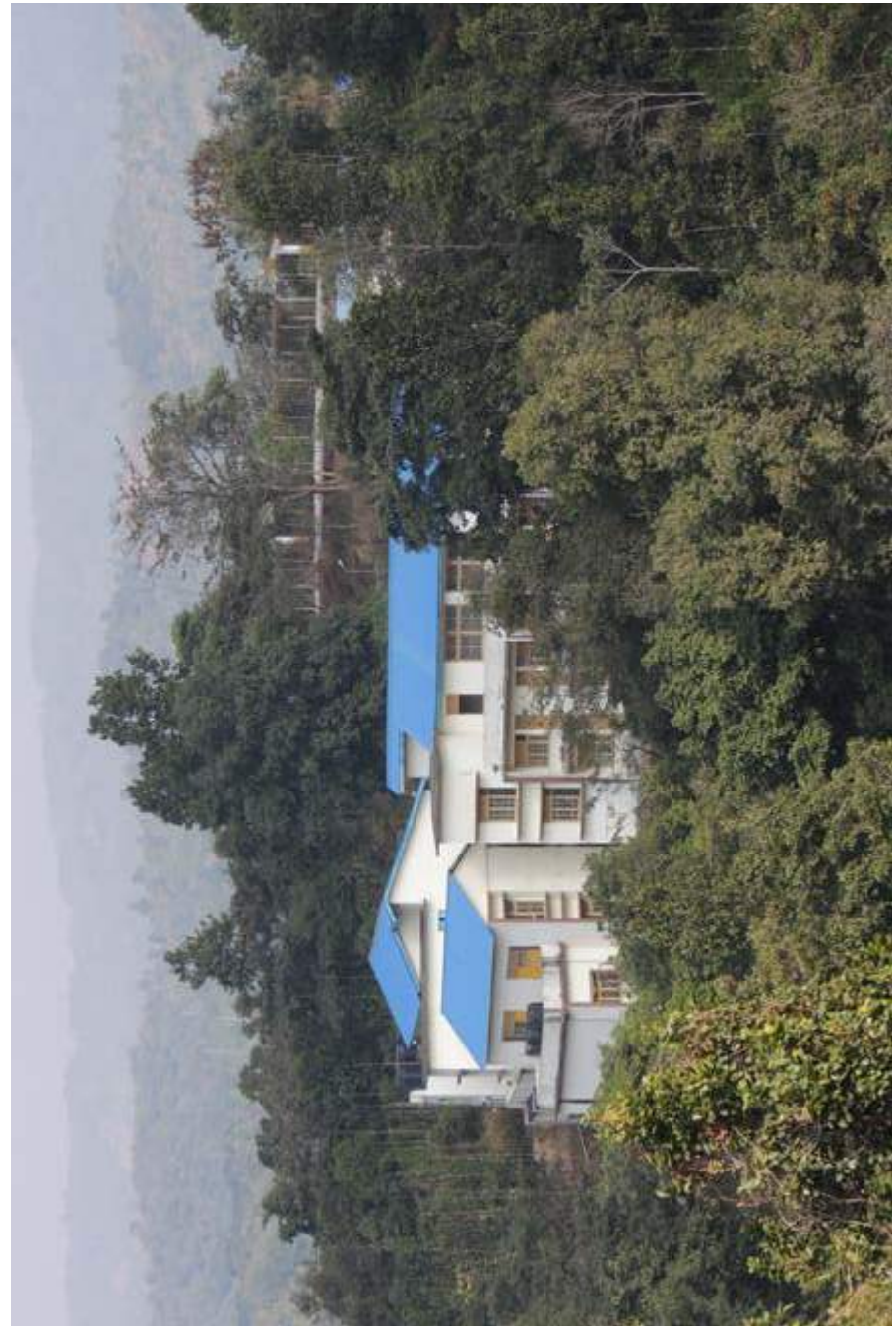


Fig. 7.15: NEHU Tura campus within the corridor area hindering elephant movement

7.20

NOKREK - IMANGRE

Ecological priority: High

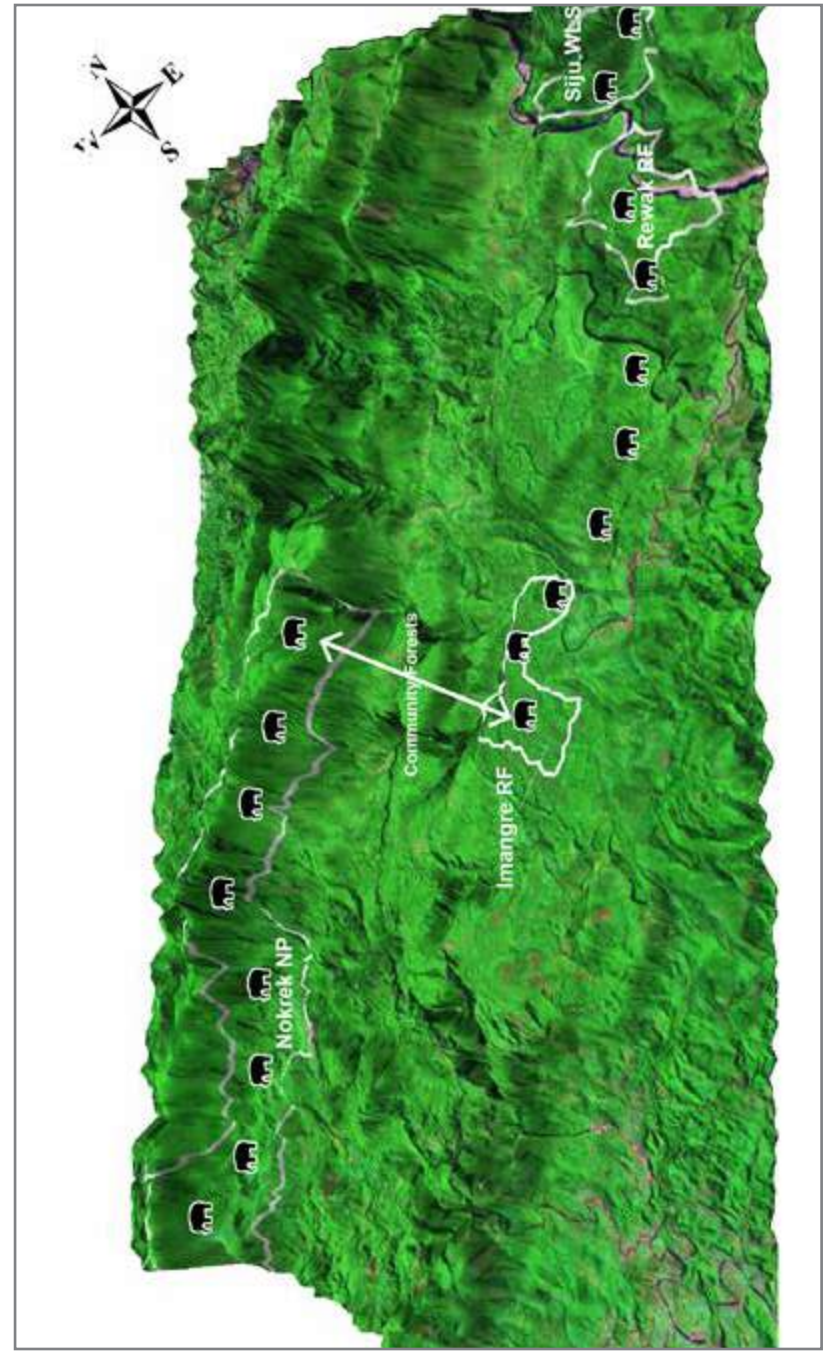
Conservation feasibility: Medium

The Nokrek-Imangre corridor connects a large stretch of forest in and around Imangre Reserve Forest with Nokrek National Park and areas adjacent to it. Being inaccessible by road and due to the comparatively low human density in the area, the corridor is safe. However, the mining and transportation of coal and limestone are potential threats to the area.

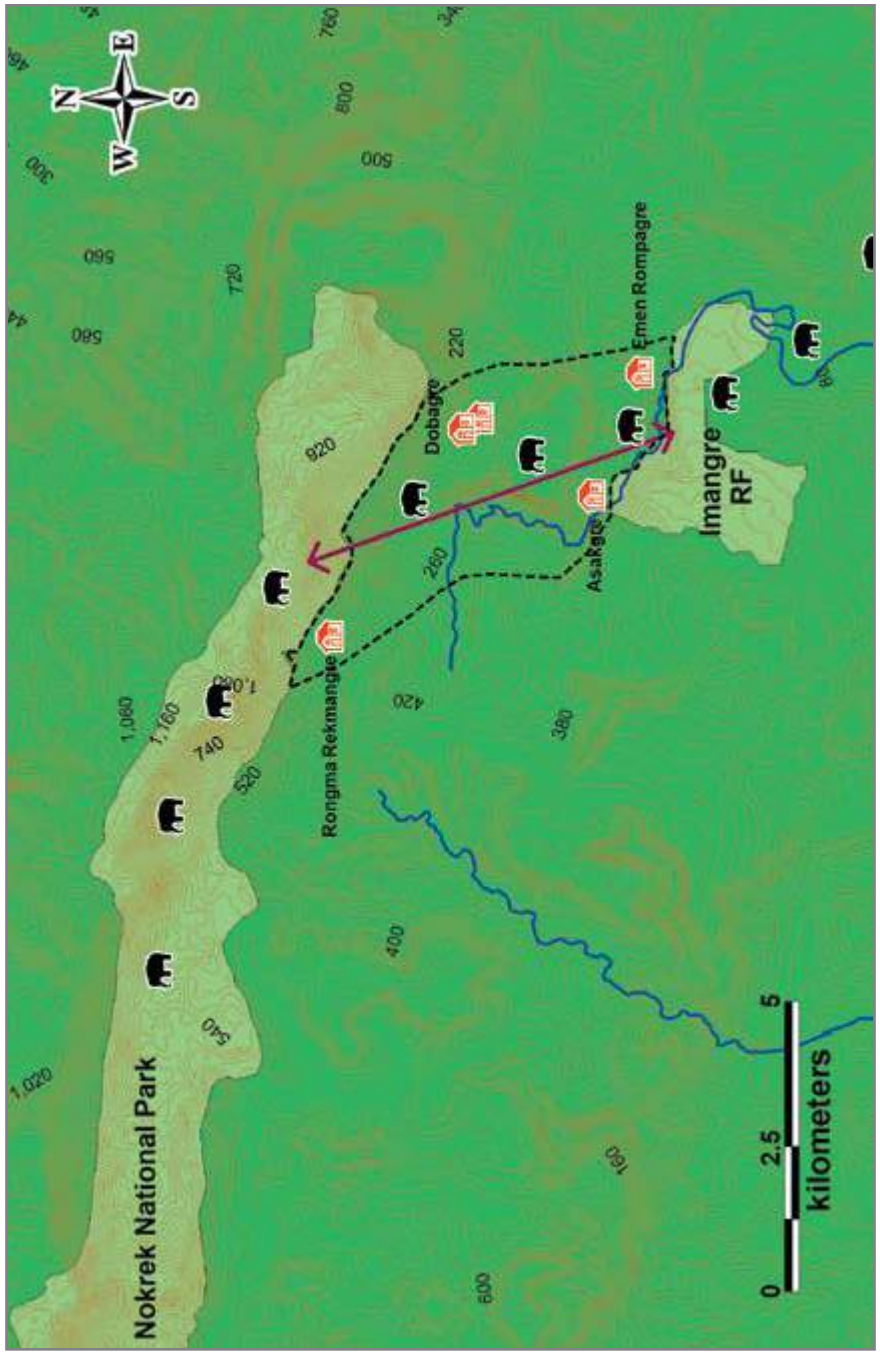
State	Meghalaya
Connectivity	Imangre Reserve Forest and Nokrek National Park
Length and Width	4-5 km and 3-4 km
Geographical coordinates	25° 21′ 41″- 25° 25′ 17″ N 90° 30′ 49″- 90° 34′ 26″ E
Legal status	Community Land (Aking Land)
Major land use	Forest, settlement and *jhum* cultivation
Major habitation/settlements	Rongma Rekmangre, Dobagre, Gopgre, Enan Rompagre and Papa Asakgre
Forest type	Tropical evergreen and moist deciduous patches
Frequency of usage by elephants	Regular

FORESTS AND ELEPHANTS

Corridor habitat status: The corridor consists of tropical evergreen forest along the southern boundary of Nokrek National Park and moist deciduous forest with patches of degraded secondary forest in and around Imangre Reserve Forest. The terrain is highly undulating. Plant species present in the area include *Macaranga*



3D map showing the landscape of Nokrek – Imangre Corridor



Map of Nokrek – Imangre Corridor showing the land to be declared as VRF

denticulata, Dillenia indica, Dillenia pentagyna, Diospyros toposia, Lagerstroemia parviflora, Duabanga grandiflora, Erythrina stricta, Grewia nervosa, Schima wallichii, Sterculia villosa, Trewia nudiflora, Dioscorea hispida, Heliotropium indicum, Litsea polyantha, Eugenia claviflora etc.

Estimated elephant numbers in the landscape

Rewak Reserve Forest, Imangre Reserve Forest and adjacent areas of Nokrek National Park: 390-400

(Elephant Census Meghalaya, 2008)

Forest/Land use

Legal status: Community land and Community Reserve

Forest type: Tropical evergreen and moist deciduous

Settlements: Dobagre, Rongma Rekmangre, Gopgre, Eman Rompagre and Papa Asakgre

Agriculture: Slash and burn cultivation

Other ecological importance

Mountain Range: Eastern Himalayas

Elephant Reserve: Garo Hills Elephant Reserve

Nearest Protected Area: Siju Wildlife Sanctuary, Nokrek National Park and Biosphere Reserve

HUMAN DIMENSIONS

Threats

1. Coal and limestone mining and associated roads opening up in the habitat are a threat to elephant movement.

2. Biotic pressure on the corridor from fringe villages, especially due to slash and burn cultivation and the Kharukhol-Chokpot mining road.

Corridor villages

Dobagre, Rongma Rekmangre, Gopgre, and Eman Rompagre and Papa Asakgre

Corridor dependent Villages

Papa Asakgre (29 families), Papa Songmong (34 families), Enan Rompagre, Agalgre (15 families) Doabgre (90 families), and Rongma Rekmangre (27 families).

CONSERVATION PLAN

1. To secure the corridor, three Community Reserves have been notified by the state forest department in collaboration with the local community. These are Rongma Rekmangre (about 90 ha), Rongma Pharungre (173 ha) and Eman Asakgre (37-38 ha). In consultation with the villagers, the remaining part of the community forest located inside the corridor (near the streams) needs to be declared as a Village Reserve Forest or Community Reserve.

2. Prevent large-scale coal and limestone mining in fringe areas and have mining regulated by the District Council.

3. Provide eco-development support to the villagers to reduce their dependence on the corridor forest, especially for fuelwood collection.



Fig. 7.16: A Western Hoolock Gibbon in the corridor

7.21

REWAK – IMANGRE

Ecological priority: High

Conservation feasibility: High

This corridor connects Rewak Reserve Forest with Imangre Reserve Forest and passes through Aking (clan) lands and the Jadegindam settlement. There is no immediate threat to the corridor except human settlements and *jhumming*.

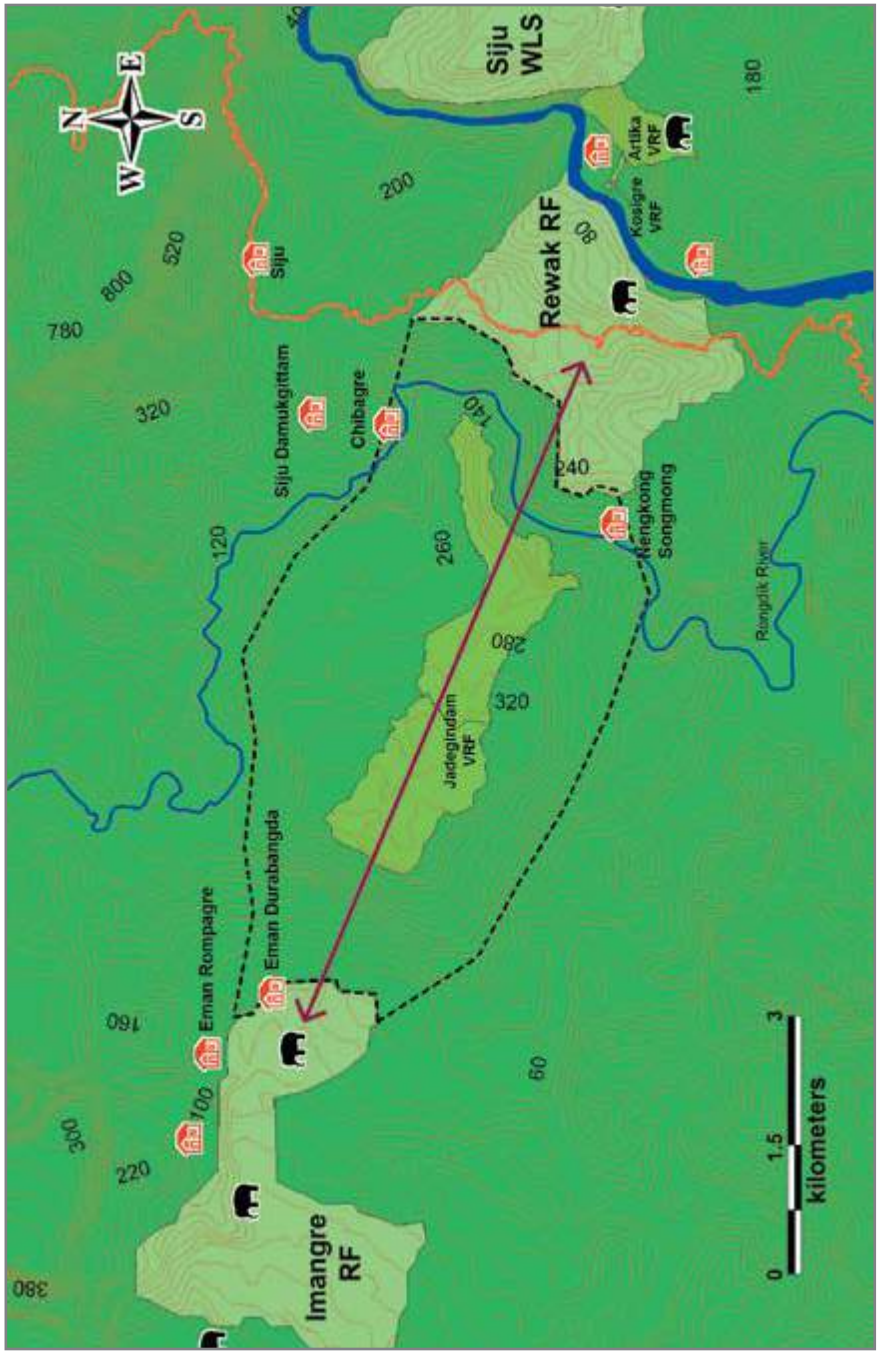
State	Meghalaya
Connectivity	Imangre Reserve Forest with Rewak Reserve Forest
Length and Width	6.5 – 8.4 km and 1.7 – 2.8 km
Geographical coordinates	25° 19′ 5″- 25° 21′ 39″ N 90° 34′ 31″- 90° 39′ 25″ E
Legal status	Community Land (Aking Land)
Major land use	Forest, settlement and shifting cultivation
Major habitation/settlements	Jadegindam
Forest type	Tropical evergreen forest
Frequency of usage by elephants	Regular; throughout the year

FORESTS AND ELEPHANTS

Corridor habitat status: Major species reported from the corridor forest include *Lagerstroemia parviflora, Duabanga grandiflora, Macaranga denticulata, Dillenia indica, Dillenia pentagyna, Diospyros toposia, Ficus racemosa, Erythrina stricta, Grewia nervosa, Schima wallichii, Sterculia villosa, Toona ciliata, Trewia nudiflora, Dioscorea hispida, Heliotropium indicum, Litsea polyantha, Wrightia tomentosa, Eugenia claviflora, Rhus succedanea* etc.



3D map showing the landscape of the Rewak – Imangre Corridor



Map of the Rewak – Imangre Corridor showing the lands to be declared as VRF

Estimated elephant numbers in the landscape

Siju Wildlife Sanctuary, Rewak Reserve Forest: 273-280
(Elephant Census Meghalaya, 2008)

Forest/Land use

Legal status of corridor forest: Aking land (clan land)
Forest type: Tropical evergreen forest
Agriculture: Slash and burn cultivation near Jadegindam village
Settlement: Jadegindam

Other ecological importance

Mountain Range: Eastern Himalayas
Elephant Reserve: Garo Hills Elephant Reserve
Nearest Protected Area: Siju Wildlife Sanctuary and Nokrek National Park & Biosphere Reserve
Siju Cave

HUMAN DIMENSIONS

Threats

1. The corridor has been secured with the declaration of the Jadegindam Village Reserve Forest but the pressures of *jhum* cultivation and expansion of habitations could be a potential threat.

2. Biotic pressure exerted by the fringe villages of Imangre and Chibagre, and the Nengkong Songonong settlement.

Corridor dependent villages: Imangre (57 families), Chibagre (55 families), Nengkong Songonong (42 families).

Most of the villagers depend upon shifting cultivation for sustenance. They also collect NTFP and other resources from the forest. A few villagers work in the adjacent coal mines. Some have their own businesses. The only village in the corridor is Jadegindam with about 18 families and a population of 93.

Human-Elephant Conflict: Conflict is reported from the area, although there has been no human casualty or injury. A vast majority (83.3%) of the households report human-elephant conflict. May to July is the peak season for crop depredation by elephants.

CONSERVATION PLAN

1. The vital part of the corridor has been notified as Jadegindam Village Reserve Forest (417 ha) through the joint efforts of the Nokma (village head), Garo Hills Autonomous District Council, forest department and Wildlife Trust of India. This VRF should be monitored periodically for usage by elephants and to prevent biotic pressures.

2. Eco-developmental and livelihood support should be provided to the villagers to reduce their dependence on the corridor forest. Wildlife Trust of India is working with the community to strengthen the livelihood prospects of people in Jadegindam and reduce pressure on forest lands.

3. Prevent the expansion of settlements as well as *jhumming* in the corridor area. Terrace cultivation could be taken up on a pilot basis as a substitute for slash and burn cultivation.



Fig. 7.17: Jadegindam VRF in the corridor



Fig. 7.18: Microhabitat of the elephant corridor

7.22

SIJU - REWAK

Ecological priority: High

Conservation feasibility: High

This narrow corridor connecting Siju Wildlife Sanctuary with Rewak Reserve Forest is a very important passage for elephants and helps in maintaining habitat continuity between Balpakram National Park, Siju Wildlife Sanctuary, Rewak and Imangre Reserve Forests, and Nokrek National Park. Elephants cross the Simsang River through the sandy stretches in the corridor near Siju Aretika village. Elsewhere, the river is bound by steep limestone cliffs and large boulder formations along both banks.

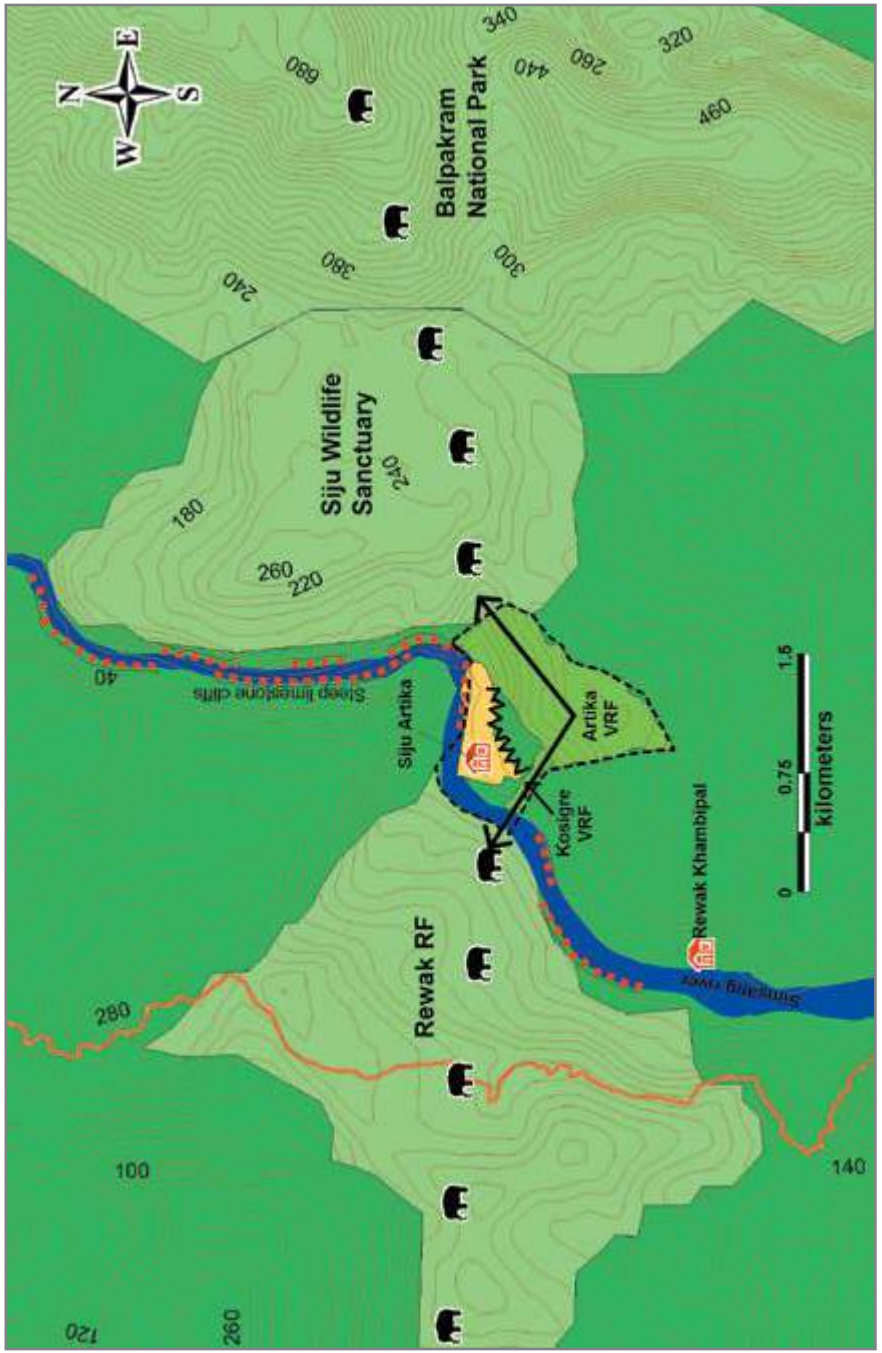
State	Meghalaya
Connectivity	Siju Wildlife Sanctuary with Rewak Reserve Forest
Length and Width	1.6 km and 0.5 km
Geographical coordinates	25° 18′ 46″- 25° 19′ 34″ N 90° 40′ 11″- 90° 41′ 3″ E
Legal status	Community Land (Aking Land)
Major land use	Forest and settlement
Major habitation/settlements	Siju Aretika
Forest type	Tropical evergreen forest with plantation
Frequency of usage by elephants	Regular; throughout the year

FORESTS AND ELEPHANTS

Corridor habitat status: The dominant species found is *Shorea robusta*. Other species include *Erythrina stricta, Lagerstroemia parviflora, Duabanga grandiflora, Macaranga denticulata, Dillenia indica, Ficus racemosa, Ficus hispida, Grewia nervosa, Streblusasper, Schima wallichii, Sterculia villosa, Toona ciliata, Dioscorea hispida, Trewia nudiflora* etc.



3D map showing the landscape of the Siju – Rewak Corridor



Map of the Siju – Rewak Corridor

Estimated elephant numbers in the landscape

Balpakram National Park, Siju and Rewak Reserve Forests: 385-400
(Elephant Census Meghalaya, 2008)

Forest/Land use

Forest type: Tropical evergreen forest with areca nut plantation
Agriculture: Slash and burn cultivation (*jhum*)
Settlement: SijuAreitika
River: Simsang

Other ecological importance

Mountain Range: Eastern Himalayas
Elephant Reserve: Garo Hills Elephant Reserve
Protected Area: Siju Wildlife Sanctuary and Balpakram National Park
Siju Cave
IBA: Balpakram Complex (IBA criteria A1, A2, A4i)

HUMAN DIMENSIONS

Threats

1. Expansion of human settlements (26 families in Siju Aretika) and *jhum* cultivation in Siju Ariteka, Rewak Kosigre and fringe villages.

2. Open cast mining for coal near the corridor and the consequent pollution of the Simsang River.

3. Traffic: NH 62 passes through the corridor but is not a major problem. The regular movement of heavy vehicles was, however, recorded throughout the day and night due to coal mining in the area.

Corridor village: Siju Aretika

Corridor dependent villages: Siju Aretika (926 households), Rewak Kosi and

Kambepal (22 households) , Rewak Daburam (32 households), Rewak Songma (27 households) and Dakopgre (21 households).

Six settlements are located in and around the corridor area, of which Siju Ariteka is situated in the bottleneck of the corridor. Agriculture (*jhum* cultivation) and areca nut plantation are the main livelihood sources, with paddy, ginger, maize, water melon, brinjal, chilli etc being popular crops. Some of the villagers also work as labourers in the nearby coal mines. They depend on the corridor forest for cattle grazing, fuelwood collection and NTFP.

Human-Elephant Conflict: Conflict is high in this area. Four human deaths and four cases of human injury were reported to have been caused by elephants from 2008 to 2014. Damage to crops and property is also high in and around the corridor area.

Working with local villagers, Wildlife Trust of India has power fenced the Siju Aretika village to prevent conflict with elephants and other animals.

CONSERVATION PLAN

1. To secure the corridor land, two Village Reserve Forests (VRFs) have been notified in the corridor area by the Garo Hills Autonomous District Council in collaboration with the Nokmas (village heads), forest department and Wildlife Trust of India: Siju Aretika Village Reserve Forest (200 ha) and Rewak Kosigre Village Reserve Forest (50 ha). These VRFs should be monitored periodically for elephant usage and to prevent biotic pressures.

2. Explore the potential of declaring Rewak Reserve Forest as a Protected Area.

3. Undertake eco-developmental and livelihood support in the villages to reduce the inhabitants' dependence on the corridor forest.

4. Prohibit destructive developmental activities in and around the Siju Wildlife Sanctuary.

5. Regulate coal mining around the corridor area.



Fig. 7.19: A view of the Siju-Rewak Corridor

7.23

BAGHMARA - BALPAKRAM

Ecological priority: High

Conservation feasibility: High

This corridor connecting Balpakram National Park with Baghmara Reserve Forest is vital in maintaining the continuity of about 600 sq km of elephant habitat. Elephants generally pass through Halwa Atong (Gamseng Community Reserve Forest), Chitmang Gonggrot, Halwa Ambeng, Dambuk Atong, Halwa Bilda and Ampangre Aking lands. Elephant movement has been hindered due to expanding settlements, plantations, slash and burn (*jhum*) cultivation, and a school that has come up in the movement path.

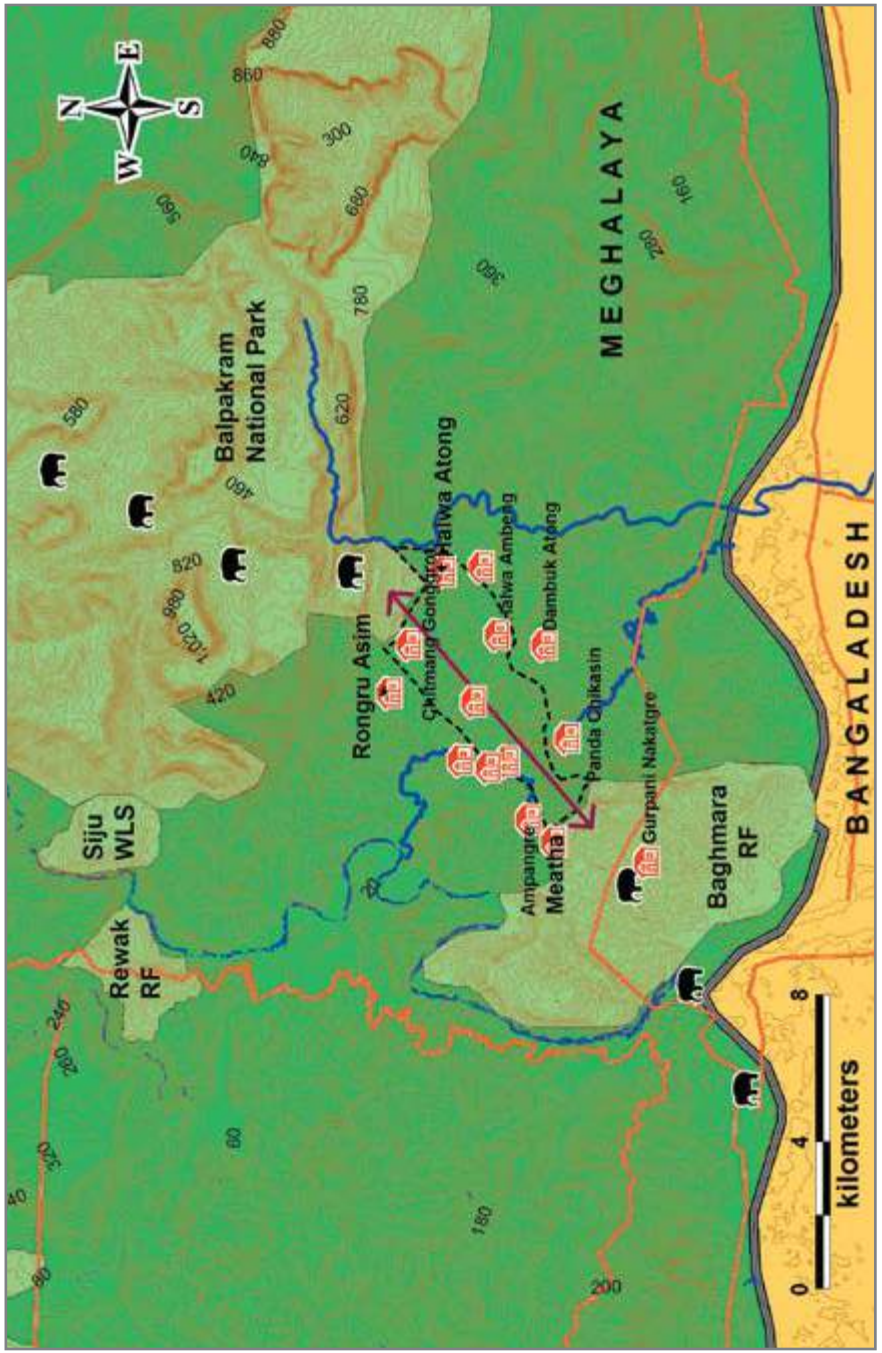
State	Meghalaya
Connectivity	Balpakram National Park with Baghmara Reserve Forest
Length and Width	6 km and 4.5 km
Geographical coordinates	25° 12′ 46″- 25° 15′ 49″ N 90° 41′ 34″-90° 46′ 12″ E
Legal status	Community Land (Aking Land)
Major land use	Forest, plantation and agriculture (*jhum*)
Major habitation/settlements	Settlements
Forest type	Tropical evergreen forest with plantation and *jhum* land
Frequency of usage by elephants	Regular

FORESTS AND ELEPHANTS

Corridor habitat status: Plant species common in the corridor area include *Dillenia pentagyna, Dillenia indica, Callicarpa arborea, Tetrameles nudiflora, Lagerstroemia parviflora, Crypteronia paniculata, Helicia nilagirica, Toona ciliata, Pterospermum*



3D map showing the landscape of the Baghmara – Balpakram Corridor



Map of the Baghmara – Balpakram Corridor

acerifolium, Schima wallichii, Gmelina arborea etc. Rubber plantations are also present.

Estimated elephant numbers in the landscape

Balpakram National Park, Baghmara Reserve Forest and Siju WLS: 456
(Elephant Census Meghalaya, 2008)

Forest/Land use

Forest type: Tropical evergreen forest with plantation
Agriculture: Slash and burn (*jhum*) cultivation
Settlements: Halwa Atong, Chitmang Gonggrot, Dambuk Atong, Halwa Ambeng, Halwa Bilda, Dambuk Jongkhol and Ampangre Aking
River: Simsang

Other ecological importance

Mountain Range: Eastern Himalayas
Elephant Reserve: Garo Hills Elephant Reserve
Protected Area: Balpakram National Park
IBA: Balpakram Complex (IBA criteria A1, A2, A4i)

HUMAN DIMENSIONS

Threats

1. Destruction of natural forests for areca nut plantation has been occuring more rapidly in recent years.

2. Expansion of villages in the corridor forest and *jhum* cultivation practices have threatened elephant habitats.

3. Construction of a school has further constricted the corridor towards Baghmara Reserve Forest.

4. The possible mining of a rich deposit of coal is a future threat.

Corridor Villages: Halwa Atong, Chitmang Gonggrot, Dambuk Atong, Halwa Ambeng, Halwa Bilda, Dambuk Jongkhol and Ampangre Aking.

Corridor dependent villages: Dambuk Jongkhol (8 families), Panda, Bolbokgre and Bolchokgiri.

Many villages are located in and around the corridor area. Of these, the settlements of Halwa Atong (101 families, population 581), Chitmang Gonggrot (20 families, population 113), Dambuk Atong (22 families, population 121), Halwa Ambeng (28 families, population 158), Halwa Bilda (39 families, population 219), and Ampangre (70 families, population 385) are in the elephant movement path.

CONSERVATION PLAN

1. Declare part of the corridor community forest as a Village Reserve Forest or Community Reserve in consultation with villagers in Halwa Atong, Halwa Ambeng and Halwa Bilda. A part of the corridor land in Ampangre village has been declared as a Community Conservation Reserve.

2. Undertake eco-developmental activities and community support activities in the villages to reduce dependency on the corridor forest. The livelihood and eco-development support could be provided based on the villagers' skill and commitment towards protecting/improving the Community Reserve.

3. Prevent new constructions in the corridor areas.

4. Regulate plantation and cultivation in the corridor area.

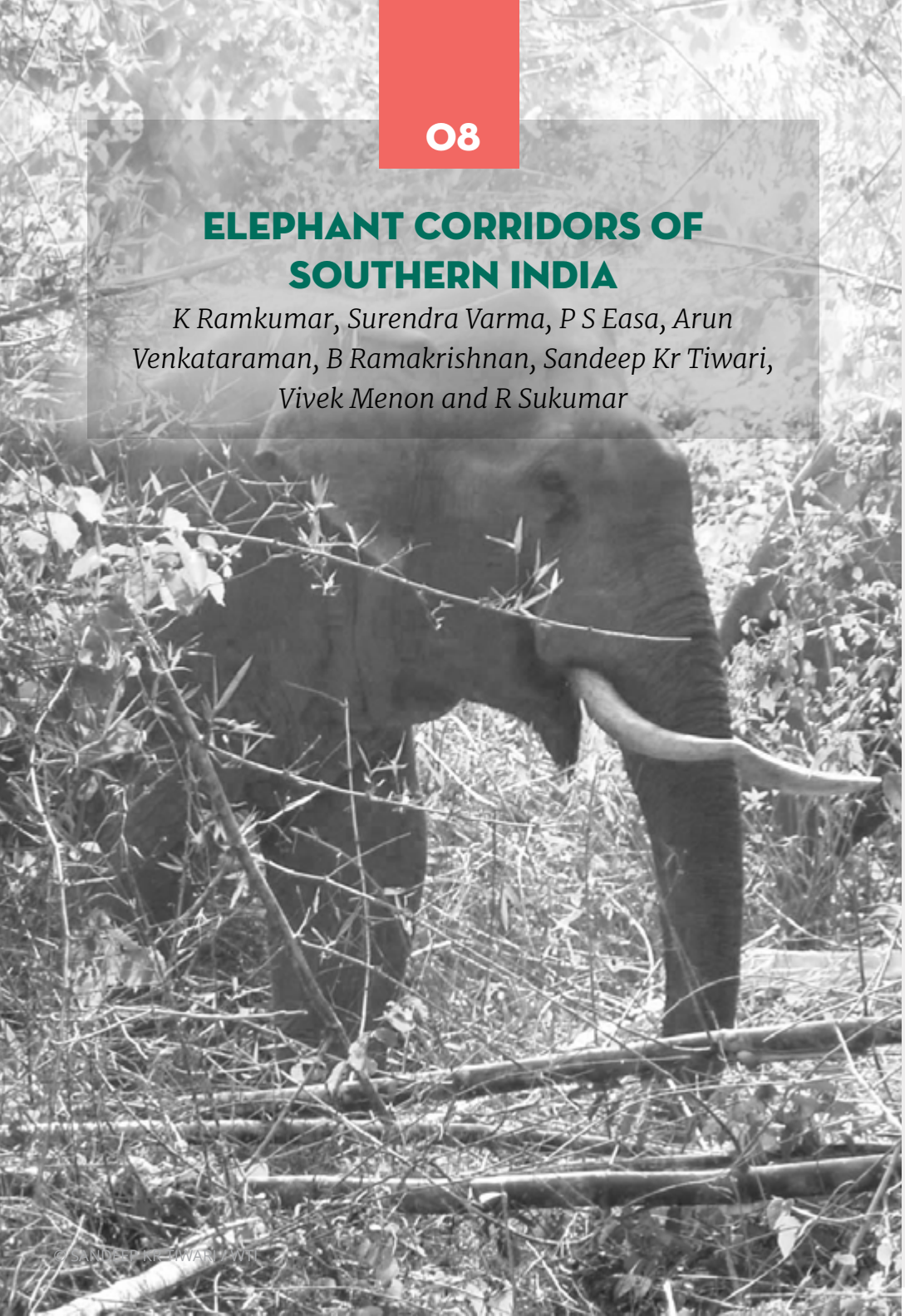


Fig. 7.20: View of the Baghmara - Balpakram Corridor

08

ELEPHANT CORRIDORS OF SOUTHERN INDIA

K Ramkumar, Surendra Varma, P S Easa, Arun Venkataraman, B Ramakrishnan, Sandeep Kr Tiwari, Vivek Menon and R Sukumar



<< Elephant in the Periya at Pakranthalam Corridor

THE SOUTHERNMOST ELEPHANT POPULATIONS OF INDIA

range over the two principal mountain chains of southern India (the Western Ghats and a part of the Eastern Ghats) in the states of Kerala, Karnataka, Tamil Nadu and Andhra Pradesh. The elephant habitats in this range, which lie between 8°15′ and 15°30′ N and between 74°15′ and 78°00′ E, are diverse and include tropical evergreen, semi evergreen, moist deciduous, dry deciduous and dry thorn forests, as well as grasslands and monoculture plantations. Elephants inhabit an area ranging in elevation between 100 msl* and 2000 msl. There are about eight populations within this range based on contiguity of habitats.

Northern Karnataka has about 40–60 elephants isolated from the other populations of the Western Ghats. These elephants are present in the Uttara Kannada and Belgaum districts of the state, inhabiting dry and moist deciduous forests. The elephants inhabiting the crestline of Karnataka are highly scattered and are distributed in the evergreen forests and montane grasslands of Dakshin Kannada, Mangalore, Shimoga and Chikkamagalur districts. This population only has about 60 elephants in small isolated groups. The natural habitats in this region are fragmented by the increasing human population, iron and manganese ore mining, and hydro-electric projects. The Dandeli Tiger Reserve alone supports the bulk of the elephants of this region. No detailed data is available for the elephants in Uttara Kannada, including in new habitats in Maharashtra and Goa. A more objective study is needed to evaluate habitat conditions, corridors, population structure and

* mean sea-level

viability, including the present scenario of human-elephant conflict, to make firm conservation recommendations for this population (*Baskaran, 2013*). As of now no elephant corridor is found in this landscape.

The moist deciduous forest cover of Bhadra Wildlife Sanctuary is the major elephant habitat that lies on the Malnad plateau on the eastern flanks of the Western Ghats. The largest single population of elephants in Asia occupies areas south of this region, extending from the Brahmagiri Hills to the Eastern Ghats, comprising the Nilgiri Hills of Tamil Nadu, the Bandipur-Nagarahole Protected Area complex of Karnataka, Wayanad in Kerala, and the Biligiri Ranganswamy Temple, Malai Madeshwara and Kavery Protected Area complex of Karnataka, Sathyamangalam Tiger Reserve, Dharmapuri Forest Division, Hosur Forest Division, Cauvery North Wildlife Sanctuary in Tamil Nadu, and Bannerghatta National Park in Karnataka.

Census estimates reveal that the forested tracts in these parts of the Western Ghats host 5900 elephants (*Elephant Census 2010*). In addition, the area being contiguous with the Eastern Ghats, the actual population exceeds 8000 elephants. Except Bhadra Wildlife Sanctuary, the forest divisions on the north of the Mysore plateau, such as those in Coorg and Malnad Plateaus (Virajpet, Madikeri, Hassan, Chikkamagalur and Koppa), and those in the crestline region (Mangalore, Brahmagiri, Pushpagiri, and Talacauveri), mostly with evergreen and semi evergreen habitats, have less than 0.5 elephants per sq km. The forests in the Mysore, Nilgiri, and southern parts of the Wayanad Plateau (Wayanad Wildlife Sanctuary), with tropical deciduous forests dominating, support the highest density of elephants (mean 1.7 elephants per sq km, range: 1.5–2.5). Spread over 2200 sq km, this region is estimated to have a mean population of 3700 elephants (*Elephant Census 2010*) (*Baskaran, 2013*).

The forest cover in the southern Malnad and Coorg Plateaus (forest divisions such as Chikkamagalur, Hassan, Madikere territorial) has been exploited extensively for commercial plantations (mainly coffee), forest-based industries (paper mills), and irrigation and hydro-electric projects (*Prasad et al., 1974*), resulting in higher fragmentation of traditional elephant habitats along the plateaus. Therefore, the forest contiguity between the Malnad and Coorg Plateaus is cut off and bulls can rarely move along the plateaus from Coorg to Malnad or vice versa using the isolated forest patches available between the coffee plantations and cultivations/ settlements. However, the forest habitats in Malnad Plateau (Chikkamagalur Forest Division), with a tenuous link to the crestline of Karnataka, are connected with the Mysore Plateau. Although it is not known whether any elephant herds or bulls from the Malnad Plateau range up to the Mysore Plateau or vice versa, the movement of elephants to the crestline from the Mysore (via Brahmagiri-Pushpagiri) and Malnad Plateaus (via Chikkamagalur Forest Division) is known to take place and hence the population is not isolated (*Varma, 2003*).

The construction of a series of hydro-electric projects (Pykara), especially on the eastern side of Mudumalai, brought with them a large influx of human population and infrastructure development, which has created many bottlenecks threatening the habitat contiguity with the Sigur Plateau that in turn connects with the Eastern Ghats. Similarly, there were proposals for infrastructure development plans to: (i) create a highway from Kozhikode to Coimbatore by widening the existing road from Vazhaithottam to Sigur and linking it to Bhavanisagar to bypass the existing Ghats section highway that goes via the Nilgiris, and (ii) extend the Mysore-Chamarajanagar railway line to Coimbatore via Bhavanisagar-Sathyamangalam cutting across the Moyar valley, the connecting link between the Western and Eastern Ghats (*Baskaran, 2013*). Land use change is one of the major issues for the conservation of elephant corridors between the Western and Eastern Ghats. About 16 land patches consisting of patta land, reserved land, revenue land, partly reserved land and encroached revenue land are needed to secure the elephant corridors at Mudumalai and Sigur Plateau (*Ramkumar and Arumugam, 2004*).

Further south, the Coimbatore Forest Division has become one of the highest human-elephant conflict areas in India due to constant human interference by various LULC (Land Use Land Cover) changes in elephant migratory routes. The conversion to built-up from barren land and of barren to agriculture land in elephant migratory routes has been a major reason for the initiation and increase of severe human-elephant conflict in the Coimbatore Forest Division (*Ramkumar, 2014*).

The Brahmagiri-Nilgiri-Eastern Ghats landscape has diverse vegetation types with over 3300 sq km out of a total of about 12,600 sq km lying within the Protected Area network. There are twenty elephant corridors found in this landscape: 1) Karadikkal – Madeswara, 2) Tali – Bilikkal, 3) Bilikkal – Javalagiri, 4) Edayarhalli – Guttiyalattur, 5) Edayarhalli – Doddasampige, 6) Chamrajanagar – Talamalai at Punjur, 7) Chamrajanagar – Talamalai at Muddahalli, 8) Talamalai – Guttiyalattur, 9) Avarahalla – Sigur, 10) Kalhatti – Sigur at Glencorin, 11) Kaniyanpura – Moyar, 12) Moyar – Avarahalla, 13) Kalmalai – Singara and Avarahalla, 14) Periya at Pakranthalam, 15) Thirunelli – Kudrakote, 16) Begur – Brahmagiri, 17) Kottiyur – Periya, 18) Jaccanaire Slope – Hulikal Durgam, 19) Anaikatti North – Anaikatti South, 20) Mudumalai – Nilambur via O' Valley.

Down south, the elephant population of the Nilambur, Silent Valley and Coimbatore belt is spread over 2300 sq km of habitat comprising diverse vegetation types ranging from evergreen forests to high altitude shola and grasslands. Two elephant corridors are found in this landscape: 1) Nilambur Kovilakam – New Amarambalam and 2) Nilambur at Appankappu.

Other than these large populations, two isolated herds also exist in this area. An isolated herd of about 30 elephants inhabits the Kaundinya Wildlife Sanctuary in the Chittoor district of Andhra Pradesh and has originally migrated from the Hosur and Anekal Forest Divisions of Tamil Nadu. A small group of about six elephants is also reported from an isolated area in the Tirupattur Forest Division of Tamil Nadu. No elephant corridor is found in this landscape.

The Anaimalai-Parambikulam area is located to the south of the Palghat gap stretch of 5500 sq km and is home to about 2500 elephants. This area covers 18 forest divisions of Kerala and Tamil Nadu, including Protected Areas such as the Anaimalai and Parambikulum Tiger Reserves, Chimmoni Wildlife Sanctuary, Peechi-Vazhani Wildlife Sanctuary, Thattekad Bird Sanctuary, Eravikulam National Park and Chinnar Wildlife Sanctuary, in addition to the Palani Hills, Vazhachal, Nelliyampathi, Malayattur, Mankulam and Munnar areas. The population range topographically consists of three major hill ranges – the eastern Palani Hills, central Anaimalai Hills, and western Nelliampathi Hills – of the Western Ghats.

The landscape also has diverse vegetation types with moist deciduous forest dominating the elephant habitats (*Baskaran et al., 2007*; *Baskaran et al., 2013).* This region is known for its rich biodiversity (*Gadgil & Meher-Homji, 2003*; *CEPF 2007*), however, the elephant habitat is under threat due to fragmentation by a large number of hydro-electric projects (dams, open canals, penstock pipelines and powerhouses), commercial plantations (tea, coffee, and cardamom), and settlement/cultivation along with the development of major roads (*Sukumar, 1989*; *Easa, et al., 1990*; *Baskaran et al., 2007*; *Baskaran et al., 2013*).

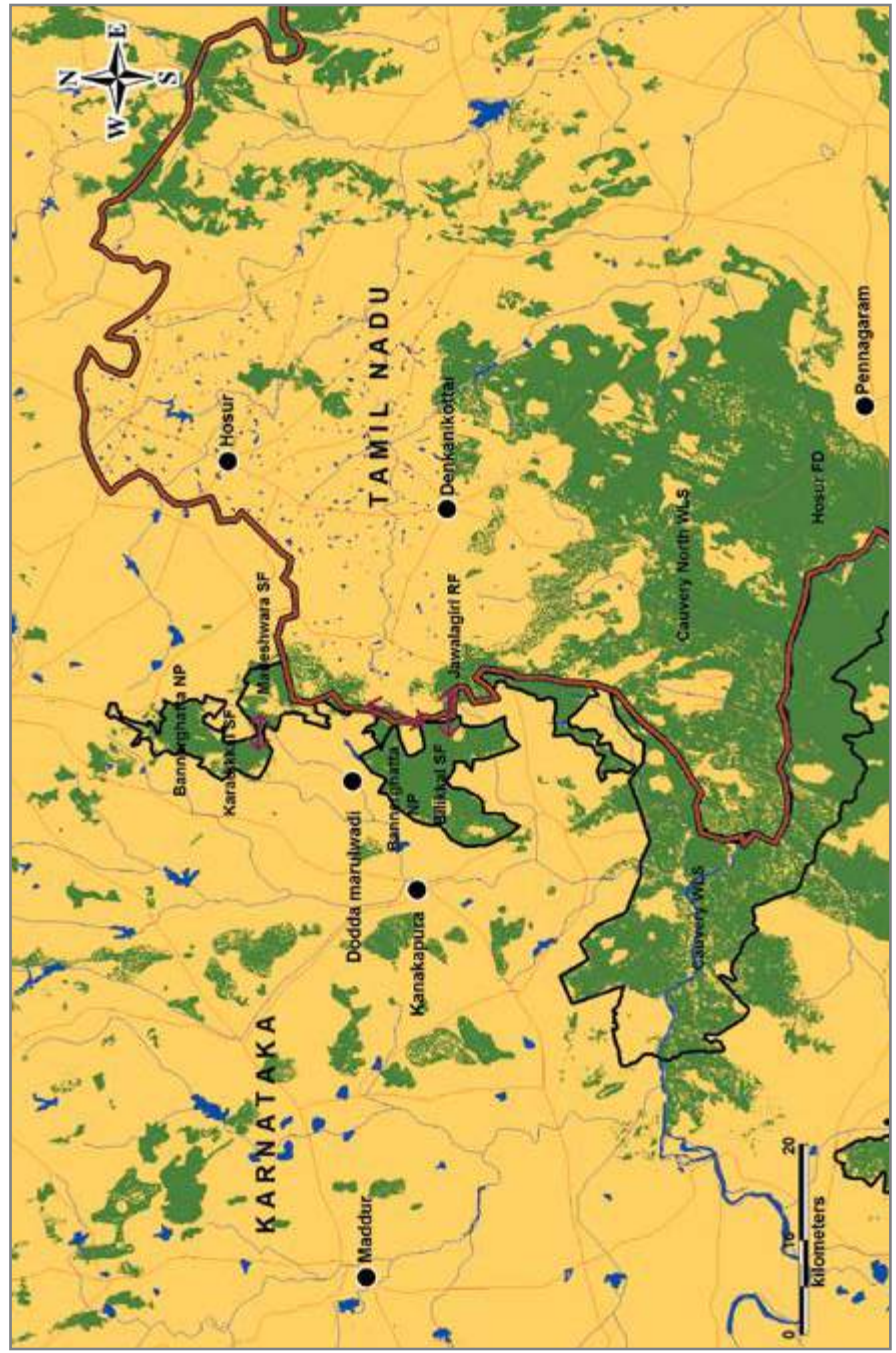
Due to greater habitat fragmentation in the Munnar Forest Division, its contiguity to Theni Forest Division is presently cut off by non-forest commercial plantations. However, elephants continue to move between these forest divisions through the commercial plantations (*Baskaran et al., 2007*; *Baskaran et al., 2013*). Human settlements along with heavy road traffic between the southwestern part of Munnar Division and the northeastern part of Kothamangalam Forest Division act as barriers to elephant movement although forest contiguity exists between these two areas. Therefore, the elephants ranging in Idukki and its adjoining habitats in Kothamangalam and Kottayam Forest Divisions are isolated from the main population in the landscape. The large-scale conversion of natural habitats, especially on the eastern side of the landscape, has resulted in an increase in human-elephant conflict. Five elephant corridors are located in this landscape: 1) Anaimalai at Punachi, 2) Anaimalai at Waterfalls Estate 3) Anaimalai between Siluvaimedu – Kadamparai, 4) Vazhachal – Anaimalai via Sholayar, and 5) Vazhachal – Anaimalai via Ryan.

Contiguity between Mattupatti-Mathikettan Shola in the Munnar Division and the Theni Forest Division is presently cut off due to tea and cardamom plantations; further south the landscape has forest contiguity with the Periyar-Agasthyamalai landscape but elephant movement has stopped between the landscapes due to the penstock pipe of the Periyar Hydroelectric Project, since its inception in 1959 (*Harikrishnan, 1972*; *Baskaran et al., 2006*).

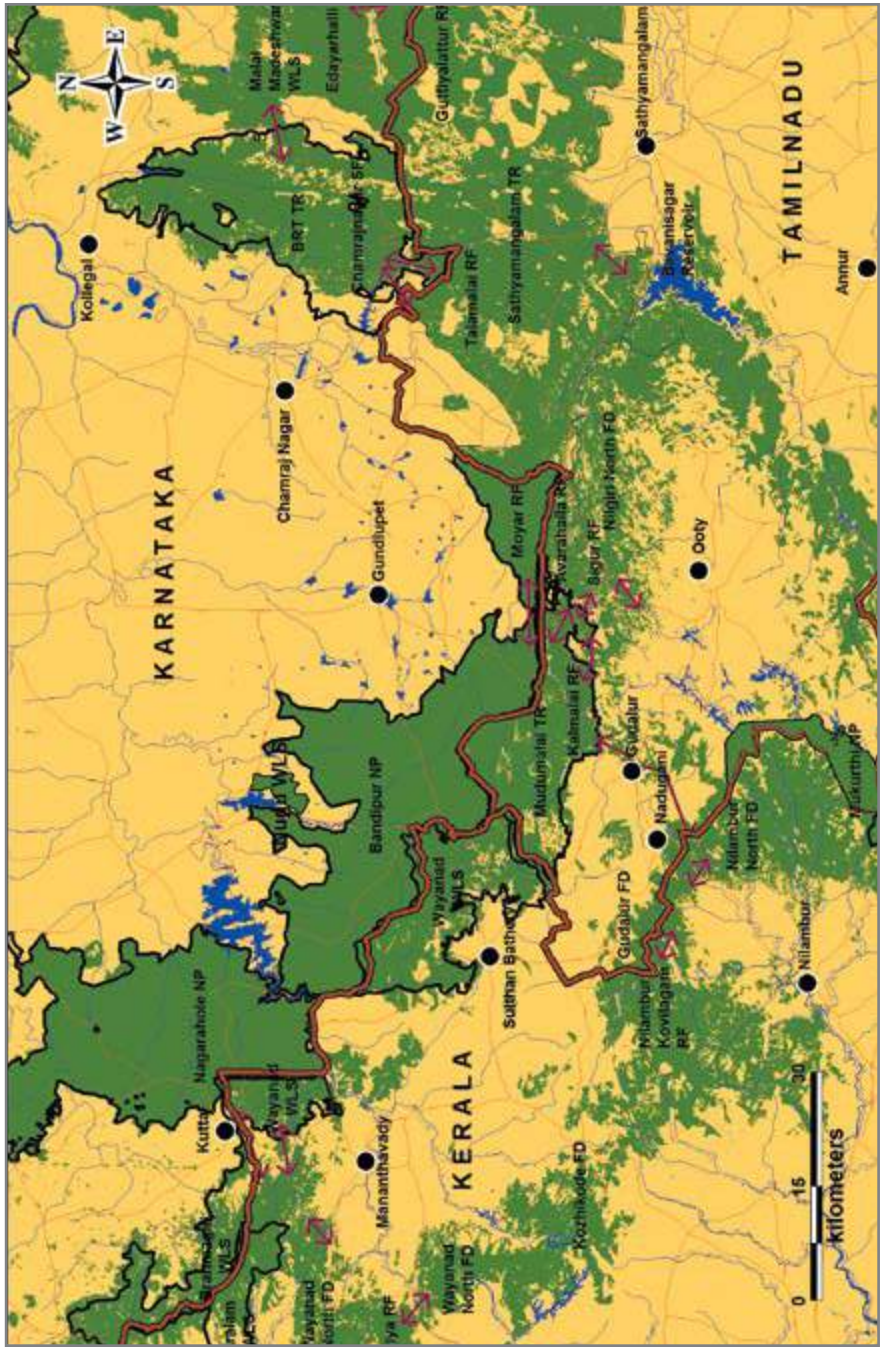
The Idukki Wildlife Sanctuary and adjacent areas of the Ayyappankoil and Nagarampara Ranges and part of the Munnar and Kothamangalam Forest Divisions have a small population of elephants (184; 2010 census) in an isolated patch of forests of about 300 sq km, with a number of settlements within and around the forests. No elephant corridors are found in this landscape.

The elephant population south of this is in the Periyar-Agasthyamalai landscape located in the states of Tamil Nadu and Kerala, and extends over 5600 sq km across 16 forest divisions. The elephant habitat in the landscape comprises the southern part of the Periyar Plateau and its eastern spur, the Varushnad and Meghamalai hill ranges, the Achankoil valley, and the Agasthyamalai and Mahendragiri hill ranges on the southern side. Like any other landscape in the Western Ghats, the eastern parts of the landscape with low rainfall have more tropical dry deciduous and thorn forests, while the hill ridges and the western sides with high rainfall have more tropical evergreen and moist deciduous forests. The landscape on the northern side (Periyar Tiger Reserve, Srivilliputhur Grizzled Squirrel Wildlife Sanctuary, Meghamalai and Thirunelveli Wildlife Sanctuaries) is probably the most intact elephant range in southern India. However, the establishment of human settlements and cultivation, and vehicular movement along the Senkotai-Punalur highway, have cut off the habitat contiguity to a large extent between the Agasthyamalai-Mahendragiri hill ranges and Periyar Plateau. Therefore, a small number of elephants ranging in the Agasthyamalai-Mahendragiri hill ranges have been isolated from the larger population found on the northern side (*Baskaran, 2013*). There is only one corridor found in this landscape: Srivilliputhur-Saptur at Srivilliputhur Grizzled Squirrel Wildlife Sanctuary.

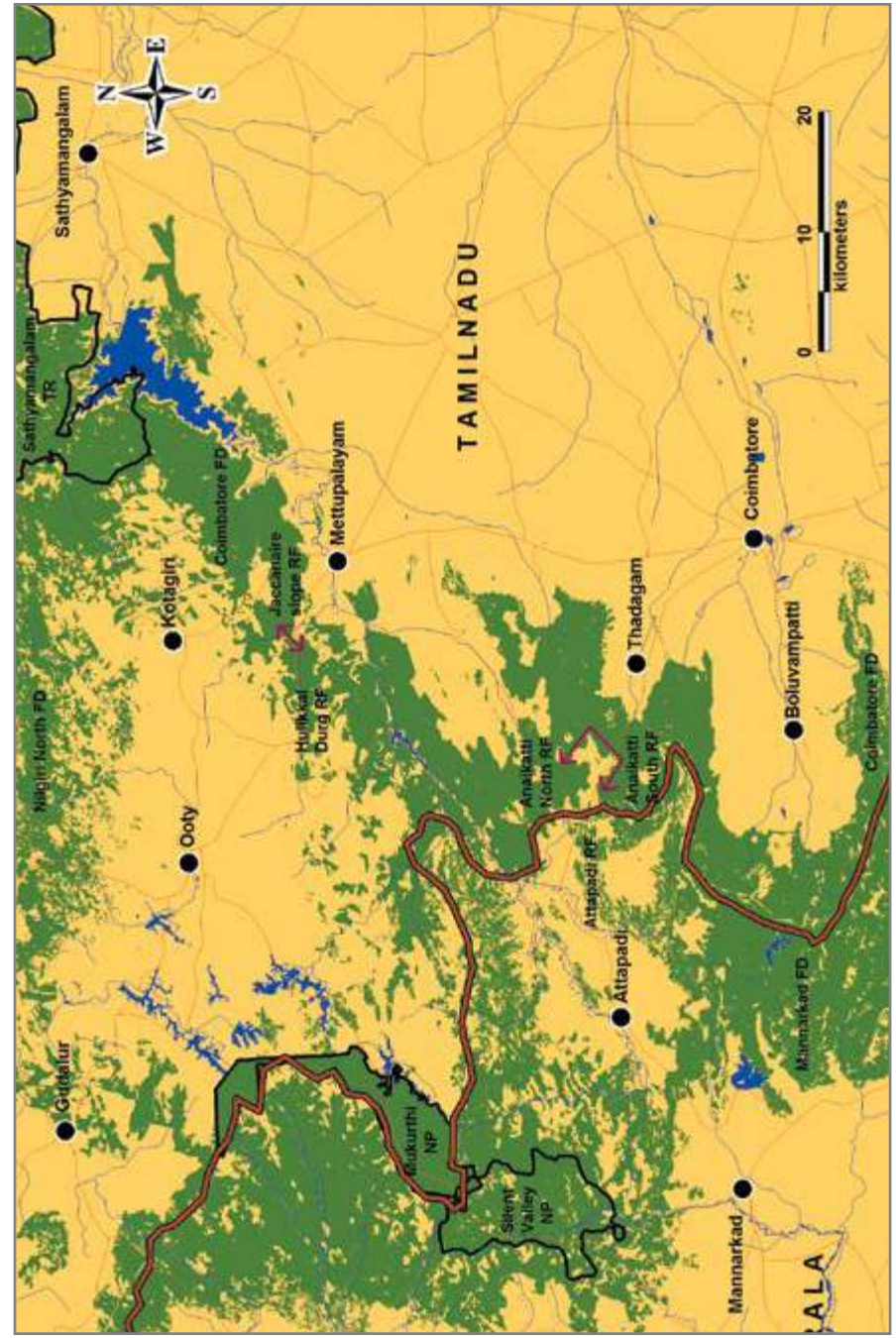
The Periyar-Agasthyamalai landscape is estimated to have 1800 elephants (*Elephant Census 2010*). Of these about 300 are isolated on the southern side in the Agasthyamalai and Mahendragiri hill ranges in the evergreen forests of Thiruvananthapuram Forest Division, Neyyar, Shendurney and Peppara Wildlife Sanctuaries, and Kalakkad-Mundanthurai Tiger Reserve.



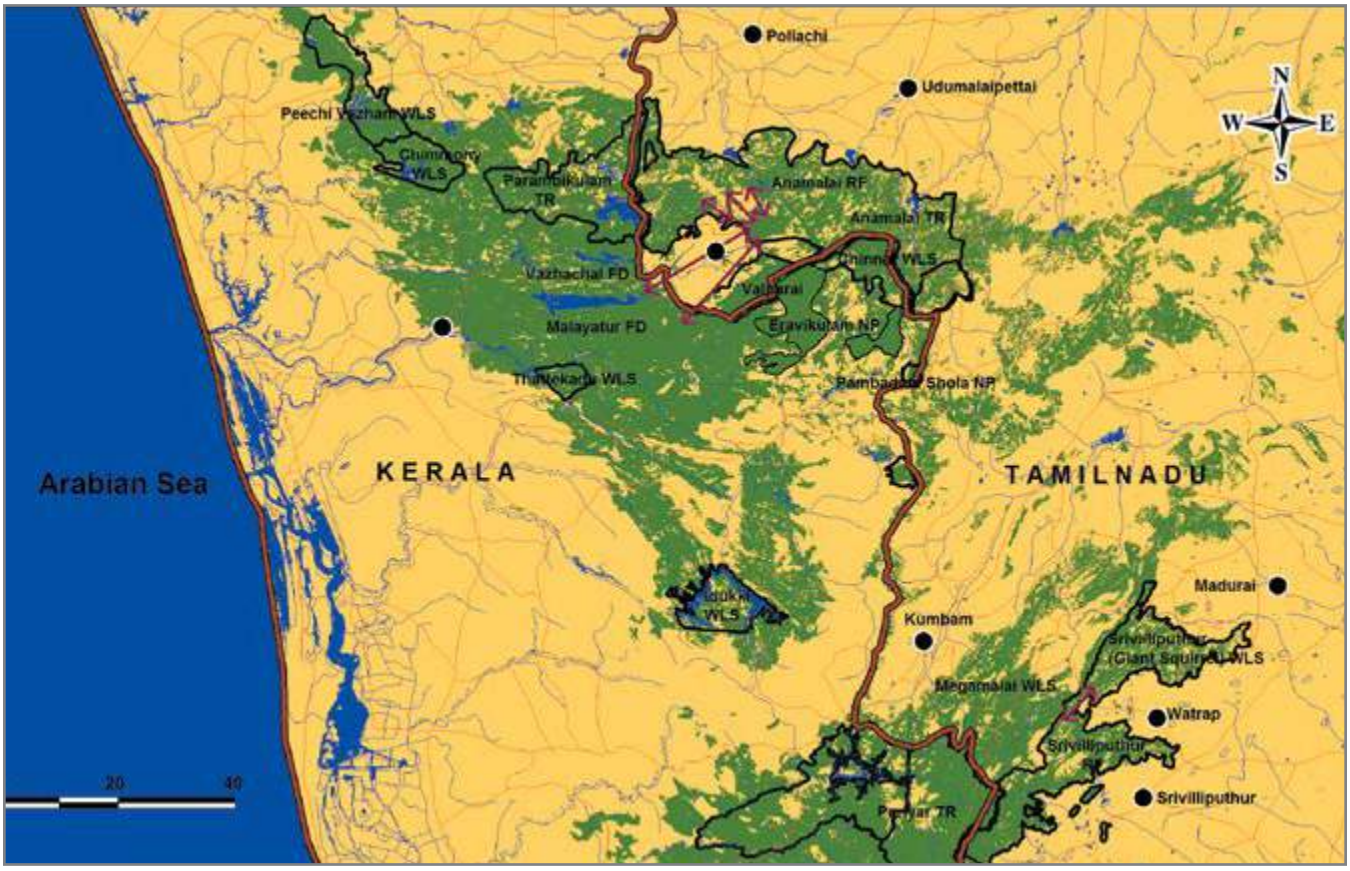
Elephant corridors in Southern India – Part I (a)



Elephant corridors in Southern India - Part I (b)



Elephant corridors in Southern India - Part 2



Elephant corridors in Southern India - Part 3



Fig. 8.01: Elephants at the Thirunelli - Kudrakote Corridor

8.01

KARADIKKAL - MADESHWARA

Ecological priority: Medium

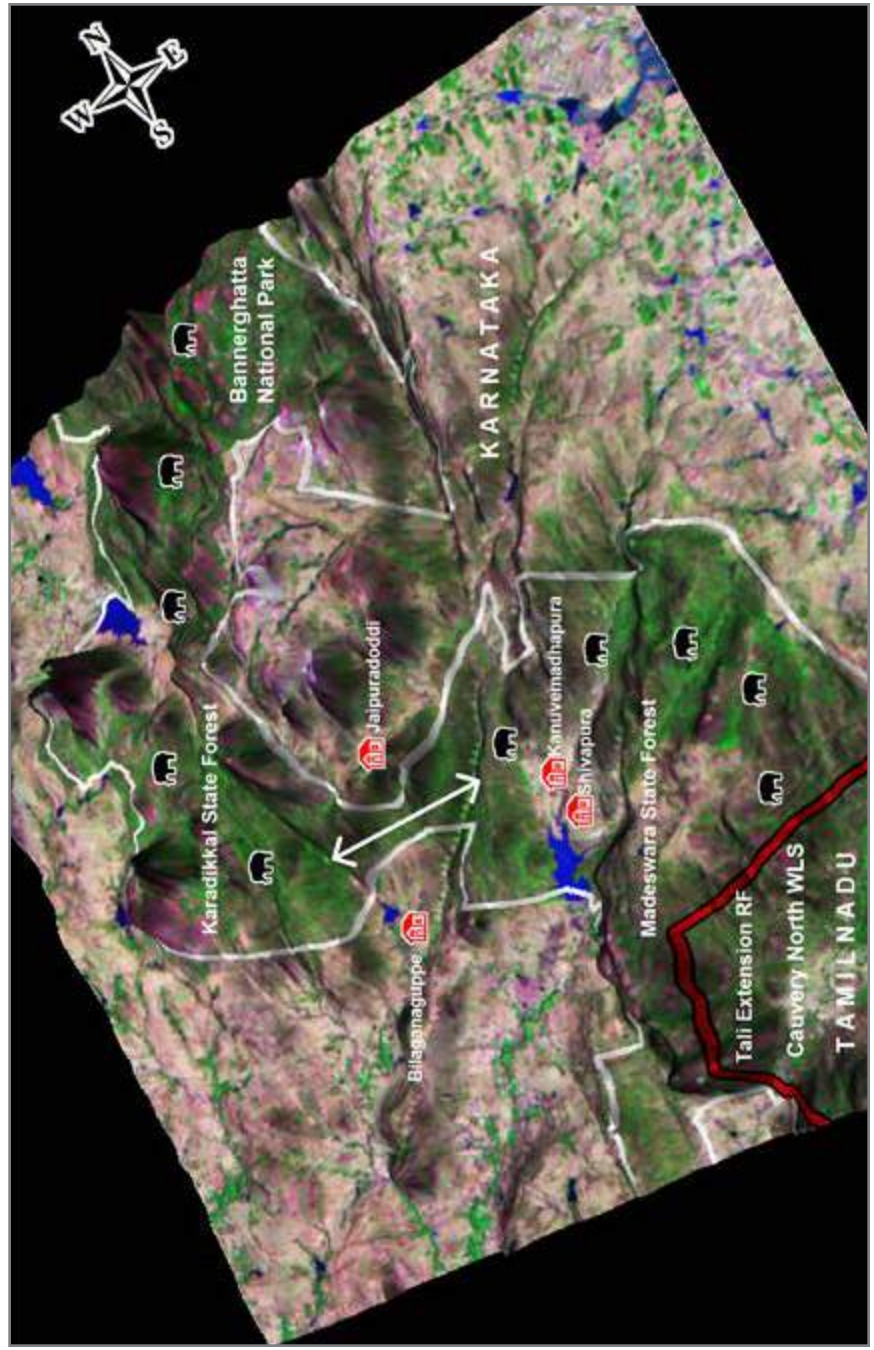
Conservation feasibility: High

This corridor connects Karadikkal State Forest and Madheshwara State Forest of Bannerghatta National Park, Karnataka. Elephants move from Bannerghatta to Hosur Forest Division in Tamil Nadu, further leading on to Cauvery Wildlife Sanctuary, Karnataka, through narrow forests between Jayapuradoddi and Bilaganaguppa settlements.

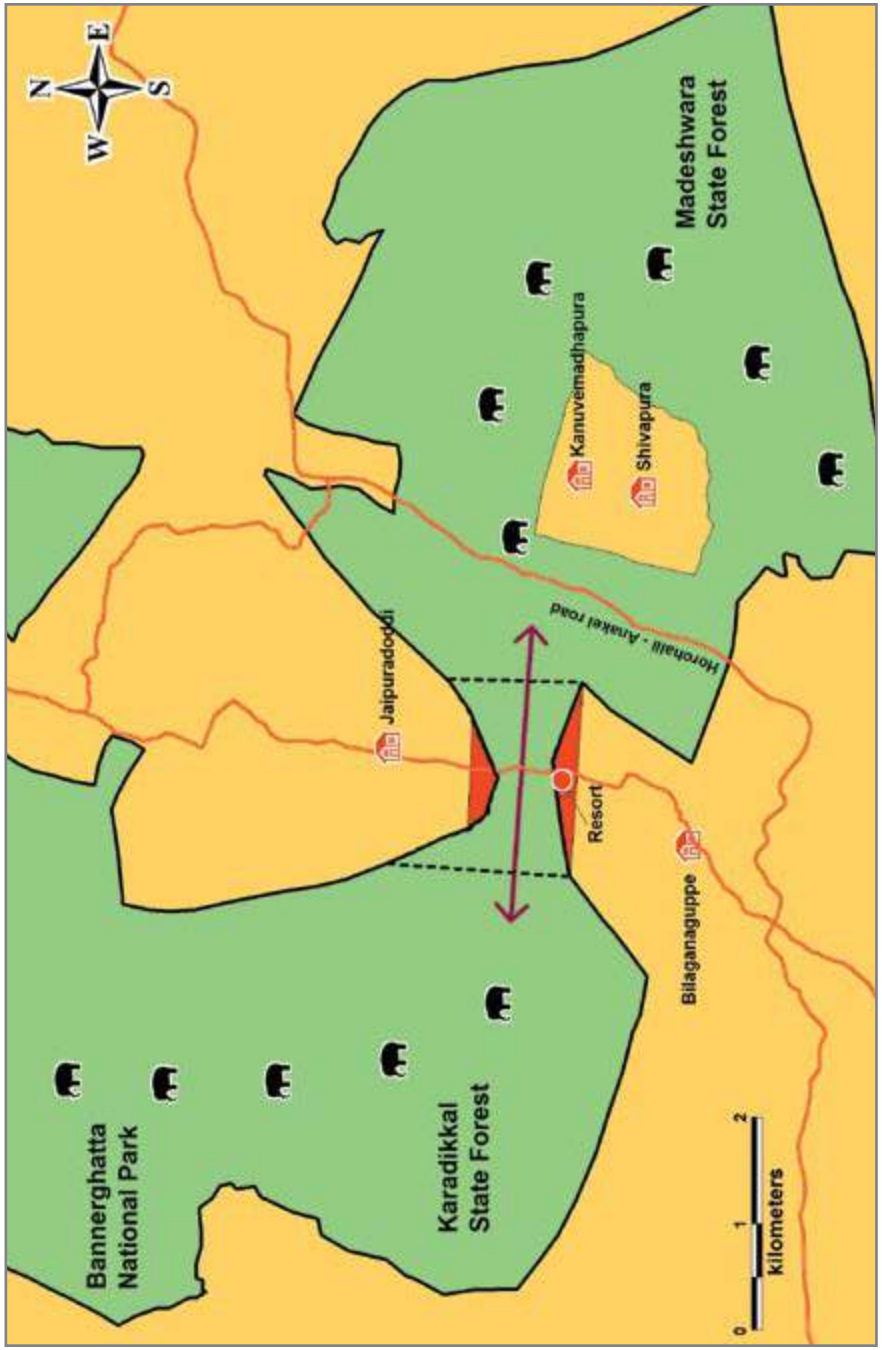
Alternate name	Ragihalli corridor
State	Karnataka
Connectivity	Karadikkal State Forest and Madheshwara State Forest of Bannerghatta National Park
Length and Width	1 km and 0.3-0.5 km
Geographical coordinates	12° 41′ 29″- 12° 42′ 30″ N 77° 33′ 46″- 77° 34′ 49″ E
Legal status	Reserve Forest
Major land use	Forest
Major habitation/settlements	Nil
Forest type	Tropical thorn and deciduous forests
Frequency of usage by elephants	Regular; both herds and bulls

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 24 tree species were recorded in the sampled area of 0.3 ha. Of these, 14 were elephant food species. A*cacia chundra, Anogeissus latifolia* and *Lagerstroemia parviflora* were the dominant species. Signs of lopping were recorded in seven tree species, of which five were elephant food species. The ground cover in 0.015 ha of corridor area was: grasses (35%), shrubs (25%), herbs (20%) and barren ground (20%).



3D map showing the landscape of the Karadikkal – Madeshwara Corridor



Map of the Karadikkal–Madeshwara corridor area showing the land to be secured

Estimated elephant numbers in the landscape

Bannerghatta National Park: 78 (77-89)
(*Synchronised Elephant Population Estimation, 2012*)

Forest/Land use

Forest type: Tropical thorn and deciduous
Road: Anekal-Harohalli State Highway
Buildings/Artefacts: Forest Checkpost near Jayapuradoddi

Other ecological importance

Mountain Range: Eastern Ghats
Elephant Range: Brahmagiri-Nilgiri-Eastern Ghats Landscape
Elephant Reserve: Mysore
Protected Area: Bannerghata National Park
IBA: Code. IN-KA-04, Criteria. A1, A2

HUMAN DIMENSIONS

Threats

1. Development activities inside the Bannerghatta National Park by private land owners at Kembadoddi, and stone quarries near the corridor area are threats to the free movement of elephants.

2. Resorts: Resorts being developed on the southern boundary of the corridor at Jayapuradoddi could encourage more resorts in this area in future, threatening the corridor and elephant movement.

3. A proposed housing colony to the south of the corridor could be a threat to the corridor.

4. Vehicle traffic: The Anekal-Harohalli State Highway and a mud road between Jayapuradoddi and Bilaganaguppa intersect the corridor in the middle. An average of 35 vehicles per hour ply on the state highway, with a peak of 72 vehicles per hour from 10 am to 4 pm and 30 vehicles per hour from 6 pm to 12 am. This is currently not a major threat to elephant movement.

5. Biotic pressure: Cattle grazing as well as fuelwood and fodder collection in the

corridor and nearby forest degrades the habitat. About 400-500 cattle from Kanuvemadhapura, 250-300 cattle from Jayapuradoddi and 70-80 cattle from Beliganaguppa villages graze in the corridor and nearby forest areas.

Corridor dependent villages: Kanuvemadhapura, Jayapuradoddi, Sivanahalli, Shivapura, Beliganaguppa and Urigendoddi.

The villages of Jayapuradoddi and Bilaganeguppa, and the Kanuvemdhapura settlement are situated near the corridor area. People from these villages depend on the corridor forest for fuelwood, fodder and cattle grazing.The Karnataka Forest Department has erected AC charged fencing and a rubble wall for Bilaganeguppa village. Elephant Proof Trenches (EPTs) have also been dug by the forest department in some places. AC charged fencing and rubble walls were also provided to Jayapuradoddi and Kanuvemadhapura villages, but most are non-functional due to a lack of maintenance and community participation. People presently use traditional methods of night guarding using *machans* (tree platforms) and firecrackers to drive elephants away.

Human-Elephant Conflict: The data on human deaths and injuries recorded for a period of eight years between 1997 and 2010 revealed that on average two people were killed and a similar number injured every year by wild elephants. Most of the human deaths had occurred on roads, or in crop fields while crops were being guarded at night.

On an average two elephants per year were also found to be killed due to human-elephant conflict in this area. The major cause of death was electrocution, resulting from the illegal power lines laid by farmers around their crop fields. The season in which migratory elephants arrive coincides with the peak cropping season, thus increasing encounters between humans and elephants. This results in the loss of crops as well as human lives, and the retaliatory killing of elephants.

CONSERVATION PLAN

1. The corridor should be notified by the state forest department and legally protected under an appropriate law to prevent encroachment and developmental activities detrimental to animal movement.

2. A total of about 87 acres of land belonging to private estates could be secured to increase the width of the corridor from 510 m to 1000 m. This could be a buffer zone to prevent developmental activities along the corridor fringes, as well as to prevent elephants from straying into Bilaganaguppa and Jayapuradoddi villages.

3. The villages of Kanuvemadhapura and Shivapura are also key for the conservation of the Karadikkal-Madeswara elephant corridor. These villages are situated just outside the bottleneck of the corridor, within the natural habitat. More than 75 families live in these villages and the total extent of the area is 570 acres. Almost all the inhabitants are ready to relocate due to severe human-elephant conflict. They have voluntarily expressed their interest to the forest department to move from their villages if suitable alternatives are available. In case if this is not possible, they should be provided with suitable eco-development assistance and livelihood support to reduce their dependence on the corridor forest.

4. The proposed housing colony near the southern end of the corridor needs to be prevented from coming up as it will further threaten the corridor.

6. Mining and stone quarries near the corridor need to be prohibited. Recently, stone quarries near corridor were sealed by the Mines and Geological Department at the request of the Karnataka Forest Department.

Land identified to secure the corridor

Village	Extent of area (acres)	Status of the land
Jayapuradoddi	35	Patta
		Patta
		Patta
		Patta
Bilaganaguppa	52	Patta

8.02
TALI - BILIKKAL

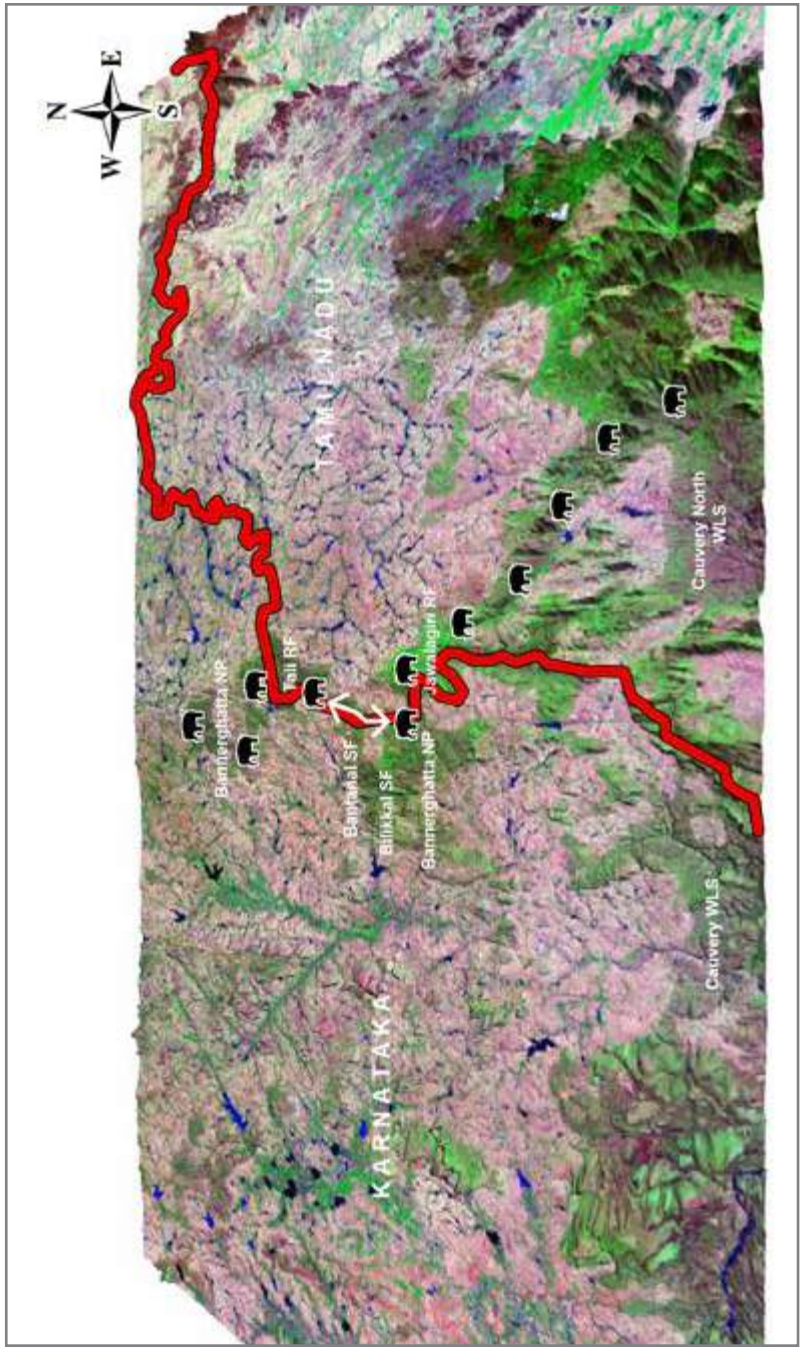
Ecological priority: High
Conservation feasibility: High

This corridor lies in the Jawalagiri Range of Cauvery North Wildlife Sanctuary (Hosur Forest Division), Tamil Nadu and Bannerghatta National Park, Karnataka. It connects the Tali Reserve Forest of the northern part of Cauvery North Wildlife Sanctuary with the Bilikkal State Forest of Bannerghatta National Park. Elephants from the northern part of Bannerghatta National Park move to Cauvery Wildlife Sanctuary, Karnataka through Cauvery North Wildlife Sanctuary, Tamil Nadu and private lands between Dodduru and Belalam villages. Although the corridor has connectivity on the Karnataka side, it is disconnected near Belalam village on one side of the state highway after Belalam village towards Marulvadi.

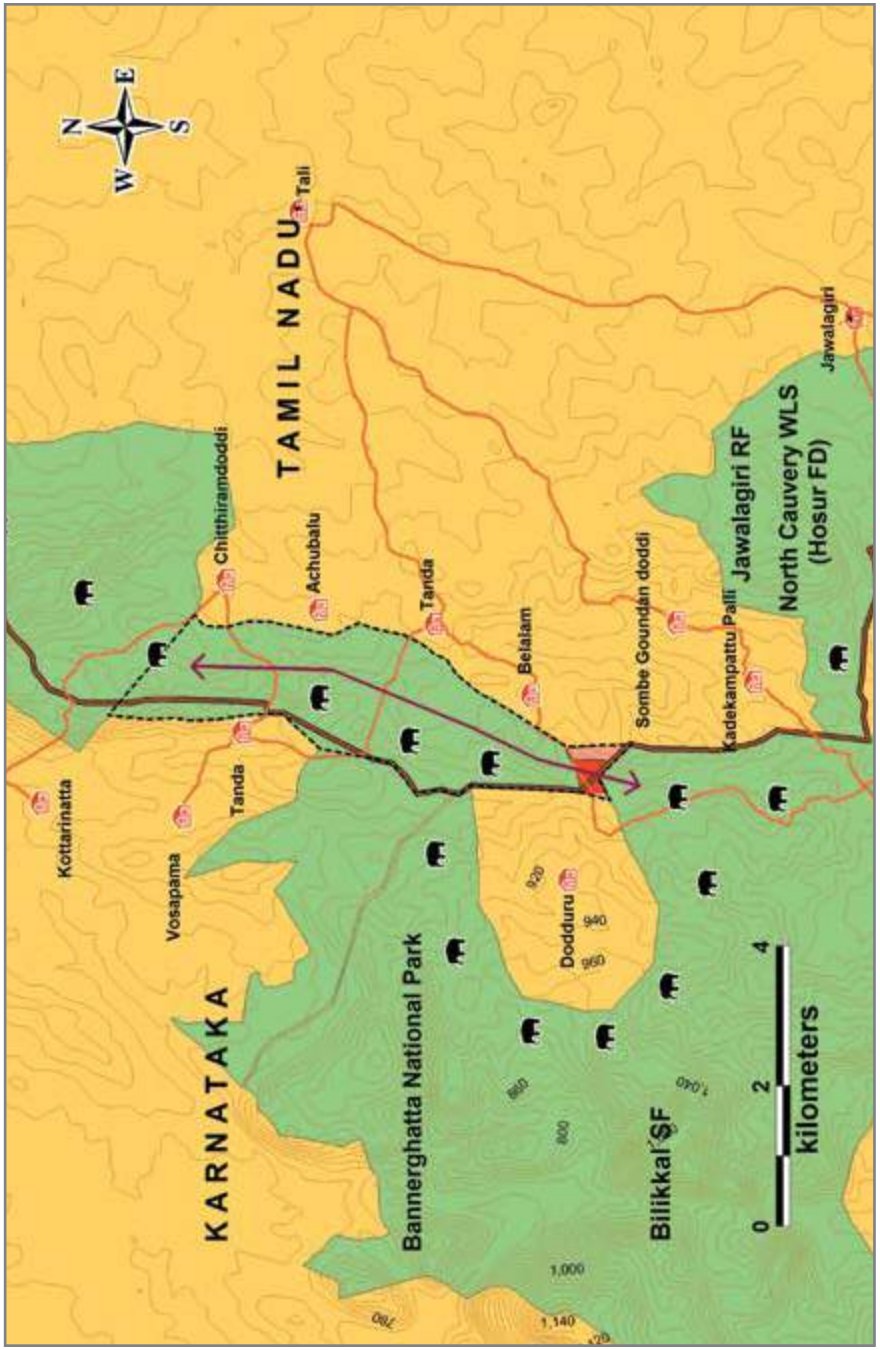
State	Tamil Nadu and Karnataka
Connectivity	Bannerghatta National Park to Cauvery North Wildlife Sanctuary (Hosur Forest Division)
Length and Width	2.2-2.5 km and 0-1.5 km
Geographical coordinates	12° 32′ 39″- 12° 36′ 41″ N 77° 34′ 50″- 77° 36′ 20″ E
Legal status	Private Land and Reserve Forest
Major land use	Settlements and forest
Major habitation/settlements	Chennangibayyailthoddi, Alappan-thoddi, Belalam and Dodduru
Forest type	Tropical deciduous and scrub forests
Frequency of usage by elephants	Regular

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 34 plant species were recorded in the sampled area. Of these, 22 species were found to be palatable to elephants.



3D map showing the landscape of the Tali-Bilikkal Corridor



Map of the Tali–Bilikkal Corridor area showing the land to be secured

Maximum average GBH was noticed in *Vitex altissima* (72.5 cm), followed by *Cochlospermum religiosum* (48.5 cm) and *Ficus benghalensis* (45 cm). Signs of lopping and wood cutting were seen on almost all tree species, especially elephant food species. Ground cover vegetation was dominated by shrubs (45%), grasses (30%), herbs (15%) and barren ground (10%).

Estimated elephant numbers in the landscape

Bannerghatta National Park: 78 (77-89)
Hosur Forest Division: 250-300
(*Synchronised Elephant Census, 2012*)

Forest/Land use

Forest type: Tropical deciduous and scrub forests
Revenue land: Encroached by local people
Human settlements: Belalam, Chatthiramdoddi, Alappandoddi, Channangibayilthodi, Munthimayanthoddi, Dodduru
Agricultural land
Buildings/Artefacts: Poultry farm, solar fence, Elephant Proof Trench (EPT)
Road: Tali-Marulvadi, Chatthiramdoddi-Kottarinatta, Chatthiramdoddi-Vosapama and Tanda-Vosapama

Other ecological importance

Mountain Range: Eastern Ghats
Elephant Range: Brahmagiri-Nilgiri-Eastern Ghats Landscape
Elephant Reserve: Mysore Elephant Reserve
Protected Area: Bannerghatta National Park

HUMAN DIMENSIONS

Threats

1. Settlements: Dodduru, Chennangibayyailthoddi, Alappanthoddi and Belalam settlements have severed the forest connectivity.

2. Encroachment: The Tamil Nadu part of the corridor is located in revenue

land that has been encroached upon by six families for many years. This encroachment has completely disconnected the corridor.

3. Biotic pressure: Cattle grazing is a severe threat affecting the quality of the corridor habitat, followed by wood cutting and fodder collection. Relentless felling of the recruitment classes of tree saplings has caused a remarkable depletion of tree density in the overall vegetation cover. Recruitment class trees are deemed suitable to make poles for edge fencing and for the construction of houses, and were found to be selectively removed by local people. Fuelwood is mostly collected by women.

Name of the village	**Cattle grazing (No. of cattle)**
Balagaari	250-300
Basuvanpura	75-150
Daverbetta	350-500
Chathiram doddi	300-450

4. Electric fence and Elephant Proof Trench: The Tamil Nadu Forest Department has erected an electric fence on the forest boundary of Jawalagiri Range and the Karnataka Forest Department has created Elephant Proof Trenches (EPTs) in the corridor areas, completely blocking elephant movement.

5. Traffic: The Tali-Marulvadi road bisects the elephant corridor near Belalam. Movement of heavy vehicles seems to be very low, with four-wheelers and two-wheelers mainly shuttling between Marulvadi and Tali throughout the day. An average of 20-25 vehicles per hour was observed during the study period. A higher number of six-wheelers was recorded between 6 am and 8 am.

Corridor Villages: Alappanthoddi and Channangibayilthoddi (Tamil Nadu); Munthimayanthoddi and Keriyanthoddi (Karnataka)

Corridor dependent villages: Balagarai, Thataparuur, Basuvanpura, Daverbetta, Bandedoddi, Thasarampalli, Bensekkaldoddi, Belalam, Sivanalidoddi, Lakshmipuram (Tamil Nadu), and Dodduru (Karnataka)

Human-Elephant Conflict: The cultivation of palatable crops in corridor fringe areas attracts elephants. Elephants are deliberately invading agriculture areas, mostly in December and January, as they prefer the taste and nutritional value of crops over wild plants.

Records of human deaths due to elephants and ex-gratia relief provided for crop damage between 2001 and 2013 in the Hosur Forest Division reveal that the division experienced severe human-elephant conflict. A total of 49 human deaths were reported within a period of 12 years. Eight human casualties were also reported between 2011 and 2015 in the jurisdiction area of Tali Forest Range.

CONSERVATION PLAN

1. The corridor should be notified by the state forest department and legally protected under an appropriate law to prevent encroachment and development activities detrimental to animal movement.

2. In consultation with the villagers and the revenue department, about 28 acres of revenue encroachment land (Survey Numbers 252 to 267), consisting of six houses and agriculture land in Channangibayilthoddi and Alappanthoddi villages (Tamil Nadu), and 11 acres of patta land consisting of a poultry farm (eight acres) and agriculture land (three acres) near Munthimayanthoddi village (Karnataka), are to be secured as Priority I to establish a corridor width of about 500 m. Another 39 acres adjoining these lands in Tamil Nadu and Karnataka could also be secured as Priority II to establish a width of about 700 m.

3. Villages are protected by Elephant Proof Trenches (EPTs) which severely hinder the free movement of elephants. These have to be strategically placed to prevent conflict while facilitating animal movement.

4. Vehicular traffic needs to be regulated in the mornings and evenings.

8.03
BILIKKAL - JAVALAGIRI

Ecological priority: High

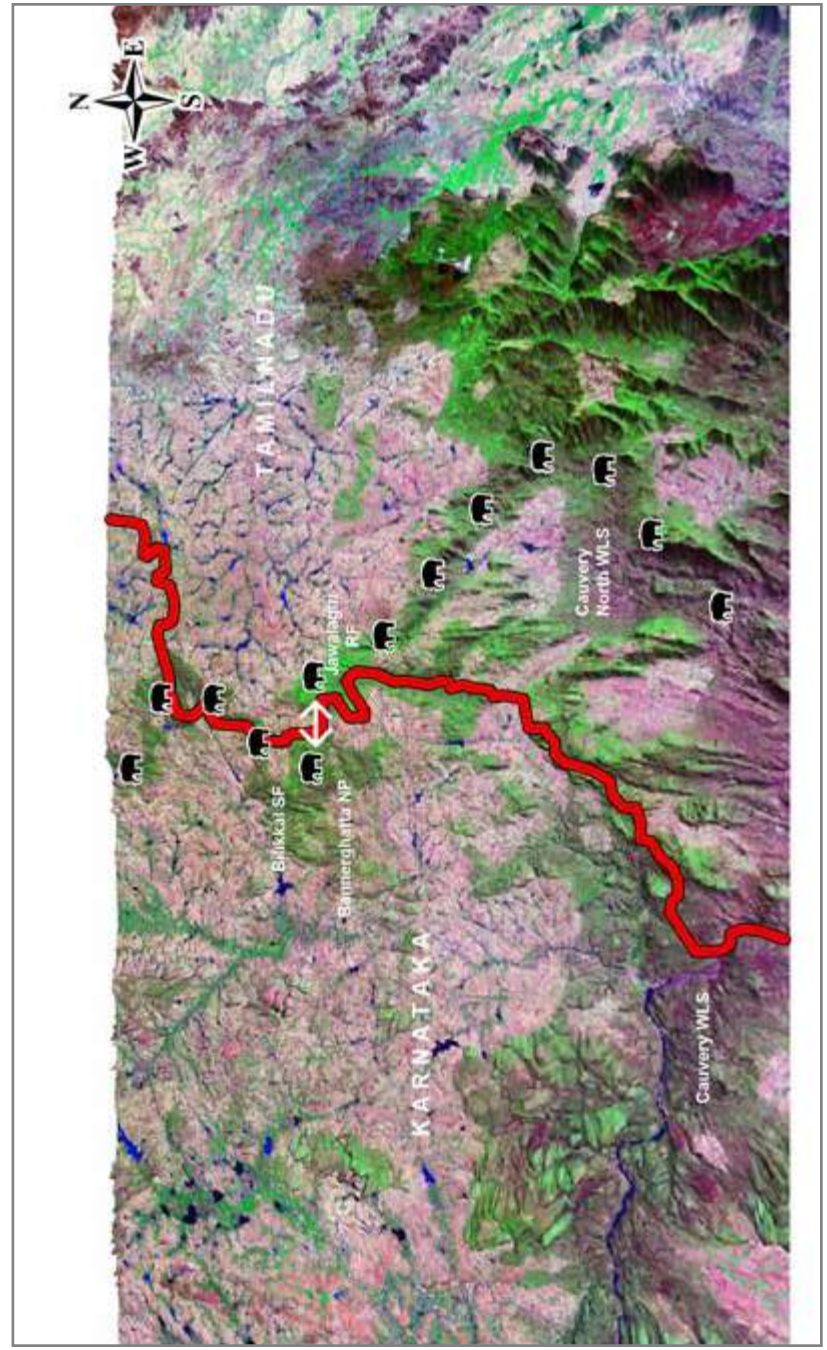
Conservation feasibility: High

This corridor connects Bilikkal State Forest of Bannerghatta National Park, Karnataka, with Javalagiri Reserve Forest of Cauvery North Wildlife Sanctuary (Hosur Forest Division), Tamil Nadu. Elephants move from Bannerghatta National Park to the southern portion of Hosur Forest Division through a narrow forest located on the interstate boundary of Tamil Nadu and Karnataka.

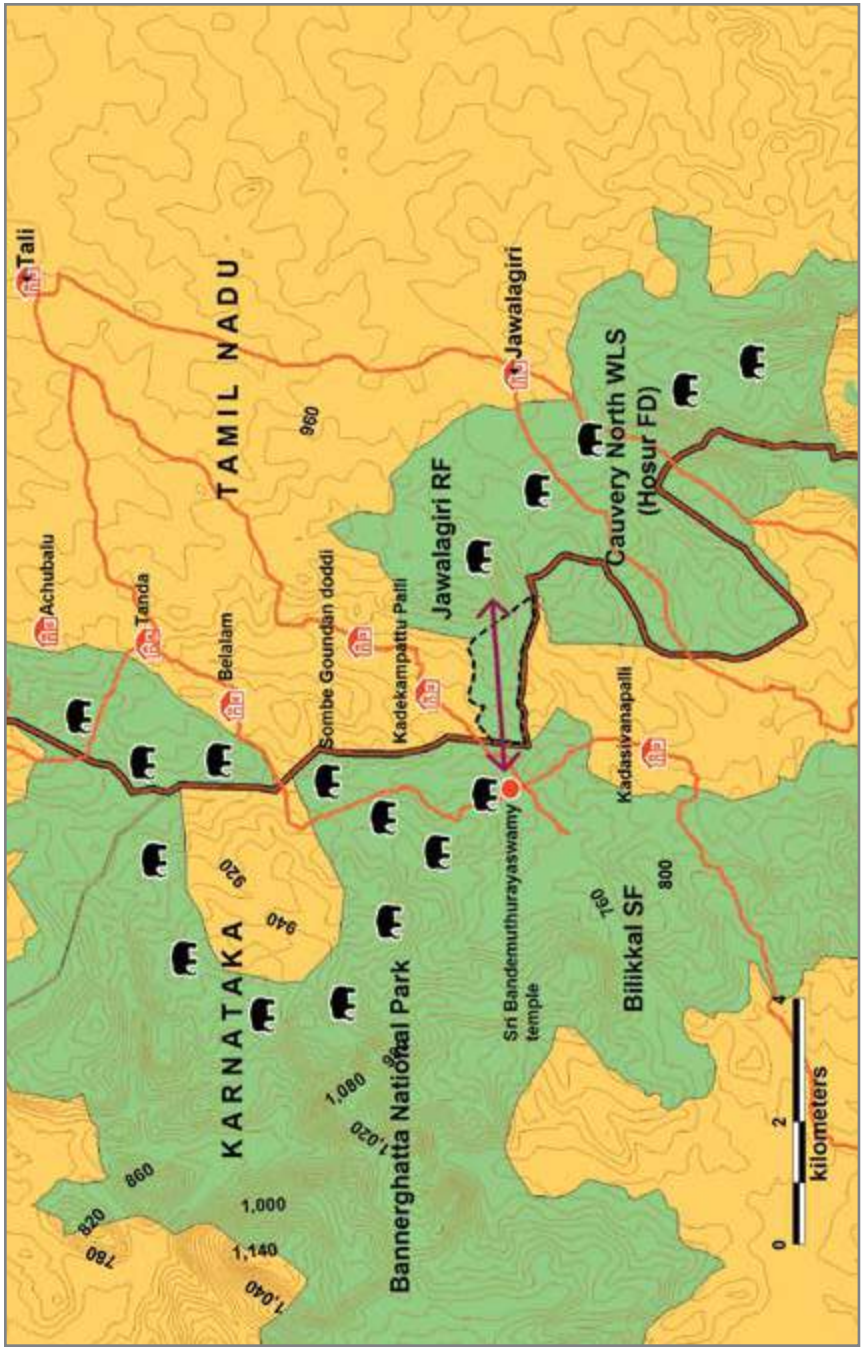
State	Tamil Nadu and Karnataka
Connectivity	Bannerghatta NP (Karnataka) with North Cauvery WLS (Tamil Nadu)
Length and Width	1.4 km and 0.47 km
Geographical coordinates	12° 30′ 45″- 12° 31′ 20″ N 77° 35′ 21″- 77° 36′ 42″ E
Legal status	Reserve Forest
Major land use	Forest and settlements
Major habitation/settlements	Nil
Forest type	Tropical thorn forest
Frequency of usage by elephants	Seasonal (October-April); small herds to more than 80 elephants together

FORESTS AND ELEPHANTS

Corridor habitat status: Bamboo patches and mixed dry deciduous vegetation are commonly found in this corridor. The tree cover is dominated by *Acacia sp*. The GBH of trees ranged from 20-210 cm. Ground cover was dominated by grasses (48%), shrubs (12%), herbs (15%) and barren ground (25%).



3D map showing the landscape of the Bilikkal – Javalagiri Corridor



Map of the Bilikkal – Javalagiri Corridor

Estimated elephant numbers in the landscape

Bannerghatta National Park: 78 (77-89)

Hosur Forest Division: 250-300

(*Synchronised Elephant Census, 2012*)

Forest/Land use

Forest type: Tropical thorn forest

Settlements: Malliandoddi and Gurusullapandoddi

Agricultural land: Millet, maize, plantain and vegetables

Road: Kadukembattupalli-Hunsanahalli

Elephant Proof Trench and solar fence

Other ecological importance

Mountain Range: Eastern Ghats

Elephant Range: Brahmagiri-Nilgiri-Eastern Ghats Landscape

Elephant Reserve: Mysore Elephant Reserve

Protected Area: North Cauvery Wildlife Sanctuary and Bannerghatta National Park

IBA: Code. IN-KA-04, Criteria. A1, A2

HUMAN DIMENSIONS

Threats

1. Settlements: Kadasivanapalli, Kadakampattupalli, Malliandoddi and Gurusullapandoddi villages are located on the corridor fringes and considerably reduce the width of the corridor.

2. Temple: The Sri Bandemuthurayaswamy Temple is located at the entrance of the corridor. Pilgrim activity during festivals exerts tremendous pressure on elephant movement and degrades the quality of the corridor forest.

3. Biotic pressure: Cattle grazing is a severe threat affecting the quality of the corridor habitat, followed by wood cutting and fodder collection.

Corridor dependent villages: Kadakampattupalli and Kadasivanapalli villages are located on the northern and southern sides of the corridor respectively. The combined population of these villages is about 250 families. People depend on the forest for cattle grazing and fuelwood collection. Malliandoddi (20-30 families) and Gurusullappandoddi (15-20 families) are other settlements near the corridor.

Human-Elephant Conflict: The cultivation of palatable crops in corridor fringe areas attracts elephants. Elephants are deliberately invading agriculture areas, mostly in December and January, as they prefer the taste and nutritional value of crops over wild plants.

Records of human deaths due to elephants and ex-gratia relief provided for crop damage between 2001 and 2013 in the Hosur Forest Division reveal that the division experienced severe human-elephant conflict. A total of 49 human deaths were reported within a period of 12 years. Eight human casualties were also reported between 2011 and 2015 in the jurisdiction area of Tali Forest Range.

CONSERVATION PLAN

1. The corridor should be notified by the state forest department and legally protected under an appropriate law to prevent encroachment and developmental activities detrimental to animal movement.

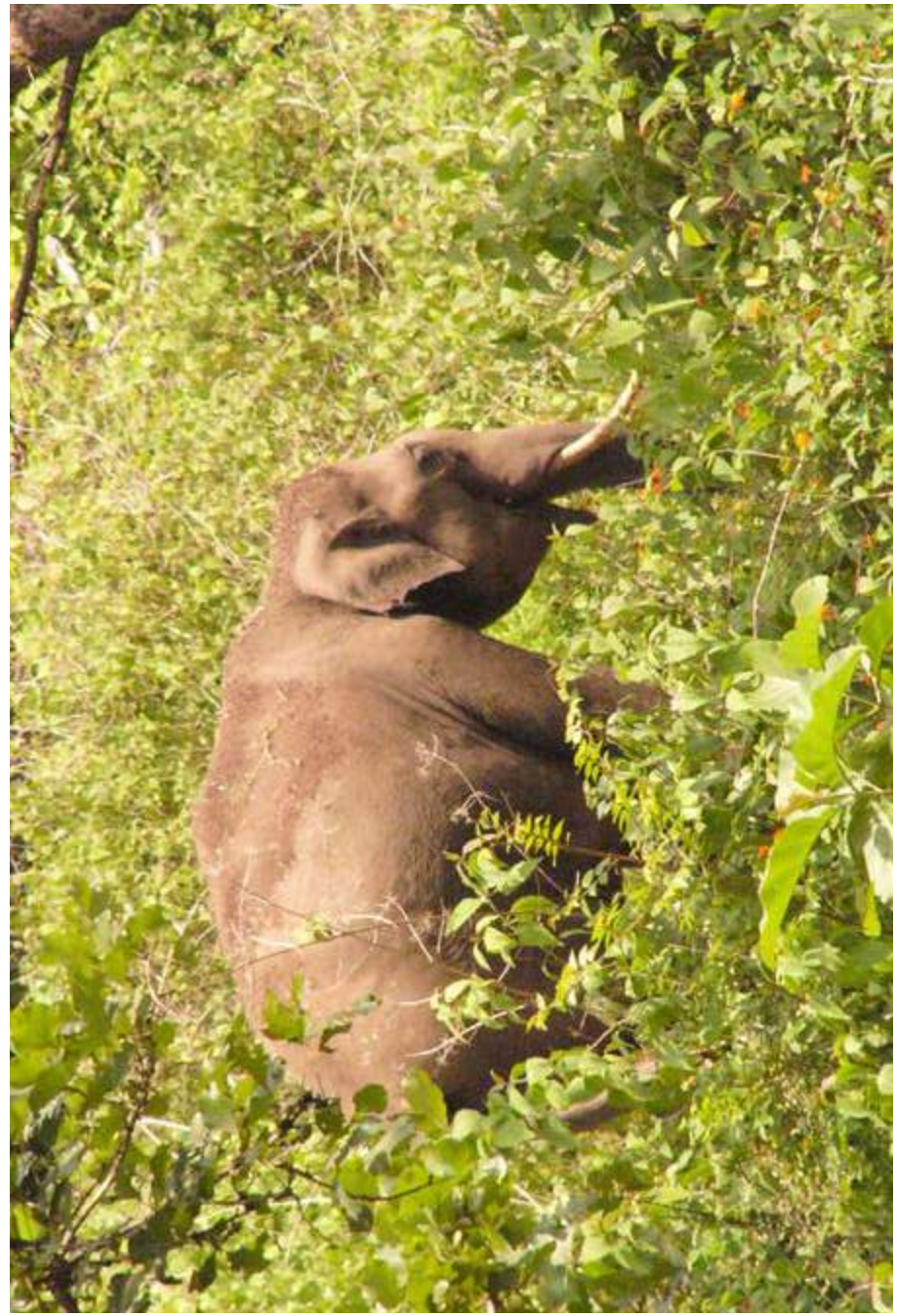


Fig. 8.02: A tusker in the Bilikkal – Javalagiri Corridor

8.04

EDAYARHALLI - GUTTIYALATTUR

Ecological priority: High

Conservation feasibility: High

This corridor connects elephant habitats within Malai Madeshwara Wildlife Sanctuary. Elephants from the Kollegal Forest Divison, Karnataka, move to Sathyamangalam Tiger Reserve, Tamil Nadu, through the bottleneck forest between Solakobe village and the Kallatibyalur tribal settlement of Malai Madeshwara Wildlife Sanctuary, Karnataka. The corridor is located very close to the inter-state boundary of Karnataka and Tamil Nadu.

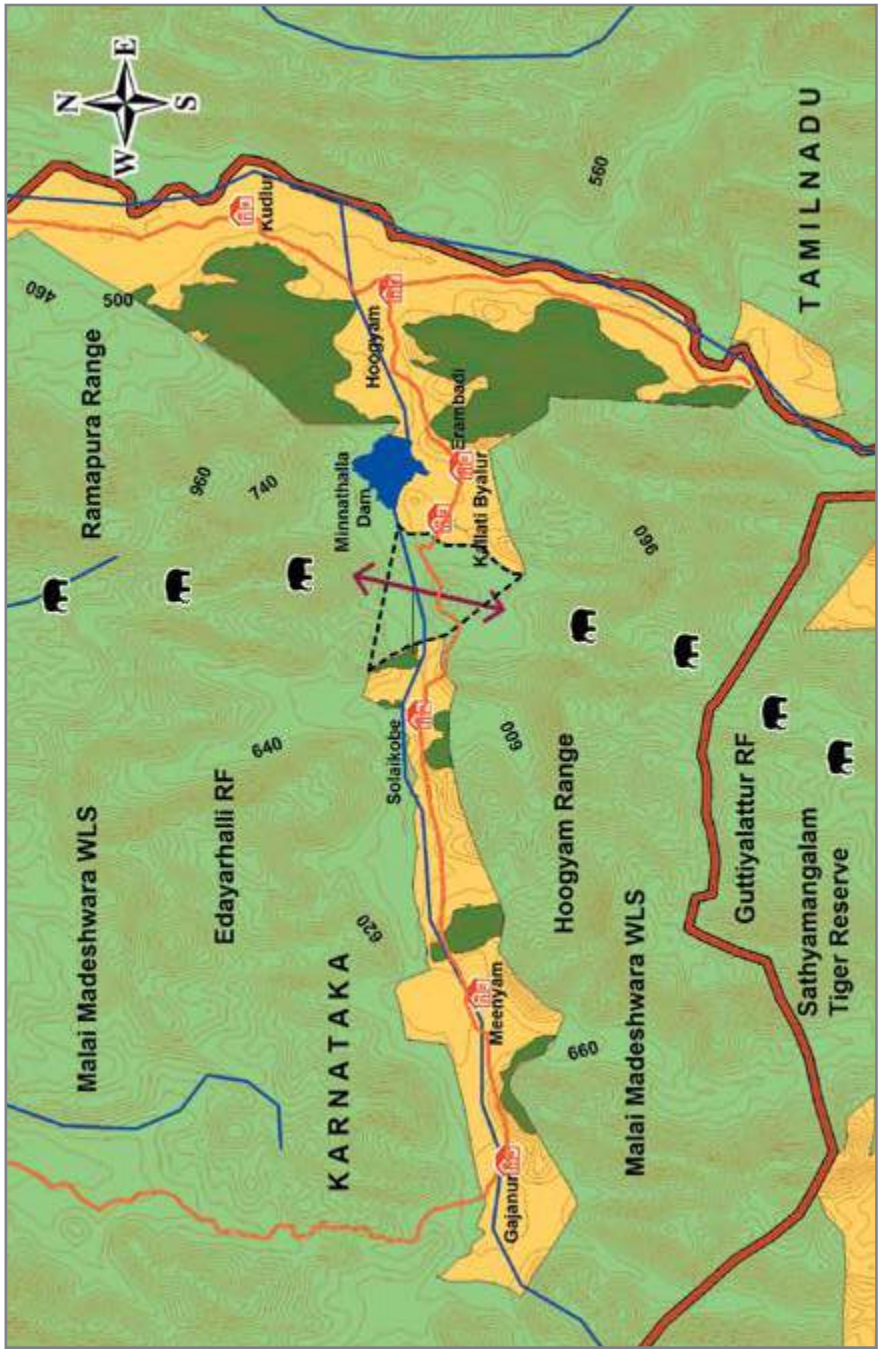
Alternate Name	Kallatibyalur
State	Karnataka
Connectivity	Malai Madeshwara Wildlife Sanctuary with Sathyamangalam Tiger Reserve
Length and Width	2 km and 1.4-2.1 km
Geographical coordinates	11° 48’ 38”- 11° 49’ 52” N 77° 23’ 60”- 77° 25’ 10” E
Legal status	Reserve Forest
Major land use	Forest
Major habitation/settlements	Erambadi tribal settlements and Solekobe group of villages
Forest type	Dry deciduous, mixed dry deciduous and shrub forests
Frequency of usage by elephants	Seasonal (May-July)

FORESTS AND ELEPHANTS

Corridor habitat status: A total of eight tree species were recorded in the sampled area within the corridor. *Swietenia sp, Terminalia catappa, Hardwickia binata and Tectona grandis* were the predominant species in this corridor.



3D map showing the landscape of the Edayarhalli – Guttiyalattur Corridor



Map of the Edayarhalli – Guttiyalattur Corridor

Bamboo patches are available in the valleys. Ground cover included grasses (25%), shrubs (10%), herbs (45%) and barren ground (20%).

Estimated elephant numbers in the landscape

Hoogyam Range of Malai Madeshwara Wildlife Sanctuary: 70-80 (*Synchronised Elephant Population Estimation, Karnataka, 2012*)

Forest/Land use

Forest Type: Dry deciduous, mixed dry deciduous and shrub

Road: Hoogyam-Minnayam-Ramapura

Other ecological importance

Mountain Range: Eastern Ghats

Elephant Range: Brahmagiri-Nilgiri-Eastern Ghats Landscape

Elephant Reserve: Mysore Elephant Reserve

Protected Area: Malai Madeshwara Wildlife Sanctuary

HUMAN DIMENSIONS

Threats:

1. Biotic pressure: Cattle grazing and fuelwood collection by people from corridor dependent villages has considerably reduced the quality of the corridor forest.

2. Encroachment: Encroachment by five families in Kallatibyalur has further reduced the width of the corridor.

Corridor dependent villages: Erambadi tribal settlements and Solekobe group of villages.

There is a group of tribal settlements and villages located on either side of the corridor: Kallatibyalur (five families), Erambadi (100 families) and Solekobe (100-125 families). They depend on the forest for cultivation, which is their primary livelihood, as well as for cattle grazing and fuelwood collection.

Human-Elephant conflict: No human deaths or cases of human injury caused by elephants have been reported for the past one decade in and around the corridor. Nor has there been any conflict-related elephant mortality. However, crop depredation by elephants is reported from the area.

CONSERVATION PLAN

1. The corridor should be notified by the state forest department and legally protected under an appropriate law to prevent encroachment and developmental activities detrimental to animal movement.

2. Encroachments in Kallatibyalur should be removed in consultation with settlers.



Fig. 8.03: A corridor dependent village

8.05

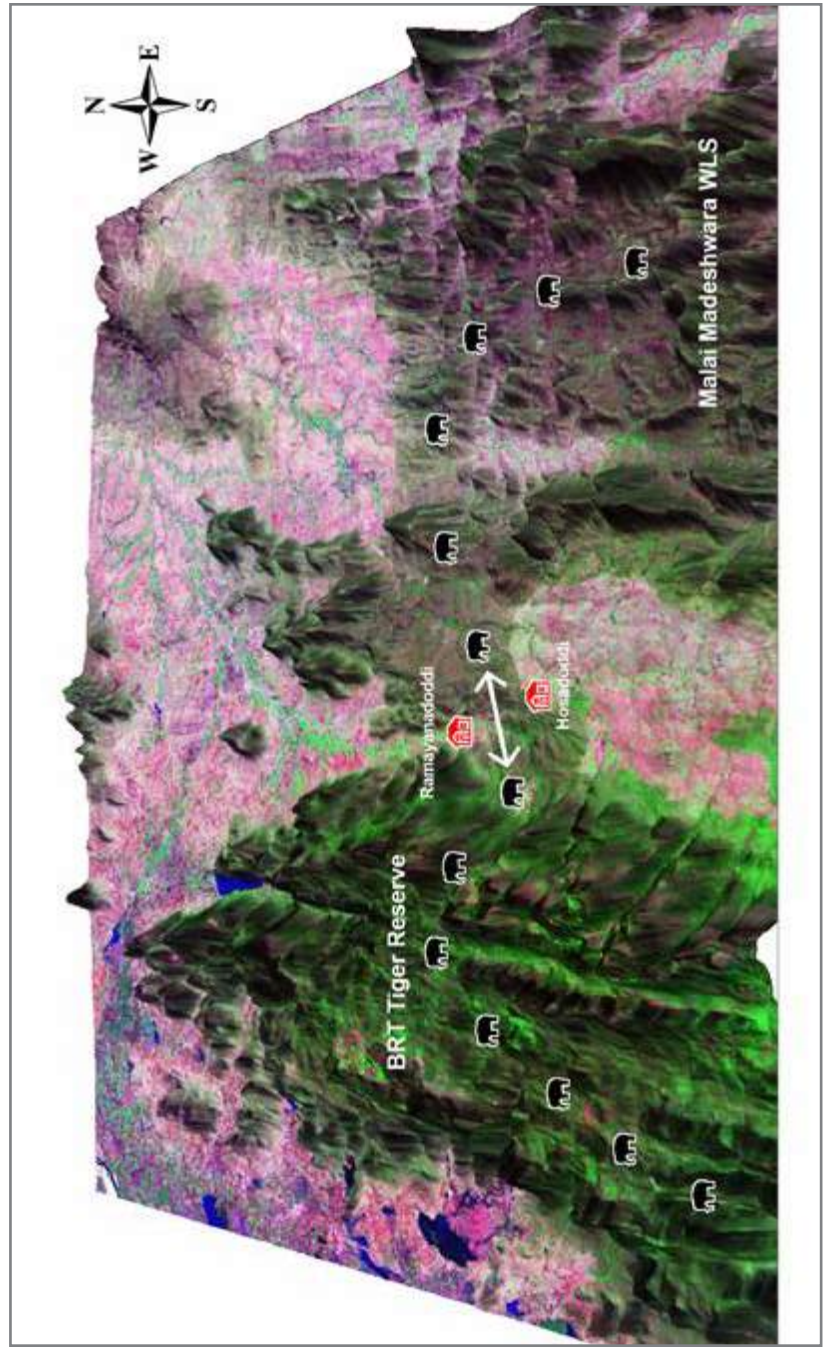
EDAYARHALLI - DODDASAMPIGE

Ecological priority: High

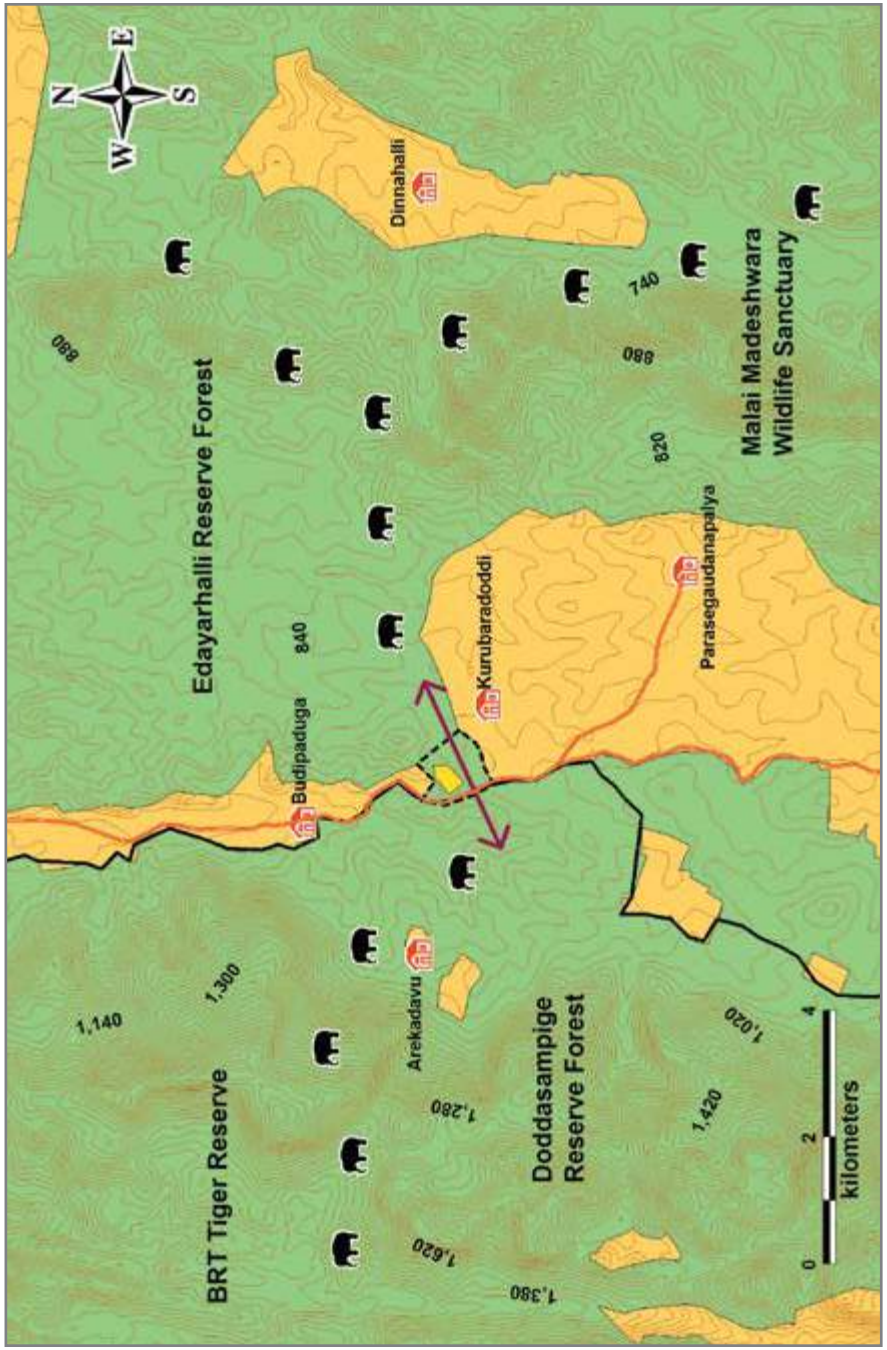
Conservation feasibility: High

This corridor connects Edayarhalli Reserve Forest of Malai Madeshwara Wildlife Sanctuary with Doddasampige Reserve Forest of Biligiri Rangaswamy Temple (BRT) Tiger Reserve.The elephant range to the east of the Biligirirangan Hills has been divided by a long strip of cultivated land, extending south from the town of Kollegal to the Tibetan settlement at Byloor for a total distance of 50 km. This strip had nearly cut off Doddasampige Reserve Forest from Edayarhalli Reserve Forest. In 2003, Wildlife Trust of India and the Asian Nature Conservation Foundation (ANCF) secured this corridor by purchasing 25.5 acres of land from Aandipalaya village located between the villages of Kurubaradoddi and Budipaduga along the Kollegal-Satyamangalam highway.

Alternate names	Bekkatur-Arabikere, Kollegal
State	Karnataka
Connectivity	BRT Tiger Reserve and Malai Madeshwara Wildlife Sanctuary
Length and Width	0.5 km and 2 km
Geographical coordinates	11° 55′ 12″- 11° 55′ 52″ N 77° 15′ 21″- 77° 16′ 1″ E
Legal status	Reserve Forest and part of BRT Wildlife Sanctuary
Major land use	Forest
Major habitation/settlements	Nil
Forest type	Tropical thorn and mixed deciduous
Frequency of usage by elephants	Regular



3D map showing the landscape of the Edayarhalli – Doddasampige Corridor



Map of the Edayarhalli– Doddasampige corridor showing the land secured by WTI and ANCF

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 48 tree species were recorded in the sampled area of 0.4 ha. Of these, 27 species (more than 50%) are palatable to elephants. The dominant plant species were *Chloroxylon swietenia, Acacia ferruginea and Randia malabarica*. More exotic plants, such as *Lantana camara*, *Doddonea viscosa* and *Flugea leucopyrus* were noticed in the regeneration class. A similar trend was noticed in the recruitment class.

Estimated elephant numbers in the landscape

BRT Tiger Reserve: 617 (335-976)
Malai Madeshwara Wildlife Sanctuary (Kollegal Forest Division): 278 (278-601)
(Synchronised Elephant Population Estimation, 2012)

Forest/Land use

Forest Type: Tropical thorn and mixed dry deciduous forest
Road: Kollegal-Sathyamangalam (State Highway 38)

Other ecological importance

Mountain Range: Eastern Ghats
Elephant Range: Brahmagiri-Nilgiri-Eastern Ghats Landscape
Elephant Reserve: Mysore Elephant Reserve
Protected Area: Biligiri Rangaswamy Temple (BRT) Tiger Reserve
IBA: Code. IN-KA-07, Criteria. A1, A2, A3

HUMAN DIMENSIONS

Threats

1. *Habitat quality* was very poor in the corridor forest. Exotic plants (*Lantana camara, Doddonea viscose, Flugea leucopyrus* etc) outnumbered endemic species in the regeneration and recruitment classes. Weed proliferation might further worsen the habitat quality in the near future and needs to be managed. Lopping of trees is also an important concern.

2. *Livestock pressure* on the corridor vegetation was found to be high, as evidenced by the occurrence of cattle dung as well as sheep and goat pellets.

Corridor dependent villages: Bekkatur, Arabikere, Hosadoddi, Kurubaradoddi, Budipaduga and Silaikattanadoddi

CONSERVATION PLAN

1. The corridor should be notified by the state forest department and legally protected under an appropriate law to prevent encroachment and developmental activities detrimental to animal movement.

2. Suitable eco-development activities need to be initiated in corridor fringe villages, especially to reduce fuelwood extraction and cattle grazing. Energy-efficient cook stoves could be provided to the villagers to minimise fuelwood extraction.

REMARKS

The agricultural land of Aandipalaya village in the corridor area had considerably reduced the width of the corridor. Realising the importance of this corridor, WTI and ANCF secured 25.5 acres of corridor land from 17 landowners in 2003. The secured land was later transferred to the Karnataka Forest department through a formal MoU in 2009, so that it could be maintained as an elephant corridor as well as incorporated as part of the Protected Area network. The secured land has recently been included as part of Malai Madeshwara Wildlife Sanctuary.



Fig. 8.04: A view of the land purchased to secure the Edayarhalli – Doddasampige Corridor

8.06

CHAMARAJANAGAR – TALAMALAI AT PUNJUR

Ecological priority: High

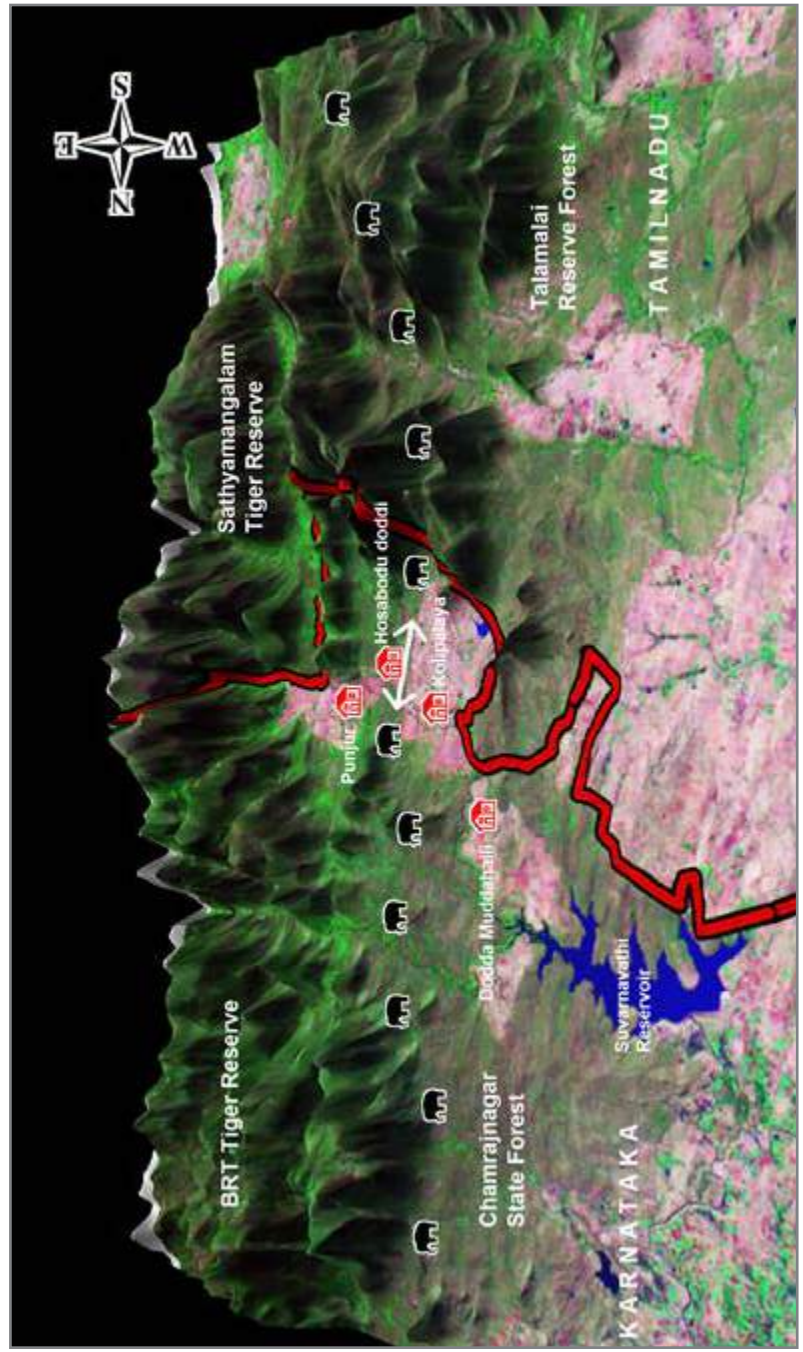
Conservation feasibility: Medium

Located at the inter-state boundary of Karnataka and Tamil Nadu, this corridor connects the K Gudi Range of Chamarajanagar Wildlife Division (BRT Tiger Reserve) with the Thalavadi Range of Sathyamangalam Tiger Reserve through the Punjur Range. Elephants from Sathyamangalam Tiger Reserve move to BRT Tiger Reserve through narrow forest patches and private lands between Hosaboddoddi, Srinivasapuram and Kolipalaya villages.

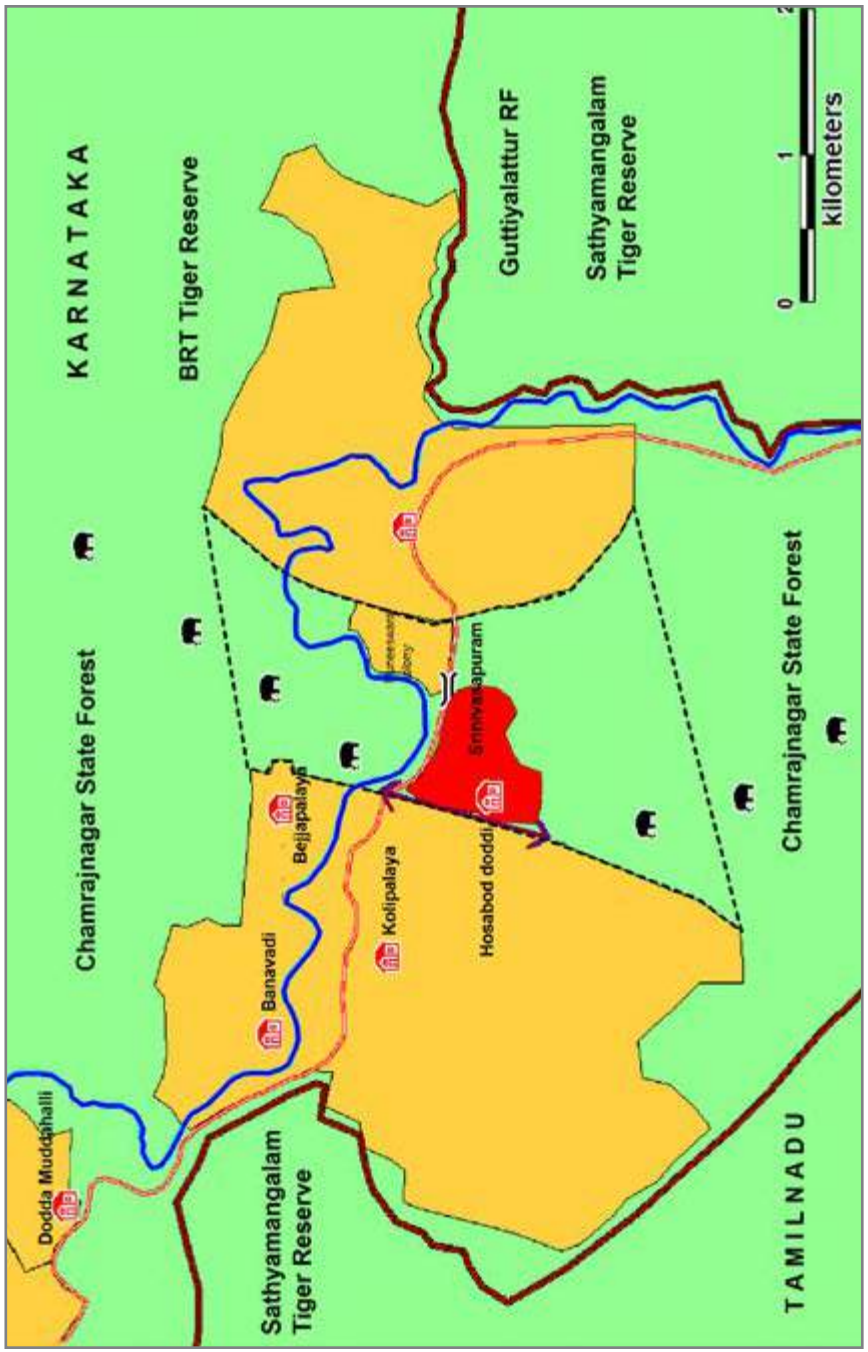
Alternate name	Punjur-Kolipalaya
State	Karnataka
Connectivity	BRT Tiger Reserve and Sathyamangalam Tiger Reserve
Length and Width	3.6 km – 4.05 km and 0.04-0.1 km
Geographical coordinates	11° 46’ - 11° 47’ N 77° 05’- 77° 06’ E
Legal status	Reserve Forest
Major land use	Forest, agriculture and settlements
Major habitation/settlements	Srinivasapuram, Hosaboddoddi, Muneeshwara Colony
Forest type	Tropical thorn and deciduous forest
Frequency of usage by elephants	Regular

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 29 plant species were recorded in the sampled area of 0.3 ha. Of these, 15 were elephant food species. *Erythroxylum monogynum*, *Chloroxylon swietenia* and *Ixora Pavetta* were the dominant tree species. It was



3D map showing the landscape of the Chamrajanagar – Talamalai at Punjur corridor



Map of Chamrajanagar – Talamalai at Punjur corridor area showing the land to be secured

quite interesting to note that *Eucalyptus sp* was extensively debarked by elephants in this corridor. The availability of other ecological resources also plays a major part in the regular use of this corridor by elephants, with bamboo patches and natural salt licks available in plenty.

The ground cover in 0.015 ha of the corridor area was grasses (60%), shrubs (22%), herbs (16%) and barren ground (2%). Although a considerable number of cattle grazed in and around the corridor area every day, the grass cover was not overly affected. The livestock grazing pressure was, however, evidenced from the low proportion of herbs and shrubs.

Estimated elephant numbers in the landscape

BRT Tiger Reserve: 617 (335-976)
Sathyamangalam Tiger Reserve: 877 (648-1174)
(*Synchronised Elephant Population Estimation, 2012*)

Forest/Land use

Forest type: Tropical thorn and deciduous forest
Settlements: Hosaboddoddi, Srinivasapuram and Muneeshwara Colony
Agricultural land
Road: National Highway 209 (Sathyamangalam-Mysore)

Other ecological importance

Mountain Range: Eastern ghats
Elephant Range: Brahmagiri-Nilgiri-Eastern Ghats Landscape
Elephant Reserve: Mysore Elephant Reserve
Protected Area: Sathyamangalam Tiger Reserve and BRT Tiger Reserve
Biosphere Reserve: Nilgiri Biosphere Reserve
IBA: Code. IN-KA-07, Criteria. A1, A2, A3

HUMAN DIMENSIONS

Threats

1. Human settlements: Hosaboddoddi, Srinivasapuram and Muneeshwara Colony located inside the corridor have severely hindered the movement of elephants and other wild animals.

2. Traffic on NH 209: A vehicular traffic survey conducted on this stretch in 2015 showed about 116.8 vehicles per hour, with almost 2800 to 3000 vehicles plying every day. This is an increase of about 30% compared to traffic volume on the same stretch in 2010. The movement of six-wheel vehicles was high compared to four- and two-wheel vehicles. Peak movement of six-wheelers carrying agricultural produce to Sathyamangalam and other places was between 8 pm and 4 am (coinciding with the peak of wildlife movement), and between 12 noon and 4 pm. Most four-wheelers plied between 6 am and 12 noon, and two-wheelers between 8 am and 5 pm. Vehicular traffic was seen to increase drastically during the Kundam festival (March-April) at Bannari Amman Temple.

3. Roadside hotels are located about 300 metres from the Punjur Forest Checkpost. Elephants generally cross the highway during the night hours. The movement of vehicles as well as people affects elephant movement. Food waste thrown out can attract also animals including elephants.

Corridor villages: There are three tribal settlements (Hosaboddoddi: 39 families; Srinivasapuram: 47 families and Muneeshwara Colony: 63 families) located in the corridor. More than 86% of the inhabitants are farmers with agriculture as their primary source of income. Although no irrigation facilities are available, they depend on rain-fed agriculture and undertake cultivation for six months in a year.

The education status indicates that more than 50% of the population here has no formal education or is illiterate, and about 25% has primary education.

Corridor dependent villages: Hosaboddoddi, Banavadi, Srinivasapuram, Edthe Gouda Doddi, Muneeshwara Colony, Bejipalya and Punjur

Human-Elephant Conflict: Conflict is reasonably high in the region. Records from 2003 to 2015 of the frequency of elephant deaths due to electrocution, as well as ex-gratia relief paid for crop damage by elephants, reveal an increasing trend of human-elephant conflict from the year 2006 onwards.

Land use has changed drastically along the corridor and in fringe areas over the last two decades. Tribal settlements have been converted into civil constructions and barren lands converted into agricultural lands, with the result that the corridor width has shrunk from 1000 metres to less than 100 metres. This has forced elephants to venture into adjacent agricultural lands and human habitations, resulting in increased crop depredation and economic losses to the farmers.

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent encroachment and developmental activities detrimental to animal movement.

2. In consultation with villagers, about 126 acres of the corridor land belonging to 86 families in the Hosaboddoddi and Srinivasapuram settlements needs to be secured on a priority basis. To further strengthen the corridor, efforts should be made to secure land from Muneeshwara Colony in the second stage, following due consultations with the local community.

3. No construction should be allowed on either side of NH 209 in the area passing through the corridor.

4. Vehicular speeds on the NH 209 stretch that passes through the corridor should be regulated with speed breakers. A flyover could be also constructed for vehicular movement on this stretch of the highway.

8.07

CHAMARAJANAGAR – TALAMALAI AT MUDDAHALLI

Ecological priority: High

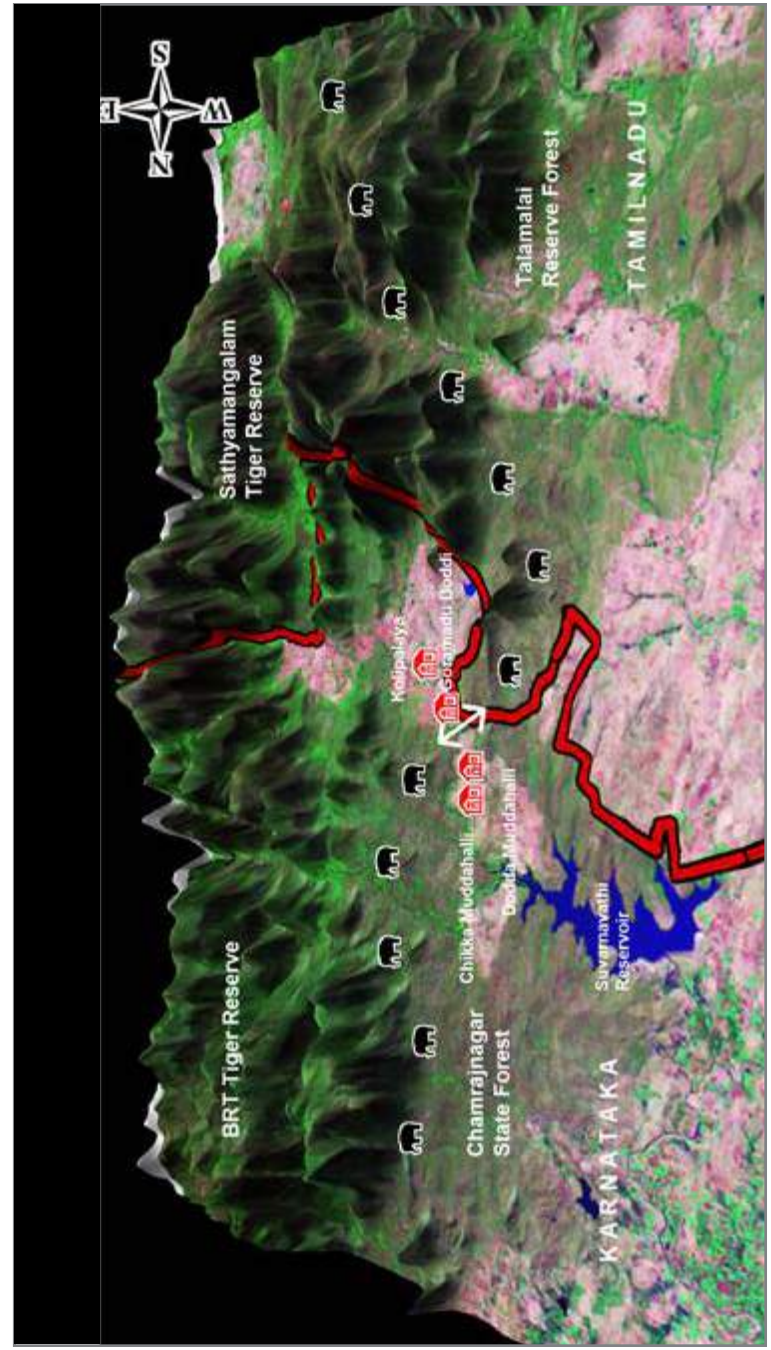
Conservation feasibility: High

This corridor connects the Punjur Range of Chamarajanagar Wildlife Division (BRT Tiger Reserve) with the Thalavadi Range of Sathyamangalam Tiger Reserve and is located at the inter-state boundary of Karnataka and Tamil Nadu. Elephants from Sathyamangalam Tiger Reserve move to BRT Tiger Reserve through narrow forest patches and private lands between Goramadu Doddi and Dodda Muddahalli villages. The corridor is regularly used by elephants, tigers and other wild animals.

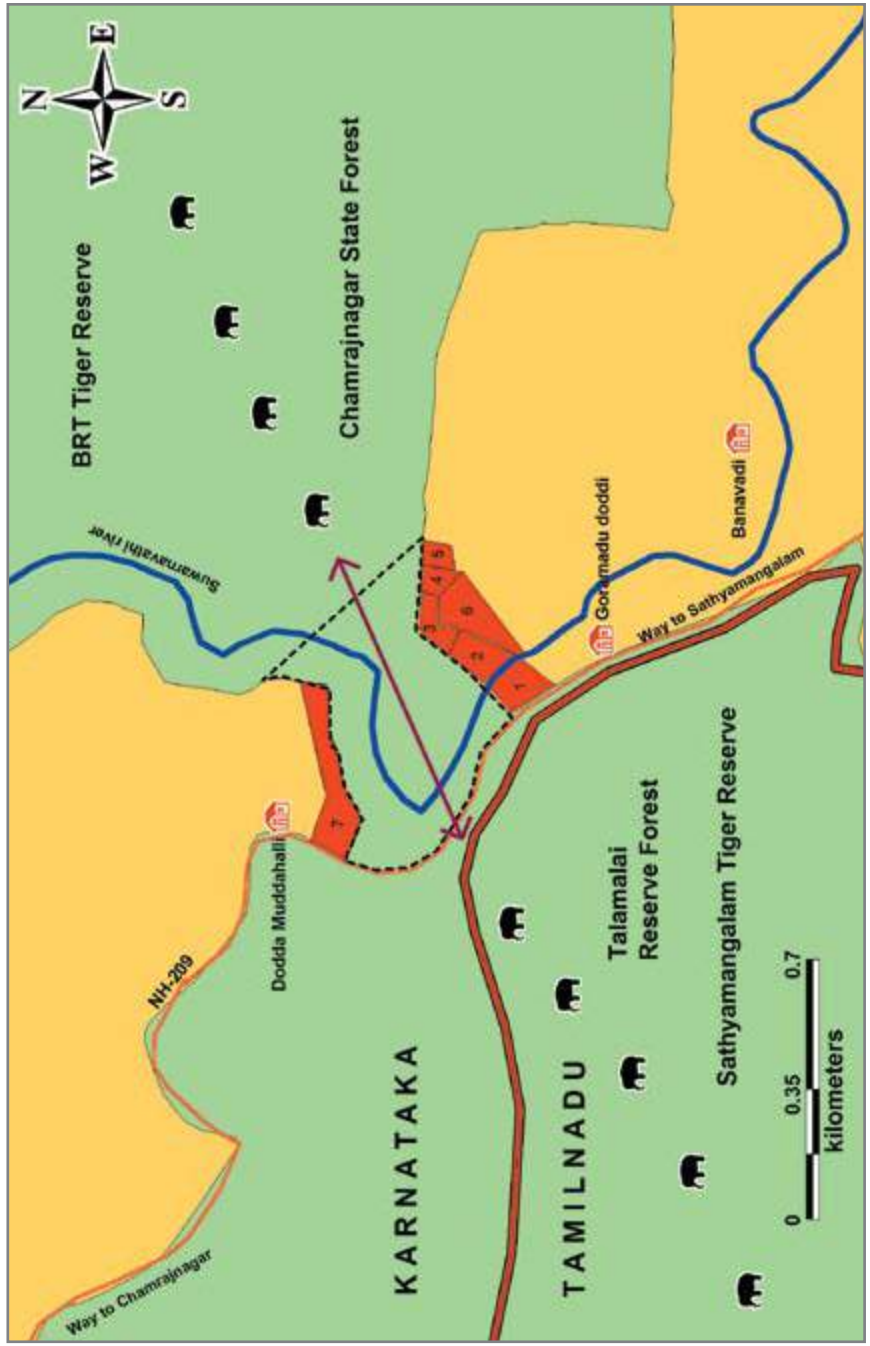
Alternate name	Thalavadi-Muddahalli
State	Karnataka and Tamil Nadu
Connectivity	BRT Tiger Reserve and SathyamangalamTiger Reserve
Length and Width	1.5 km and 0.5 km
Geographical coordinates	11° 47′ 12″- 11° 47′ 37″ N 77° 3′ 50″- 77° 4′ 20″ E
Legal status	Reserve forest
Major land use	Forest and settlements
Major habitation/settlements	Goramadu Doddi, Dodda Muddahalli
Forest type	Tropical deciduous and thorn forest
Frequency of usage by elephants	Regular

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 35 tree species were recorded in the sampled area of 0.3 ha. Of these, 25 species are palatable to elephants. Maximum average



3D map showing the landscape of the Chamrajanagar – Talamalai at Muddahalli Corridor



Map of the Chamrajanagar – Talamalai at Muddahalli Corridor showing the land to be secured

GBH was noticed in *Eucalyptus sp* (84.5 cm), followed by *Ficus benghalensis* (53.5 cm) and *Butea monosperma* (51.0 cm). Signs of lopping and wood cutting were seen on all trees, especially elephant food species like *Acorus calamus, Erythroxylon monogynum, Ixora pavetta, Decalepis hamiltonii* and *Somida fabrifuga*. Ground cover vegetation in 0.015 ha of sampled corridor area consisted of grasses (50%), shrubs (20%), herbs (15%) and barren ground (15%) .

Estimated elephant numbers in the landscape

BRT Tiger Reserve: 617 (335-976)
Sathyamangalam Tiger Reserve: 877 (648-1174)
(*Synchronised Elephant Population Estimation, 2012*)

Forest/Land use

Settlements: Goramadu Doddi, Dodda Muddahalli
Agriculture: Ginger, banana, maize and beans
Road: National Highway 209 (Sathyamangalam-Mysore)

Other ecological importance

Mountain Range: Eastern Ghats
Elephant Range: Brahmagiri-Nilgiri-Eastern Ghats Landscape
Elephant Reserve: Mysore Elephant Reserve
Protected Area: SathyamangalamTiger Reserve and BRT Tiger Reserve
Biosphere Reserve: Nilgiri Bioshpere Reserve
IBA: Code. IN-KA-07, Criteria. A1, A2, A3

HUMAN DIMENSIONS

Threats

1. Settlements: Expansion of villages such as Dodda Muddahalli, Goramadu Doddi and Mookanpalya along the corridor fringes has decreased the width of the corridor.

2. Traffic on NH 209: A vehicular traffic survey conducted on this stretch in 2015 showed about 116.8 vehicles per hour, with almost 2800 to 3000 vehicles plying every day. This is an increase of about 30% compared to traffic volume on the same stretch in 2010. The movement of six-wheel vehicles was high compared to four- and two-wheel vehicles. Peak movement of six-wheelers carrying agricultural produce to Sathyamangalam and other places was between 8 pm and 4 am (coinciding with the peak of wildlife movement), and between 12 noon and 4 pm. Most four-wheelers plied between 6 am and 12 noon, and two-wheelers between 8 am and 5 pm. Vehicular traffic was seen to increase drastically during the Kundam festival (March-April) at Bannari Amman Temple.

Corridor dependent villages: Dodda Muddahalli (97 families) Boodhipaduga, Chiku Muddahalli, Kumbaragundi, Goramadu Doddi (39 families), Mookanpalya.

Since the corridor is very close to Goramadu Doddi and Dodda Muddahalli, most of the villagers' needs are being met from the corridor areas. People are dependent on the forest for fuelwood and NTFP collection, and preparation of agricultural products.

Almost 50% of the families here depend on agriculture for sustenance. More than 50% of the people are illiterate or have no formal education.

Human-Elephant Conflict: Incidents of crop depredation by elephants and of elephant deaths due to electrocution indicate that human-elephant conflict has been on the rise since 2006. Human-carnivore conflict is also a major concern. About 158 livestock deaths were reported between February 2009 and May 2011 in and around Sathyamangalam Tiger Reserve (*Satheesh et al., 2011*); 36 livestock deaths were reported from BRT Tiger Reserve during the same period.

The perception of villagers living on the corridor fringes is that human-elephant conflict is high (67.5%). Most of them felt that the intensity of conflict has increased over the years (80%) and occurs throughout the year (67%). This area is known for the high influx of elephants during the dry season, mainly because of the perennial Suwarnavathi reservoir which is near the corridor.

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent encroachment and developmental activities detrimental to animal movement.

2. In consultation with villagers, 27.39 acres of land belonging to six families from Goramadu Doddi, and 10 acres of forest leased land from the Muddahalli Joint Farming Cooperative Society, should be secured as a priority to increase the width of the corridor.

3. No construction should be allowed on either side of the national highway passing through the corridor.

4. In consultation with the National Highway Authority of India, speed breakers should be created on the stretch passing through the corridor to minimise vehicular speeds and facilitate elephant movement.

Land identified to secure the corridor

S.No	Village	Extent of area (acres)	Land status
1	Goramadu Doddi	3.25	Wet Land
2	Goramadu Doddi		Wet Land
3	Goramadu Doddi	3.12	Wet Land

4	Goramadu Doddi	4.38	Wet Land
5	Goramadu Doddi	6.64	Wet Land
6	Goramadu Doddi	10.0	Wet Land
7	Muddahalli	10.0	Dry Land
	Total	**37.39**	



Fig. 8.05: A view of the Chamrajanagar- Talamalai at Muddahalli corridor



Fig. 8.06: Elephants moving through the Chamarajanagar – Talamalai at Muddahalli Corridor

8.08

TALAMALAI - GUTTIYALATTUR

Ecological priority: High

Conservation feasibility: High

This corridor connects elephant habitats between Guttiyalattur Reserve Forest and Talamalai Reserve Forest of Sathyamangalam Tiger Reserve. Elephants from Sathyamangalam Tiger Reserve move to the Coimbatore Forest Division through Nilgiri North Division between Bannari, Karachikorai, Pudubirkadavu, Pungar, Patramangalam, Sujalkuttai and Rajan Nagar villages.

Alternate name	Sujalkuttai- Bannari
State	Tamil Nadu
Connectivity	Moyar Valley and Nilgiri Eastern Slope RF with Guttiyalattur RF and vice-versa
Length and Width	3 km and 0.3-0.55 km
Geographical coordinates	11° 30′ 31″- 11° 33′ 37″ N 77° 5′ 46″- 77° 8′ 26″ E
Legal status	Reserve Forest
Major land use	Forest, settlements and fallow lands
Major habitation/settlements	Pudubirkadavu and Patramangalam
Forest type	Tropical thorn and deciduous forest
Frequency of usage by elephants	Regular (mostly October to December)

FORESTS AND ELEPHANTS

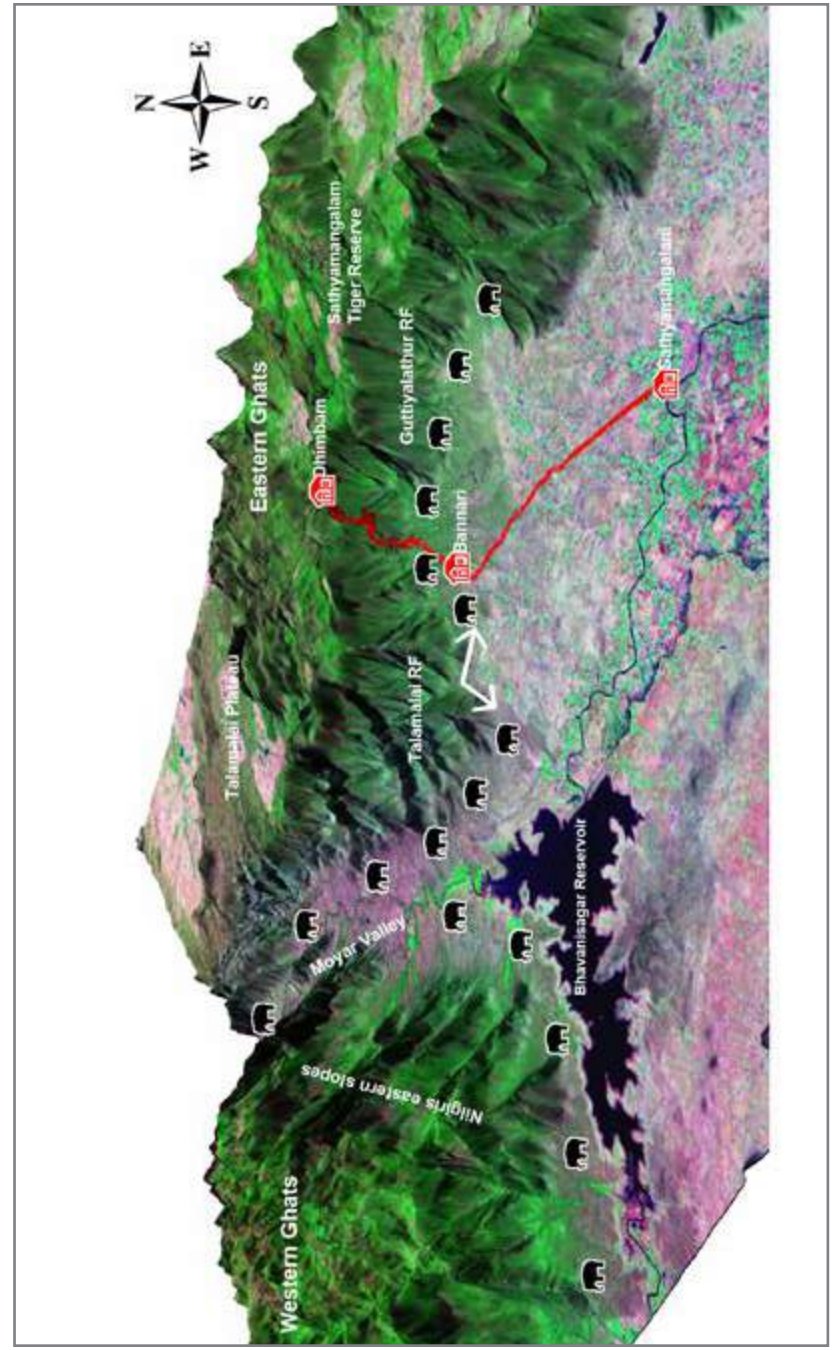
Estimated elephant numbers in the landscape

Sathyamangalam Tiger Reserve: 877 (648-1174)

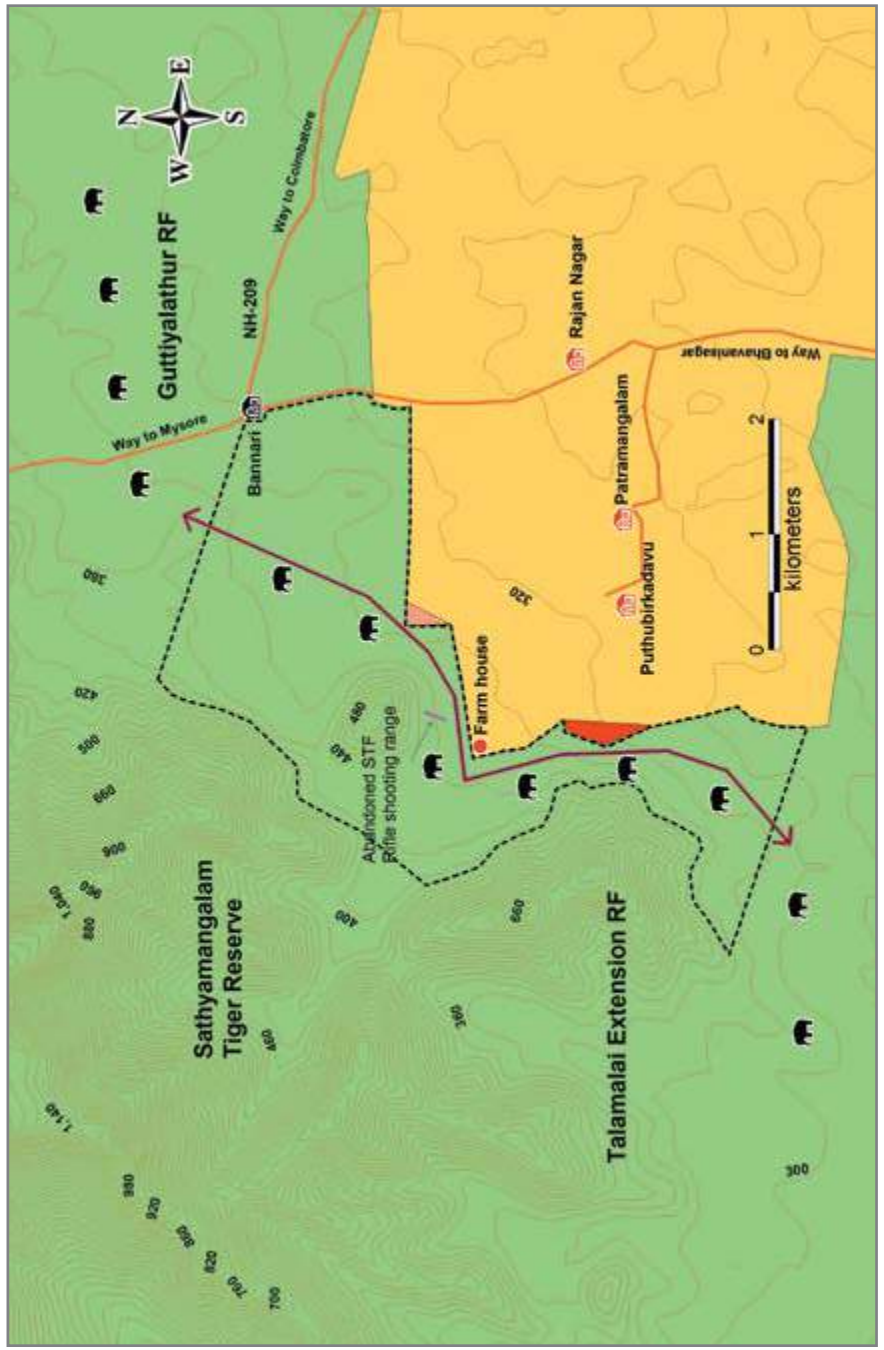
Nilgiri North Forest Division: 272

Coimbatore Forest Division: 400

(Synchronised Elephant Population Estimation, Tamil Nadu, 2012)



3D map showing the landscape of the Talamalai – Guttiyalattur Corridor



Map of the Talamalai - Guttiyalattur Corridor showing the lands to be secured

Forest/Land use

Forest type: Tropical thorn and deciduous forest
Settlements: Puthubirkadavu and Patramangalam
Agriculture: Banana, paddy, vegetables
Road: National Highway 209 (Sathyamangalam-Mysore)

Other ecological importance

Mountain Range: Eastern Ghats
Elephant Range: Brahmagiri-Nilgiri-Eastern Ghats Landscape
Elephant Reserve: Mysore Elephant Reserve
Protected Area: Sathyamangalam Tiger Reserve
Biosphere Reserve: Nilgiri Biosphere Reserve

HUMAN DIMENSIONS

Threats

1. *Settlements*: The expansion of Puthubirkadavu and Patramangalam villages has considerably decreased the width of the corridor.

2. *Intensive agricultural activities* of the above villages have reached the foothills of Talamalai Reserve Forest, obstructing elephant movement. People from nearby areas are also purchasing land near the corridor.

3. *A farm house* has recently come up close to the corridor; this will pose a serious threat to the free movement of elephants in future.

4. *High vehicular traffic* on NH 209 (Sathyamangalam-Mysore), which passes through the corridor. According to a 2015 survey 116.8 vehicles ply per hour and almost 2800-3000 vehicles ply every day.

5. *Fuelwood collection for commercial uses* is an important threat to corridor habitat quality. The selective felling of elephant food species has degraded the corridor.

6. *Livestock grazing in the corridor area* has reduced the availability of regeneration and recruitment saplings of elephant food species as well as cover plants.

7. *Potential linear infrastructure threats:* The proposed establishment of a railway line between Mettupalayam and Chamrajanagar, and a highway between Siriyur and Bhavanisagar, would affect the movement of elephants and other wild animals. Although these projects have been shelved as of now they could still pose a threat in future.

Corridor villages: Pudubirkadavu and Patramangalam

Corridor dependent villages: Bannari, Karachikorai, Pudubirkadavu, Pungar, Patramangalam, Sujalkuttai, Rajan Nagar

Human-Elephant Conflict: The trend in and around the Talamalai-Guttiyalattur corridor between 1996 and 2007 reveals that till the year 2000, elephant poaching (n=6) was higher than human deaths caused by elephants (n=2) as well as elephant deaths due to conflict (n=1). After that, elephant deaths especially due to electrocution, and human deaths caused by elephants, increased considerably compared to poaching. This could also be due to better enforcement by the state forest department, but human-elephant conflict has increased during the past few years, mainly because of increased biotic pressure due to human population growth, increased vehicular traffic and changed cropping patterns.

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent developmental activities affecting elephant movement.

2. In consultation with villagers, 25.41 acres of land need to be secured as Priority I and 11 acres as Priority II.

3. A farm house close to the corridor needs to be closed.

4. Vehicular speeds should be regulated by suitable barriers on NH 209 in the corridor area, especially between 9 pm and 5 am. Adequate mitigation measures are needed to minimise the impact of the NH 209 expansion.

5. Elephant Proof Trenches and/or fencing obstructing elephant movement should be removed and not be encouraged to mitigate human-elephant conflict.

Land identified to secure the corridor

Extent of area (acres)	**Land use**
Priority I	
1.13	Recently modified for agricultural practices
3.17	Recently modified for agricultural practices
2.5	Agriculture land
0.86	Fallow land
2.17	Recently modified for agricultural practices
4.12	Agriculture land
5.63	Agriculture land
5.83	Agriculture land
Priority II	
4.32	Agriculture land & settlement
4	Agriculture land & settlement
2.68	Agriculture land & settlement
36.4 acres	

8.09
KALLHATTI - SIGUR AT GLENCORIN

Ecological priority: High

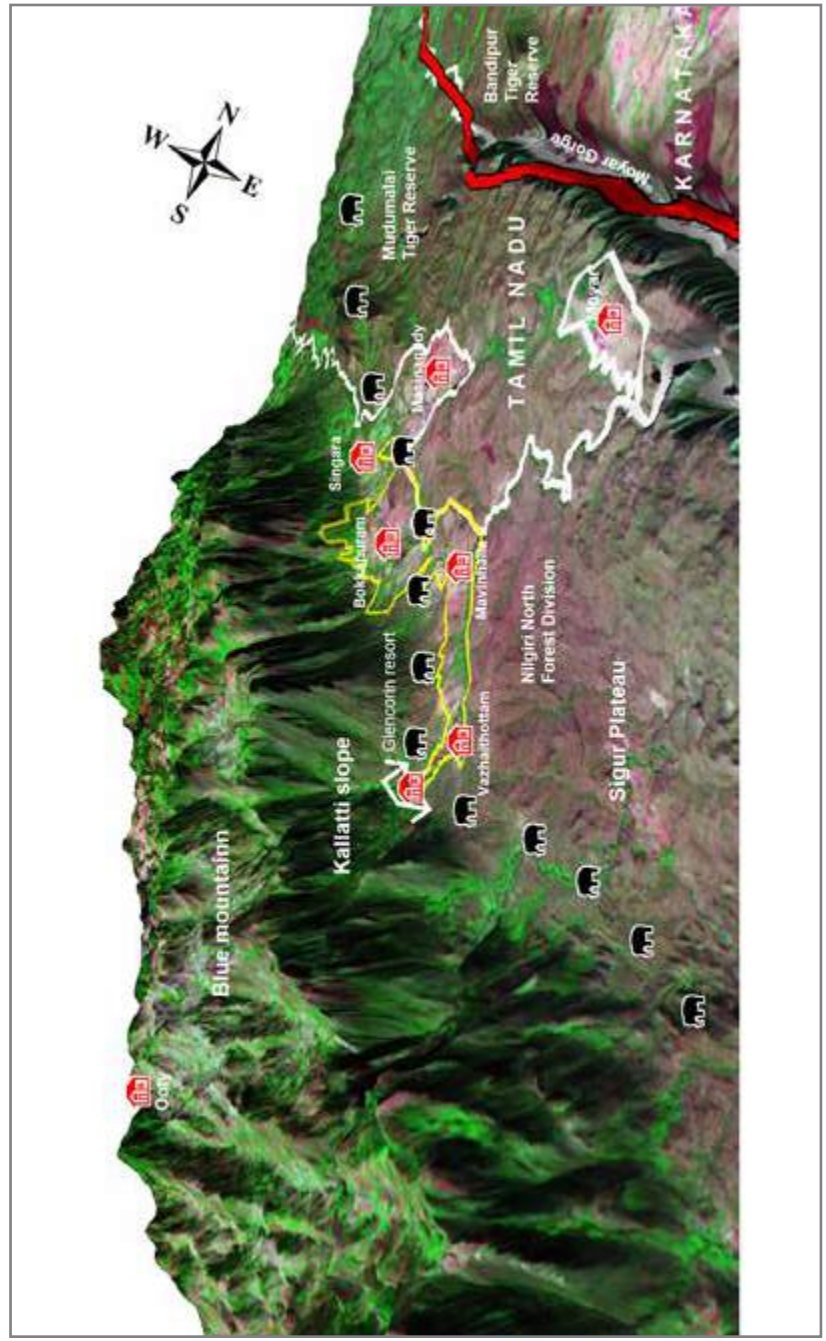
Conservation feasibility: High

This corridor connects Singara Reserve Forest of Mudumalai Tiger Reserve and Kallhatti Reserve Forest of Nilgiri North Division. Elephants from Nilgiri North Division move to Mudumalai Tiger Reserve and Bandipur Tiger Reserve through the northern foothills of Kallhatti Mountains near Glanton Inn Hotel at Glencorin.

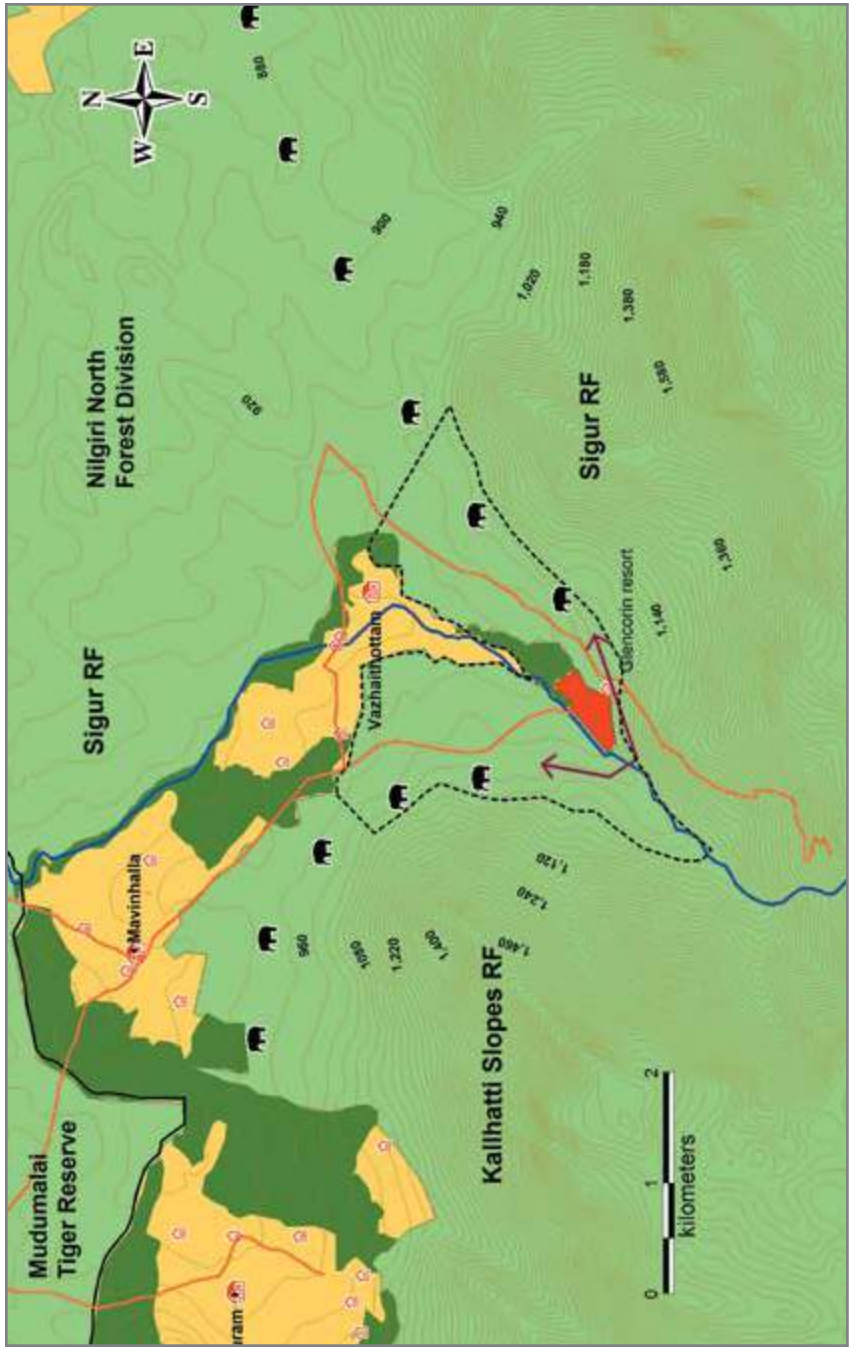
Alternate name	Glencorin
State	Tamil Nadu
Connectivity	Singara Reserve Forest with Kallhatti Reserve Forest through Bokkapuram Reserve Forest
Length and Width	0.75 km and 0.1-0.3 km
Geographical coordinates	11° 29′ 56″- 11° 31′ 47″ N 76° 41′ 7″- 76° 43′ 22″ E
Legal status	Private Land and Reserve Forest
Major land use	Forest, resorts and estates
Major habitation/settlements	Nil
Forest type	Tropical thorn forest
Frequency of usage by elephants	Regular

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 18 plant species were identified in a sampled area of three hectares. The predominant tree species in this corridor is *Cantheum parviflorum*. Other tree species found in this corridor include *Acacia chundra, Erithroxylon monogynum, Gardenia sp* etc. All of them are palatable to elephants.



3D map showing the landscape of the Kallhatti - Sigur at Glencorin Corridor



Map of the Kallhatti – Sigur at Glencorin Corridor showing the lands to be secured

Estimated elephant numbers in the landscape

Nilgiri North Forest Division: 272

Mudumalai Tiger Reserve: 840

(Synchronised Elephant Population Estimation, Tamil Nadu, 2012)

Forest/Land use

Forest type: Tropical thorn forest

Buildings/Artefacts: Anti-poaching camp, Glanton Inn Hotel

Road: Mudumalai-Ooty State Highway

Other ecological importance

Mountain Range: Western Ghats

Elephant Range: Brahmagiri-Nilgiri-Eastern Ghats Landscape

Elephant Reserve: Nilgiri Elephant Reserve

Biosphere Reserve: Nilgiri Biosphere Reserve

IBA: Code. IN-TN-17, Criteria. A1, A2, A3

HUMAN DIMENSIONS

Threats

1. *Developmental activities*: The land in Kallhatti-Sigur was left fallow for several decades. Now, due to an escalation in land prices, people have started clearing their patta lands and selling them at high prices to people from nearby towns. Two resorts have come up in this area, forcing elephants to use the foothills. (These resorts also take tourists to the corridor areas for wildlife sightings throughout the day and at night.) The forest department has an anti-poaching camp in the corridor which also blocks the unhindered movement of elephants.

2. *Vehicular traffic:* The Mudumalai-Ooty State Highway passes through the corridor. Ooty (Udhagamandalam), the famous hill station, is located just about 20 kilometers from the corridor. This road is open from 6 am to 8 pm but vehicular movement is seen throughout the day and night. Late evening elephant movement is affected by traffic on this road.

Corridor dependent villages: Mavinhalla, Vazhaithottam, Hullathi and Chockanalli

Human-Elephant Conflict: Conflict is low in this area due to the fact that most of the land is being used by tourist resorts and there is little cultivation of crops. Most of the human deaths reported in this area are of people who venture carelessly into the forest.

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent encroachment and developmental activities detrimental to animal movement.

2. In consultation with landowners, 45.2 acres of identified land (resorts and fallow lands from Hullathi village) needs to be secured.

3. Cattle grazing should not be allowed in the corridor areas during the elephant migratory season. Cattle reared in corridor fringe villages should be vaccinated every year against foot-and-mouth disease (FMD), anthrax, rinderpest and other diseases that are transmitted to wildlife.

4. Awareness programmes targeting villagers living in corridor fringe areas, as well as tourist resorts, tourist guides, local jeep drivers and tourists should be carried out through campaigns informing them about the criticality of the corridor, the increased human-elephant conflict in the area due to land use changes and obstructions to the corridor, and how the securing of the corridor could help minimise conflict.

Land identified to secure the corridor

Area (acres)	Village	Priority
28.12	Hullathi	P1
17.1	Hullathi	P1

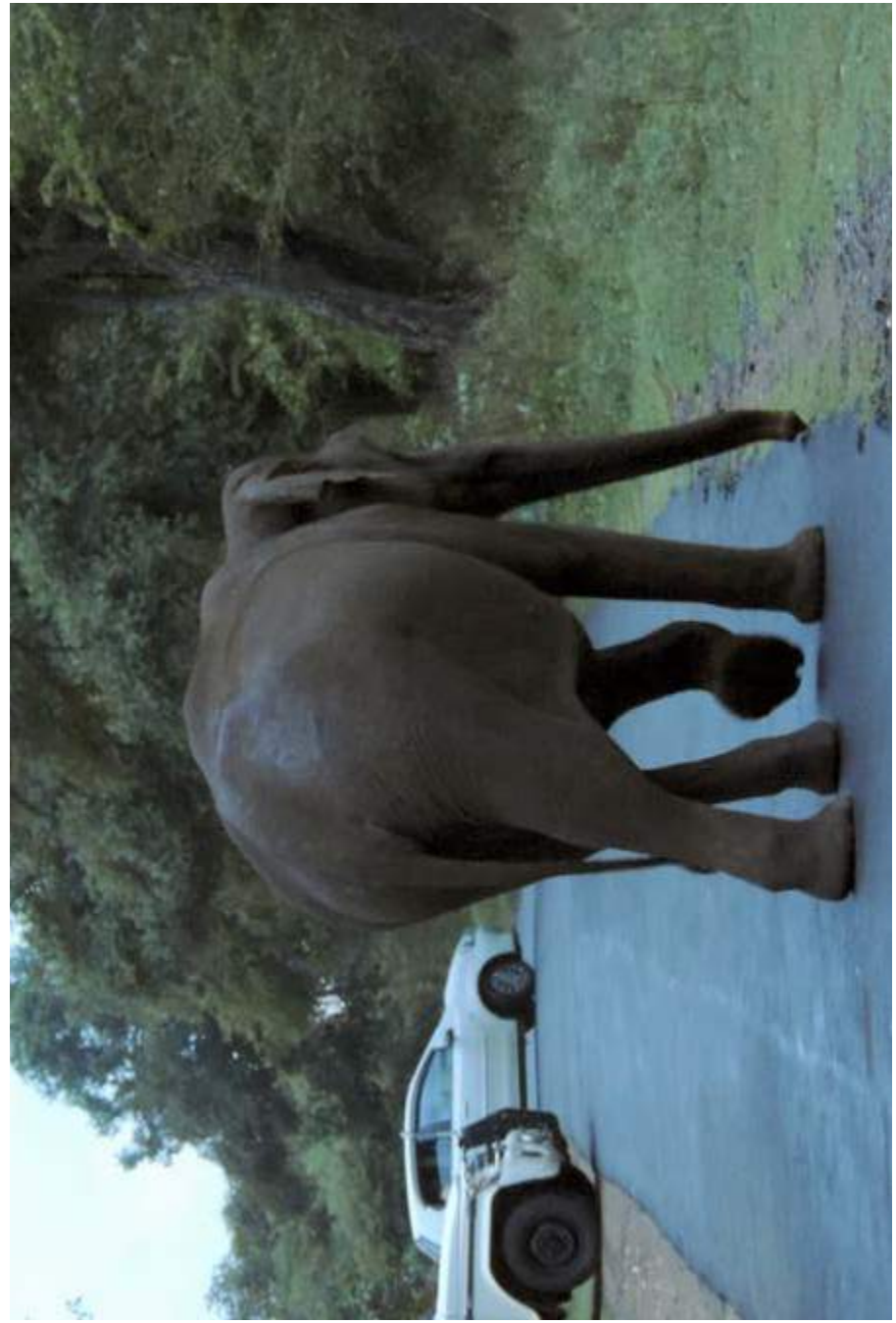


Fig. 8.07: An elephant crossing road in Kallhatti – Sigur at Glencorin Corridor

8.10
AVARAHALLA - SIGUR

Ecological priority: High

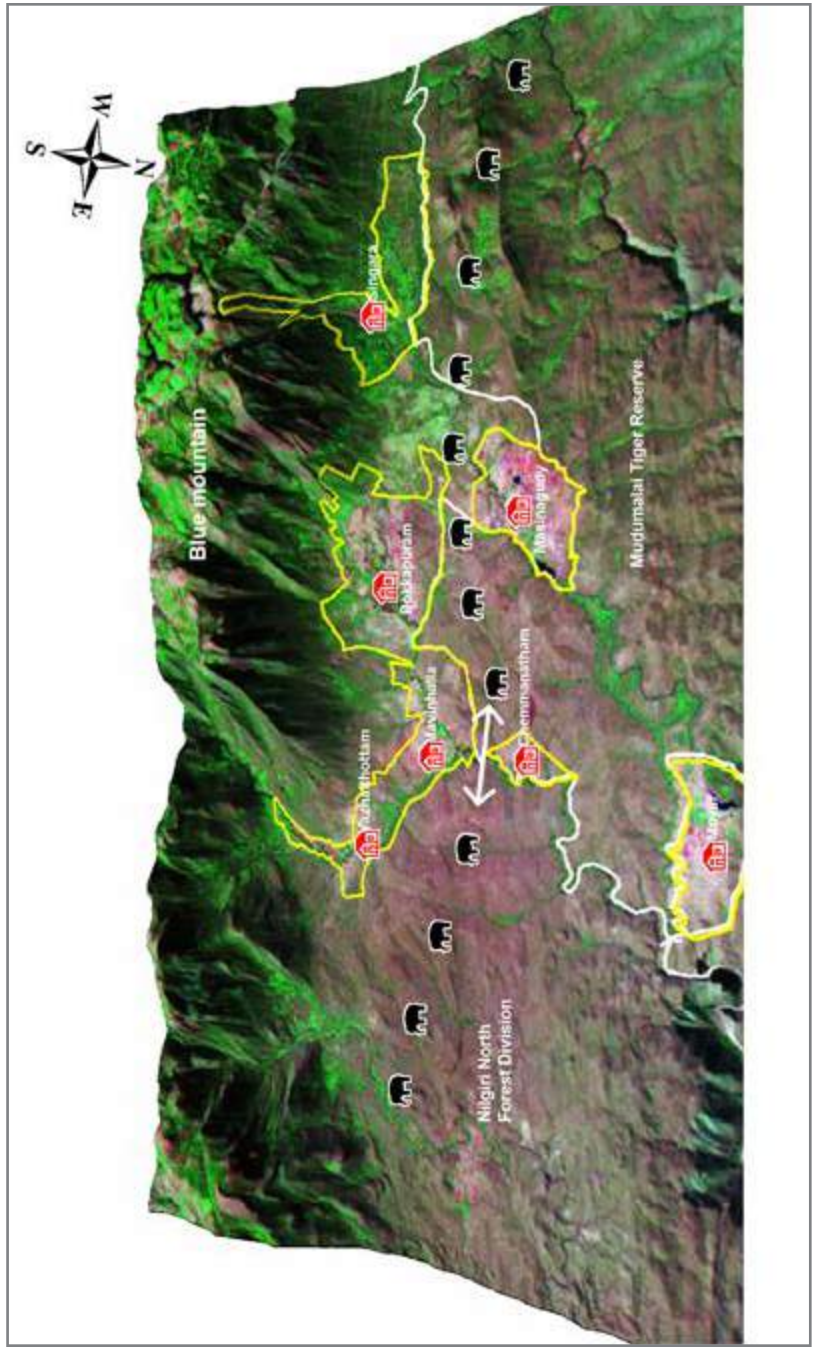
Conservation feasibility: High

This corridor connects Avarahalla Reserve Forest of Mudumalai Tiger Reserve with Sigur Reserve Forest of Nilgiri North Division. Elephants from Nilgiri North Division move to Bandipur Tiger Reserve through Mudumalai Tiger Reserve, between the villages of Chemmanatham and Mavinhalla.

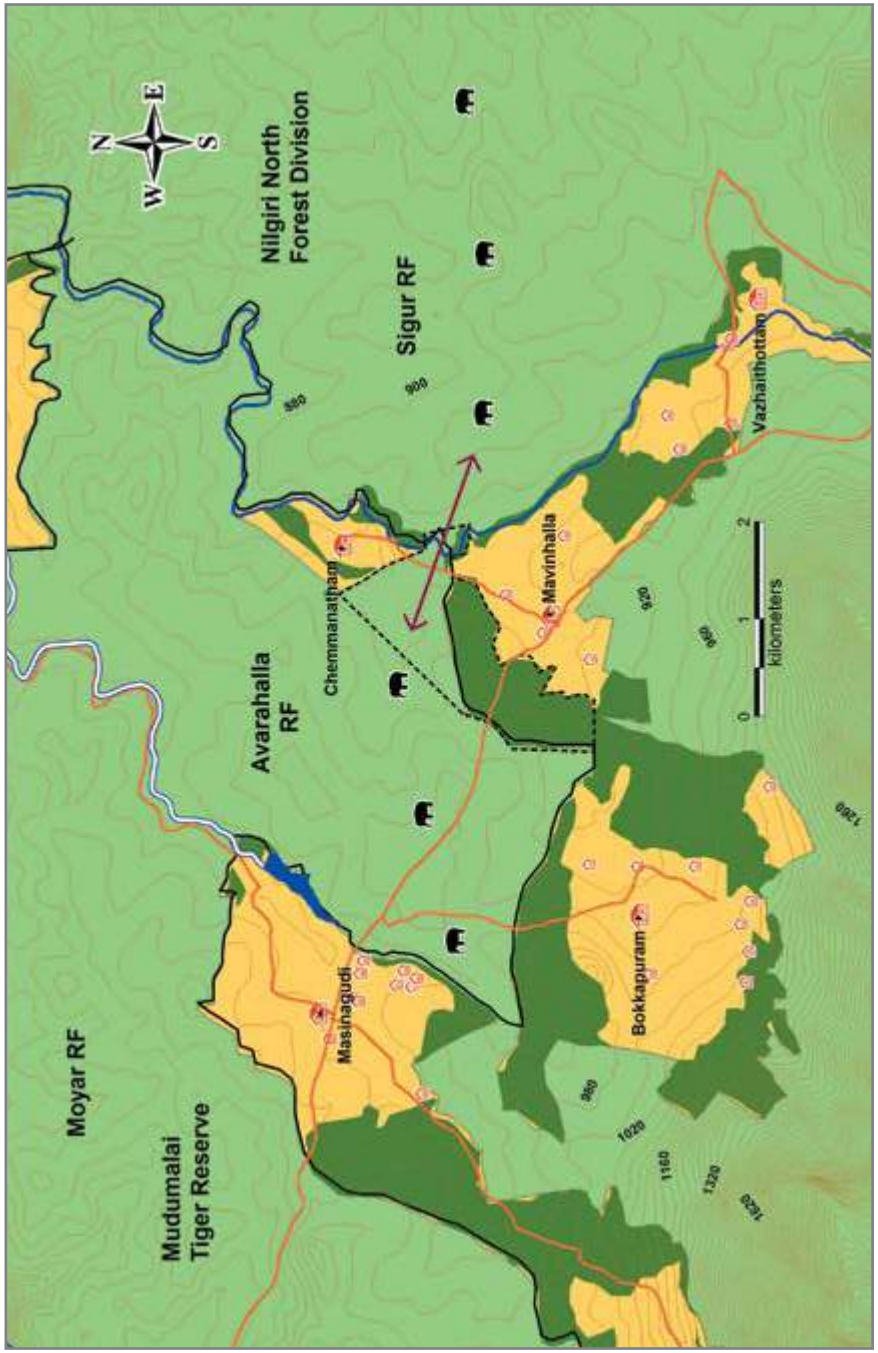
Alternate name	Mavinhalla-Chemmanatham
State	Tamil Nadu
Connectivity	Mudumalai Tiger Reserve with Nilgiri North Division
Length and Width	1 km and 0.5 km
Geographical coordinates	11° 32′ 32″- 11° 33′ 58″ N 76° 39′ 54″- 76° 41′ 11″ E
Legal status	Reserve Forest, Revenue Forest, Private Land
Major land use	Forest, resorts and settlements
Major habitation/settlements	Mavinhalla and Chemmanatham
Forest type	Tropical thorn forest
Frequency of usage by elephants	Regular

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 12 tree species were recorded in the sampled area of 0.03 ha. Of these, four species are palatable to elephants. Signs of wood cutting were recorded in 10 tree species, of which four were elephant food species: *Randia dumetorum, Diospyros montana, Cordia gharf* and *Zyziphus sp*. The availability of other ecological resources plays a major part in the regular use of this corridor by elephants, with bamboo patches and natural salt licks available. Ground cover in the corridor was represented by shrubs (15%), grasses (25%), herbs (20%) and barren ground (40%).



3D map showing the landscape of the Avarahalla – Sigur Corridor



Map of the Avarahalla – Sigur Corridor

Estimated elephant numbers in the landscape

Nilgiri North Forest Division: 272

Mudumalai Tiger Reserve: 840

(Synchronised Elephant Population Estimation, Tamil Nadu, 2012)

Forest/Land use

Forest type: Tropical thorn forest

Buildings/Artefacts: Tourist resorts

Human settlements: Mavinhalla and Chemmanatham

Road: Mavinhalla-Chemmanatham road

Other ecological importance

Mountain Range: Western Ghats

Elephant Range: Brahmagiri-Nilgiri-Eastern Ghats Landscape

Elephant Reserve Name & No: Nilgiri Elephant Reserve (No.23)

Biosphere Reserve: Nilgiri Biosphere Reserve

IBA: Code. IN-TN-17, Criteria. A1, A2, A3

HUMAN DIMENSIONS

Threats

1. Settlements: The corridor's width has been considerably reduced by Mavinhalla and Chemmanatham villages, which are located on either side of it.

2. Cattle grazing: This is a major problem in this corridor. Cattle use the corridor frequently and branches of elephant fodder trees are cut for livestock.

3. Resorts: Most of the resorts in the area are located near the corridor. Resort owners take their guests to view wildlife in the late evenings and early mornings, and even at night. Some abandoned resorts were reopened recently and pose a threat to the free movement of elephants.

Corridor dependent villages: Mavinhalla (150 families), Chemmanatham (35 families)

Human-Elephant conflict: Some 12 elephant deaths and 13 human deaths due to conflict were reported in and around the corridor area between 2001 and 2013. Conflict has increased during the past few years due to biotic pressure, human population growth, vehicular traffic, changed cropping patterns etc.

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent encroachment and development activities detrimental to animal movement.

2. Tourism activities (night safaris, disposal of garbage etc) should be strictly controlled in the corridor area.

3. Cattle grazing should not be allowed in the corridor area during the elephant migratory season. Cattle reared in corridor fringe villages should be vaccinated every year against foot-and-mouth disease (FMD), anthrax, rinderpest and other diseases that are transmitted to wildlife.

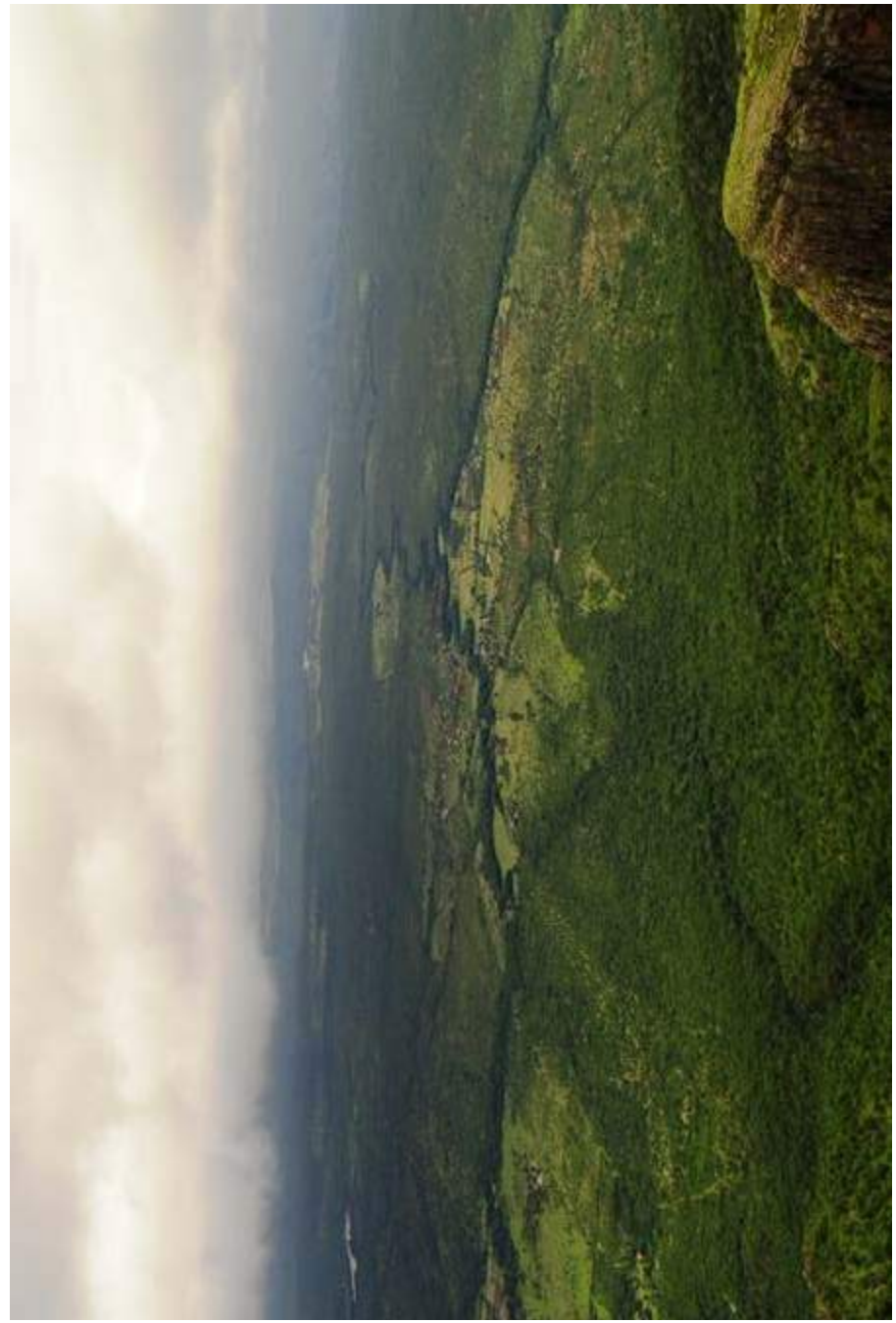


Fig. 8.08: A view of the Avarahalla – Sigur Corridor

8.11
KALMALAI - SINGARA AND AVARAHALLA

Ecological priority: High

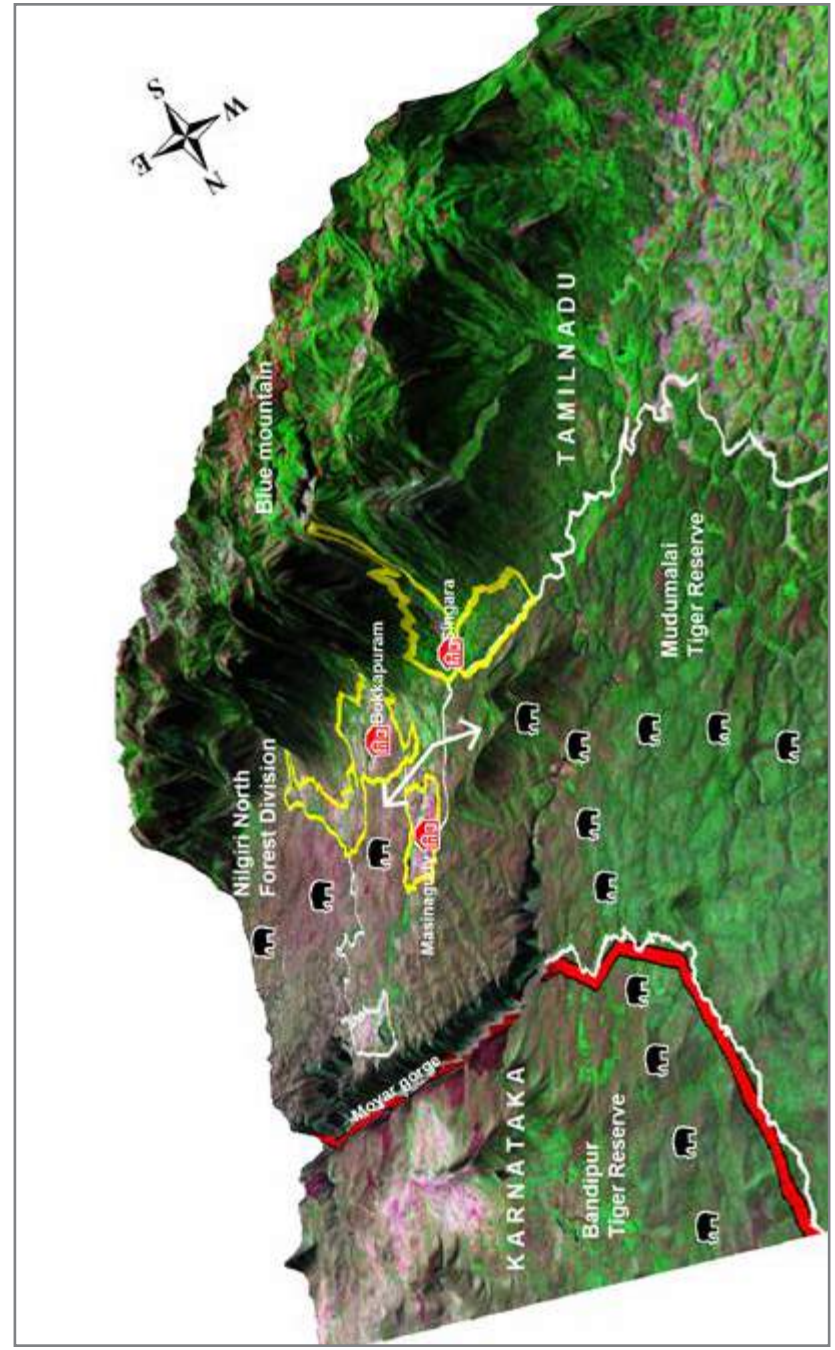
Conservation feasibility: High

This corridor lies between the villages of Singara and Masinagudi on the northern slopes of the Nilgiri Hills. It comprises forests on either side of the road connecting these two villages. Approximately 50 metres of the forest on either side of the road is privately owned. The corridor is intensively used by elephants that seasonally move from Mudumalai Tiger Reserve to Nilgiri North Division. As movement is not possible along the Nilgiri slopes (due to penstock pipes of a hydro-electric project between Glenmorgan and Singara), this corridor is of great significance.

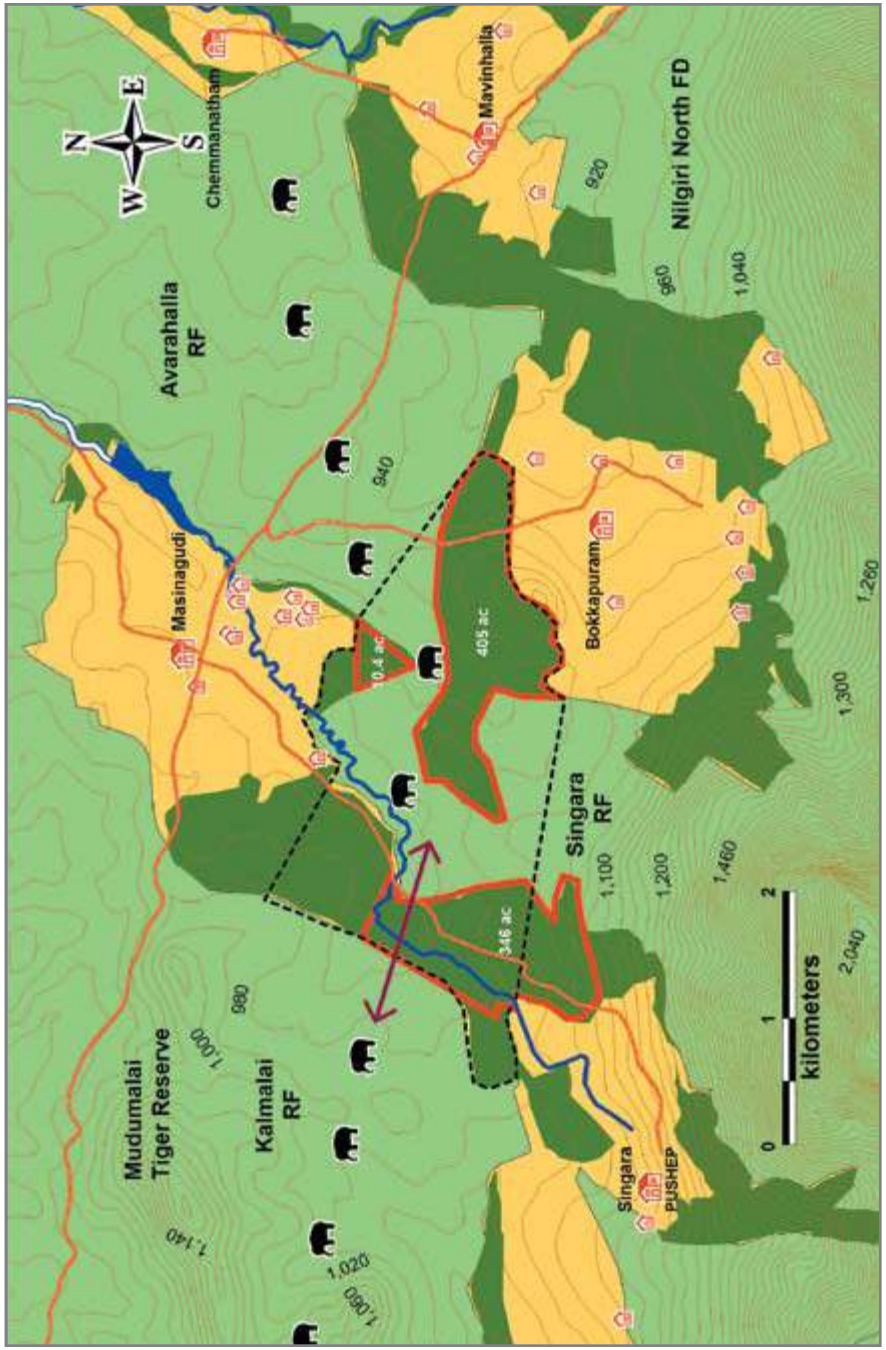
Alternate name	Singara-Masinagudi
State	Tamil Nadu
Connectivity	Kalmalai Reserve Forest of Mudumalai Tiger Reserve with Singara Reserve Forest of Nilgiri North Division
Length and Width	1.4 km and 0.8 km
Geographical coordinates	11° 32' 25"- 11° 33' 44" N 76° 36' 33"- 76° 39' 18" E
Legal status	Private Land
Major land use	Forest
Major habitation/settlements	Nil
Forest type	Tropical thorn and deciduous forest
Frequency of usage by elephants	Regular

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 42 tree species were reported in the sampled area of three hectares. The predominant tree species were *Anogeissus latifolia*



3D map showing the landscape of the Kalmalai – Singara and Avarahalla Corridor



Map of the Kalmalai – Singara and Avarahalla Corridor

(47 per ha), *Randia dumetorum* (59 per ha), *Zyziphus xylopyrus* (18 per ha) and *Erythroxylon monogynum* (18 per ha). The overall tree density was estimated at 327 per ha. The density of elephant-preferred fodder tree species was 111 per ha. Apart from migration, elephants are attracted to the corridor area due to abundant food species, availability of perennial water sources and seven major salt licks.

Estimated elephant numbers in the landscape

Nilgiri North Forest Division: 272
Mudumalai Tiger Reserve: 840
(Synchronised Elephant Population Estimation, Tamil Nadu, 2012)

Forest/Land use

Forest type: Tropical thorn and deciduous forest
Estate: Singara estate
Human settlements: Masinagudi, Achakarai, Singara, Bokkapuram and Thodling
Agriculture land
River: Kallar
Road: Masinagudi-Singara

Other ecological importance

Mountain Range: Western Ghats
Elephant Range: Brahmagiri-Nilgiri-Eastern Ghats Landscape
Elephant Reserve: Nilgiri Elephant Reserve
Protected Area: Mudumalai Tiger Reserve
Biosphere Reserve: Nilgiri Biosphere Reserve
IBA: Code. IN-TN-17, Criteria. A1, A2, A3

HUMAN DIMENSIONS

Threats

1. Developmental activities: Activities related to the Pykara Ultimate Stage Hydro-electric Project (PUSHEP), and human settlements.

2. Traffic: The Singara-Masinagudi road passes through the corridor for about three kilometres. On an average, 409 vehicles were recorded in the corridor during the day, mostly two-wheelers (n=118) and four-wheelers (n=284). During the early mornings, late evenings and even at night, tourist resorts use this road to show wildlife to their guests.

3. Tourism: Tourist resorts in the area organise vehicle safaris and trekking for their guests into the private forests located in this corridor. This is a major problem for elephants, especially during migratory season. Vehicles from Masinagudi are also cleaned near the Kalhalla Bridge; this pollutes the water used by wildlife (and people) downstream of the flume channel.

4. Cattle grazing: Cattle compete with elephants and other wild herbivores for fodder resources in this corridor. The encounter rate of cattle dung is very high, at 1176 dung piles per sq km.

Corridor dependent villages: Masinagudi (500 households), Achakarai (35 households), Singara (40 households), Thodling (80 households), Bokkapuram (150 households)

Human-Elephant Conflict: Conflict is very low in this corridor. People in the area either only have coffee plantations (which are not affected by elephants) or patta land that is left with its forest cover intact. Most of the people killed or injured in this area ventured into the forest, either to view wildlife or to collect fuelwood and cattle dung. There is no record of elephants damaging huts in this corridor.

CONSERVATION PLAN

1. The corridor should be legally protected by the state forest department under an appropriate law, and action should be taken to prevent encroachment of corridor forest and developmental activities detrimental to the corridor.

2. Some 761.4 acres of private and revenue forest land needs to be secured in consultation with the landowners.

3. Jeep safaris, trekking and other wildlife viewing activities, whether on the Masinagudi-Singara road or inside private and revenue forests, need to be controlled very strictly.

4. Cattle grazing should not be allowed in the corridor area during the elephant migratory season. Cattle reared in corridor fringe villages should be vaccinated every year against foot-and-mouth disease (FMD), anthrax, rinderpest and other diseases that are transmitted to wildlife.

Land identified for securing the corridor

Extent of area (acres)	**Land status**	**Priority**
346	Patta land (Private Forest)	P1
10.4	Patta land (Private Forest)	P1
405	Revenue Forest	P2

8.12
MOYAR - AVARAHALLA

Ecological priority: High
Conservation feasibility: High

This corridor connects Moyar Reserve Forest to Avarahalla Reserve Forest of Mudumalai Tiger Reserve. Elephants from Nilgiri North Division move to Bandipur Tiger Reserve through Mudumalai Tiger Reserve between Moyar and Masinagudi villages.

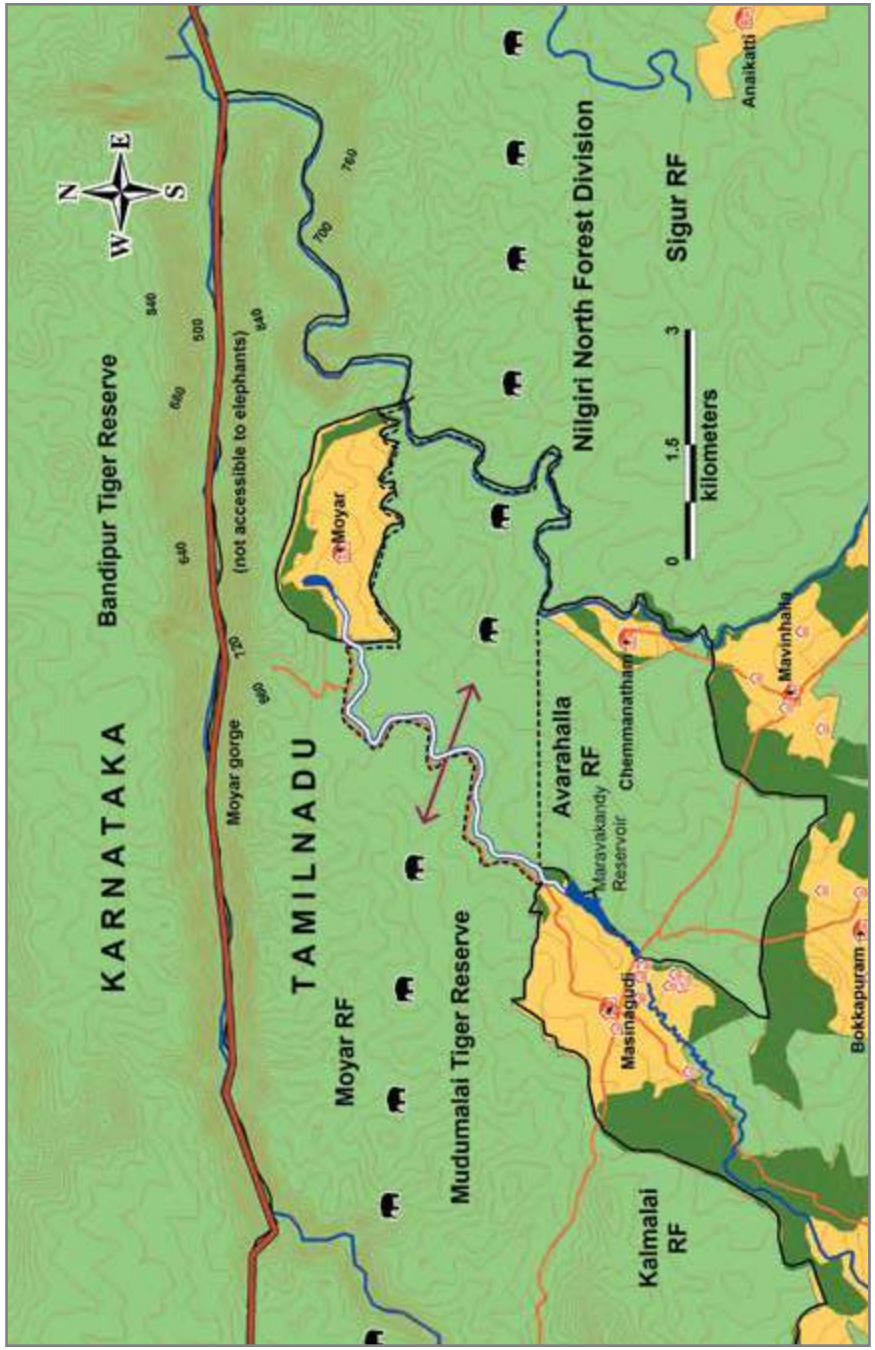
Alternate name	Masinagudi - Moyar
State	Tamil Nadu
Connectivity	North-eastern and south-eastern part of Mudumalai Tiger Reserve
Length and Width	1 km and 6 km
Geographical coordinates	11° 34′ 22″- 11° 35′ 59″ N 76° 39′ 18″- 76° 42′ 44″ E
Legal status	Tiger Reserve
Major land use	Forest
Major habitation/settlements	Nil
Forest type	Tropical thorn and deciduous forest
Frequency of usage by elephants	Regular

FORESTS AND ELEPHANTS

Corridor habitat status: The density of tree species in the Moyar-Avarahalla corridor is approximately 15 per hectare, with 37 species of trees reported from the corridor in the sampled plot of three hectares. The predominant tree species include *Randia dumatorum* (40%), *Cantheum parviflorum* (12%), *Acacia chundra* (5%), *Erithroxylon monogynum* and *Gardenia sp* (5%), all of which are palatable to elephants. Three species of shrubs found in the corridor are also eaten by elephants. Water bodies are abundant; there is a perennial flume channel



3D Map showing the landscape of the Moyar – Avarahalla Corridor



Map of the Moyar – Avarahalla Corridor

running from Masinagudi to Moyar village and two perennial ponds located in this corridor. Two seasonal water courses are also found in the corridor.

Estimated elephant numbers in the landscape

Nilgiri North Forest Division: 272
Mudumalai Tiger Reserve: 840
(Synchronised Elephant Population Estimation, Tamil Nadu, 2012)

Forest/Land use

Forest type: Tropical thorn and deciduous forest
Artefacts: Moyar flume channel
Road: Masinagudi-Moyar

Other ecological importance

Mountain Range: Western Ghats
Elephant Range: Brahmagiri-Nilgiri-Eastern Ghats Landscape
Elephant Reserve: Nilgiri Elephant Reserve
Protected Area: Mudumalai Tiger Reserve
Biosphere Reserve: Nilgiri Biosphere Reserve
IBA: Code. IN-TN-17, Criteria. A1, A2, A3

HUMAN DIMENSIONS

Threats

1. Developmental activities: The major development activity in this area is the Moyar hydro-electric power project.

2. Cattle grazing: Cattle are competing with elephants and other wild herbivores for fodder. The encounter rate of cattle dung in this corridor is very high (919 dung piles per sq km).

3. Vehicular traffic is a major problem for elephants in this corridor. Jeep safaris organised by resorts and local jeep drivers for wildlife viewing pose a severe threat to the free movement of elephants and other animals.

Human-Elephant Conflict: Conflict is very low in this corridor. Most of the people killed or injured in the area ventured into the forest, either to view wildlife or to collect fuelwood and cattle dung. There is no record of elephants damaging huts in this corridor.

CONSERVATION PLAN

1. The corridor should be notified by the state forest department and legally protected under an appropriate law; action should be taken to prevent illegal construction or the diversion of forest land for non-forestry and developmental activities and regulation of jeep safari for tourism in the corridor area.

2. Cattle grazing should not be allowed in the corridor area during the elephant migratory season. Cattle reared in corridor fringe villages should be vaccinated every year against Foot-and-Mouth disease (FMD), anthrax, rinderpest and other diseases that are transmitted to wildlife.

3. No developmental activities hindering elephant movement should be allowed between Masinagudi, Moyar, Boothanatham and Chemmanatham villages.

4. Jeep safaris for wildlife viewing need to be regulated very strictly on the road between Masinagudi and Moyar, particularly in the dry season when the elephants needs to access the flume channel for water.

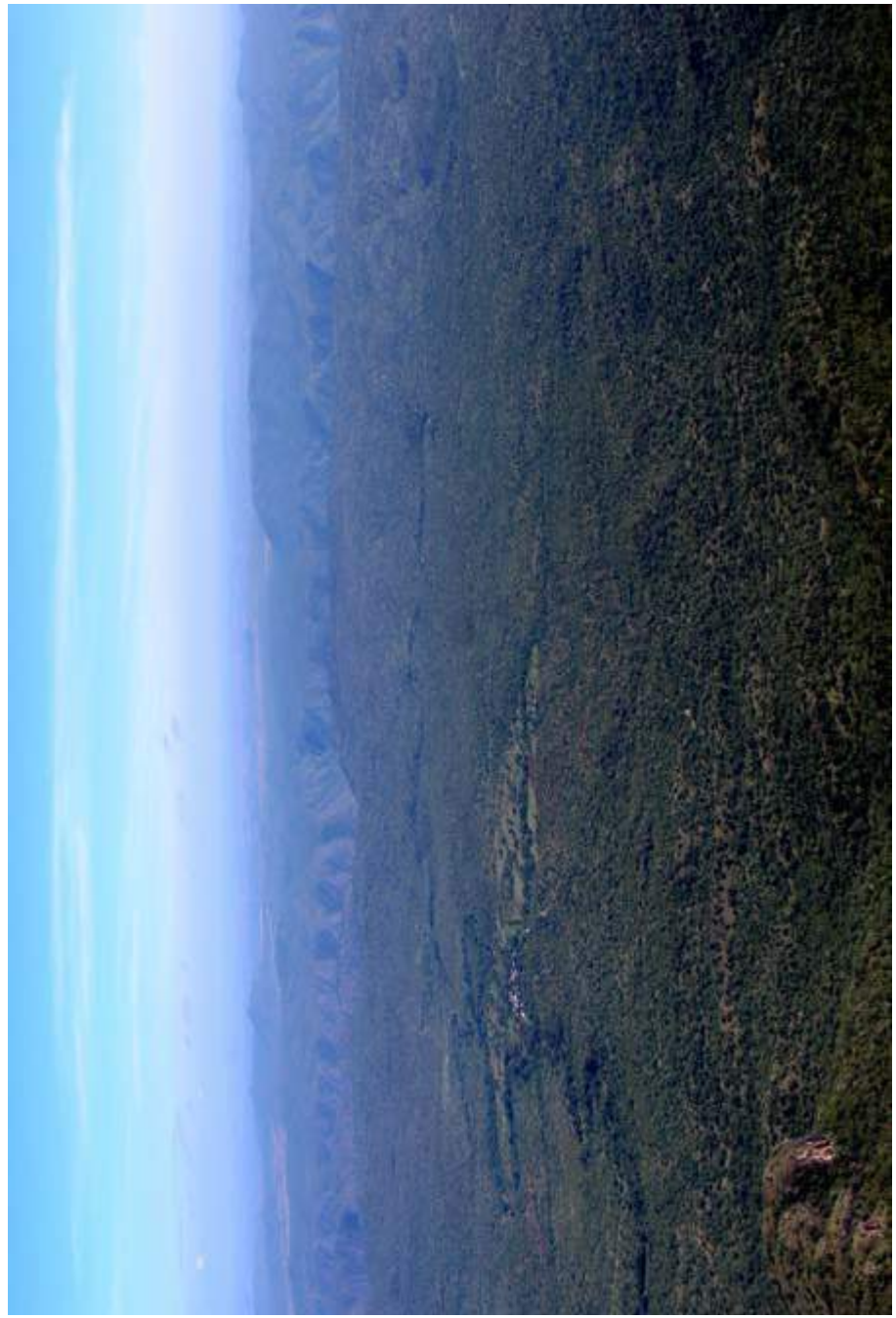


Fig. 8.09: A view of the Moyar – Avarahalla Corridor

8.13

KANIYANPURA - MOYAR

Ecological priority: High

Conservation feasibility: High

This corridor connects the Kaniyanpura Reserve Forest with the Moyar Reserve Forest of Bandipur Tiger Reserve and is located on the inter-state boundary of Karnataka and Tamil Nadu. Elephants from Sathyamangalam Tiger Reserve move to Bandipur Tiger Reserve through narrow forests located between the settlements of Kaniyanpura, Karagundi and Kaniyanpura Colony, and the steep slopes of the Moyar gorge.

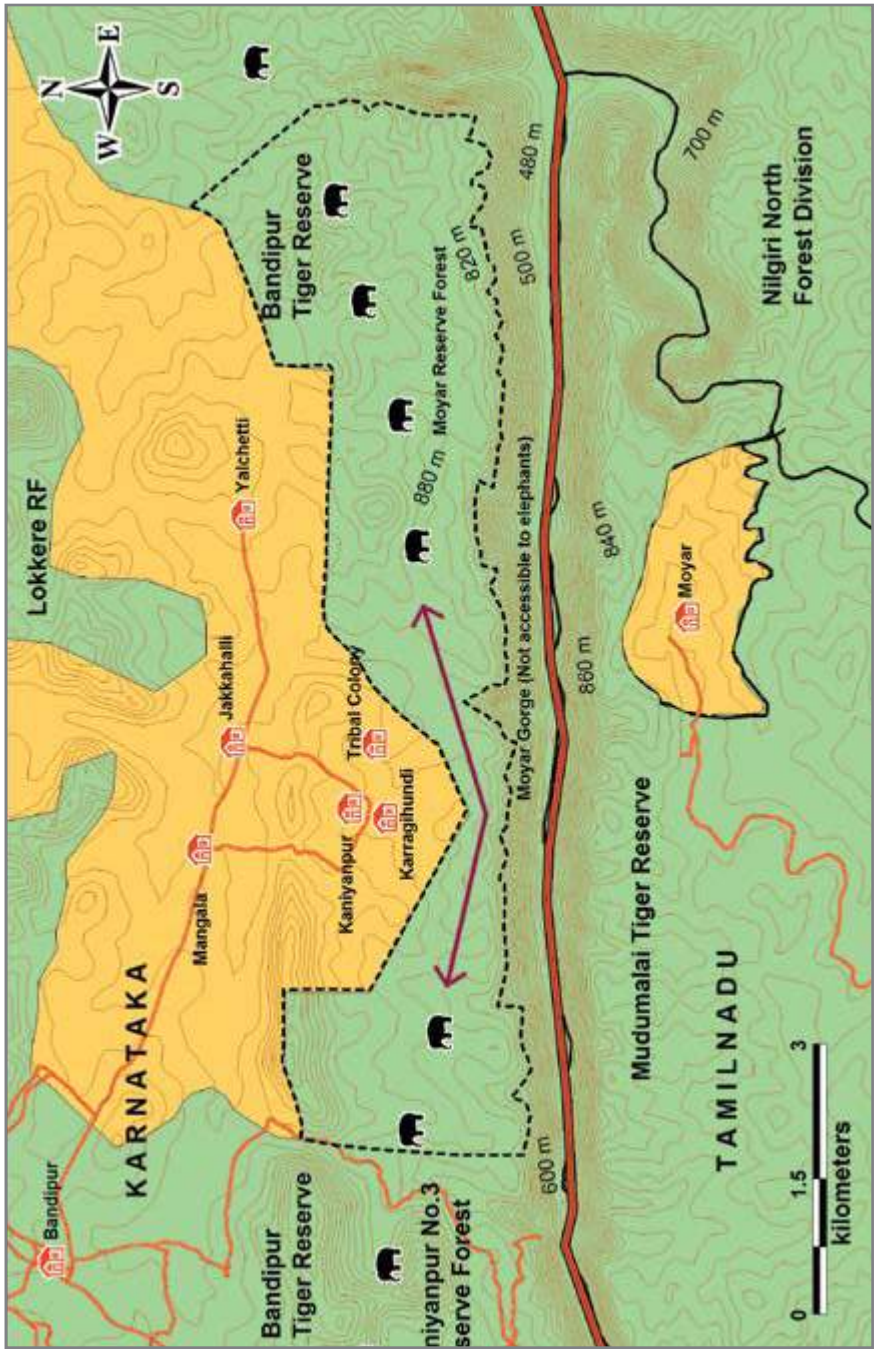
State	Karnataka
Connectivity	Bandipur Tiger Reserve to Sathyamangalam Tiger Reserve
Length and Width	3 km and 0.05-0.4 km
Geographical coordinates	11° 37′ 1″- 11° 39′ 6″ N 76° 38′ 22″- 76° 44′ 49″ E
Legal status	Protected Area
Major land use	Forest, plantations and settlement
Major habitation/settlements	Nil
Forest type	Dry deciduous and mixed thorn forest
Frequency of usage by elephants	Regular; seasonal, mostly during October to January

FORESTS AND ELEPHANTS

Corridor habitat status: A total of nine tree species were recorded in the sampled area of the corridor, of which seven are considered to be elephant food species. *Lagerstroemia lanceolata* was the predominant species. Ground cover comprised grasses (28%), shrubs (22%), herbs (8%) and barren ground (42%).



3D map showing the landscape of the Kaniyanpura – Moyar Corridor



Map of the Kaniyanpura – Moyar Corridor

Estimated elephant numbers in the landscape

Bandipur Tiger Reserve: 1263 (674-2000)
(Synchronised Elephant Population Estimation, Karnataka, 2012)
Sathyamangalam Tiger Reserve: 877 (648-1174)
(Synchronised Elephant Population Estimation, Tamil Nadu, 2012)

Forest/Land use

Forest type: Dry deciduous and mixed thorn forest
Settlements: Kaniyanpura, Karagundi and Kaniyanpura Colony
Agricultural land, barren land and *plantations*

Other ecological importance

Mountain Range: Western Ghats & Eastern Ghats
Elephant Range: Brahmagiri-Nilgiri-Eastern Ghats Landscape
Elephant Reserve: Nilgiri Elephant Reserve
Protected Area: Bandipur and Sathyamangalam Tiger Reserves
Biosphere Reserve: Nilgiri Biosphere Reserve
IBA: IN-KA-03, Criteria: A1, A2

HUMAN DIMENSIONS

Threats

1. *Biotic pressure:* Cattle grazing and fuelwood collection by people from corridor dependent villages has considerably degraded the quality of the corridor forest.

2. *The emergence of resorts* near the corridor will pose serious problems in the future.

Corridor dependent villages: Kaniyanpura Colony, Karagundi and Kaniyanpura. Karagundi and Kaniyanpura in particular are located very close to the corridor. Cultivation is less due to crop depredation by elephants. The community mainly depends on the corridor forest for cattle grazing and fuelwood collection. Community Names: Soligar, Lingayathar, Boyar.

Human-Elephant Conflict: Three elephant deaths were recorded due to electrocution between 2009 and 2013 around the corridor area. The age of the electrocuted elephants ranged from 10 to 20 years. The crop ex-gratia trend has decreased drastically (15.3 lakhs to 2.3 lakhs) in this same period as agricultural activity has lessened and mitigation measures have become more effective.

CONSERVATION PLAN

1. The corridor should be notified by the state forest department.

2. Reduce dependency of fringe villagers on the corridor forest through suitable eco-developmental support and assistance.

3. More area (south of the Mangala-Jakkahalli-Yelchetti road) could be secured to widen the corridor at its bottleneck. The Karnataka Forest Department has plans to add more area to the corridor.

REMARKS

This corridor was initially quite narrow, just about 0.1 km at its widest. The Karnataka Forest Department, with financial assistance from Project Elephant, Ministry of Environment, and technical assistance from the Asian Nature Conservation Foundation (ANCF), secured the adjacent revenue land and annexed it to the Reserve Forest to widen the corridor near Karagundi village.



Fig. 8.10: A tusker passing through the corridor

8.14

BEGUR - BRAHMAGIRI

Ecological priority: High

Conservation feasibility: Medium

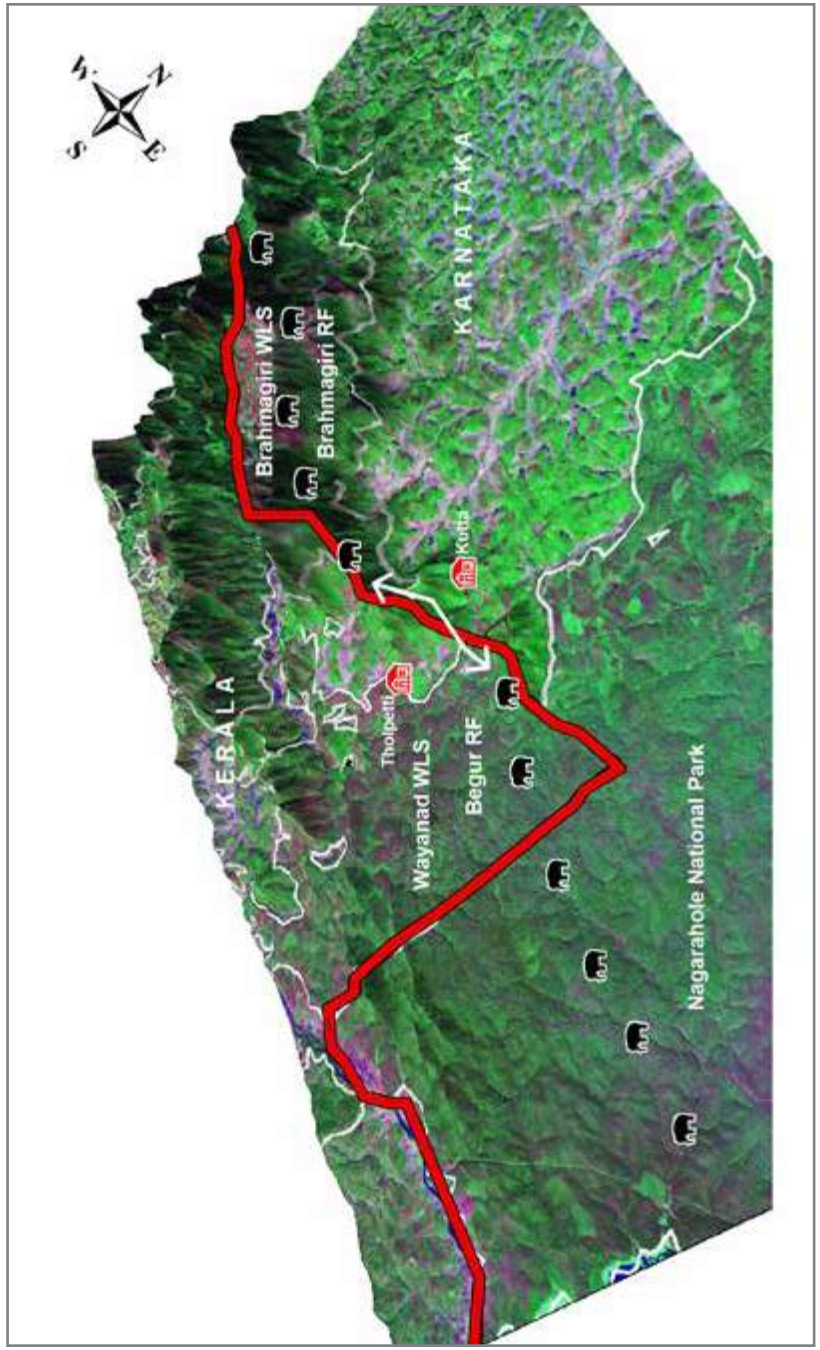
This corridor connects Begur Reserve Forest and the Tholpetty Range of Wayanad Wildlife Sanctuary with Brahmagiri Reserve Forest and the Srimangala Range of Brahmagiri Wildlife Sanctuary. The corridor is located on the inter-state boundary of Karnataka and Kerala. Elephants from Brahmagiri Wildlife Sanctuary move to Nagarahole Tiger Reserve, Karnataka, through Wayanad Wildlife Sanctuary and private coffee estates between Tholpetty village and Kutta town. This corridor between Brahmagiri and Wayanad Wildlife Sanctuaries is in addition to the Thirunelli-Kudrakote corridor, which has already been secured.

Alternate name	Tholpetty
State	Karnataka and Kerala
Connectivity	Brahmagiri Wildlife Sanctuary with Wayanad Wildlife Sanctuary and Nagarahole Tiger Reserve
Length and Width	1 km and 0-0.8 km
Geographical coordinates	11° 55′ 55″- 11° 57′ 60″ N 76° 0′ 36″- 76° 4′ 15″ E
Legal status	Private Land
Major land use	Coffee estate and human habitation
Major habitation/settlements	Nil
Forest type	Moist deciduous forest
Frequency of usage by elephants	Regular

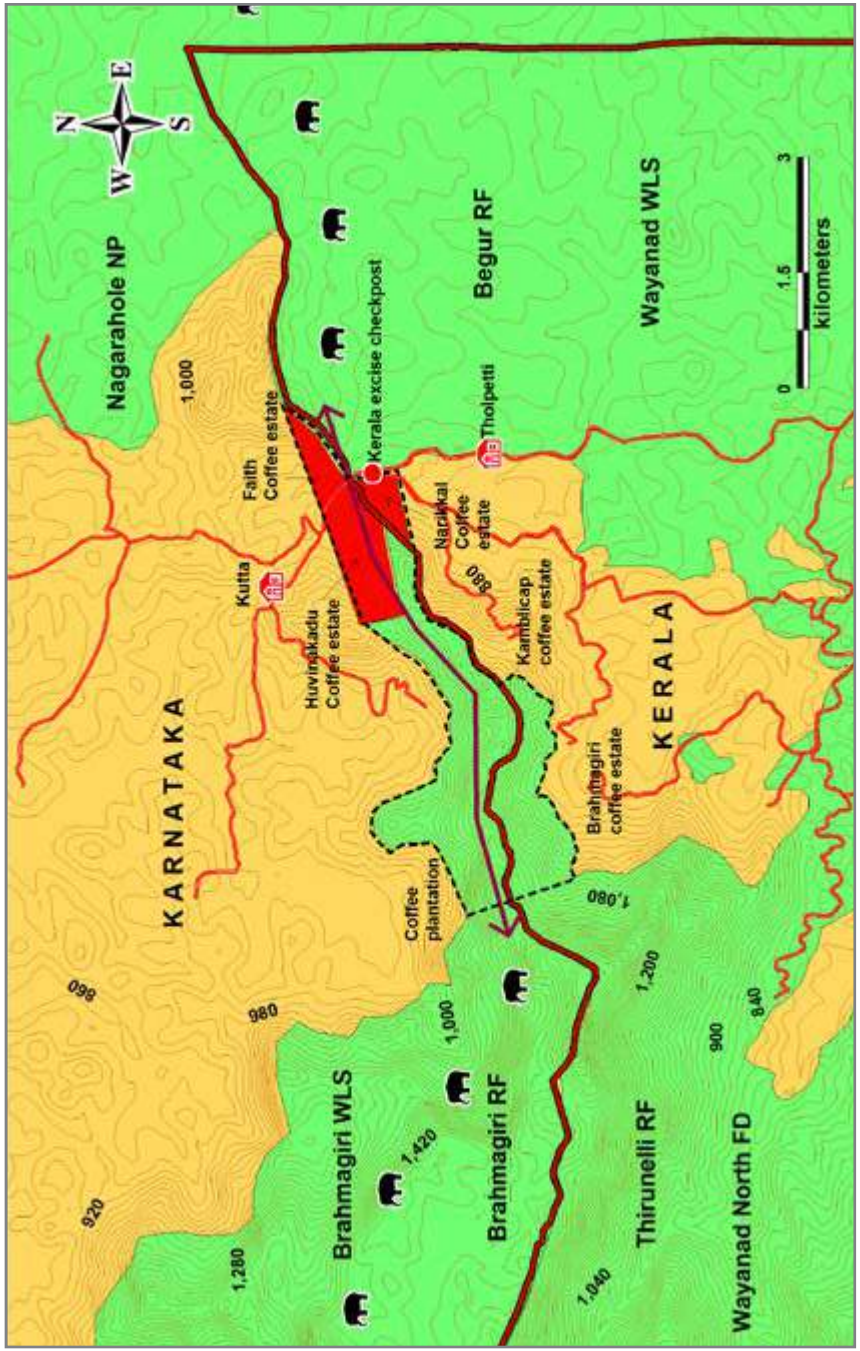
FORESTS AND ELEPHANTS

Estimated elephant numbers in the landscape

Wayanad Wildlife Sanctuary: 224 (elephant density of 2.0718 per sq km)



3D map showing the landscape of the Begur – Brahmagiri Corridor



Map of the Begur – Brahmagiri Corridor showing the land to be secured

Hunsur Wildlife Division, Nagarahole Tiger Reserve: 408 (elephant density of 1.0 per sq km)
(Synchronised Elephant Population Estimation, 2012)

Forest/Land use

Forest Type: Tropical moist deciduous forest
Road: Mananthavady-Kutta State Highway

Other ecological importance

Mountain Range: Western Ghats
Elephant Range: Brahmagiri-Nilgiri-Eastern Ghats Landscape
Elephant Reserve: Wayanad Elephant Reserve
Protected Area: Brahmagiri Wildlife Sanctuary and Wayanad Wildlife Sanctuary

HUMAN DIMENSIONS

Threats

1. Coffee plantations: The Huvinakadu and Faith Coffee Estates in Karnataka and Narikkal Coffee Estate in Kerala exert biotic pressure on the corridor area.

2. Vehicle traffic: The Mananthavady-Kutta State Highway bisects the corridor. Vehicular traffic is high during the night, hindering the free movement of elephants.

3. Electric fences and Elephant Proof Trenches (EPTs): All the coffee estates are well protected by electric fences and EPTs, which completely block elephant movement between Begur and Brahmagiri.

Corridor dependent villages: Tholpetty, Kutta and Poojekal

Human-Elephant Conflict: Records of ex-gratia support provided by the Srimangala Range indicate that the level of human-elephant conflict is moderate. No human or elephant death was reported till 2013-14, though six cases of human injury due to elephants were recorded.

CONSERVATION PLAN

1. The corridor should be notified by the state forest department and legally protected under an appropriate law to prevent encroachment and development activities detrimental to animal movement.

2. Electric fences and EPTs in the corridor area should be removed on a priority basis.

3. About 375 acres of land identified in the Huvinakadu and Faith Coffee Estates in Karnataka needs to be secured in consultation with the management of these estates. Similarly, about 100 acres of land identified in the Narikkal Coffee Estate in Kerala should be secured for the long-term conservation of elephants in the region.

4. Inter-state border checkposts in the corridor area should be shifted.

5. No construction should be allowed on either side of the road passing through the corridor.



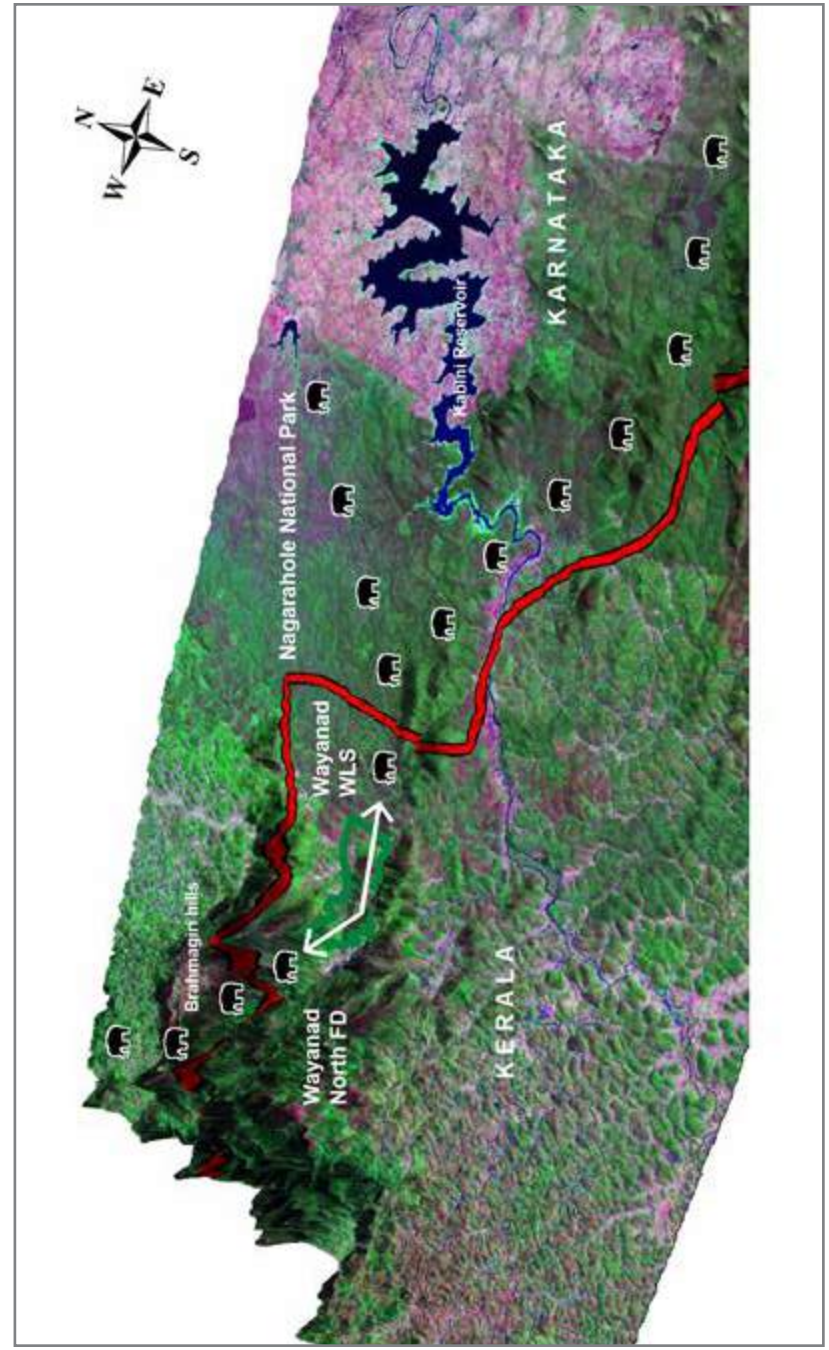
Fig. 8.11: Power fencing near the corridor

8.15
THIRUNELLI - KUDRAKOTE

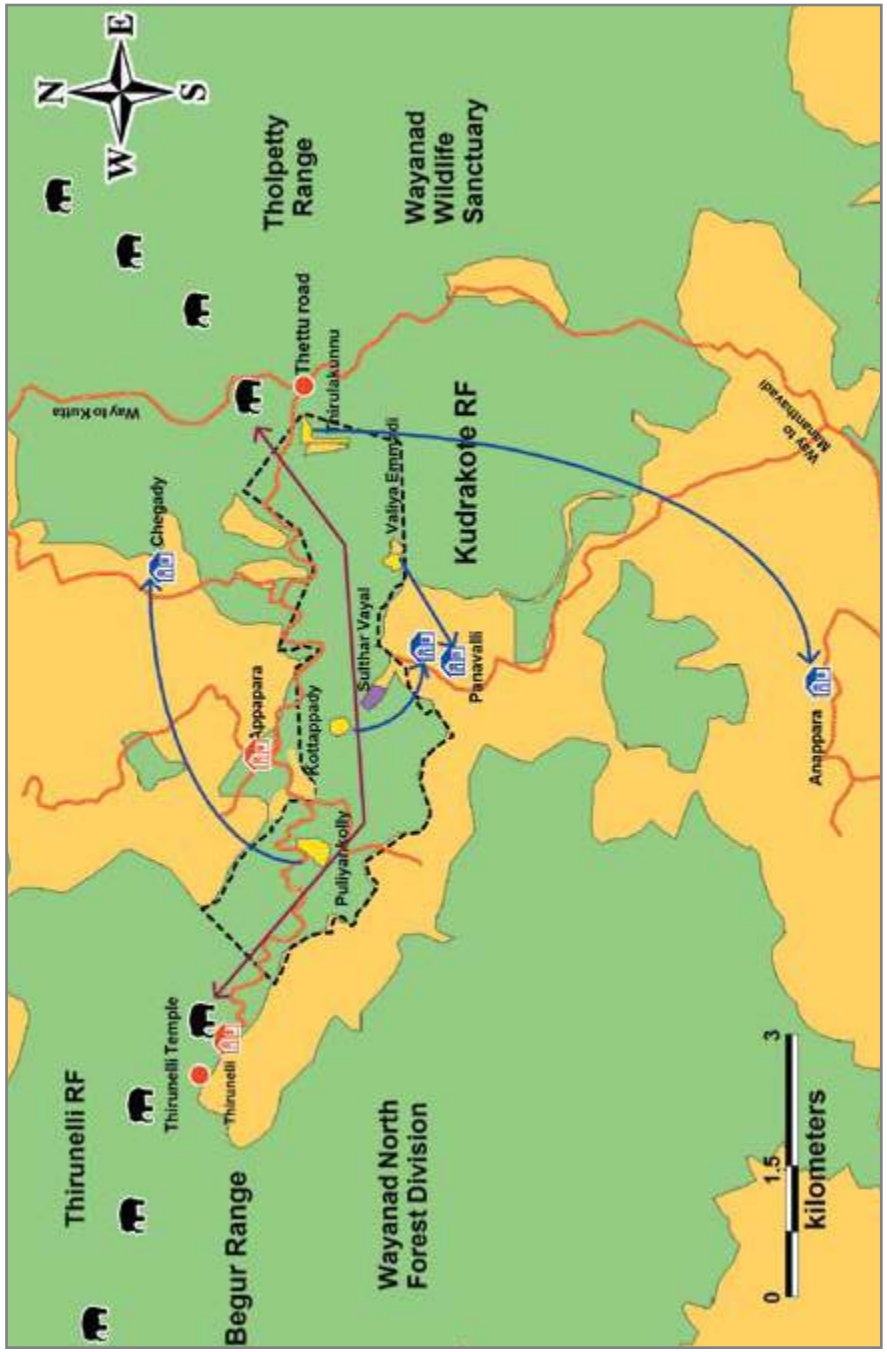
Ecological priority: High
Conservation feasibility: High

The elephant habitats of north Karnataka along the Brahmagiri Hills are connected to those on the Coorg plateau (also in Karnataka) through the northern Wayanad region of Kerala. The southern tip of the Brahmagiris extends into Kerala's Wayanad North Forest Division, where the Thirunelli Reserve Forest and Kudrakote Reserve Forest provide a narrow eastward connection to the Tholpetty Range of Wayanad Wildlife Sanctuary. This is an important corridor to maintain habitat contiguity for elephant populations along the Brahmagiri Hills and has been secured by Wildlife Trust of India (WTI) and the Asian Nature Conservation Foundation (ANCF) through the purchase of land and voluntary rehabilitation of people from the corridor.

Alternate Name	Brahmagiri-Thirunelli
State	Kerala
Connectivity	Wayanad Wildlife Sanctuary with Wayanad North Division (Kerala)
Length and Width	6 km and 1–1.5 km
Geographical coordinates	11° 53′ 9″- 11° 54′ 44″ N 76° 0′ 19″- 76° 3′ 55″ E
Legal status	Reserve Forest
Major land use	Forest, agriculture
Major habitation/settlements	Nil
Forest type	Tropical dry deciduous and teak plantation
Frequency of usage by elephants	Regular



3D map showing the landscape of the Thirunelli – Kudrakote Corridor



Map of Thirunelli- Kudrakote corridor showing the secured land

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 41 tree species were recorded in corridor villages. The most common species were *Olea dioica, Dalbergia latifolia, Mallotus tetracoccus, Cassia fistula, Largestroemia lanceolata* and *Coffea Arabica*, which accounted for more than 10% of the total trees. The dominant tree species varied between the corridor villages: O*lea dioica* and *Mallotus tetracoccus* were the most common in Kottapady and bamboo and *Cinnamumam verum* were dominant in Puliyankolly.

Estimated elephant numbers in the landscape

Wayanad Wildlife Sanctuary: 224 (elephant density of 2.0718 per sq km)
Wayanad North Division: 33 (elephant density of 0.3116 per sq km)

Forest/Land use

Forest type: Tropical dry deciduous and teak plantation
Human settlements: Edayurvayal (four other villages were relocated by WTI), and homestays
Agriculture land
Buildings/Artefacts: Solar fencing, Elephant Proof Trench, forest timber depot
Road: Mananthavady-Thirunelli

Other ecological importance

Mountain Range: Western Ghats
Elephant Range: Brahmagiri-Nilgiri-Eastern Ghats Landscape
Elephant Reserve: Wayanad Elephant Reserve
Protected Area: Wayanad Wildlife Sanctuary
Biosphere Reserve: Nilgiri Biosphere Reserve

HUMAN DIMENSIONS

Threats

1. Road: The Mananthavady-Thirunelli temple road passes through the corridor for about six kilometres and is a threat to the free movement of elephants.

Vehicle movement is highest from 1 pm to 2 pm (54 vehicles), followed by 2 pm to 5 pm (20 vehicles) and 4 pm to 7 pm (14 vehicles). Eighty-six vehicles were recorded on the road between 6 am and 10 am, and 56 vehicles between 8 pm and 6 am. As most elephants cross the road in the late evenings and at night, the threat from road traffic is not severe. However, vehicular movement increases drastically during festivals at the Thirunelli Temple, significantly hindering the movement of elephants.

Corridor villages: Five villages were located inside the corridor: Valiya Emmady, Thirulakunnu, Kottapady, Puliyankolly and Edayurvayal. Of these, the first four had considerably reduced the width of the corridor. These villages have been relocated by Wildlife Trust of India and the Kerala Forest Department to alternate sites where the villagers were provided with agricultural land, new houses and other amenities. WTI handed over the secured corridor lands to the forest department for further legal protection and these have been notified as part of Wayanad Wildlife Sanctuary and Wayanad North Division.

Corridor dependent villages: Edayurvayal (10 families) and Panavally

Human-Elephant Conflict: Conflict is quite high in and around the corridor area. Some 23 cases of human injury and 24 human deaths were reported from the region between 2001 and 2013.

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent development activities hindering elephant movement.

2. Four corridor villages were secured by WTI through the purchase of 25.4 acres of land and voluntary relocation of 37 families. The secured land has been notified as part of Wayanad Wildlife Sanctuary and Wayanad North Division, but needs to be monitored regularly by WTI and the forest department to prevent land use changes. ANCF has also secured 12 acres of land from Sultharvayal.

3. About 12 acres of land in Thirulakunnu, currently under the ownership of a private tourism company, should be secured by the forest department and added to the Protected Area network. This land has already been declared as Ecologically Fragile Land (under Section 4 of the EFL Act).



Fig. 8.12: Elephants passing through the Thirunelli–Kudrakote corridor

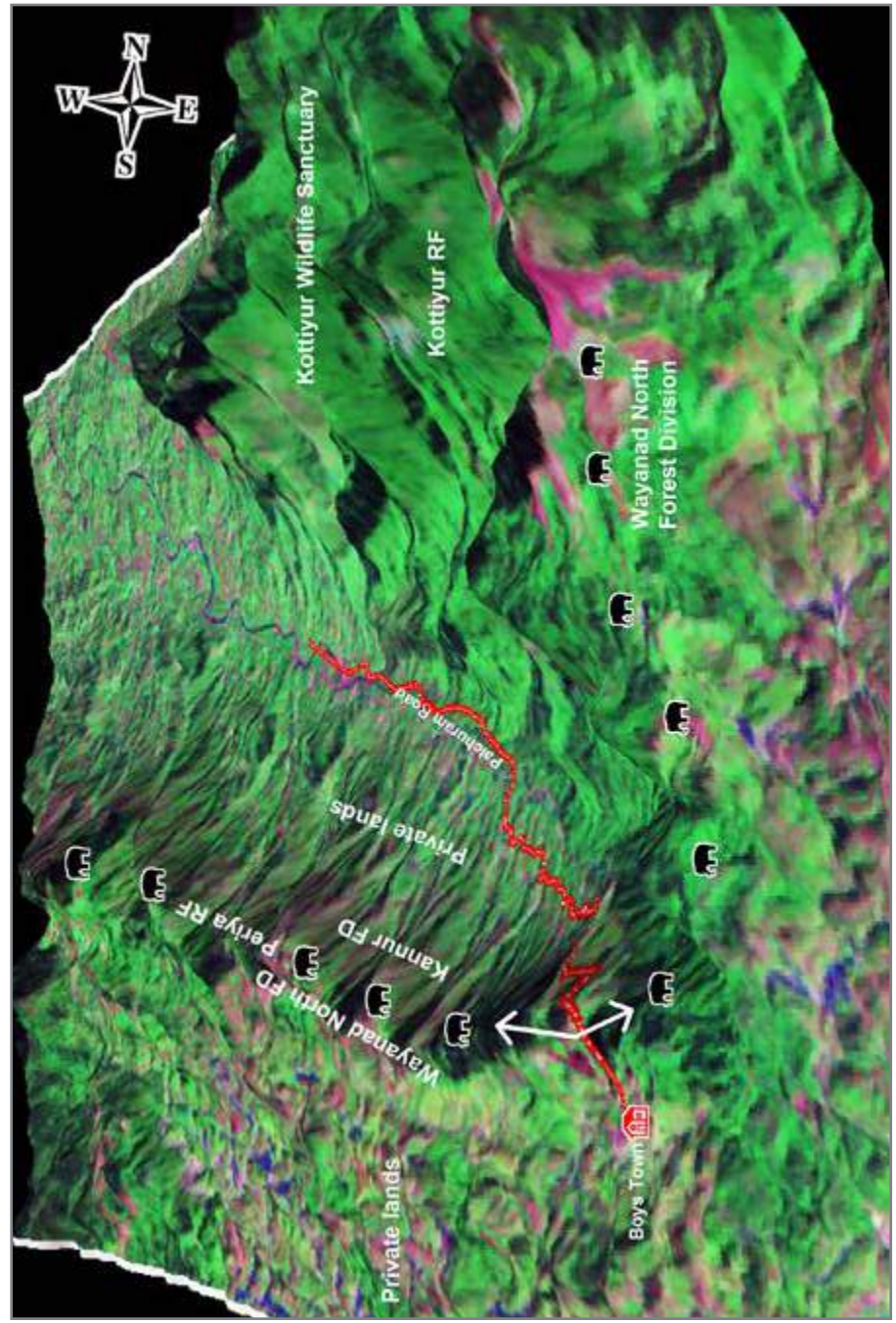
8.16
KOTTIYUR - PERIYA

Ecological priority: Medium

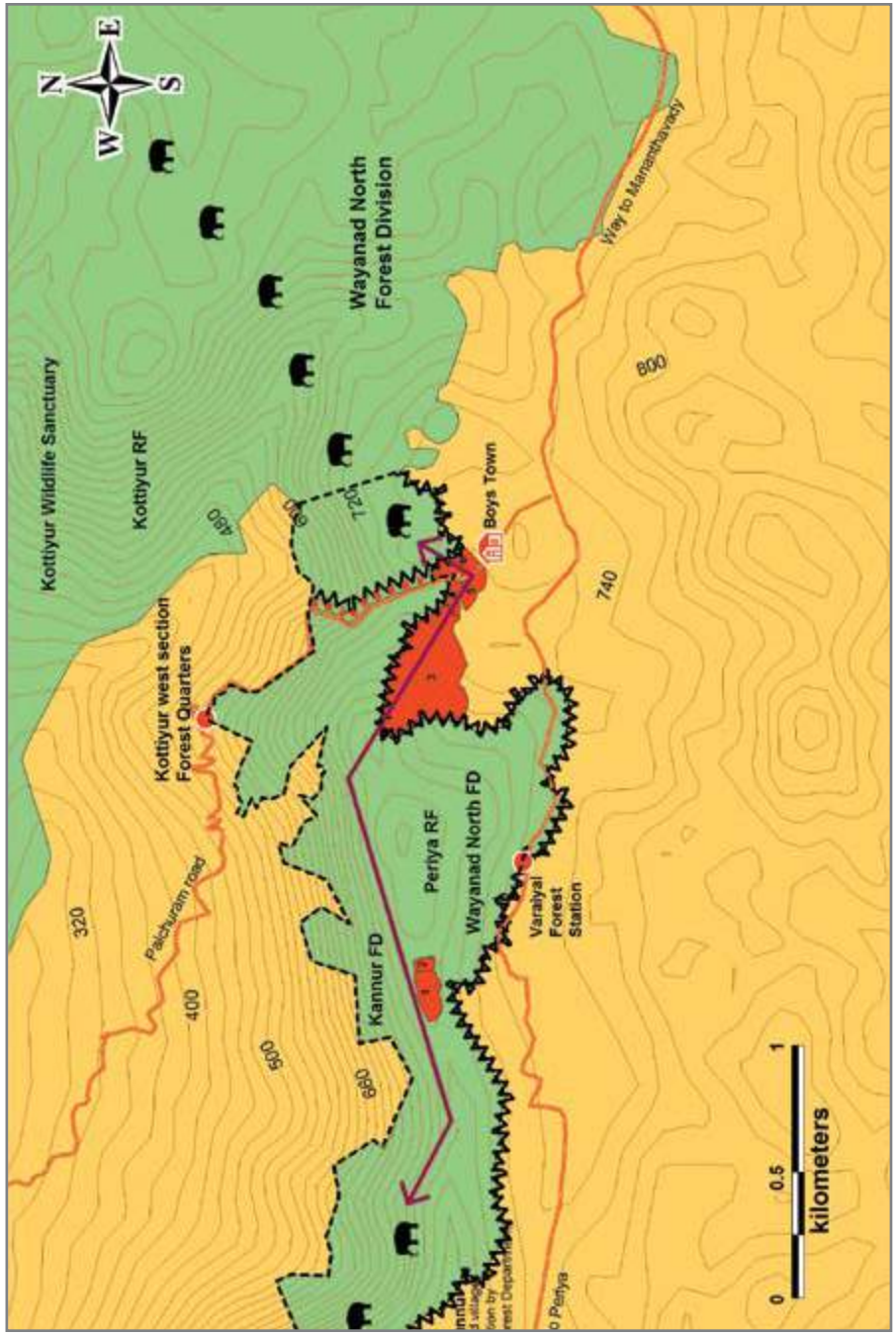
Conservation feasibility: Medium

The Kottiyur-Periya corridor is located within the Periya Reserve Forest (Periya Range) of Wayanad North Forest Division and Kottiyur Range of Kannur Forest Division extending up to Kottiyur Reserve Forest of Kottiyur Wildlife Sanctuary under Kannur Forest Division. Elephants from Wayanad North Division move to Brahmagiri Wildlife Sanctuary through Kannur Forest Division and Wayanad Wildlife Sanctuary, via the narrow and undulating forests, rubber estates and agricultural lands at Boys Town village. The corridor forest is disconnected due to the steep edges that were cut into the mountain while constructing the Palchuram road between Boys Town and Kottiyur. Elephants can now cross the corridor only near a bridge located 500 metres from Boys Town junction.

Alternate Name	Periya, Palchuram
State	Kerala
Connectivity	Periya Reserve Forest of Wayanad Forest Division with Kottiyur Reserve Forest of Kottiyur Wildlife Sanctuary
Length and Width	3 km and 0 – 0.15 km
Geographical coordinates	11° 50’ 20”- 11° 51’ 6” N 75° 53’ 13”- 75° 55’ 15” E
Legal status	Reserve Forests
Major land use	Reserve forest, rubber estate, tea garden, coffee estate, private lands, agriculture, settlement
Major habitation/settlements	Boys Town and Varaiyal
Forest type	Tropical semi evergreen forest
Frequency of usage by elephants	Regular



3D map showing the landscape of the Kottiyur – Periya Corridor



Map of the Kottiyur – Periya Corridor showing the land to be secured

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 16 tree species were recorded in the sampled area, of which eight are palatable to elephants. *Artocarpus hirsutus, Oroxylum indicum, Alstonia scholaris* and *Terminalia paniculata* were the dominant species in the corridor forest. *Terminalia paniculata, Myristica contorta, Grewia tiliifolia* and *Mesua ferrea* were important among the high girth class. Ground cover comprised shrubs (36%), followed by herbs (33%) and grasses (31%).

Estimated elephant numbers in the landscape

The South India synchronised elephant census conducted during 2010 in Kerala shows an estimated mean density of 0.3116 and 0.1220 elephants per sq km in North Wayanad Division and Kannur Forest Division respectively. The elephant population of these two forest divisions indicates that a minimum of 121 elephants are extensively using this corridor.

Forest/Land use

Forest type: Tropical semi evergreen forest
Coffee and Rubber estates
Agriculture: Banana, coconut, pepper, vegetables, areca nut etc
Settlements: Boys Town and Varaiyal
Road: Mananthavady-Kannur state highway (Palchuram road)

Other ecological importance

Mountain Range: Western Ghats
Elephant Range: Brahmagiri-Nilgiri-Eastern Ghats Landscape
Elephant Reserve: Wayanad Elephant Reserve
Protected Area: Kottiyur Wildlife Sanctuary

HUMAN DIMENSIONS

Threats

1. Vehicular traffic on the Palchuram-Mananthavady road: Heavy vehicles carrying bricks ply regularly on this road, with a peak in the evening hours. Four-wheeled

vehicles also ply regularly, except at night, with their peak movement happening in the afternoons and evenings. The peak movement of two-wheelers happens in the afternoons and about 8 o'clock at night. Overall, while traffic volume lessens at night, it still hinders elephant movement since the peak movement of heavy vehicles coincides with that of elephants.

3. Coffee estates: Two coffee estates are located inside the corridor at Varaiyal and considerably reduce the width of the corridor.

4. Boys Town village: The village completely blocks the movement path of elephants.

5. Solar fences erected by the forest department and estate owners in the corridor hinder animal movement.

Corridor villages: Boys Town is situated about 18 km from Mananthavady. There are 12 households in this village, with a total of 65 individuals (28 male and 37 female). The village comes under the Thavinjal Grama Panchayath, Periya Village and Mananthavady Taluk of Wayanad district.

The village's inhabitants have been facing problems with elephants and other wild animals for the past decade. A few of them cultivate coffee, areca nut, pepper, banana, vegetables, coconut etc. They are unable to earn an adequate living from agriculture, however, with up to 60% of their profits being lost due to crop depredation by elephants and other wildlife. Some of them work as daily wage labourers in the nearby coffee and rubber estates.

Corridor dependent villages: Periya, Pokkottu-Chapparam, Chanthanathodu, 37th Mile and CRP Kunnu.

Human-Elephant Conflict: There has been an increasing trend of crop depredation by elephants over the years. From 2006 to 2011, ex-gratia support of Rs 119.5 lakh was paid by the forest department for crop damage and damage to property by elephants, at an average of about Rs 20 lakh per annum.

CONSERVATION PLAN

1. The corridor should be notified by the state forest department and legally protected under an appropriate law to prevent encroachment and developmental activities detrimental to animal movement.

2. Since the corridor area is of a very critical nature, part of it could be declared as Ecologically Fragile Land (EFL). A total of 48.2 acres of land has been identified as Priority I to secure the corridor and increase its width at Boys Town village and Varaiyal.

Land identified to secure the corridor

Plot No. as marked in Map	**Extent of area (acres)**	**Survey Number**
In Varaiyal village		
1	5.20	3023
2	1	3023
	6.20	
In Boys Town village		
3	12	5/1A
3	2.70	5/1A
3	2.70	5/1A
3	2.70	5/1A
3	2.70	5/1A
3	2.70	5/1A
4	12	5/1A
5	0.15	5/1B
5	0.45	5/1B
5	1.50	5/1A
5	1.90	5/1A
5	0.05	5/1B

5	0.30	5/1B
5	0.10	5/1B
5	13.50	5/1A
6	1.50	5/1A
6	0.04	5/1B
6	1.10	5/1B
6	3.18	5/1A
6	1.50	5/1B
	62.77	

The Priority I land identified for securing the corridor from Boys Town village is about 42 acres out of 62.77 acres.

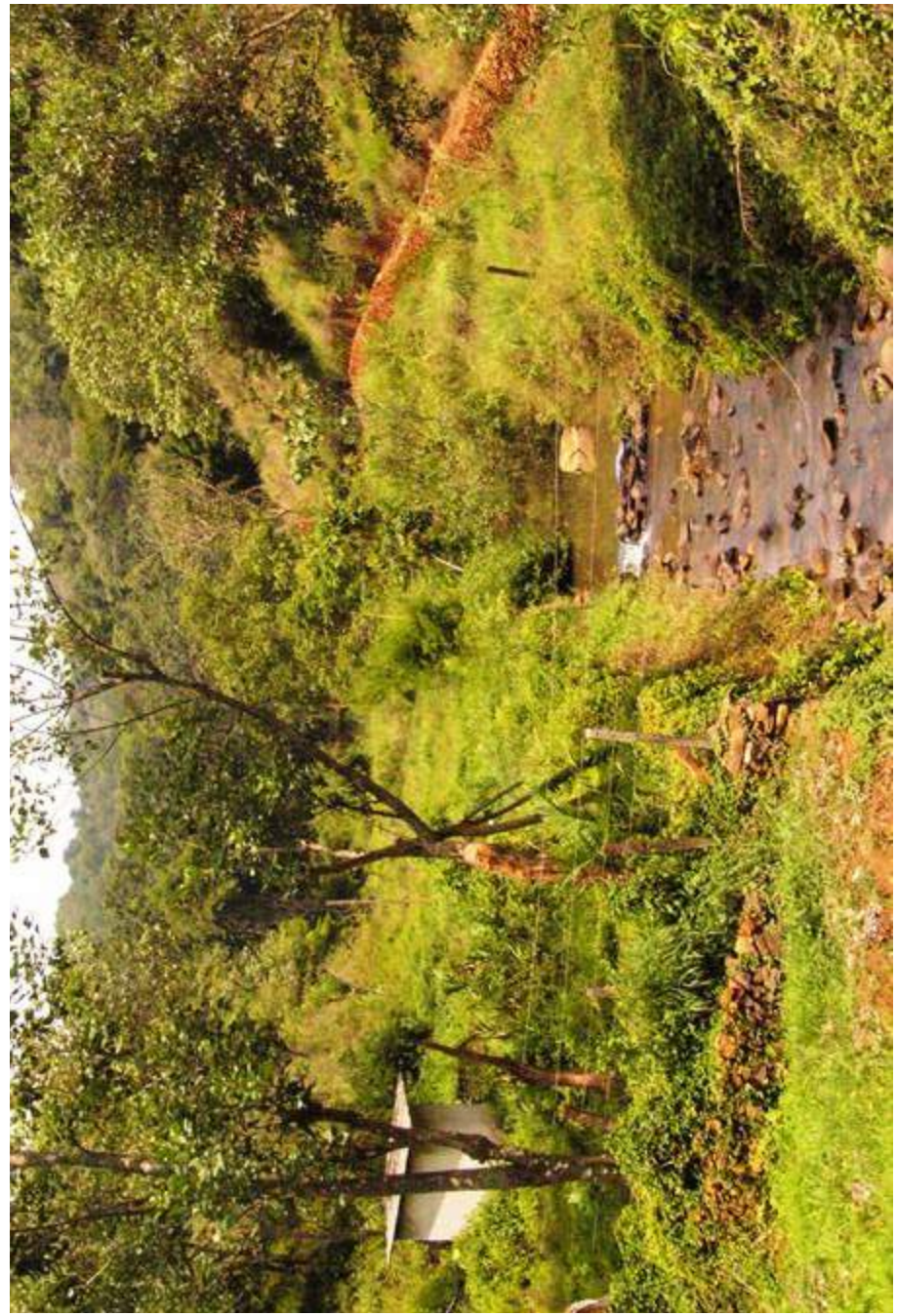


Fig. 8.13: Land identified for securing Kottiyur–Periya corridor

8.17
PERIYA AT PAKRANTHALAM

Ecological priority: Medium

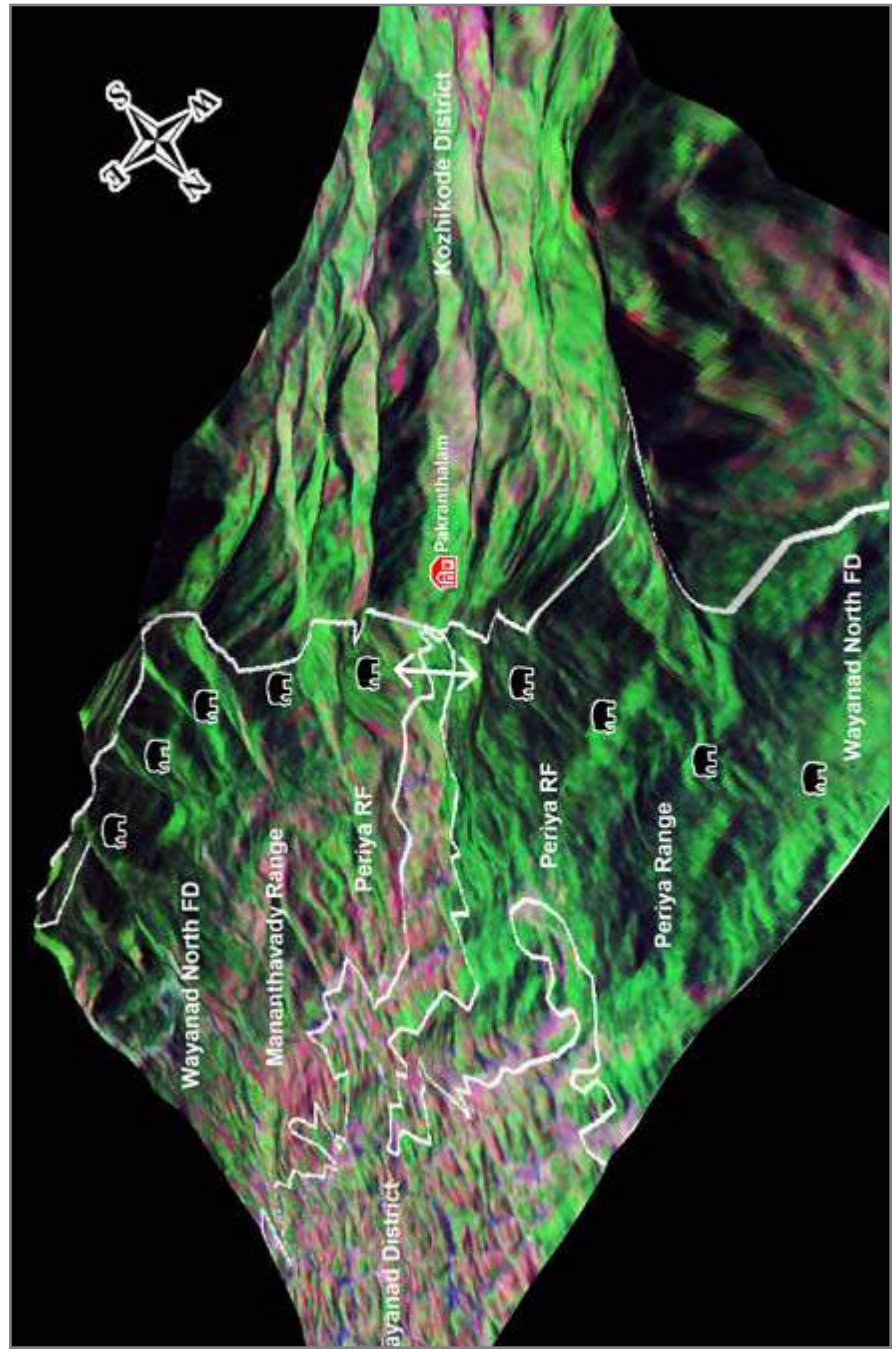
Conservation feasibility: High

This corridor connects the northern and southern portions of the Periya Reserve Forest in Wayanad North Division. Elephants from Wayanad North Division move to Kozhikode Forest Division through narrow and undulating forests between Periya and Pakranthalam villages. Forest connectivity has been cut off due to the Mananthavady-Kuttiadi ghat road and a cell phone tower at the Kozhikode-Mananthavady district border. Presently, elephants pass through the farmlands and fallow estate lands in the area.

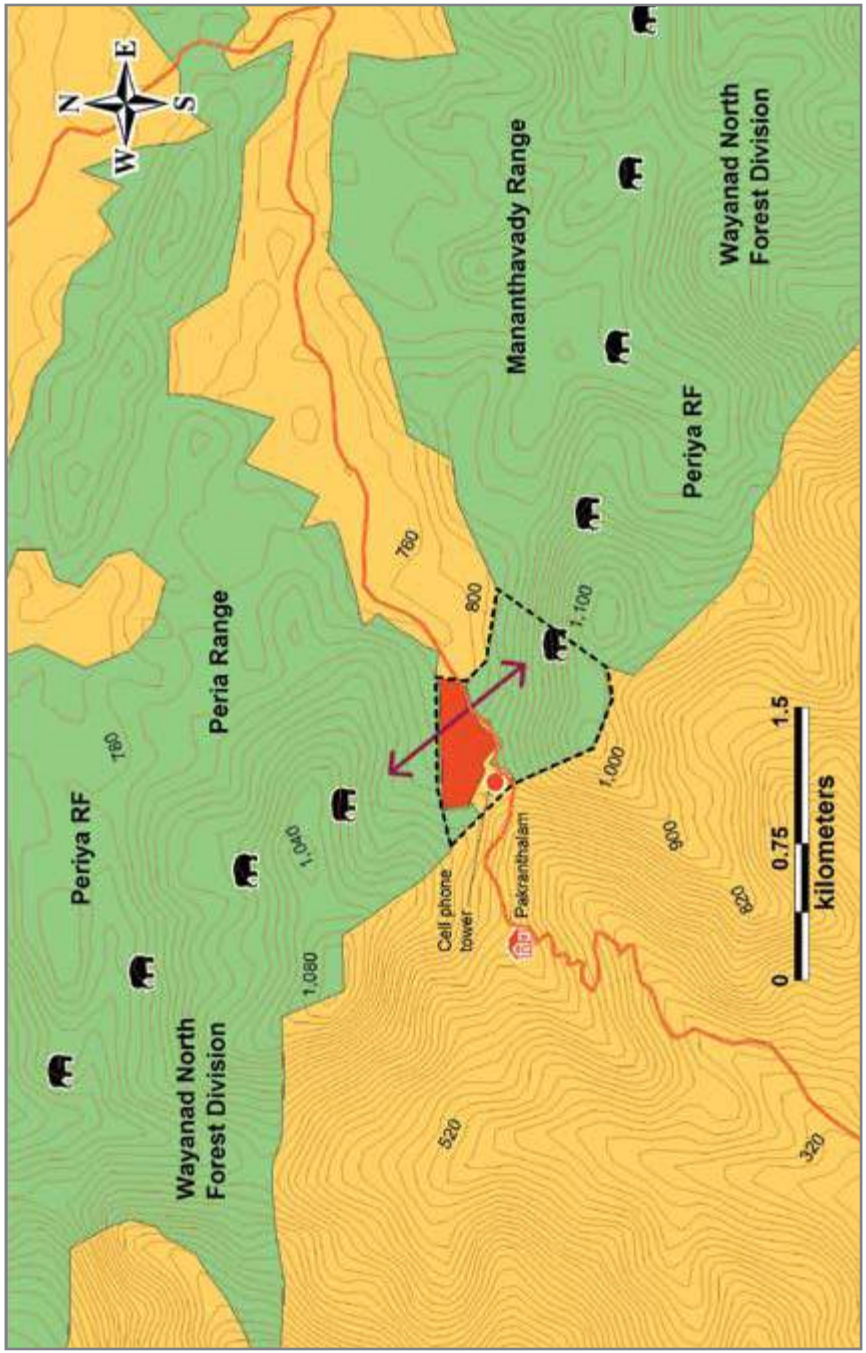
Alternate Name	Pakranthalam
State	Kerala
Connectivity	Northern and southern portion of Periya Reserve Forest
Length and Width	0.5 km and 0-0.3 km
Geographical coordinates	11° 43′ 37″- 11° 44′ 8″ N 75° 49′ 8″- 75° 49′ 55″ E
Legal status	Reserve Forest and Private Land
Major land use	Forest, estate, settlement
Major habitation/settlements	Pakranthalam
Forest type	Tropical moist deciduous forest
Frequency of usage by elephants	Seasonal

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 17 tree species were recorded in the sampled area, of which seven are palatable to elephants. *Schleichera oleosa* and *Bischofia javanica* were the dominant tree species. *Clutia retusa, Mesua ferra, Syzygium lanceolaria, Lagerstroemia microcarpa* and *Dalbergia latifolia* were important among the high girth class.



3D map showing the landscape of the Periya at Pakranthalam Corridor



Map of the Periya at Pakranthalam Corridor showing the land to be secured

Ground cover: Shrubs covered almost 40% of the ground, followed by grasses (30%) and herbs (30%).

Estimated elephant numbers in the landscape

North Wayanad Forest Division: 33
Kozhikode Forest Division: 26
(Wild Elephant Census of Kerala State, 2010)

Forest/Land use

Forest: Tropical moist deciduous
Agriculture land and Coffee estates
Buildings/Artefacts: Cell phone tower, Private farm house
Road: Mananthavady-Pakranthalam state highway

Other ecological importance

Mountain Range: Western Ghats
Elephant Range: Brahmagiri-Nilgiri-Eastern Ghats Landscape
Elephant Reserve: Wayanad Elephant Reserve

HUMAN DIMENSIONS

Threats

1. A cell phone tower is located on the Kozhikode-Manathavady district boundary in the bottleneck of this corridor and has completely blocked elephant movement.

2. Kozhikode-Mananthavady via Kuttiadi road: This is a ghat road that passes through the corridor. Steep downward and upward slopes on both sides of the road hinder elephant movement.

3. Traffic: A traffic intensity survey conducted on the Pakranthalam-Mananthavady road revealed that 44 vehicles per hour ply through the corridor on average. Vehicle movement was highest from 1 pm to 2 pm (60 vehicles),

followed by 2 pm to 5 pm (58 vehicles) and 5 pm to 6 pm (58 vehicles). Vehicle movement was high between 6 am and 8 pm (53 vehicles) compared to the night hours (31 vehicles between 8 pm and 6 am). As elephants mostly cross the road during the late evenings and nights, the threat from road traffic is as yet manageable.

4. Plantation: The corridor is blocked by a patch of private land which is partially cultivated.

5. A resort is under contruction within 200 metres of the corridor and just one metre from the forest boundary. This will be a major obstruction to the free movement of elephants and other wildlife.

Corridor villages: No settlements lie within the corridor. However, there are a few plantations with farm houses, where crops such as coffee, areca nut, ginger and turmeric are cultivated. The landowners are from upper middle-class backgrounds and are financially stable.

A cell phone tower is also located on 13.50 acres of land with a degraded agricultural field which falls within the corridor area. This area has been declared as Ecologically Fragile Land (EFL).

Corridor dependent villages: Pakranthalam, Surani, Valanthode, Pannoth, Niravilpuzha and Kunhome

Human – Elephant conflict: Crop damage by elephants is high in the corridor area. No human or elephant death has been recorded due to conflict, though one person was injured in an elephant-related incident in 2009.

CONSERVATION PLAN

1. The corridor should be notified by the state forest department and protected under an appropriate law to prevent encroachment and development activities detrimental to animal movement.

2. Since the traditional corridor is almost blocked, the elephants are mostly passing through four plots of about 31.8 acres, owned by four individuals. These need to be secured to restore the corridor. Coffee, arecanut, ginger, turmeric etc. are being cultivated in the three farmland plots here. The fourth plot of 13.5 acres in which a cell phone tower is located in the most vital part of the corridor.

Land identified to secure the corridor

Extent of area (acres)	**Status of the land**
13.50	Patta land
6.70	Patta land
8.6	Patta land
3	Patta land

8.18
NILAMBUR AT APPANKAPPU

Ecological priority: High
Conservation feasibility: High

This corridor connects the Nilambur and Vazhikadavu Ranges of Nilambur North Forest Division. The corridor is located at the inter-state boundary of Tamil Nadu and Kerala. Elephants move from Wayanad South Forest Division to Gudalur Forest Division, Tamil Nadu and Nilambur South Forest Division, Kerala through a bottleneck forest patch between Appankappu Rubber Estate and Munderi village in Nilambur North Forest Division.

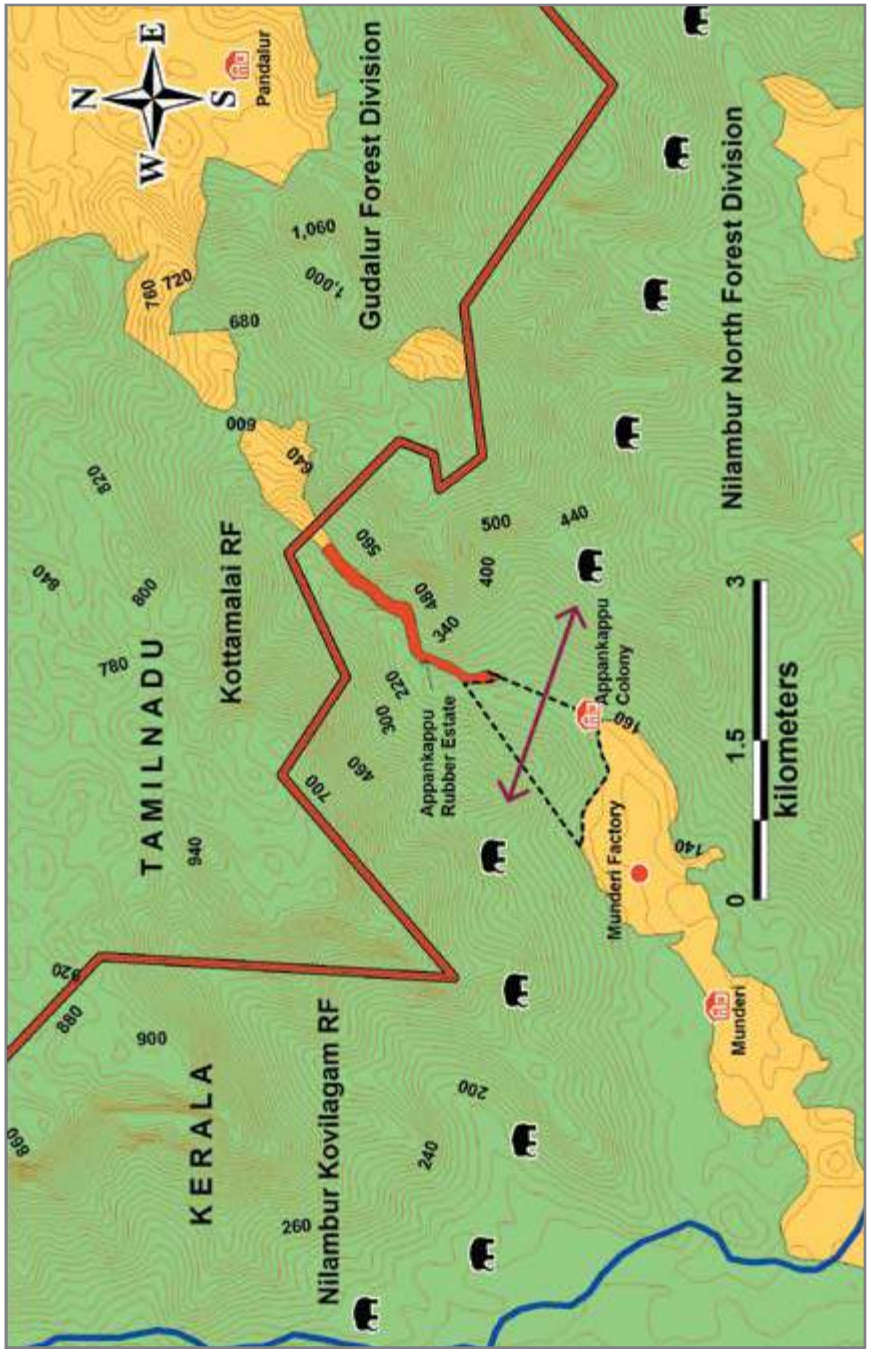
Alternate Name	Nilambur
State	Kerala
Connectivity	Nilambur North and Nilambur South Division
Length and Width	0.4 km and 0.5 km
Geographical coordinates	11° 27′ 9″- 11° 28′ 38″ N 76° 16′ 23″- 76° 17′ 58″ E
Legal status	Reserve Forest
Major land use	Forest, agriculture and settlements
Major habitation/settlements	Appankappu, Munderi
Forest type	Tropical thorn and deciduous forest
Frequency of usage by elephants	Regular

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 27 tree species were recorded in the sampled area, of which six were elephant food species. Maximum GBH was recorded in *Lagerstomia microcarpa* (136 cm). The maximum height was observed in *L. microcarpa* (30 m), Poovathi (25 m) and Kalpoovathi (12 m). There were



3D map showing the landscape of the Nilambur at Appankappu Corridor



Map of the Nilambur at Appankappu Corridor showing the land to be secured

positive indicators of bamboo regeneration in the corridor, but signs of lopping and wood cutting were seen on nearly all trees.

Ground cover: Grasses: 20%, shrubs: 25%, herbs: 20% and barren ground: 35%.

Estimated elephant numbers in the landscape

Nilambur North Division: 73 (elephant density: 0.2536 per sq km)
Nilambur South Division: 33 (elephant density: 0.1924 per sq km)

Forest/Land use

Forest type: Tropical thorn and deciduous forest
Settlements: Appankappu and Munderi
Buildings/Artefacts: Rubber estates
River: Nirpuzha

Other ecological importance

Mountain Range: Western Ghats
Elephant Range: Brahmagiri-Nilgiri-Eastern Ghats Landscape
Elephant Reserve: Nilambur Elephant Reserve

HUMAN DIMENSIONS

Threats

1. Rubber estates: Appankappu Rubber Estate considerably reduces the width of the corridor, hindering the free movement of elephants.

2. Settlements: There is a major human settlement, Appankappu Colony (132 households) surrounded by a six-foot-high stone wall that extends for about two kilometres. The inhabitants mainly depend on the corridor forest for NTFP.

Corridor villages: Apart from the families living in Appankappu Colony, there are 10 families living in Appankappu Rubber Estate. The estate owners and local people here are not prepared to accept voluntary relocation to an alternate site.

Corridor dependent villages: Munderi, Appankappu

Community: Paliyar Tribals

Human-Elephant Conflict: Conflict is on the rise in and around the corridor, with 91 cases reported between 2009 and 2013. A total of Rs 3,00,898 was disbursed as ex-gratia for losses due to crop depredation by elephants.

CONSERVATION PLAN

1. The corridor should be notified by the state forest department and protected under an appropriate law to prevent encroachment and developmental activities detrimental to animal movement.

2. In consultation with the villagers, corridor land in Appankappu Rubber Estate could be secured.

3. Construction on either side of the corridor needs to be regulated.

Land identified to secure the corridor

Extent of area (acres)	**Status of the land**
3.5	Patta land
10.40	Patta land
2	Patta land
4	Patta land
40	Patta land
18	Patta land



Fig. 8.14: A view of the Nilambur at Appankappu Corridor

8.19
NILAMBUR KOVILAGAM - NEW AMARAMBALAM

Ecological priority: Medium

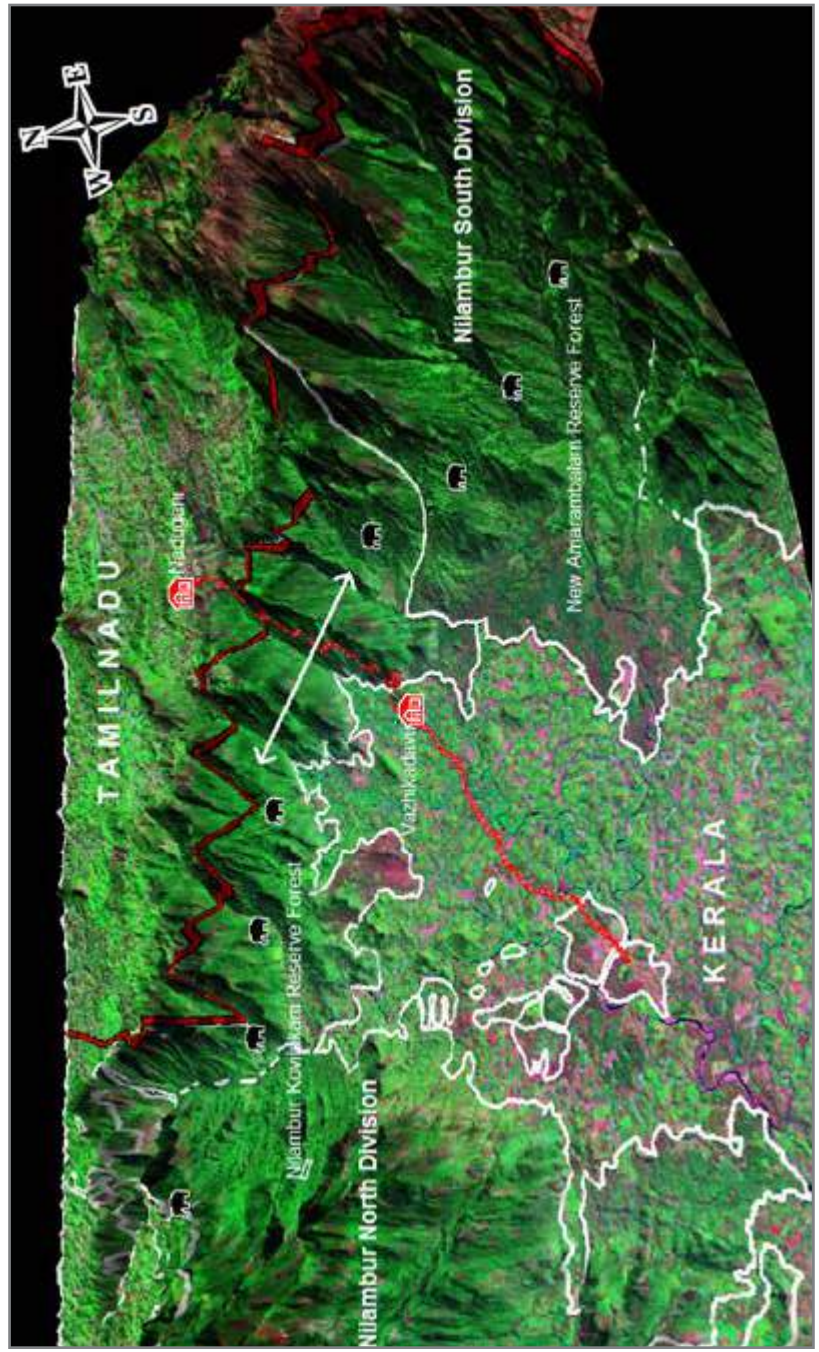
Conservation feasibility: High

This corridor connects the Nilambur Kovilagam Reserve Forest of Nilambur North Division and the New Amarambalam Reserve Forest of Nilambur South Division. The corridor links to Wayanad South Division in the northwest and to Nilgiri Biosphere Reserve and Nilambur South Division in the south, and further on to Silent Valley and Mukurthi National Parks. The corridor is situated on the Gudalur-Nilambur road, with a stretch of forest on both sides of the road. The slopes are very steep and elephants can cross only at four points.

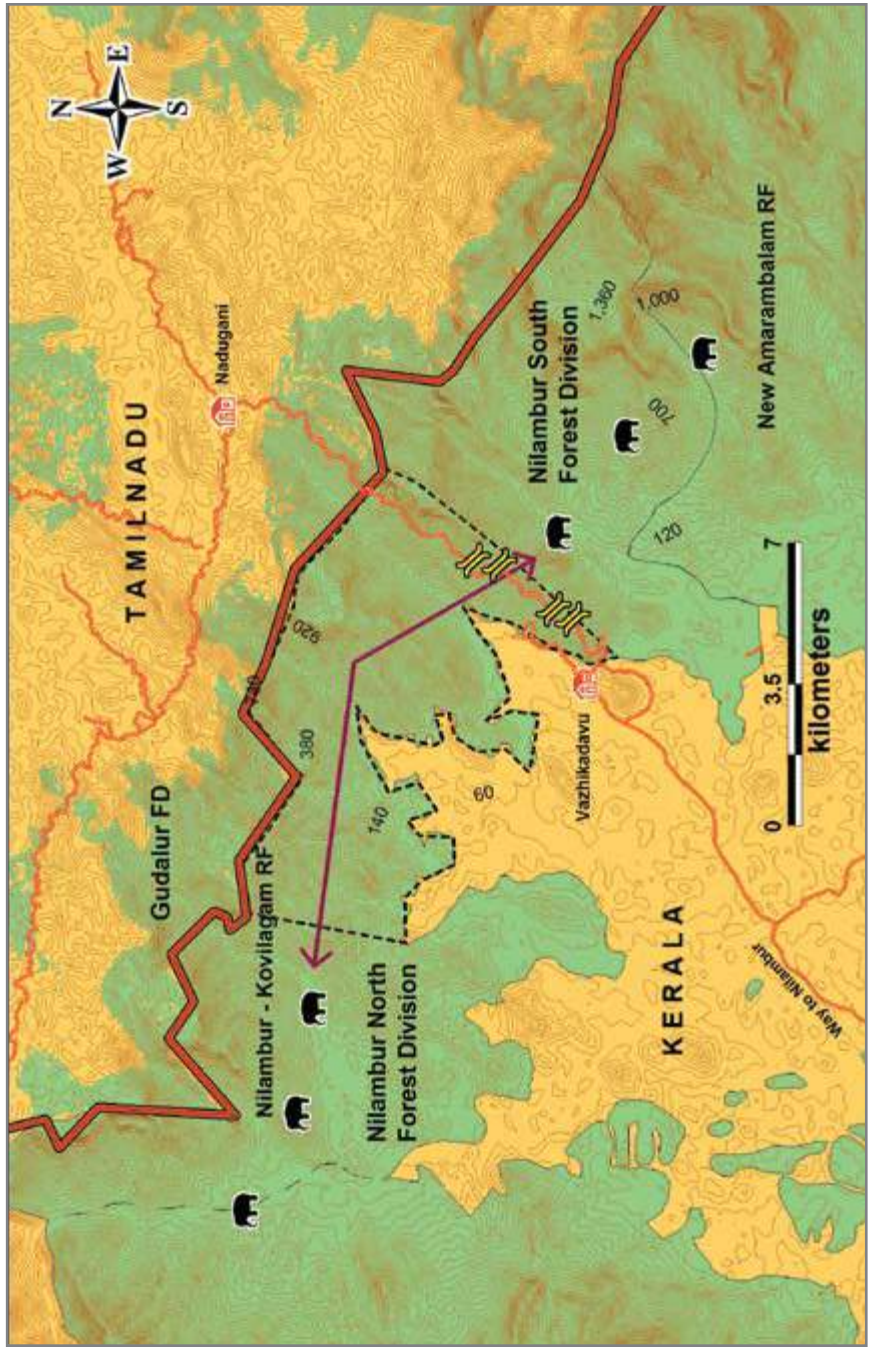
Alternate Name	Vazhikadavu
State	Kerala
Connectivity	Nilambur North Division to Nilambur South Division
Length and Width	1 km and 0.2-0.4 km
Geographical coordinates	11° 23′ 2″- 11° 27′ 59″ N 76° 17′ 23″- 76° 23′ 51″ E
Legal status	Reserve Forest
Major land use	Forest
Major habitation/settlements	Nil
Forest type	Tropical semi evergreen forest
Frequency of usage by elephants	Occasional

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 20 tree species were recorded in the sampled area. Of these, 11 species are palatable to elephants. A*nogeissus latifolia, Terminalia paniculata, Xylia xylocarpa, Alstonia scholaris* and *Tectona grandis* were



3D map showing the landscape of the Nilambur Kovilagam – New Amarambalam Corridor



Map of the Nilambur Kovilagam – New Amarambalam Corridor

the dominant species. Fruiting and shade bearing trees were very limited. There was no salt lick found near the corridor area. The Karakodu and Punjakolly Rivers provide water throughout the year for elephants.

Ground cover: Shrubs (37%) and grasses (37%) were found in equal proportion, followed by herbs (26%). In spite of cattle grazing from nearby villages, the grass cover was good.

Estimated elephant numbers in the landscape

Nilambur North Division: 73 (elephant density of 0.2536 per sq km)
Nilambur South Division: 33 (elephant density of 0.1924 per sq km)

Forest/Land use

Forest type: Tropical semi evergreen forest
Road: Nilambur-Gudalur road

Other ecological importance

Mountain Range: Western Ghats
Elephant Range: Brahmagiri-Nilgiri-Eastern Ghats Landscape
Elephant Reserve: Nilambur Elephant Reserve
Biosphere Reserve: Nilgiri Biosphere Reserve

HUMAN DIMENSIONS

Threats

1. Gudalur-Nilambur road: The state highway connecting Ooty with Kozhikode city passes through the corridor. Steep edges on both sides of the road allow elephants to cross only at four points.

2. Biotic pressure: Villages in and around the corridor depend on the corridor forest for NTFP and fuelwood collection, and cattle grazing.

3. Plantations in nearby forest areas have electric fences installed, narrowing the available movement path for elephants and other wild animals. The PCK plantation which is spread over 345 ha significantly affects elephant movement in the lowland forests.

4. Vehicular traffic: Traffic intensity on the Gudalur-Nilambur road is high between 5 am and 7 am (350 vehicles) and again in the evening between 6 pm and 11 pm (334 vehicles). Mostly four- and six-wheel vehicles were recorded in the corridor during these times. The peak hours for vehicular movement coincide with the times when elephants are most active. With vehicles plying at high speeds, the movement of elephants is significantly hindered.

Corridor dependent villages: Vazhikadavu, Punjakolli, Anamari and Karakkodu

Human-Elephant Conflict: Incidents of human death, injury and crop damage were reported in the corridor dependent villages. That conflict is on the rise is revealed by the ex-gratia disbursement records of the forest department, as well as through discussions with the villagers.

Two people were killed by elephants in the Vazhikkadavu Range in 2008-09.

CONSERVATION PLAN

1. The corridor should be notified by the state forest department and legally protected under an appropriate law to prevent encroachment and development activities detrimental to animal movement.

2. The Vazhikadavu and Nadukani ghat road has steep slopes on either side, allowing elephants to cross at only four places. Even in these four places, elephants cannot cross the road right away: once they reach the road they have to walk along it for about 20-80 metres to find the suitable exit point. It is therefore essential that traffic be regulated in the morning and evening hours. The slopes in these four places could be levelled if possible to facilitate elephant movement.



Fog. 8.15: A view of the Nilambur Kovilagam – New Amarambalam Corridor

8.20
MUDUMALAI - NILAMBUR VIA O' VALLEY

Ecological priority: High

Conservation feasibility: Medium

Located on the inter-state boundary of Tamil Nadu and Kerala, this corridor connects Nilambur North Forest Division in Kerala with Nilgiri North Division, Gudalur Forest Division and Mudumalai Tiger Reserve in Tamil Nadu. Elephants move from Nilambur North Division to Mudumalai Tiger Reserve and Bandipur Tiger Reserve through fragmented forest patches, tea/coffee/clove/cardamom estates, and human habitations in Gudalur Forest Division via O' Valley.

Alternate name	Mudumalai-Nilambur
State	Tamil Nadu, Kerala
Connectivity	Mudumalai Tiger Reserve with Nilambur North Forest Division
Length and Width	35 km and 0- 1 km
Geographical coordinates	76 31' 47.725" E, 11 32' 53.874"N 76 24' 34.841" E, 11 25' 30.235"N
Legal status	Reserve Forest
Major land use	Tea, coffee and cardamom plantations, settlements
Major habitation/settlements	26 human settlements
Forest type	Dry deciduous and shola forest
Frequency of usage by elephants	Regular

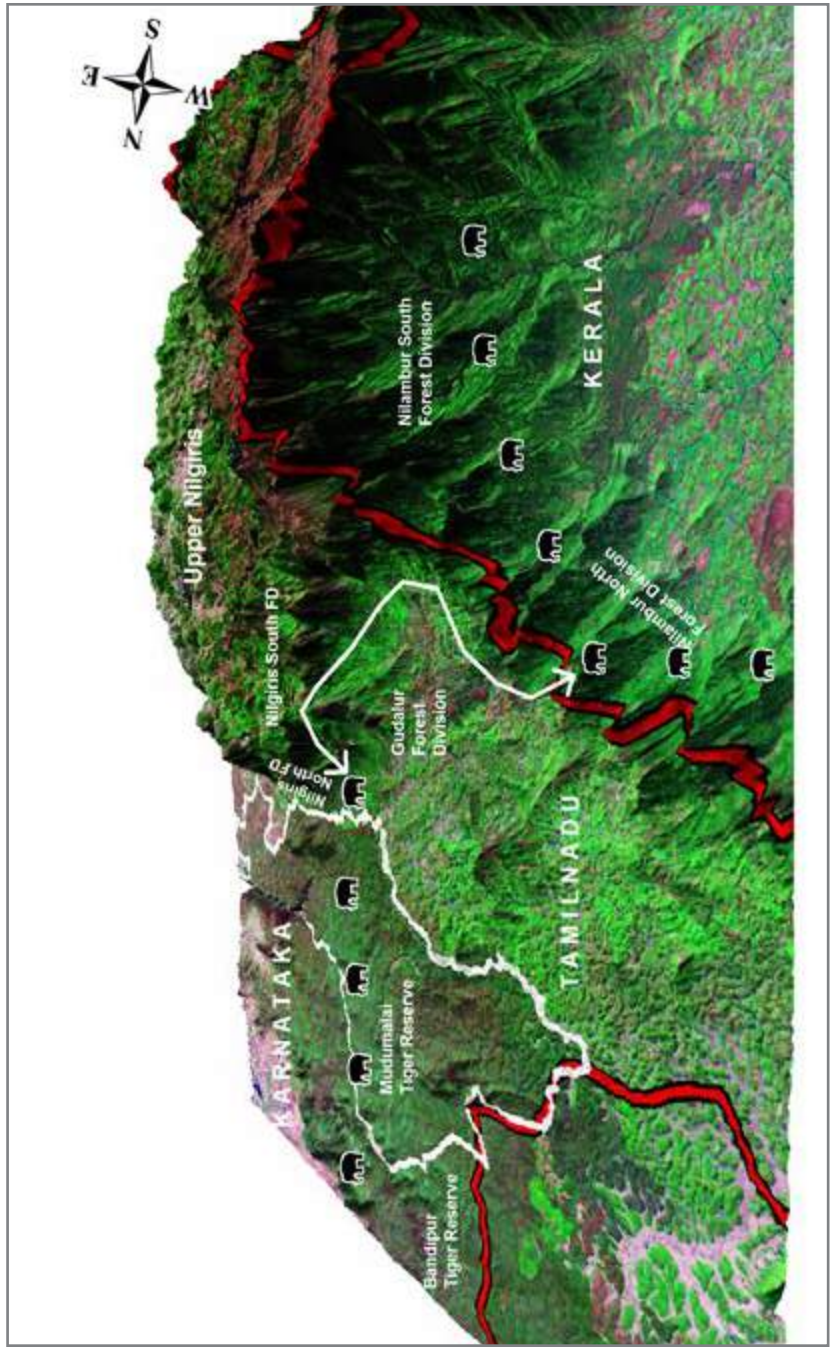
FORESTS AND ELEPHANTS

Estimated elephant population in the landscape

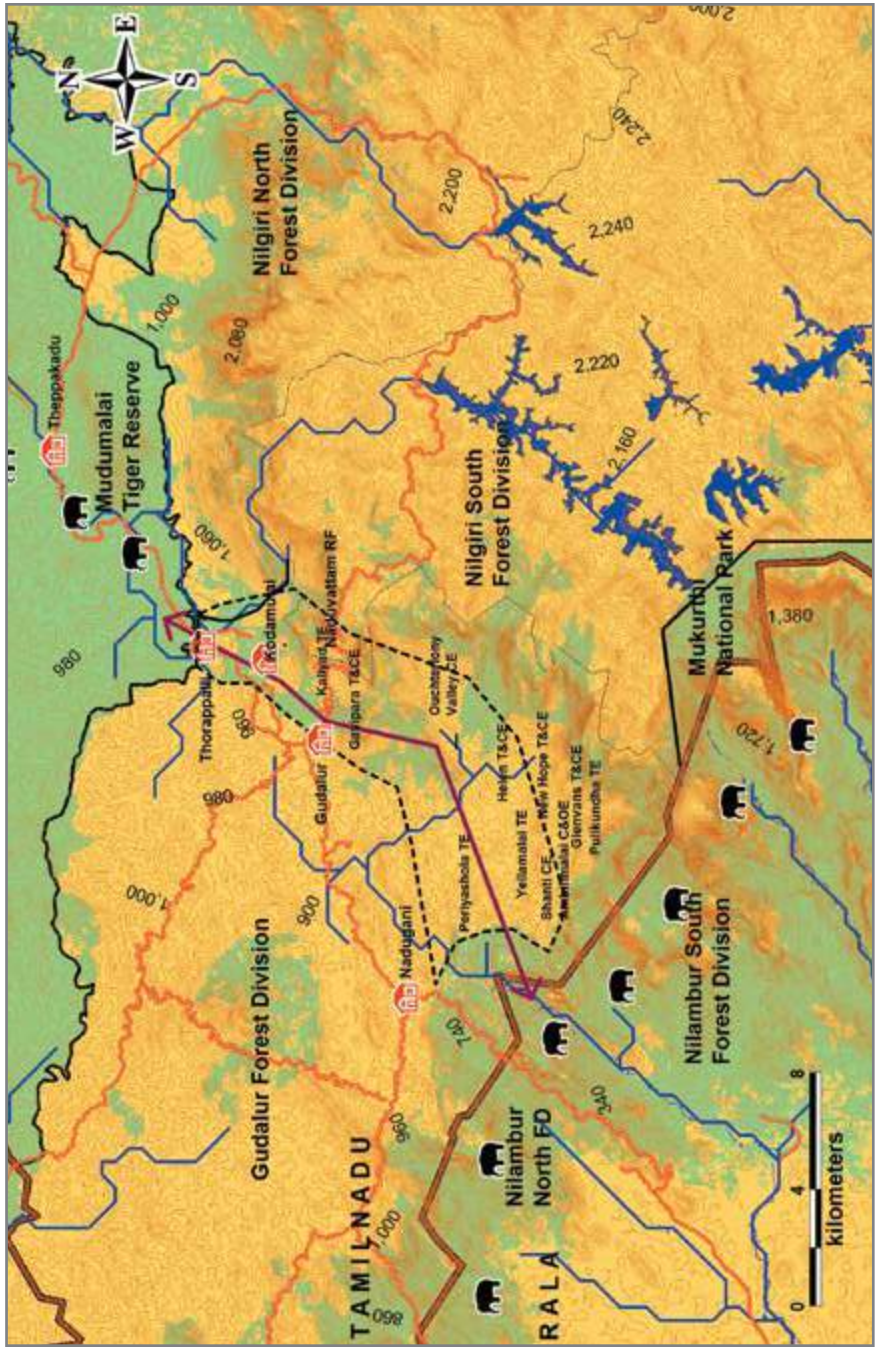
Mudumalai Tiger Reserve: 840

Gudalur Forest Division: 112

Nilgiri North Forest Division: 272



3D map showing the landscape of the Mudumalai – Nilambur via O' Valley Corridor



Map of the Mudumalai – Nilambur via O' Valley Corridor

(*Synchronised Elephant Census, Tamil Nadu, 2012*)
Nilambur North Forest Division: 195 elephants
(*Wild Elephant Census of Kerala State, 2010*)

Forest/Land use

Forest type: Dry deciduous and shola forest
Plantations: Coffee, cardamom, tea
Settlements: Gudalur and surrounding villages
Highway: National Highway 67 (Ooty-Bengaluru)

Other ecological importance

Mountain Range: Western Ghats
Elephant Range: Brahmagiri-Nilgiri-Eastern Ghats Landscape
Elephant Reserve: Nilgiri Elephant Reserve
Protected Area: Mudumalai Tiger reserve
Biosphere Reserve: Nilgiri Biosphere Reserve

HUMAN DIMENSIONS

Threats

1. Human settlements: About 26 settlements are located in the corridor, causing biotic pressure and physically obstructing elephant movement.

2. Plantations: Several tea, coffee and cardamom estates are located all along the corridor. Some of these are protected by electric fences, which significantly affect the free movement of elephants (for instance, the electric fence in Balmadi Estate.)

3. Vehicular traffic: NH 67 connecting Ooty and Bengaluru passes through the corridor. On average, 113.5 vehicles per hour were recorded around the clock on this highway. The movement of four-wheelers was highest (75 per hour), followed by six-wheelers (24 per hour). The frequency of heavy vehicles (three per hour) seemed to be very low. Movement of four-wheelers was very high between 1 pm and 10 pm.

Corridor Villages: About 26 villages/settlements/estate labour quarters with approximately 2000 households are located along the corridor. Most of the people here are wage labourers in the nearby tea and coffee estates. They depend on the corridor forest patches for fuelwood and cattle grazing.

S.no	Name of the settlement / village	Households	Population
1	Silver Cloud Labour Quarters	86	400
2	27th Mail	52	227
3	Gudalur Mali Labour Quarters	42	2
4	Vatta Parai	25	70
5	Number 4	60	300
6	Number 5	16	40
7	Number 6	15	40
8	Gandhinagar	350	700
9	Bulmadi Labour Quarters	15	-
10	Guind Labour Quarters	65	300
11	Kelly	70	400
12	New Hope Labour Quarters	42	200
13	Glenvence Labour Quarters	175	500
14	Mulakadu	212	300
15	Pulikundha	40	-
16	Number 1	80	250
17	Number 2	100	300
18	Number 3	50	100
19	Number 4	180	200
20	Number 6	10	-
21	Indira Magar	100	250
22	Ambulimala	20	10
23	Santhi Estate Labour Quarters	10	2
24	Sathiya Kumari Estate Labour Quarters	20	30
25	Manga Maram	10	30
26	Line Kadu	30	60

Human-Elephant Conflict: The trend of human-elephant conflict in and around the corridor between 2001 and 2013 revealed a high number of human deaths (n=31). About 47 cases of human injury due to elephants were recorded during the same period.

The nature of this landscape, with the corridor being located in a mosaic of forest patches, tea/coffee/clove/cardamom estates and human habitations, is the major cause for elevated human-elephant conflict in this region.

CONSERVATION PLAN

1. The corridor should be notified by the state forest department and legally protected under an appropriate law to prevent encroachment and development activities detrimental to animal movement.

2. Electric fences obstructing elephant movement should be removed.

8.21
JACCANAIRE SLOPE - HULIKAL DURGAM

Ecological priority: High

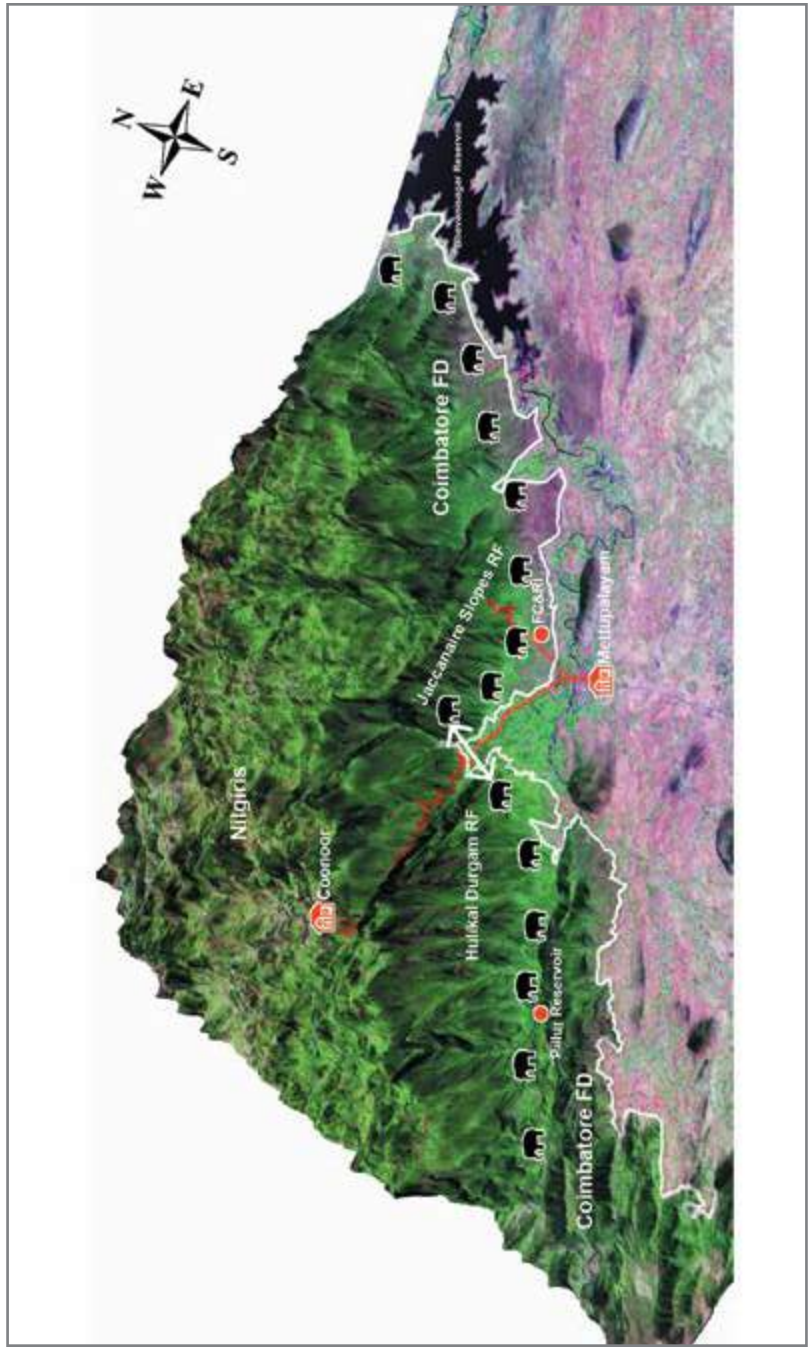
Conservation feasibility: Medium

The corridor connects the Jaccanaire Slope Reserve Forest and Hulikal Durgam Reserve Forest of Coimabatore Forest Division. Elephants from Sathyamangalam Tiger Reserve move to the southern part of Coimbatore Forest Division through the foothills of highly undulating mountains and cross the corridor between the second hairpin bend of the Mettupalayam-Coonoor highway and Kallar village. The corridor is very narrow due to plantations and various development activities.

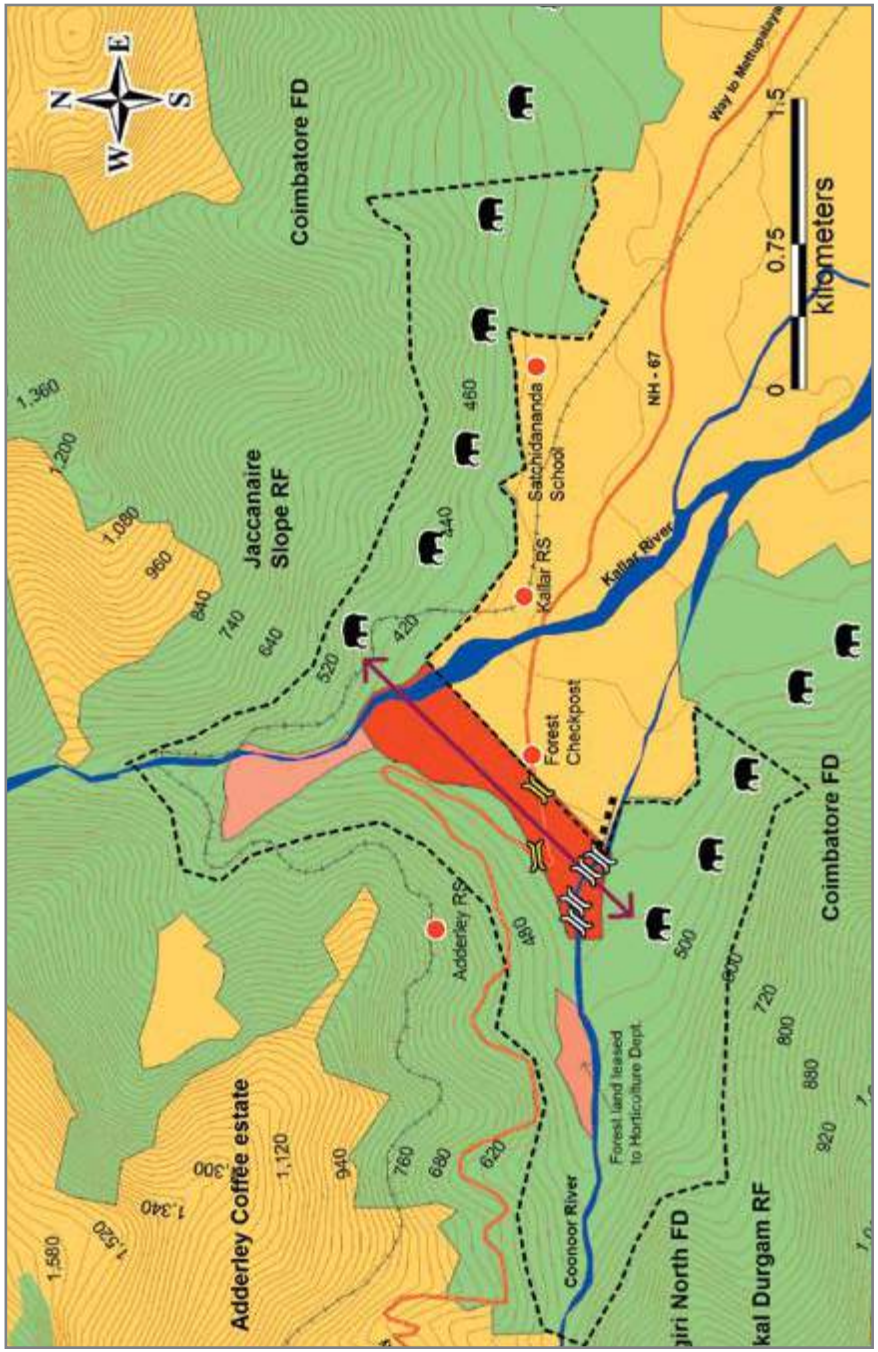
Alternate name	Kallar, Kallar at Ghandhapallam
State	Tamil Nadu
Connectivity	Sathyamangalam Tiger Reserve and Coimbatore Forest Division
Length and Width	7 km and 0-0.3 km
Geographical coordinates	11° 19′ 30″- 11° 21′ 26″ N 76° 50′ 52″- 76° 54′ 12″ E
Legal status	Reserve Forest, Private Forest, Private Land
Major land use	Forests, private plantations and settlements
Major habitation/settlements	Kallar and Kallar Pudur
Forest type	Tropical thorn and dry deciduous forests
Frequency of usage by elephants	Regular

FOREST AND ELEPHANTS

Corridor habitat status: A total of 26 tree species were recorded in the sampled area of 0.3 ha. Of these, 16 are elephant food species. The maximum average GBH was observed in *Ficus benghalensis* (145 cm), followed by *Azadiracta indica*



3D map showing the landscape of the Jaccanaire Slope – Hulikal Durgam Corridor



Map of the Jaccanaire Slope – Hulikal Durgam Corridor

(85 cm) and *Acacia nilotica* (82 cm). Maximum average height was recorded in Bamboo sp (22 m), followed by *Acacia nilotica* (15 m) and *Albizzia amara* (12 m). Signs of lopping and wood cutting were seen on almost all tree species. The ground cover comprised shrubs (8%), grasses (2%), herbs (10%) and barren ground (80%).

Estimated elephant numbers in the landscape

Sathyamangalam Tiger Reserve: 877
Coimbatore Forest Division: 390
(Synchronised Elephant Population Estimation, Tamil Nadu, 2012)

Forest/Land use

Forest type: Tropical thorn and dry deciduous forests
Buildings/Artefacts: Swami Sachidhanandha Jothi Niketan
Settlements: Nellithurai, Nandhavana Pudur, Kallar and Kallar Pudur
Agricultural land & plantations: Banana, areca nut and coconut
Road: National Highway 67 (Mettupalayam-Ooty)

Other ecological importance

Mountain Range: Western Ghats
Elephant Range: Brahmagiri-Nilgiri-Eastern Ghats Landscape
Elephant Reserve: Coimbatore Elephant Reserve
Biosphere Reserve: Nilgiri Biosphere Reserve

HUMAN DIMENSIONS

Threats

1. *The Swami Sachidhanandha Jothi Niketan* occupies a vast area adjacent to the corridor. Its boundary is protected by a solar fence.

2. *Black Thunder (Water Theme Park)*: Indiscriminate construction around the theme park has increased human occupancy and biotic pressure on the corridor areas.

3. *Kallar Pudur* (an encroachment near Swami Sachidhanandha Jothi Niketan): The huts here have been gradually been replaced by concrete buildings. The area now also has streetlights.

4. *Kallar village* has expanded on the northern side of Kallar railway station.

5. *Areca nut, banana and coconut plantations* are hindering elephant movement through the corridor.

6. *Unscientifically designed electric fences* have been erected in the area in the last few years, posing a threat to elephants.

7. *Heavy traffic* on the Mettupalayam-Coonoor and Mettupalayam-Kotagiri highways. An average of 285 vehicles per hour was recorded on the Mettupalayam-Coonoor highway, with peak traffic between 12 noon and 4 pm. Vehicle movement was low at night and in the early morning hours (1 am to 5 am). The high traffic volume, especially during the dry season, is a serious impediment to elephant movement.

8. *Government Horticultural Garden:* Located in the bottleneck of the corridor, this has blocked elephant movement to a significant extent.

Corridor dependent villages: Nellithurai, Nandhavanapudur, Kallar and Kallar Pudur

Human-Elephant Conflict: Development activities increased in the area around 1997, leading to a rise in conflict. Fifteen human deaths due to elephants and nine elephant deaths due to electrocution were reported between 1994 and 2007.

CONSERVATION PLAN

1. The corridor should be legally protected by the state forest department under an appropriate law to prevent encroachment, diversion of forest land for non-forestry activities, and development activities that hinder animal movement.

2. In consultation with villagers, 92.05 acres (59.9 acres as Priority I and 32.15 acres as Priority II) of land in Kallar village, Kallar Pudur (including a forest nursery) and Barliyar village could be secured and conserved with the active participation of local communities and the district administration.

3. No development activities should be permitted on either side of National Highway 67 (between the forest checkpost and the first hairpin) in the corridor area.

4. An overpass is needed for vehicles on NH 67, from Kallar bridge to the second hairpin. The use of pre-fabricated structures would minimise the adverse effects of construction. Till the overpass is constructed, vehicular movement on NH 67 should be regulated, especially during the peak elephant movement season.

5. Roadside restaurants in Barliyar are dumping waste material in forest areas. These dumping sites attract elephants and deer and require the enforcement of proper garbage management practices.

Land identified to secure the corridor

Extent of area (acres)	**Status of the land**	**Priority**
21.9	Patta land	P1
16.85	Patta land	P1
7.65	Patta land, owned by four families	P1

7.9	Patta land, owned by 47 different owners	P1
5.6	Patta land, owned by four tribal families	P1
20.15	Patta land	P2
12	Leased to the horticulture department	P2
92.05 acres		

59.9 acres as Priority 1 and 32.15 acres as Priority 2



Fig. 8.16: Ghat road passing through the Jaccanaire Slope – Hulikal Durgam Corridor

8.22
ANAIKATTI NORTH - ANAIKATTI SOUTH

Ecological priority: High

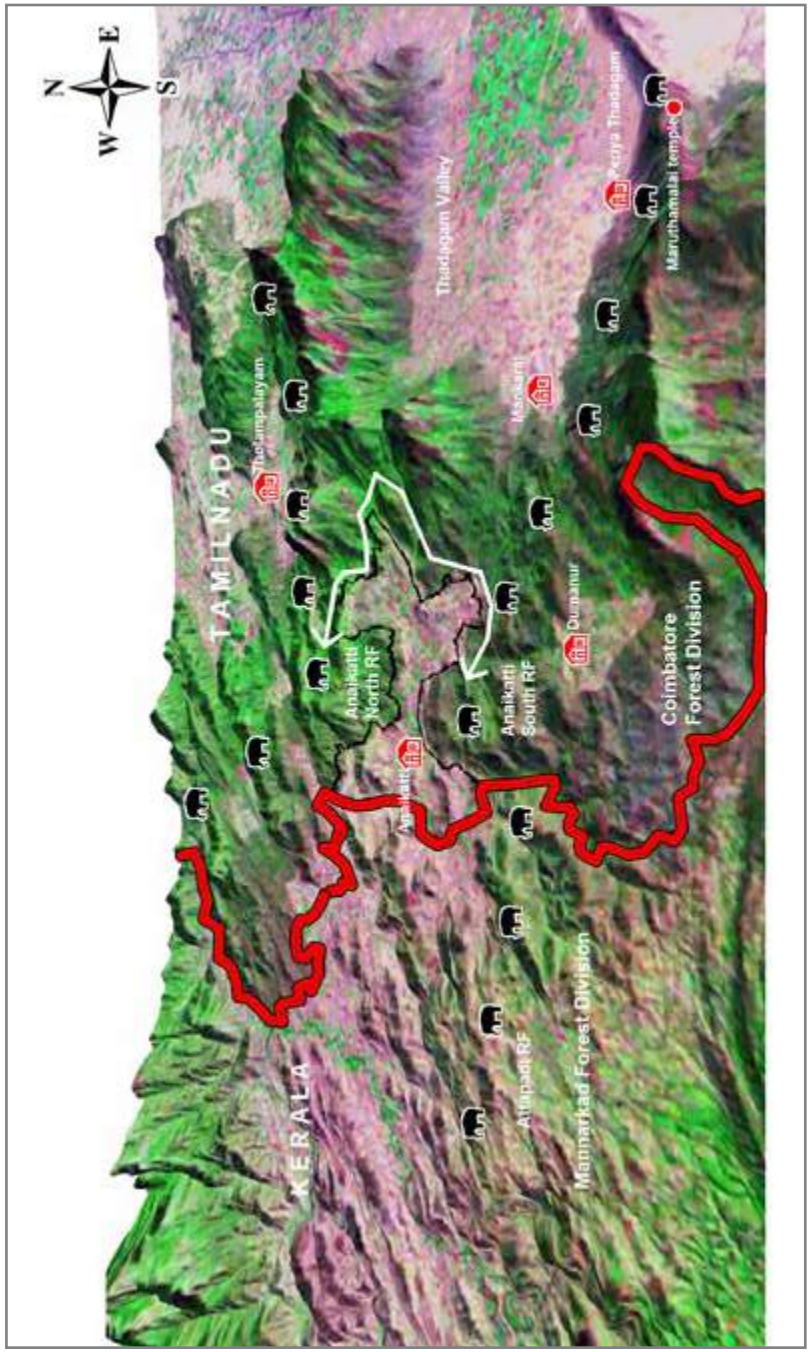
Conservation feasibility: Medium

This corridor connects Anaikatti North Reserve Forest and Anaikatti South Reserve Forest of Coimbatore Forest Division. Elephants from Sathyamangalam Tiger Reserve move to Mannarkad Forest Division, Kerala through the foothills of highly undulating mountains in the upper plateau of Coimbatore Forest Division, and cross the corridor near the villages of Panapalli, Kondanur Pudur, Kuttupuli and Anaikatti.

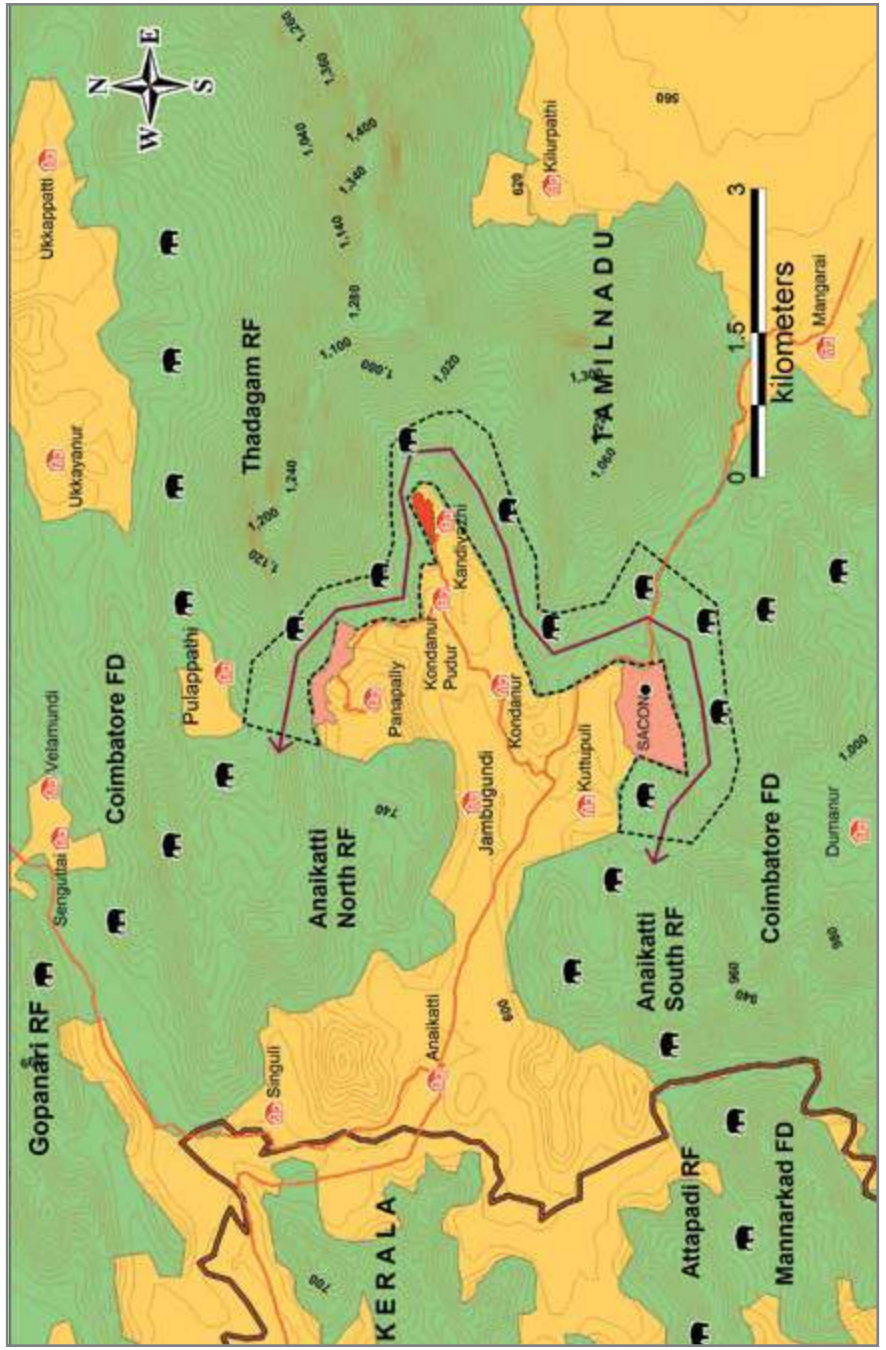
Alternate name	Anaikatti, Boluvampatti-Attapadi
State	Tamil Nadu
Connectivity	Boluvampatti Reserve Forest with Attapadi Reserve Forest
Length and Width	9 km and 0.15-1 km
Geographical coordinates	11° 5′ 8″- 11° 7′ 58″ N 76° 46′ 30″- 76° 48′ 59″ E
Legal status	Reserve Forest
Major land use	Forest, agriculture, settlements, Institutions
Major habitation/settlements	Nil
Forest type	Tropical thorn and deciduous forest
Frequency of usage by elephants	Regular

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 34 tree species were recorded in the sampled area of 0.03 ha. Of these, 18 are elephant food species. The maximum average GBH was recorded in *Acacia planifirons* (142 cm), followed by *Dichrostachys cinerea* (112 cm) and *Zyziphus mauritiona* (107 cm). Maximum average height was recorded in *Azadiracta indica* (25 m), followed by *Dichrostachys cinerea* (22 m) and



3D map showing the landscape of the Anaikatti North - Anaikatti South Corridor



Map of the Anaikatti North - Anaikatti South Corridor

Anogessius latifolia (18 m). The ground cover was represented by shrubs (20%), grasses (20%) and herbs (20%), with the remainder being barren ground (40%).

Estimated elephant numbers in the landscape

Coimbatore Forest Division: 390

(Synchronised Elephant Population Estimation, Tamil Nadu, 2012)

Forest/Land use

Forest type: Tropical thorn and deciduous forest

Revenue land

Buildings/Artefacts: Salim Ali Centre for Ornithology and Natural History (SACON), Karl Kubel Institute, PSG Institution and Swami Dayanand Saraswati Ashram

Human settlements: Sembukarai, Kandivalli, Dhoomanur, Panapalli, Jambukandi, Veerapandi Pudur, Kondanur, Mel Baavi, Pudur, Kil Baavi

Agriculture land

Road: Coimbatore-Anaikatti state highway

Other ecological importance

Mountain Range: Western Ghats

Elephant Range: Brahmagiri-Nilgiri-Eastern Ghats Landscape

Elephant Reserve: Coimbatore Elephant Reserve

Biosphere Reserve: Nilgiri Biosphere Reserve

HUMAN DIMENSIONS

Threats

1. *The Swami Dayanand Saraswati Ashram* occupies a vast area adjacent to the corridor. A solar power fence marks the ashram's boundary, with only a narrow passage available for elephant's to move through.

2. *The Salim Ali Centre for Ornithology and Natural History* occupies a vast area adjacent to the corridor and is also well protected by solar power fences, which hinder elephant movement.

3. *Karl Kubel Institute:* Again, occupies a large area adjacent to the corridor and is protected by solar fences. The staff quarters and powerful lights in the compound are psychological barriers to elephants, preventing free movement.

4. *Avila Teacher Training Institute (Proposed):* Also occupies a large area adjacent to the corridor, and is protected by solar fences. Construction has not been permitted by the district administration as per the Hill Area Conservation Authority (HACA), but this could be a potential threat.

5. *PSG institution* has started a new construction; the area is completely protected by an electric fence.

6. *Coimbatore Zoological Park (Proposed)*: A zoological park has been proposed on the southwest side of this corridor. A large area has been purchased and could be a potential threat to the corridor.

7. *Vehicular traffic:* Medium-sized vehicles such as jeeps and cars extensively use the Coimbatore-Anaikatti State Highway even at night. Some 92 vehicles per hour pass through the corridor as per a survey conducted in 2014-15.

Corridor villages: Kandivalli, Kondanur Pudur, Panapalli and Moongilpallam are located in and around the corridor area.

Corridor dependent villages: Sembukarai, Kandivalli, Dhoomanur, Panapalli, Jambukandi, Veerapandi Pudur, Kondanur, Mel Baavi, Pudur, Kil Baavi.

Human-Elephant Conflict: Data on human-elephant conflict between 1993 and 2014 reveals that human deaths due to elephants mostly began occuring after 2004. A lot of construction happened near the corridor area from 1995 onwards, causing conflict to escalate. No human deaths were reported from the Coimbatore Forest Division between 1993 and 1998, but 99 human deaths due to elephants were reported from 1999 to 2014. These incidences have further increased since 2010.

CONSERVATION PLAN

1. The corridor should be notified by the state forest department and legally protected under an appropriate law to prevent encroachment and developmental activities detrimental to animal movement.

2. In consultation with the villagers and the state government, about 25.7 acres of patta land should be secured on a priority basis.

Revenue land measuring 48.94 acres could also be notified and secured in consultation with the district administration. Further, in consultation with SACON, the unused land with the institute could also be secured for elephant movement.

3. Traffic on the state highway should be regulated between 9 pm and 5 am.

4. No developmental activities should be allowed on either side of the highway passing through the corridor.

Land identified to secure the corridor

About 25.7 acres of patta land to be secured on a priority basis. About 48.9 acres are directly controlled by the district administration and could be secured in consultation with the government.

Land ownership	Extent of area (Acres)	Status of the land
Priority I		
Private	18	Patta land
Private	2.76	Patta Land
Private	4.95	Patta Land (Near SACON)
Priority II		

Government Land	32.84	Panapalli Revenue Land (Porambokku)
Government Land	2.79	Panapalli Revenue Land (Porambokku)
Government Land	2.54	Panapalli Revenue Land (Porambokku)
Government Land	3.63	Panapalli Revenue Land (Porambokku)
Government Land	4.39	Panapalli Revenue Land (Porambokku)
Government Land	1.75	Panapalli Revenue Land (Porambokku)
Barren Land	1.0	Cart road, Government Land

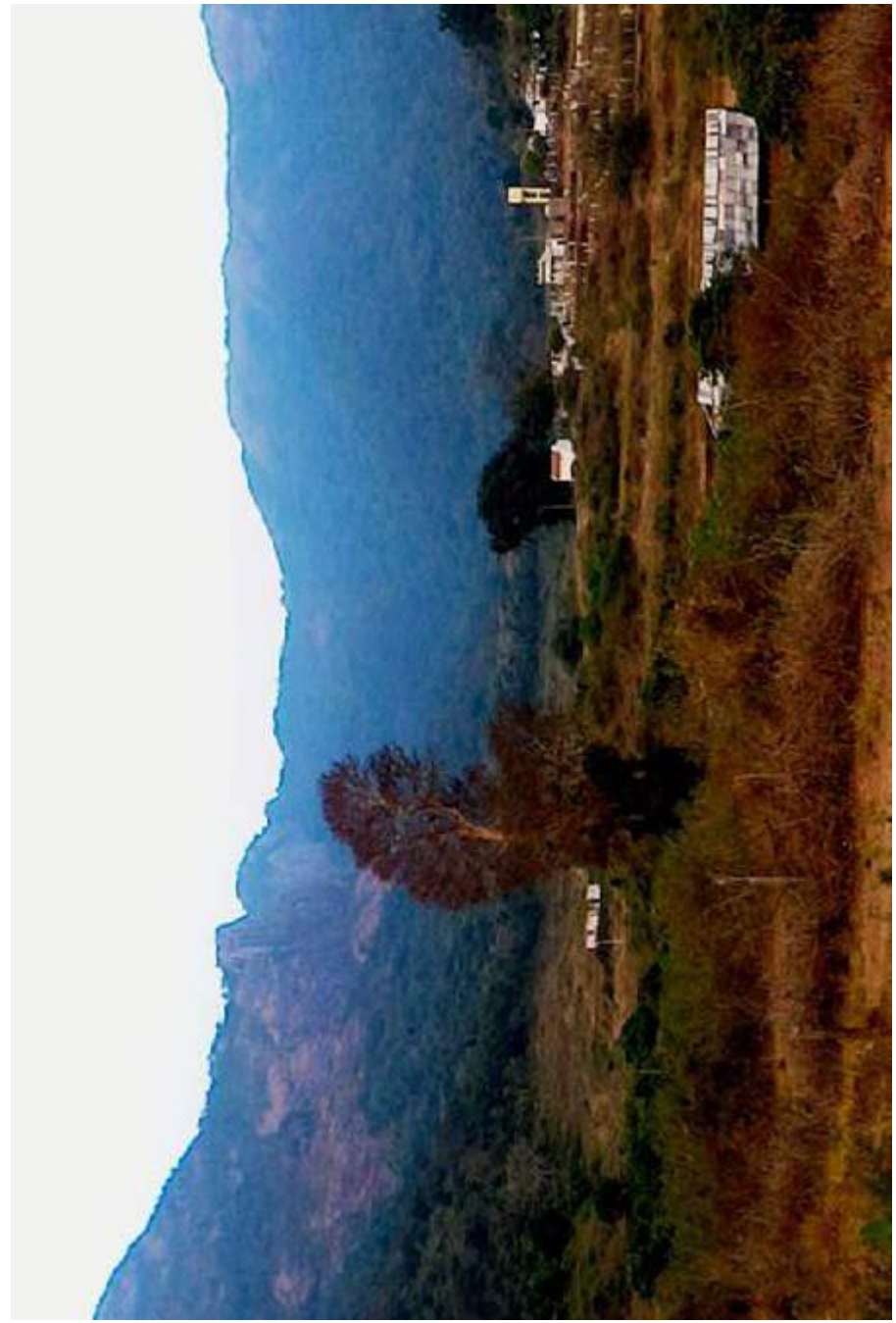


Fig. 8.17: A view of tthe Anaikatti North – Anaikatti South Corridor

8.23
ANAIMALAI AT PUNACHI

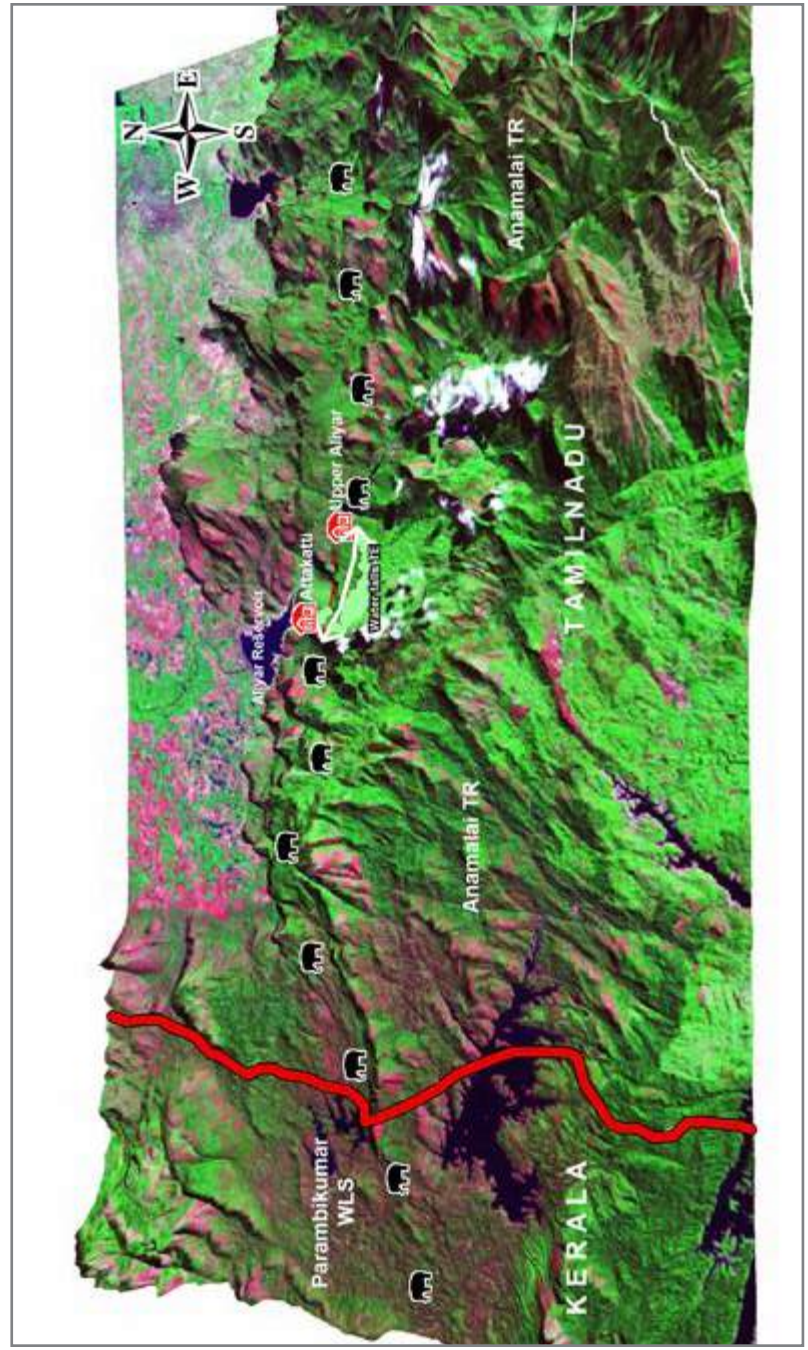
Ecological priority: High
Conservation feasibility: High

The Anaimalai at Punachi corridor connects Punachi Reserve Forest and Anaimalai Reserve Forest within Anaimalai Tiger Reserve. Elephants from Anaimalai Tiger Reserve move to Parambikulam Tiger Reserve through highly undulating forests between the villages of Attakatti, Kilpunachi and Upper Aliyar.

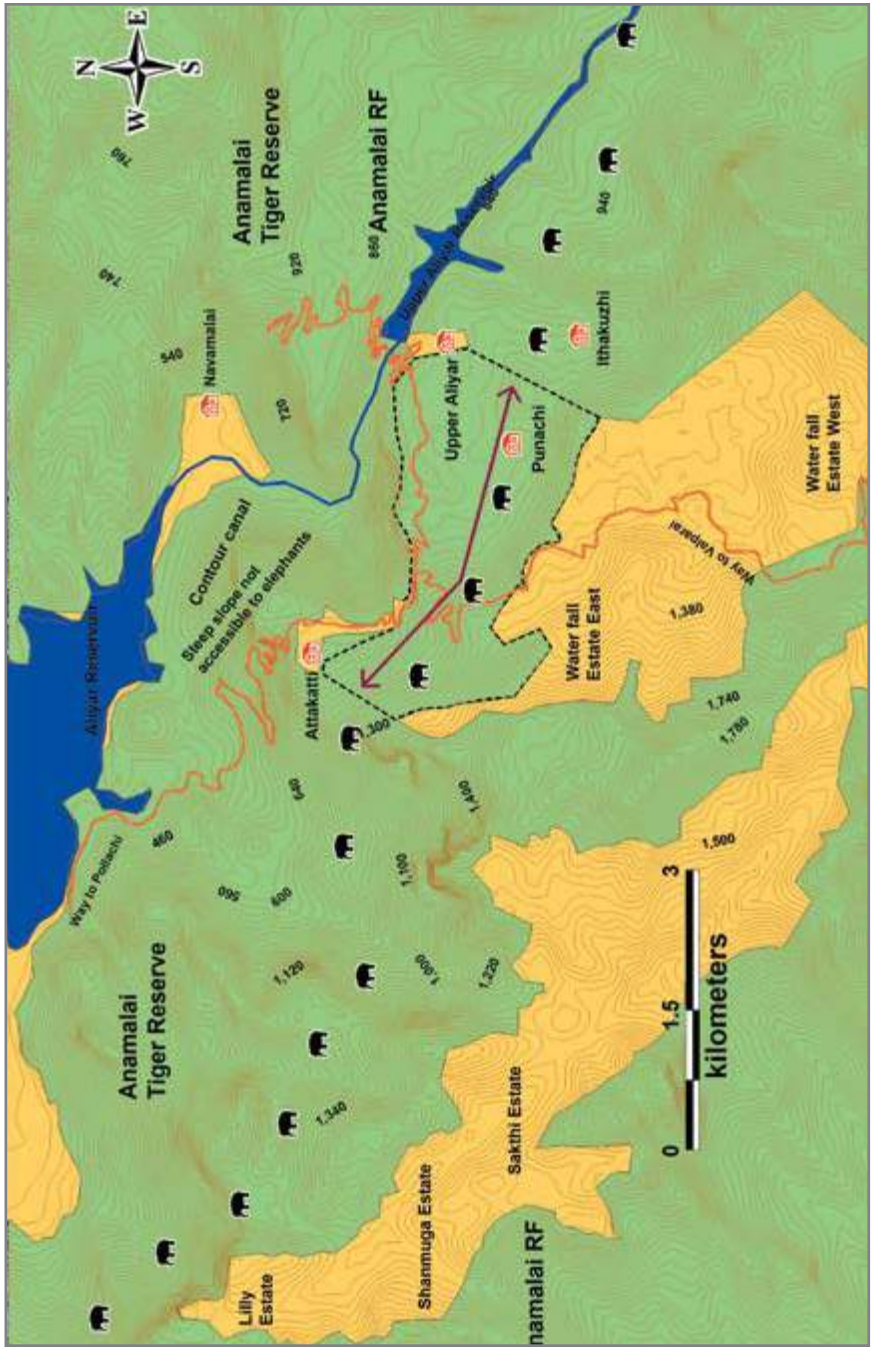
Alternate name	Attakatti-Upper Aliyar
State	Tamil Nadu
Connectivity	Punachi Reserve Forest with Anaimalai Reserve Forest of Anaimalai Tiger Reserve
Length and Width	4 km and 0.8-1.6 km
Geographical coordinates	10° 25′ 3″- 10° 26′ 42″ N 76° 58′ 34″- 77° 0′ 46″ E
Legal status	Tiger Reserve and Patta Land
Major land use	Forest
Major habitation/settlements	Nil
Forest type	Tropical moist deciduous forest
Frequency of usage by elephants	Seasonal

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 30 tree species were recorded in the sampled area. Of these,12 were elephant food species. The maximum average GBH was observed in *Syzygium cumini* (300 cm), followed by *Olea dioica* (225 cm) and *Albizzia lebbeck* (220 cm). Maximum average height was recorded in *Olea dioica* (18 m), followed by *Anogeissus latifolia* (15 m) and *Grewia tillifolia* (14 m). The ground cover comprised grasses (60%), herbs (10%) and shrubs (15%), with the remainder as barren ground (15%).



3D map showing the landscape of the Anaimalai at Punachi Corridor



Map of the Anaimalai at Punachi Corridor

Estimated elephant numbers in the landscape

Anaimalai Tiger Reserve: 584
(*Synchronised Elephant Population Estimation, Tamil Nadu, 2012*)
Parambikulam Tiger Reserve: 331
(*Wild Elephant Census of Kerala State, 2010*)

Forest/Land use

Forest type: Tropical moist deciduous forest
Road: Pollachi-Valparai State Highway (SH 78)
Settlement: Kilpunachi

Other ecological importance

Mountain Range: Western Ghats
Elephant Range: Anaimalai-Nelliampathy-High Range Landscape
Elephant Reserve: Anaimalai Elephant Reserve
Protected Area: Anaimalai Tiger Reserve
IBA: Code. IN-TN-10, Criteria. A1, A2, A3

HUMAN DIMENSIONS

Threats

1. Highway: The expansion of State Highway 78 and the construction of a wall along it will hinder elephant movement. The number of vehicles passing through the corridor is very high, especially during elephant migratory season. Tourists stop their vehicles all along the corridor for refreshments.

Corridor villages: Although Kilpunachi village is located in the corridor, human-elephant conflict is minimal, in keeping with the lack of agricultural activity in the corridor area.

Corridor dependent villages: Attakatti and Upper Aliyar villages, and Punachi forest settlement.

Human-Elephant Conflict: There is no record of human death caused by elephants in this corridor in recent years. This is mainly because local villagers do not use the Kadamparai and Aliyar-Valparai road in late evenings and early mornings. There are also very few plantations in the area, with most starting a kilometre away from the corridor. There is an abandoned coffee estate nearby.

CONSERVATION PLAN

1. The corridor should be notified and legally protected by the state forest department under an appropriate law, and action should be taken to prevent developmental activities hindering elephant movement.

2. Vehicular speed should be regulated on the Valparai ghat road and visitors prevented from stopping. Suitable signages could also be placed to create awareness about the corridor and its importance.



Fig. 8.18: Anaimalai at Punachi corridor

8.24
ANAIMALAI AT WATERFALLS ESTATE

Ecological priority: High

Conservation feasibility: High

This corridor links the habitats of the Valparai and Pollachi Ranges of Anaimalai Tiger Reserve. Elephants from Anaimalai Tiger Reserve move to Parambikulam Tiger Reserve through a narrow reserve forest between Waterfalls and Mount Stuart Estates.

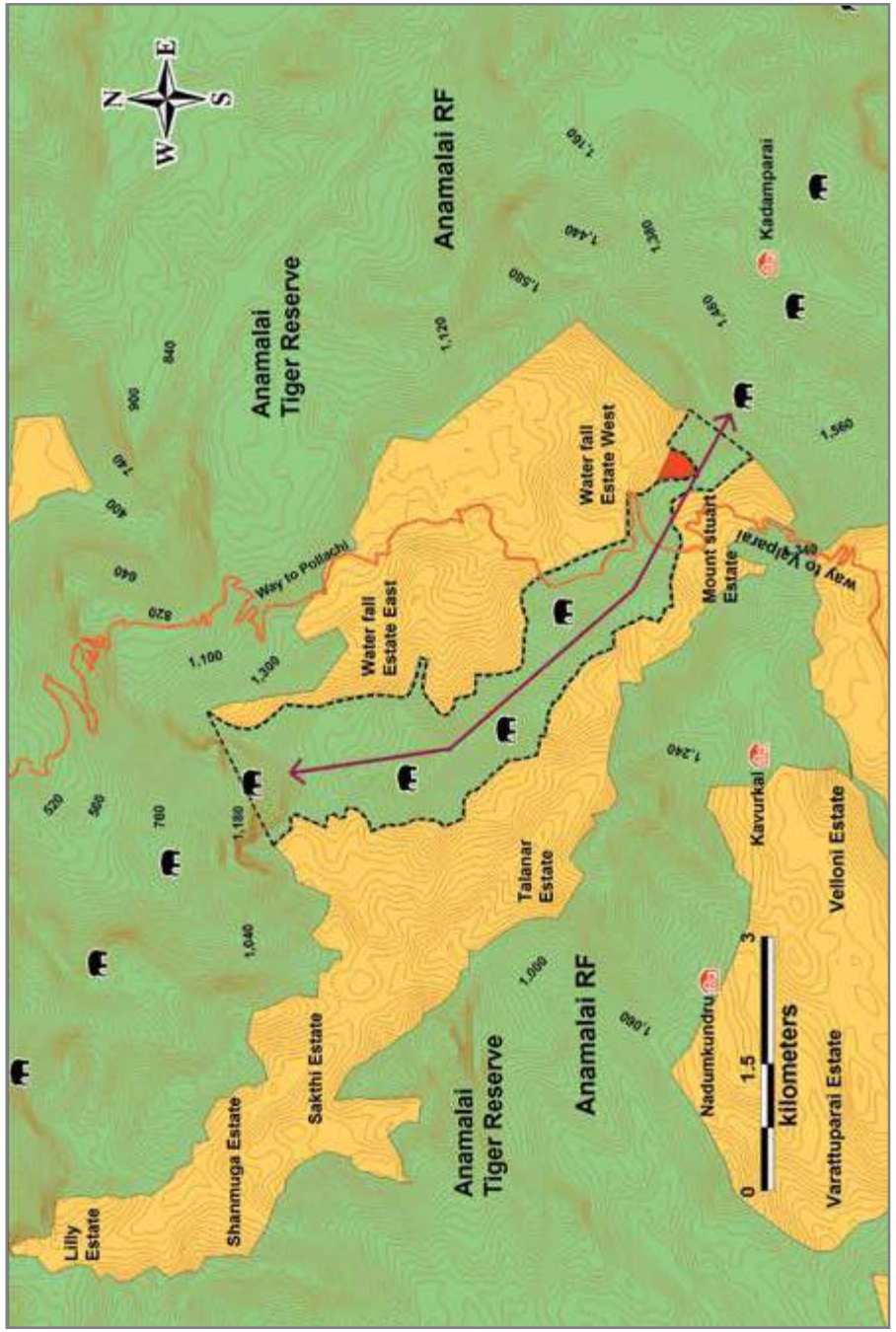
Alternate name	Ayerpadi-Waterfalls Estate
State	Tamil Nadu
Connectivity	West to East of Anaimalai Tiger Reserve
Length and Width	7.5 km and 0.17-1.8 km
Geographical coordinates	10° 22′ 42″- 10° 26′ 15″ N 76° 57′ 42″- 77° 0′ 31″ E
Legal status	Tiger Reserve and Forest Leased Land
Major land use	Forest and tea gardens
Major habitation/settlements	Nil
Forest type	Tropical moist deciduous forest
Frequency of usage by elephants	Regular

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 30 tree species were recorded in the sampled area, of which three are palatable to elephants. The maximum average GBH was recorded in *Cullenia exarillata* (255 cm), followed by *Syzygium cumini* (185 cm). Maximum average height was seen in *Wrightia tinctoria* and *Listea wightiana* (25 m), followed by *Syzygium cumini* (20 m). Ground cover comprised shrubs (30%), grasses (15%) and herbs (15%), with the rest as barren ground (40%).



3D map showing the landscape of the Anaimalai at Waterfalls Estate Corridor



Map of the Anaimalai at Waterfalls Estate Corridor showing the land to be secured

Estimated elephant numbers in the landscape

Anaimalai Tiger Reserve: 584
(*Synchronised Elephant Population Estimation, Tamil Nadu, 2012*)
Parambikulam Tiger Reserve: 331
(*Wild Elephant Census of Kerala State, 2010*)

Forest/Land use

Forest type: Tropical moist deciduous forest
Tea Estates: Waterfalls, Mount Stuart and Waverly Estates
Road: State Highway 78 (Pollachi-Valparai)

Other ecological importance

Mountain Range: Western Ghats
Elephant Range: Anaimalai-Nelliampathy-High Range Landscape
Elephant Reserve: Anaimalai Elephant Reserve
Protected Area: Anaimalai Tiger Reserve
IBA: Code. IN-TN-10, Criteria. A1, A2, A3

HUMAN DIMENSION

Threats

1. Uncontrolled tourism is a major problem along this corridor with visitors stopping to see animals. This not only disturbs wildlife movement but at times leads to conflict.

2. Biotic pressure from the labour colonies of Waterfalls Estate and Mount Stuart Estate are a threat to the corridor forest.

3. Vehicular traffic is high between 10 pm and 5 pm on SH 78. On an average 50 vehicles per hour ply on this road. People also stop on the way to view wildlife. Vehicle movement was found to be low in the early mornings and late evenings (after 6 pm) as mist covers the area and visibility becomes poor.

Corridor villages: No villages are located inside the corridor. The corridor is, however, surrounded by three large tea estates: Waverly Estate, NEPC (Mount Stuart Estate) and Waterfalls Estate. The labour colonies of these estates depend on the corridor forest for fuelwood collection.

Corridor dependent villages: Waterfalls Estate and Mount Stuart Estate labour colonies.

Human-Elephant Conflict: Conflict is a major problem in the area. Thirteen human deaths and 18 elephant deaths due to conflict were reported in Anaimalai Tiger Reserve between 2001 and 2012. The intensity of both human deaths and property damage caused by elephants increases between August and February each year.

CONSERVATION PLAN

1. The corridor should be legally protected by the state forest department under an appropriate law, and action should be taken to prevent encroachment of forest land, illicit felling of trees and development activities detrimental to the corridor.

2. In consultation with the Waterfalls Estate ownership, 24 acres of land on the southern side of the estate needs to be secured.

3. The expansion of tea estates, human settlements and encroachments along Waterfalls Estate should be prevented.

4. Vehicular speeds should be regulated through suitable barriers in the stretch of Valparai-Pollachi State Highway that passes through the corridor.

Land identified to secure the corridor

This corridor is very narrow on the eastern side of the Pollachi-Valparai state highway, between Mount Stuart and Waterfalls Estates. At least 24 acres of land located on the southern side of Waterfalls Estate could be secured to increase the corridor's width.



Fig. 8.19: A road passing through the Anaimalai at Waterfalls Estate Corridor

8.25
ANAIMALAI BETWEEN SILUVAIMEDU - KADAMPARAI

Ecological priority: High

Conservation feasibility: High

This corridor connects the habitats of the Valparai and Manambolly Ranges of Anaimalai Tiger Reserve. Elephants from Anaimalai Tiger Reserve move to Parambikulam Tiger Reserve through highly undulating and narrow forests between Mount Stuart Estate and Iyerpadi Estate.

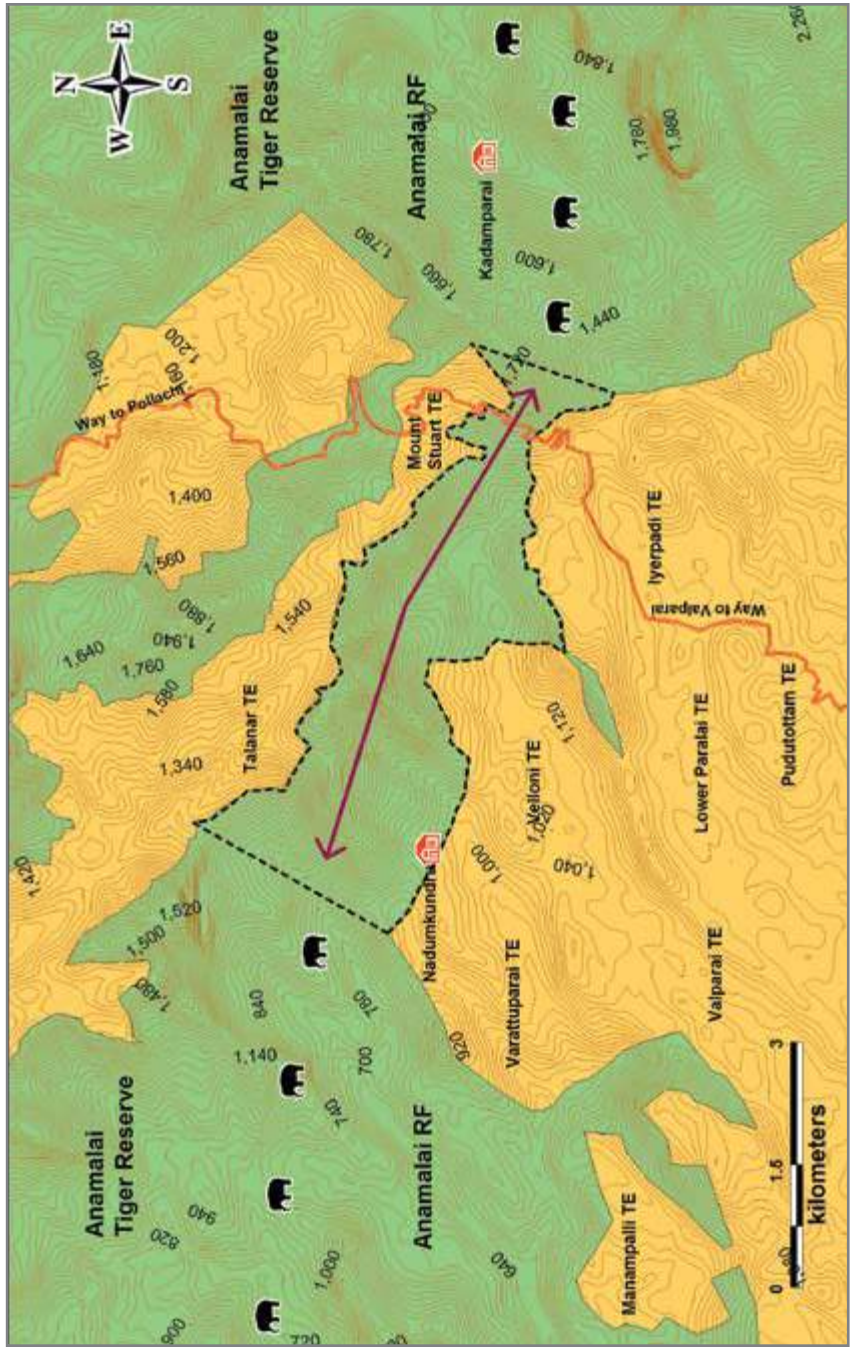
Alternate name	Siluvaimedu-Kadamparai
State	Tamil Nadu
Connectivity	West to East of Anaimalai Tiger Reserve
Length and Width	7 km and 0.5-2.7 km
Geographical coordinates	10° 21′ 45″- 10° 24′ 34″ N 76° 56′ 15″- 77° 0′ 14″ E
Legal status	Tiger Reserve
Major land use	Forest
Major habitation/settlements	Kavarukal
Forest type	Tropical moist deciduous forest
Frequency of usage by elephants	Occasional

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 35 tree species were recorded in the sampled area, of which three are elephant food species. The maximum average GBH was recorded in *Cullenia exarillata* (250 cm), followed by *Syzygium cumini* (185 cm), and maximum average height in *Litsea wightiana* (23 m). Ground cover comprised shrubs (20%), grasses (10%), herbs (20%) and barren ground (50%).



3D map showing the landscape of the Anaimalai between Siluvaimedu – Kadamparai Corridor



Map of the Anaimalai between Siluvaimedu–Kadamparai Corridor

Estimated elephant numbers in the landscape

Anaimalai Tiger Reserve: 584
(*Synchronised Elephant Population Estimation, Tamil Nadu, 2012*)
Parambikulam Wildlife Sanctuary: 331
(*Wild Elephant Census of Kerala State, 2010*)

Forest/Land use

Forest: Tropical moist deciduous forest
Tea Estates: Mount Stuart Estate, Velloni Estate, Talanar Estate and Varattuparai Estate
Road: State Highway 78 (Pollachi-Valparai)

Other ecological importance

Mountain Range: Southern Western Ghats
Elephant Range: Anaimalai-Nelliampathy-High Range Landscape
Elephant Reserve: Anaimalai Elephant Reserve
Protected Area: Anaimalai Tiger Reserve
IBA: Code. IN-TN-10, Criteria. A1, A2, A3

HUMAN DIMENSIONS

Threats

1. Biotic Pressure: Kavarukal estate settlement, Siluvaimedu and Kadamparai on the fringe depend on the corridor forest for fuelwood collection and cattle grazing, posing a major threat to the corridor habitat.

2. Developmental activities: Uncontrolled tourism and the clearing of the remaining evergreen forest patches located inside tea plantations are degrading the habitat

3. Traffic intensity is very high along the state highway from 9 am to 5 pm.

Corridor Villages: The corridor has Nadumkundru village at its fringe and this is not a hindrance to elephant movement.

Corridor dependent villages: Kadamparai, Kavarukal Estate settlements and Iyerpadi Estate settlements.

Human – Elephant conflict: Conflict is a major problem in Anaimalai. The intensity of both human deaths and property damage caused by elephants increases between August and February each year.

CONSERVATION PLAN

1. The corridor should be legally protected by the state forest department under appropriate law to prevent encroachment of the river bank, diversion of forest land for non-forestry activities, and other developmental activities in the corridor area.

2. Vehicular speed on the state highway passing through the corridor should be regulated by suitable physical barriers.

3. Village committees need to be strengthened for better protection and conservation of the corridor.



Fig. 8.20: Signage in the corridor area



Fig. 8.21: A view of the Anaimalai between Siluvaimedu-Kadamparai Corridor

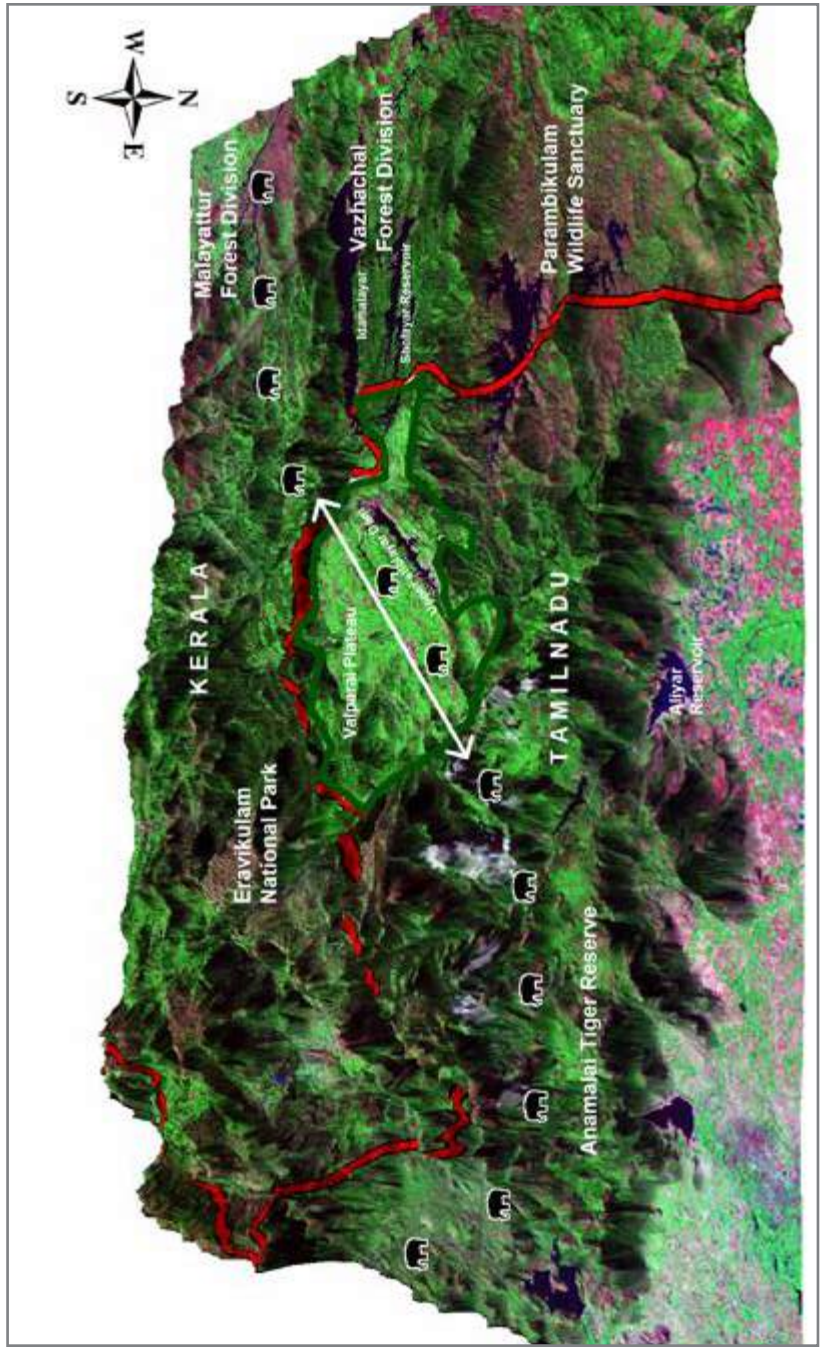
8.26
VAZHACHAL - ANAIMALAI VIA SHOLAYAR

Ecological priority: High

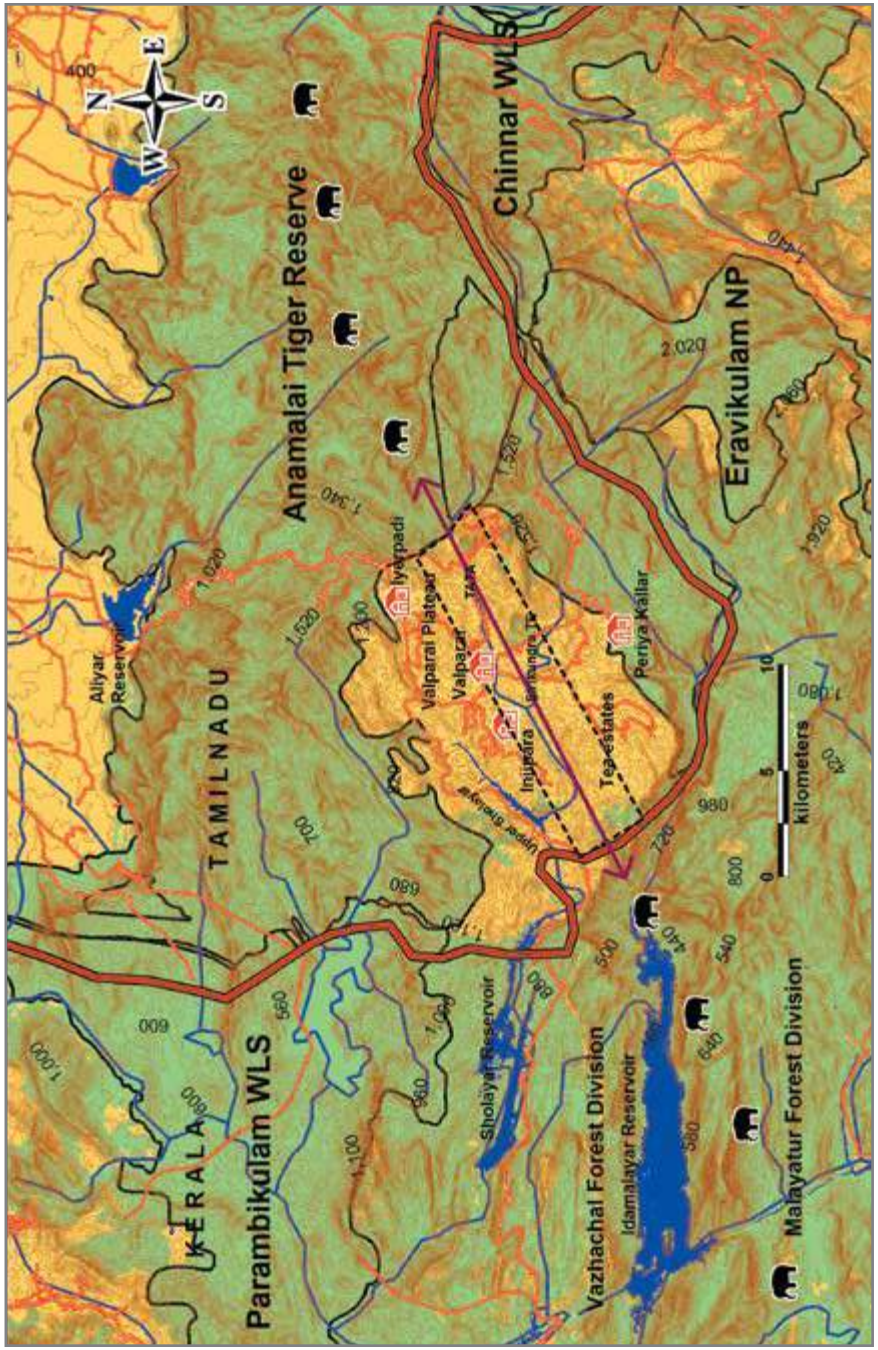
Conservation feasibility: Medium

This corridor connects the Valparai and Manambolly Ranges of Anaimalai Tiger Reserve, Tamil Nadu with Malayattur Forest Division, Kerala. It is located on the inter-state boundary of Tamil Nadu and Kerala. Elephants from the Malayattur and Vazhachal Forest Divisions in Kerala move to Anaimalai Tiger Reserve through TATA Coffee Ltd at Pachhamalai, Sirikundra Tea Estates India Ltd, Periya Karamalai Tea Company, Parry Agro Industries Ltd at Iyerpadi, and Pannimed, Murugan, Korangumudi, Injipara, Sholayar, Kallar, Vellamalai and Nadumalai villages on the Valparai plateau in Tamil Nadu.

Alternate name	Karumalai-Sholayar
State	Tamil Nadu
Connectivity	Valparai Range and Manambolly Range of Anaimalai Tiger Reserve, Tamil Nadu with Malayattur Forest Division, Kerala
Length and Width	13 km and 0.3-1.5 km
Geographical coordinates	10 °21'24.498" N - 10°16'10.465" N 77°1'58.72" E - 76°51' 15.877" E
Legal status	Anaimalai Tiger Reserve and Private Tea Estates
Major land use	Tea estates, settlements, forest
Major habitation/settlements	Valparai and Iyerpadi
Forest type	Moist evergreen forest
Frequency of usage by elephants	Seasonal



3D map showing the landscape of the Vazhachal – Anaimalai via Sholayar corridor



Map of the Vazhachal – Anaimalai via Sholayar Corridor

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 35 tree species were recorded in the sampled area. Of these, four are elephant food species. The maximum average GBH was recorded in *Canthium dicoccum* (230 cm), followed by *Salix tetrasperma* (210 cm) and *Manikara hexandra* (185 cm). Maximum average height was noticed in *Haldina cordifolia* (25 m) and *Cullenia exarillata* (15 m). Ground cover vegetation was dominated by herbs (25%), grasses (15%) and shrubs (15%), with the remainder as barren ground (45%).

Estimated elephant numbers in the landscape

Anaimalai Tiger Reserve: 584
(*Synchronised Elephant Population Estimation, Tamil Nadu, 2012*)
Parambikulam Wildlife Sanctuary: 331
Vazhachal Division: 574
Malayattur Division: 404
Munnar Wildlife Division: 529
(*Wild Elephant Census of Kerala State, 2010*)

Forest/Land use

Forest type: Moist evergreen forest
Estates: TATA Coffee Ltd at Pachhamalai, Sirikundra Tea Estates India Ltd, Periya Karamalai Tea Company, Parry Agro Industries Ltd at Iyerpadi
River: Nadumalai aaru

Other ecological importance

Mountain Range: Western Ghats
Elephant Range: Anaimalai-Nelliampathy-High Range Landscape
Elephant Reserve: Anaimalai Elephant Reserve
Protected Area: Anaimalai Tiger Reserve
IBA: Code. IN-TN-10, Criteria. A1, A2, A3

HUMAN DIMENSIONS

Threats

1. Settlements: A large number of villages as well as the labour lines of tea and coffee estates hinder elephant movement.

2. Plantations: A large part of the corridor area comprises tea and coffee plantations along with their labour lines and factories.

3. Vehicular traffic: This corridor has numerous estate roads, especially Karumalai-Balaji Temple and Valparai-Sholayar Dam, which have heavy traffic movement through the corridor.

Corridor dependent villages: Iyerpadi, Kavarukal, Puthothottam and Valparai Town

CONSERVATION PLAN

1. The corridor should be notified by the state forest department and legally protected under an appropriate law to prevent encroachment and development activities detrimental to animal movement.

2. No construction should be allowed on either side of the roads passing through the corridor.

3. An awareness programme targeting the villagers living both within and on the fringes of the corridor should be initiated through schools and community organisations, informing them about the criticality of the corridor and how the increased human-elephant conflict in the area has been caused by the obstruction of the corridor.

4. A concerted effort needs to be made towards mitigating human-elephant conflict in the region.



Fig. 8.22: A view of the Vazhachal – Anaimalai via Sholayar Corridor

8.27
VAZHACHAL - ANAIMALAI VIA RYAN

Ecological priority: High

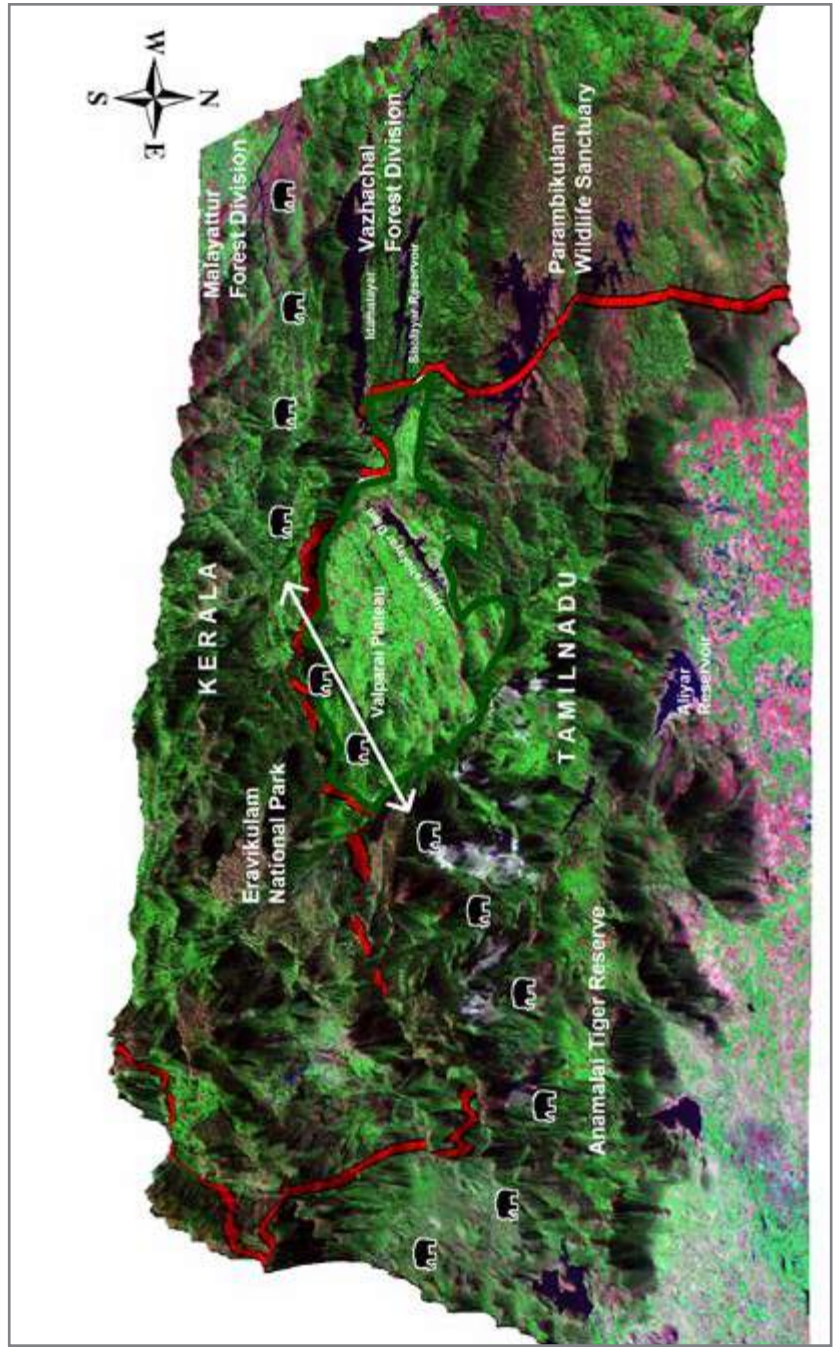
Conservation feasibility: Medium

This corridor connects the Valparai and Manambolly Ranges of Anaimalai Tiger Reserve, Tamil Nadu with Malayattur Forest Division, Kerala. It is located on the inter-state boundary of Tamil Nadu and Kerala. Elephants move from Malayattur Forest Division and Vazhachal Forest Division in Kerala to Anaimalai Tiger Reserve through the Ryan division of TANTEA (the Tamil Nadu Tea Plantation Corporation Ltd) and eight to ten fragmented rainforest patches.

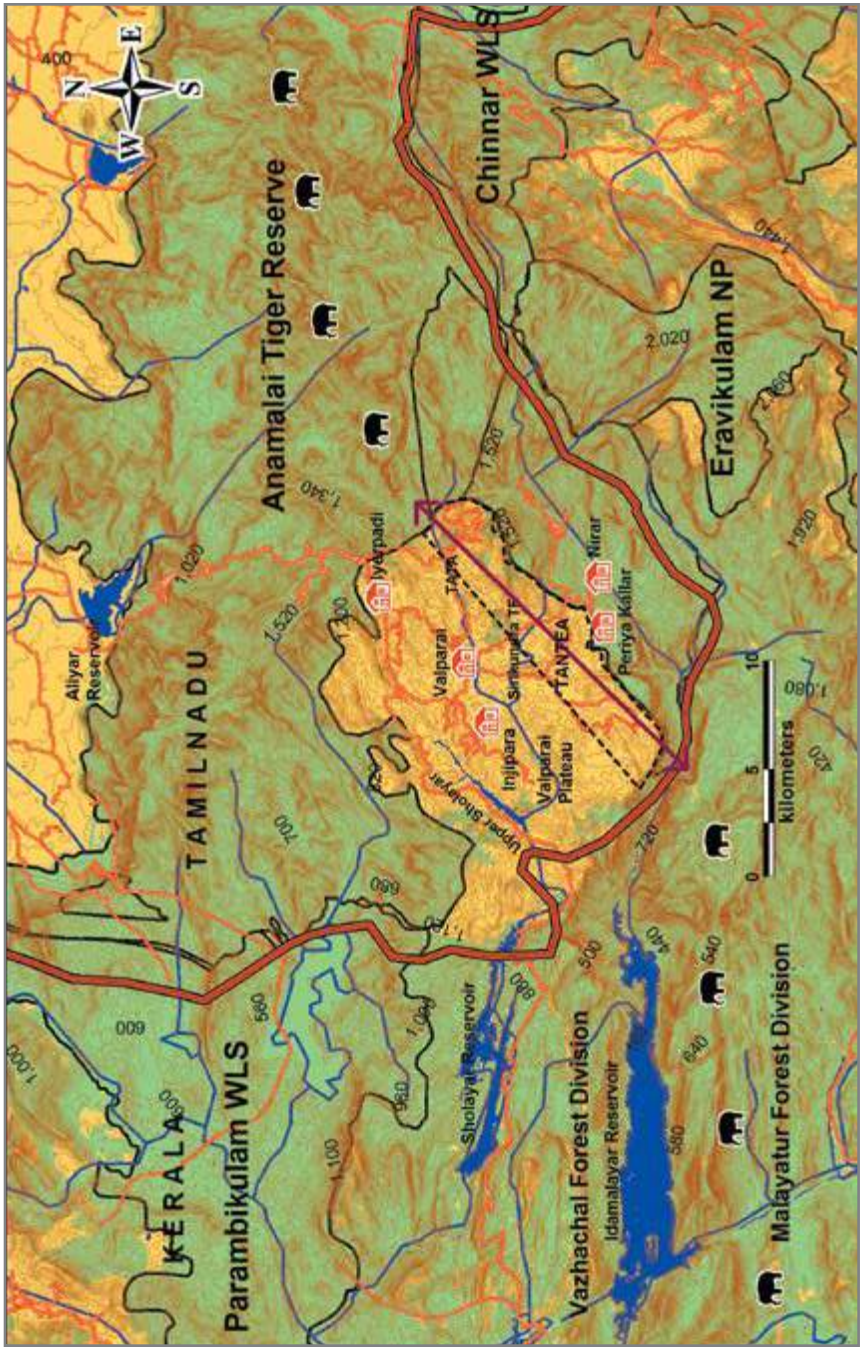
Alternate name	Ryan Corridor
State	Tamil Nadu
Connectivity	Anaimalai Tiger Reserve to Vazhachal Forest Division
Length and Width	6 km and 1 km
Geographical coordinates	10° 21' 13.414" N, 10°13'57.463" 77°1'25.469" E- 76°54'16.907" E
Legal status	Reserve Forest
Major land use	Tea estates and settlements
Major habitation/settlements	Sankarankudi, Sundarankudi, Periya Kallar, Lower and Upper Nirar Colony.
Forest type	Evergreen forest
Frequency of usage by elephants	Regular

FORESTS AND ELEPHANTS

Corridor habitat status: A total of 26 tree species were recorded in the sampled area. Of these, five were elephant food species. Maximum average GBH was recorded in *Canthium diococcum* (230 cm), *Salix tetrasperma* (210 cm) and *Cullenia exarillata* (150 cm). Maximum average height was noticed in *Haldina*



3D map showing the landscape of the Vazhachal – Anaimalai via Ryan Corridor



Map of the Vazhachal – Anaimalai via Ryan Corridor

cordifolia (22 m) and *Strychnos potatorum* (20 m). Ground cover vegetation was dominated by shrubs (25%), followed by grasses (20%), and herbs (15%), with the remainder as barren ground (40%).

Estimated elephant numbers in the landscape

Anaimalai Tiger Reserve: 584
(*Synchronised Elephant Population Estimation, Tamil Nadu, 2012*)
Vazhachal Division: 574; Malayattur Division: 404; Munnar Division: 529
(*Wild Elephant Census of Kerala State, 2010*)

Forest/Land use

Forest type: Evergreen forest
Tea estate: TANTEA: Lawson and Ryan divisions
Road: Pollachi-Valparai state highway
Settlements: Paraman Kadavu, Sankaran Kudi, Sundaran Kudi, Kallar Kudi, Lower Nirar Colony, Upper Nirar colony and Periya Kallar
River: Poovar and Kallar

Other ecological importance

Mountain Range: Western Ghats
Elephant Range: Anaimalai-Nelliampathy-High Range Landscape
Elephant Reserve Name: Anaimalai Elephant Reserve
Protected Area: Anaimalai Tiger Reserve
IBA: Code. IN-TN-10, Criteria. A1, A2, A3

HUMAN DIMENSIONS

Threats

1. Tea estates: The Ryan and Lawson divisions of TANTEA completely interrupt the corridor connectivity.

2. Human settlements: Tribal settlements and tea estate labour colonies are located inside the corridor areas, posing a severe threat.

3. Vehicular traffic: Vehicular traffic on the state highway passing through the corridor hinders the free movement of elephants.

Corridor dependent villages: Paraman Kadavu, Sankaran Kudi, Sundaran Kudi, Kallar Kudi, Lower Nirar Colony, Upper Nirar Colony and Periya Kallar.

Human-Elephant Conflict: Ryan division has been a hotbed of human-elephant conflict with 25% of human deaths (nine of 36 people killed by elephants between 1994 and 2011) in the Valparai Plateau occurring in an area occupying less than 2% of the Valparai plantation landscape. Damage to property is also common and local people face immense difficulties due to the remoteness of their fields and housing.

CONSERVATION PLAN

1. The corridor should be notified by the state forest department and legally protected under an appropriate law to prevent encroachment and developmental activities detrimental to animal movement.

2. No more labour colonies, tea factories and other development activities should be allowed in the corridor.

3. Land use change should be strictly prohibited in the corridor area, especially between the fragmented forest patches.



Fig. 8.23: A settlement in the Vazhachal – Anaimalai via Ryan Corridor

8.28
SRIVILLIPUTHUR - SAPTUR

Ecological priority: High

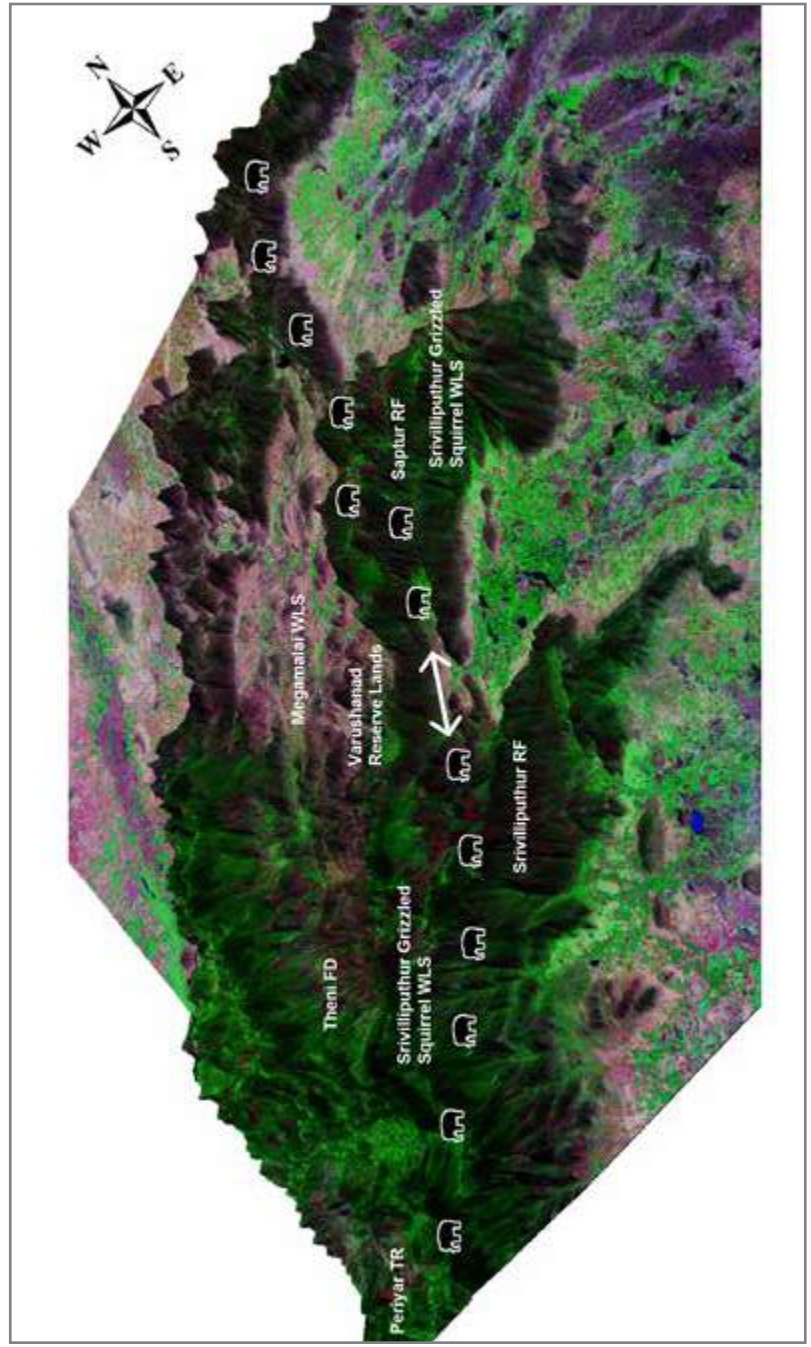
Conservation feasibility: High

This corridor connects Saptur Reserve Forest with Srivilliputhur Reserve Forest of the Srivilliputhur Grizzled Squirrel Sanctuary. Elephants move through narrow forest foothills of steep mountains between Pilavikkal reservoir and Varushanad reserved land in the Watrap Range. The corridor is bounded on the north by Madurai Forest Division, the southwest by Periyar Tiger Reserve and the northwest by Meghamalai Wildlife Sanctuary.

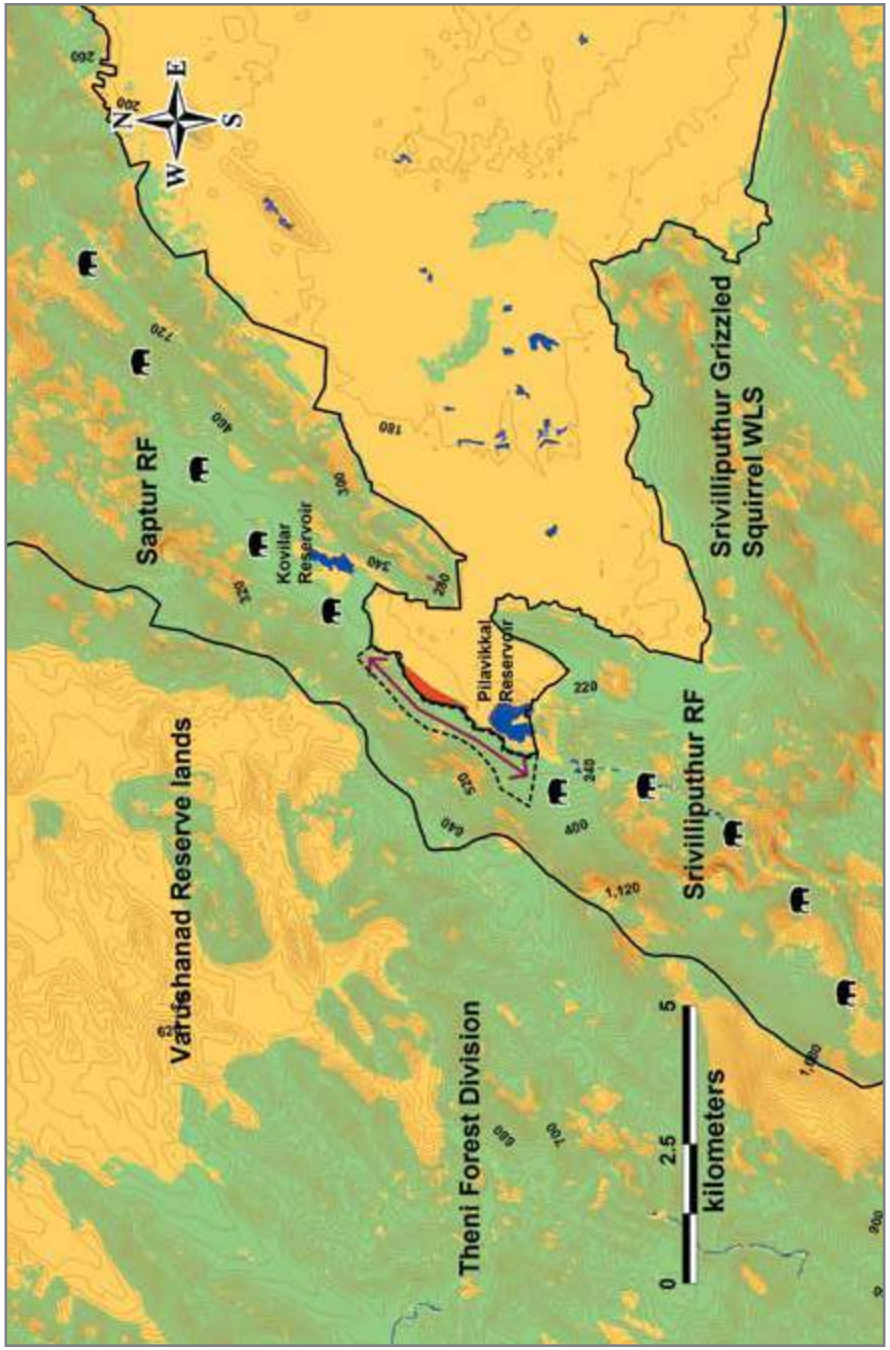
Alternate name	Pilavikkal-Watrap
State	Tamil Nadu
Connectivity	Saptur Reserve Forest with Srivilliputhur Reserve Forest of Srivilliputhur Grizzled Squirrel Sanctuary
Length and Width	3 km and 0.3-0.5 km
Geographical coordinates	9° 38′ 3″- 9° 39′ 48″ N 77° 30′ 39″- 77° 32′ 14″ E
Legal status	Reserve Forest
Major land use	Forest
Major habitation/settlements	Nil
Forest type	Tropical thorn and deciduous forests
Frequency of usage by elephants	Regular (November to January)

FORESTS AND ELEPHANTS

Corridor habitat status: Fourteen plant species were recorded in the sampled area, of which 12 are elephant food species. Maximum average GBH and height was recorded in *Albizzia amara* (GBH: 179 cm; H: 15 m) and *Sterculia guttata* (GBH: 150 cm; H: 25 m). Ground cover was dominated by grasses (25%), herbs (15%) and shrubs (10%), with the remainder as barren ground (50%).



3D map showing the landscape of the Srivilliputhur – Saptur Corridor



Map of the Srivilliputhur – Saptur Corridor showing the land to be secured

Estimated elephant numbers in the landscape

Srivilliputhur Grizzled Squirrel Sanctuary: 156 (*2002 census*)

Forest/Land use

Forest type: Tropical thorn and deciduous forests

Roads: Kizhavankovil-Kovilar Dam

Dam: Pilavikkal Dam and Kovilar Dam

Other ecological importance

Mountain Range: Western Ghats

Elephant Range: Periyar-Agasthyamalai Landscape

Elephant Reserve: Srivilliputhur Elephant Reserve

Protected Area: Srivilliputhur Grizzled Squirrel Sanctuary

IBA: IN-TN-23, Criteria. A1, A2

HUMAN DIMENSIONS

Threats

1. Biotic pressure: Cattle grazing and illegal extraction of wood from the corridor forest by the adjoining villages of Venobhava Nagar, Indira Nagar and Kizhavankovil has affected the corridor habitat quality and diurnal movement of elephants.

2. Human disturbance: Tourists and locals visiting the Kovilar Dam pollute the corridor forest by throwing bottles, plastic and food waste which is a threat to elephants.

Corridor dependent villages: Kizhavankovil, Venobhava Nagar and Indira Nagar (Silk Farm)

Human-Elephant Conflict: With agriculture being limited there is very little conflict in the corridor area. Only a few lands have coconut, mango and silk plantations. A few instances of crop damage by elephants were reported during 2008-2013.

CONSERVATION PLAN

1. The corridor should be notified by the state forest department and legally protected under an appropriate law to prevent encroachment and developmental activities detrimental to animal movement.

2. About 187 acres of land need to be secured to increase the width of the corridor from 200 m to 300 m.

3. Regulated tourism could be conducted and the revenue earned could be used to supplement the livelihood of fringe villagers.

Land identified to secure the corridor

Village Name	Name of the landowner	Extent of area (acres)	Status of the land
Venobhava Nagari	Chinnamuthu	6	Patta
	Kamatchi		Patta
	Velandi		Patta
	Sellaiya		Patta
Kizhavan Kovil	Siva suriya Prakash	25	Patta
Kizhavan Kovil		65	Patta
Kizhavan Kovil	Ramanathan	10	Patta
Kizhavan Kovil	Prabhu	50	Patta
Kizhavan Kovil	Muthumalai	20	Patta
Kizhavan Kovil	Bava Rawuthar	11	Patta

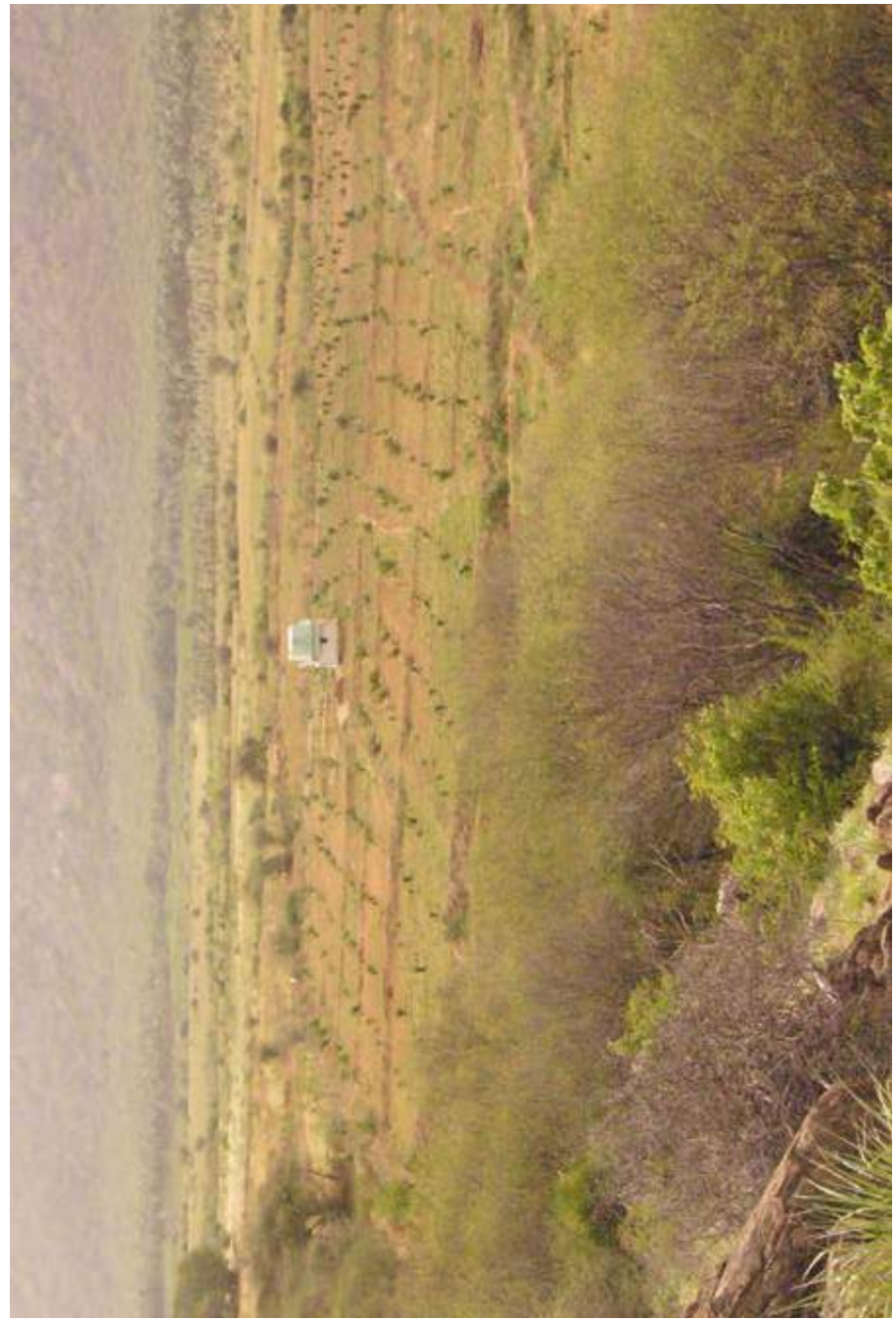
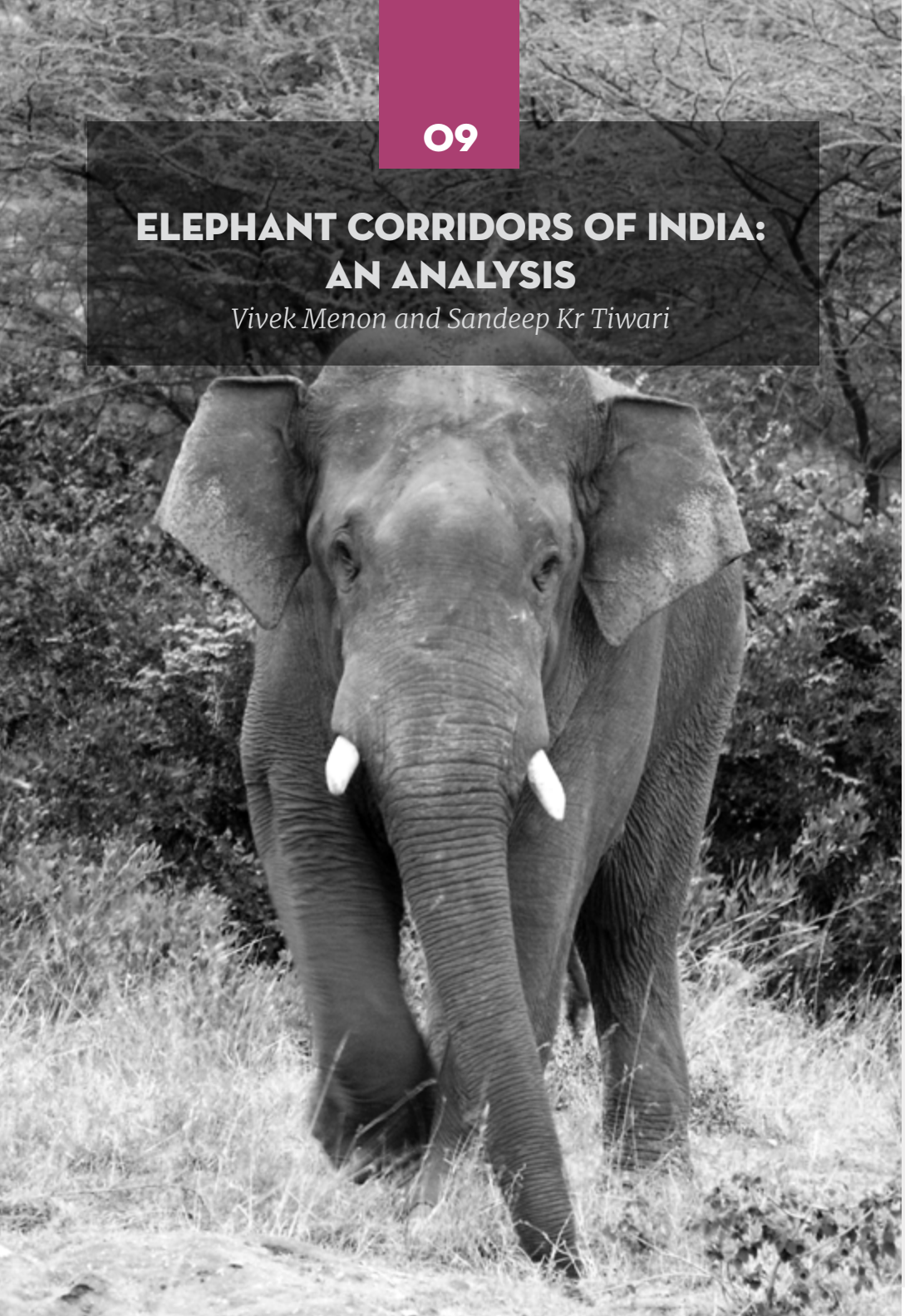


Fig. 8.24: A view of the Srivilliputhur – Saptur Corridor



09

ELEPHANT CORRIDORS OF INDIA: AN ANALYSIS

Vivek Menon and Sandeep Kr Tiwari

THE SURVIVAL OF WIDE-RANGING AND LARGE NOMADIC MAMMALS LIKE ASIAN ELEPHANTS in fragmented and human dominated landscape is a major challenge. Of the available forest cover of 697,898 sq km in India (*FSI 2015*), only about 110,000 sq km (or 15.75%) is available to elephants. Of this, about 65,000 sq km (59.1%) is notified as Elephant Reserves. Only about 27% of Elephant Reserves are legally protected under the Protected Area network.

A large extent of elephant habitat is thus outside the purview of legal protection and much of it is not free of human habitation and its disturbances. Many elephant habitats are connected by narrow forest patches and in several other cases, elephants pass through agriculture lands, plantations and human settlements to move between habitats, leading to increased human-elephant conflict.

After extensive research and field surveys, 88 elephant corridors were identified across India in 2005. However, in the last one decade, there have been further changes in the landscape; the expanding economy and the heightened pace of development have further impacted elephant habitats and corridors. Hence, the existing corridors and new ones that may have emerged in the last decade were visited and surveyed to understand their current status and to prepare conservation plans for securing each of them.

A total of 101 elephant corridors have now been identified in the country (*Figure 9.01*) and seven corridors that were identified earlier in 2005 have been

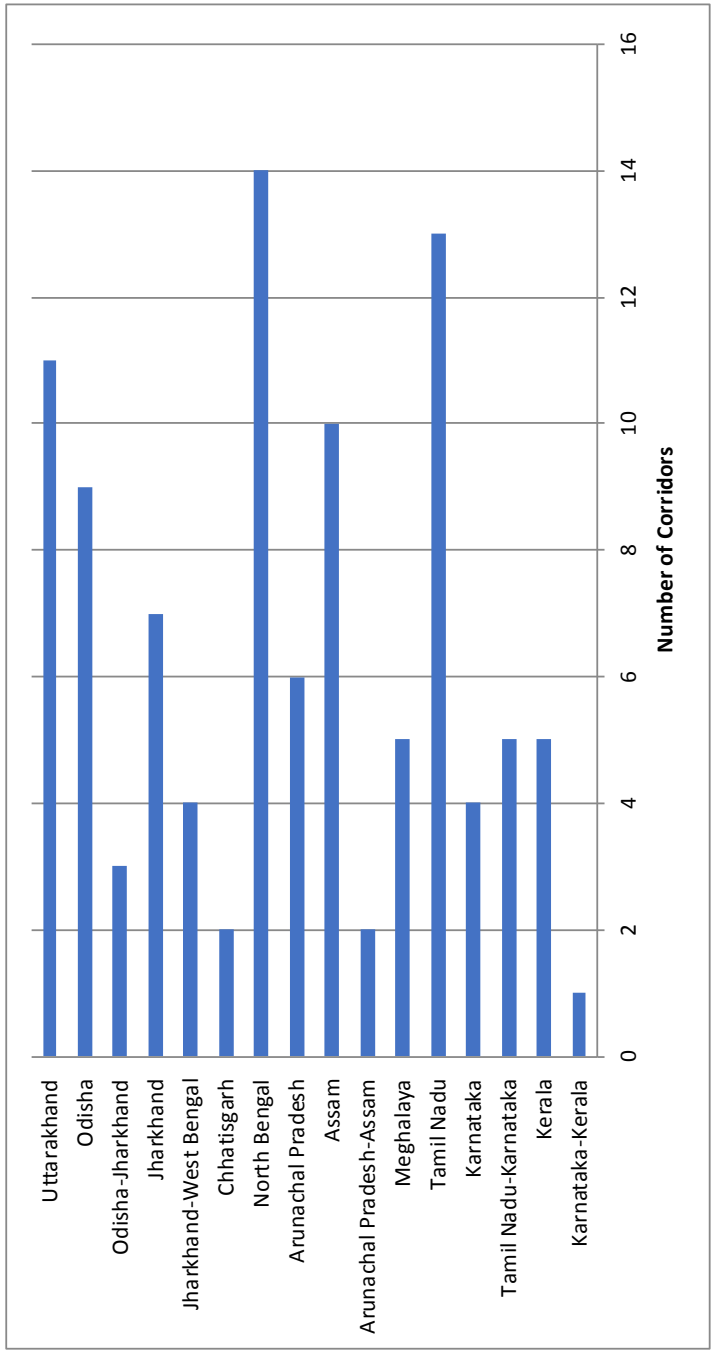


Figure 9.01: State–wise distribution of elephant corridors India

found impaired in the last decade due to developmental activities and land use changes. Of the identified corridors, 15 (14.85%) are inter-state corridors. A detailed methodology is given in the chapter 'Documenting and Securing Corridors' in this publication, based on which this analysis is presented.

Of the identified corridors, 36.6% of the corridors are in North-eastern India and Northern West Bengal and 27.7% in Southern India (*Figure 9.02*). There is an inverse relationship between forest cover available in elephant ranging states and the number of corridors in each state (*Figure 9.03*), indicating

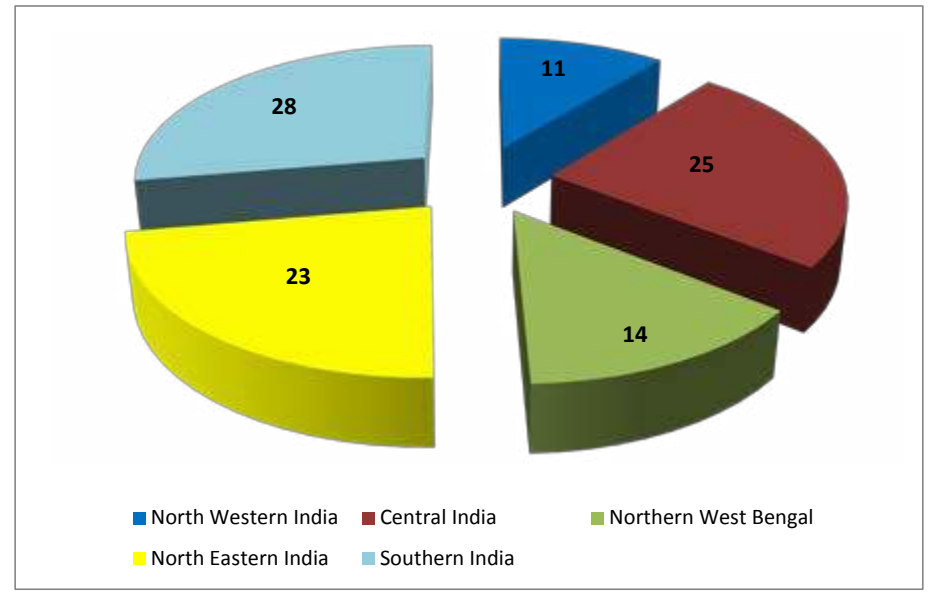


Figure 9.02: Elephant corridors in different zones of India

greater fragmentation of the smaller forest habitats. In other words, the more the degradation of the habitats, the more the number of corridors.

On a zonal basis, the highest number of corridors is present in Northern West Bengal, which has one corridor for every 150 sq km of available elephant habitat, whereas North-east India has about one corridor for every 1565 sq km of available elephant habitat. Southern India has one corridor for every

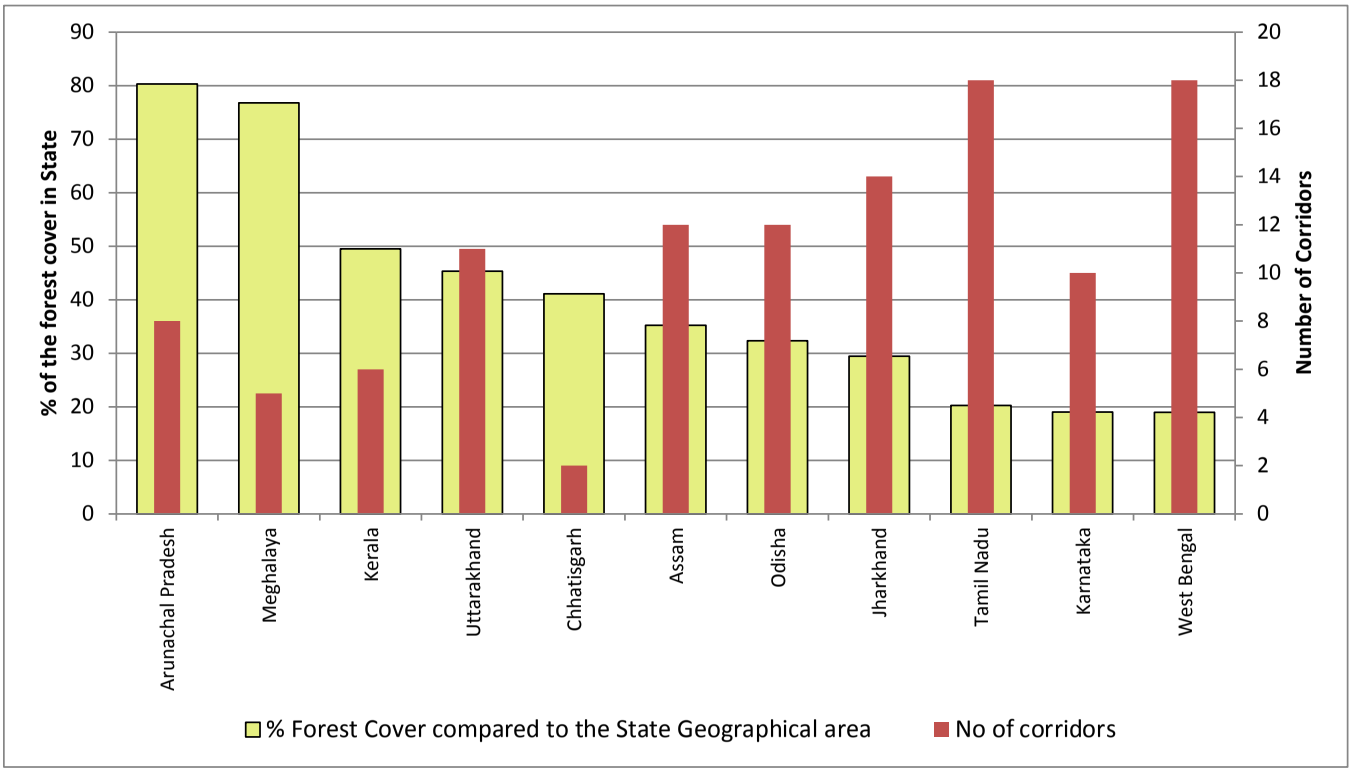


Figure 9.03: Forest cover and elephant corridors in different states of India

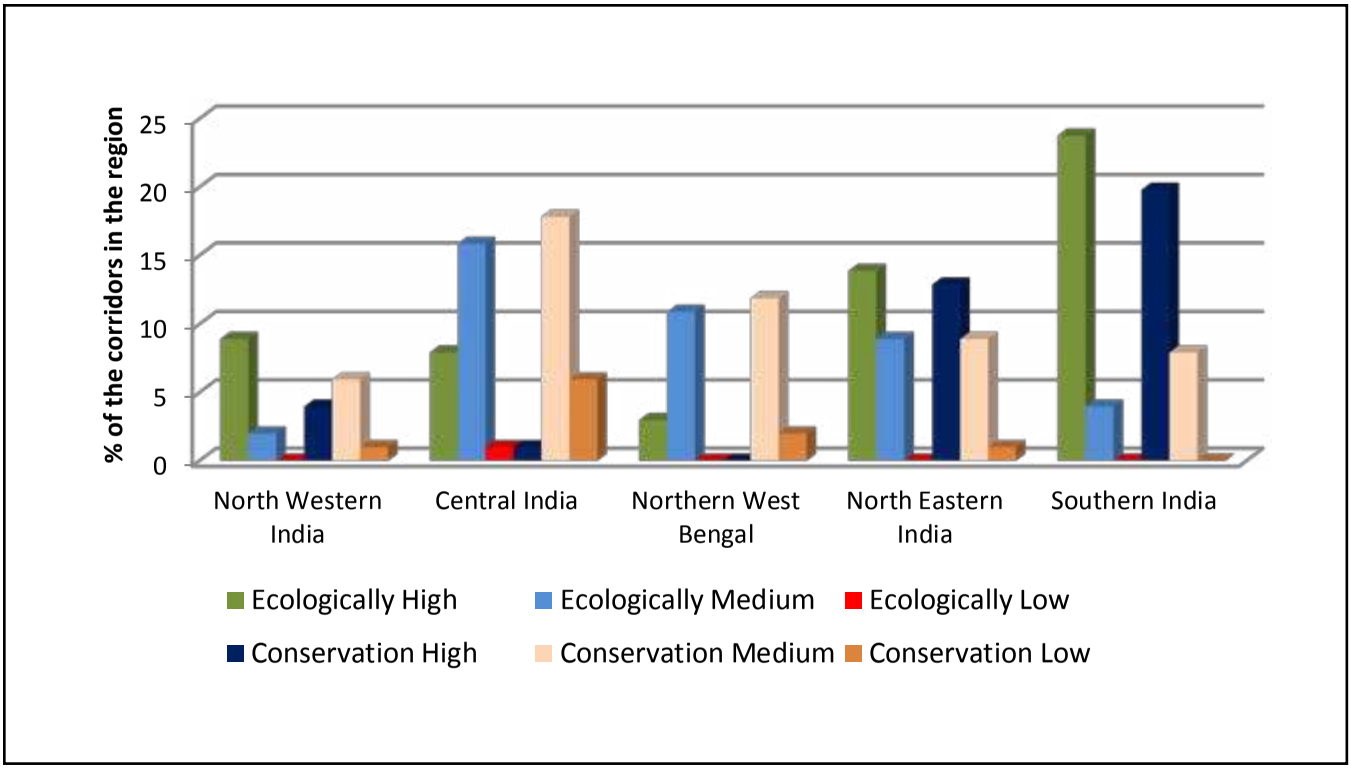


Figure 9.04: Ecological and Conservation priority of corridors in the different zones

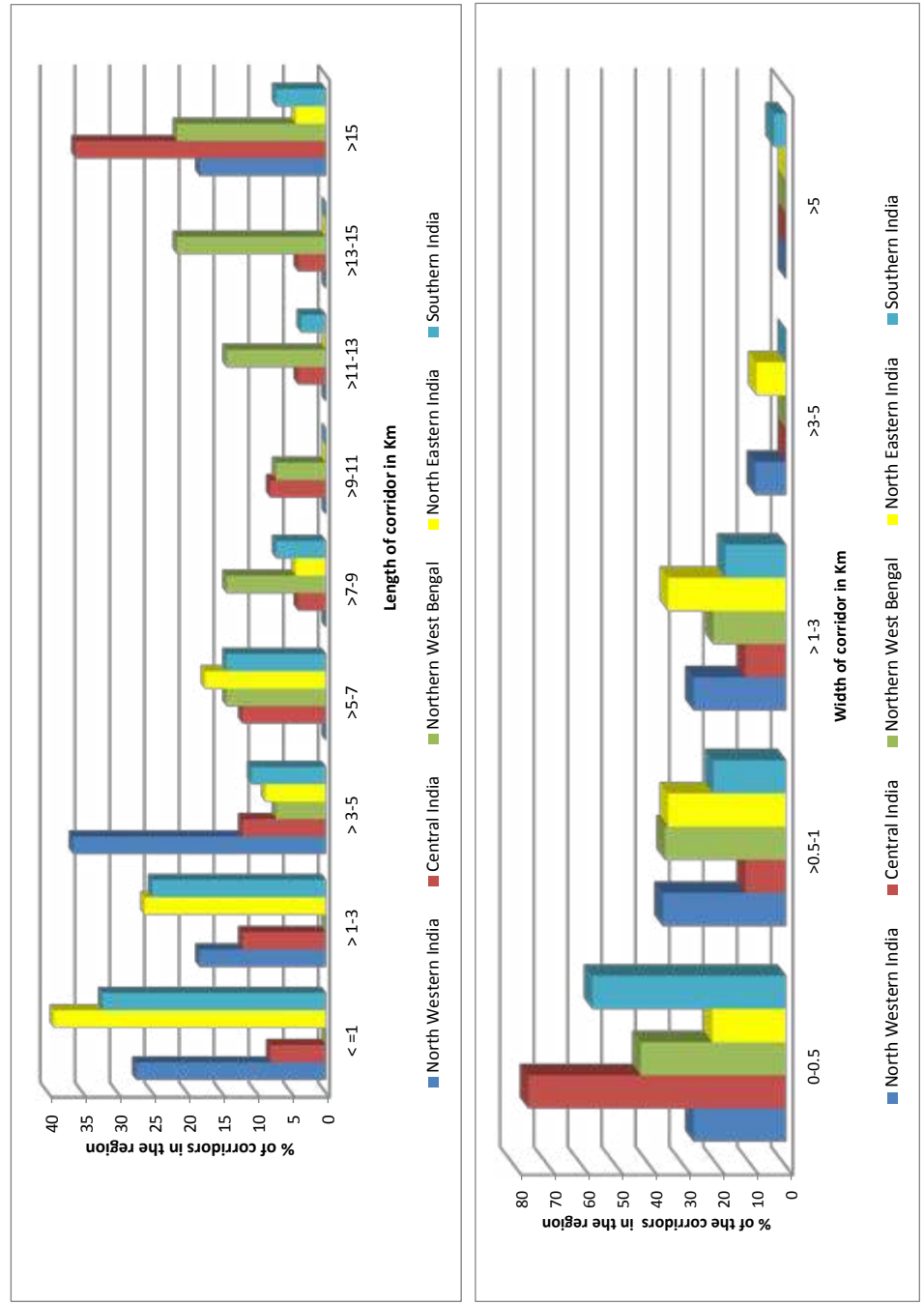
1410 sq km of available habitat; North-western India has one corridor for every 500 sq km of available habitat; and Central India has a corridor for every 840 sq km of available elephant habitat.

Of the identified corridors, 57.5% are ecologically of high priority and 41.5% are of medium priority, indicating that most of them are important for elephant movement. Based on conservation feasibility, 38.6% are of high feasibility, 51.5% of medium and 9.9% of low feasibility (*Figure 9.4*).

The dimensions of corridors indicate the level of fragmentation between the connecting habitats. Corridor lands vary from a maximum of 40-45 km in Surguja-Jashpur (Chhattisgarh) to a minimum of 0-100 metres in Chamrajanagar-Talamalai at Punjur (Karnataka). Analysis of the dimensions of a corridor indicates that 39.1% of the corridors in North-eastern India and 32.14% of the corridors in Southern India have a length of one kilometre or less. About 36.3% of the corridors in North-western India are of three to five kilometres in length whereas 36% of the corridors in Central India are more than 15 km in length. Overall, currently 22.8% of the corridors are one kilometre or less (compared to 28.5% of the corridors in 2005) and 17.8% of the corridors are between one to three kilometres (compared to 19.3% in 2005), indicating further fragmentation of the habitats and corridors.

When the width of the corridor (the constriction on either side of the corridor connecting the habitats) is analysed, 48.5% of the corridors are between 0 and 500 metres in width and 25.7% of the corridors are of 500 metres to one kilometre in width. In 2005, about 45.5% of the corridors were one kilometre or less in width. Further, only about 21.8% of the corridors are of one to three kilometres in width currently, compared to 41% in 2005. This indicates that the corridors have further constricted due to biotic pressure and other land use changes.

Biotic pressure on the corridors was also looked at to understand the impact it has on corridors and their sustainability. Looking at the land use patterns of the corridor lands, the most severely affected corridors are in Central India



Figures 9.05 & 9.06: Length of the corridors in different zones (top); breadth of the corridors in different zones (above)

where almost 88% of the corridors are jointly under forest, agriculture and settlements and only 4% of the corridors are completely forest. In Northern West Bengal, 57.1% of the corridors are under forest, tea plantation and settlements and 35.7% are under forest, tea plantation, agriculture and settlements. In North-Eastern India, about 47.8% of the corridors are under forest, agriculture and settlements and 13% have forest, tea plantation and settlements. In Southern India, 35.7% of the corridors are totally under forest cover compared to 65% in 2005. In North-Western India, 54.5% of the corridors are jointly under forest, agriculture and settlements and 27.3% are under forest and settlements. Overall, only 12.9% of the corridors are totally under forest cover compared to 24% in 2005. Similarly, 44.5% of the corridors are currently jointly under forest, agriculture and settlements compared to 40% in 2005, and 15.85% are under forest, tea garden and settlements as compared to 16% in 2005.

Thus, there has been a severe negative impact on several corridors in the last decade (*Figure 9.07*). Corridors under the combination of tea garden and forest land can be safeguarded only through the strict enforcement of the law prohibiting land use changes, especially labour lines and other structures coming up in these tea gardens.

About 46.5% of the corridors in Southern India are without any settlements (compared to 40% in 2005) and a similar percentage with one to three settlements, showing comparatively little pressure on the corridors. In North-Western India, 36.4% of the corridors are without settlements and a similar percentage with one to three settlements. In northern West Bengal, about 57.2% of the corridors are with 1-3 settlements and 28.6% with 4-6 settlements. In North eastern India, about 52.2% of the corridors are with 1-3 settlements and 30.4% with 4-6 settlements. In Central India, 36% of the

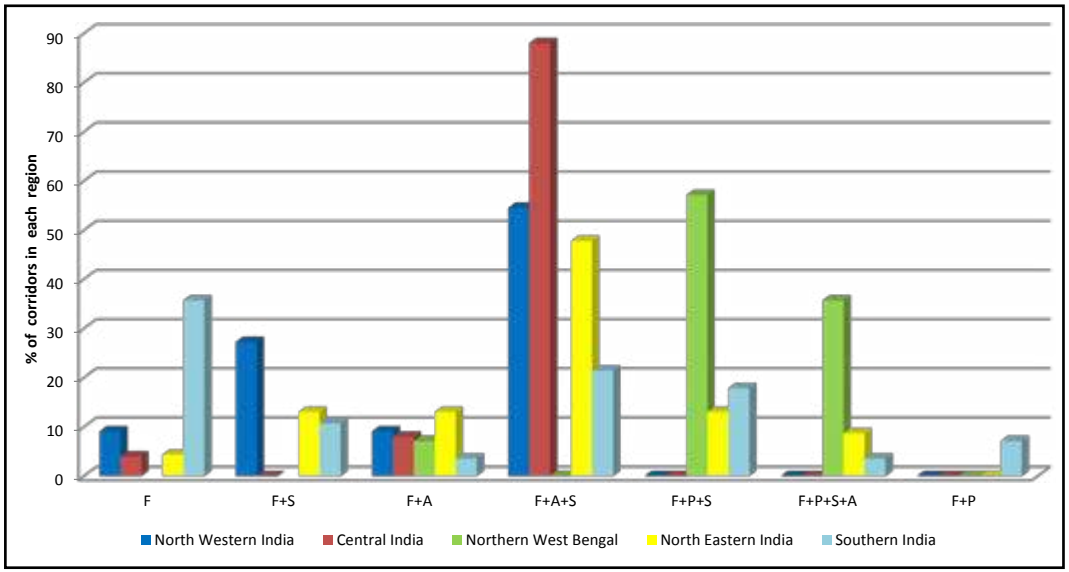


Figure 9.07: Land use pattern of the corridors

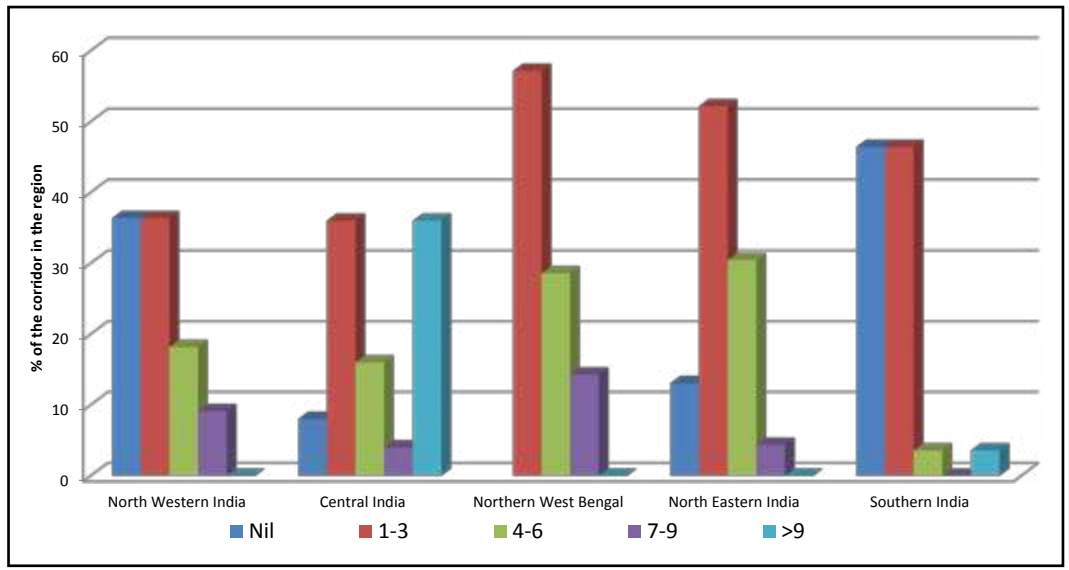


Figure 9.08: Presence of settlements in the corridors

F= Forest S= Settlements A= Agriculture
P= Plantation (tea/coffee garden)

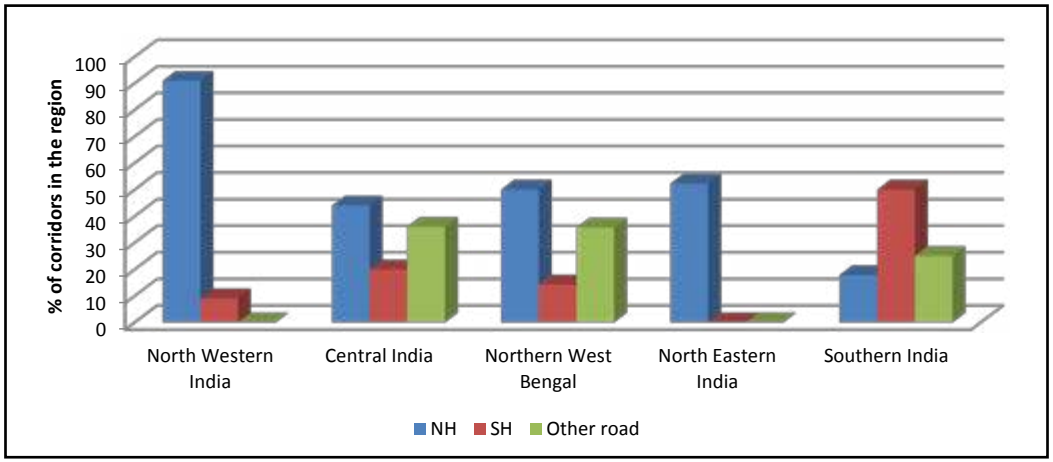


Figure: 9.09: Percentage of corridors with roads/highways

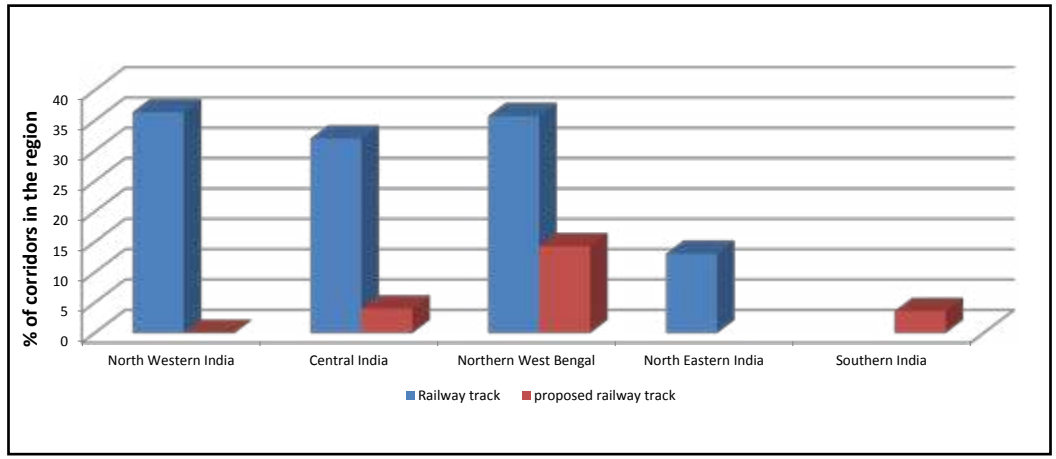


Figure 9.10: Percentage of corridors with railway lines

corridors have one to three settlements and 36% of the corridors have more than nine settlements. Across all regions, 21.8% of the corridors are free of human settlements compared to 22.8% in 2005, and 45.5% of the corridors have one to three settlements compared to 42% in 2005. For corridors with one to three settlements, efforts should be made on an urgent basis to voluntarily rehabilitate these settlements to facilitate animal movement and secure the corridors.

Another factor affecting elephant movement through corridors is the presence of linear infrastructure elements (roads, railway lines, canals). Almost 66.3% of the corridors have highways (national and/or state) passing through them (*Figure 9.09*). The physical presence of the roads and railway lines creates new habitat edges, alters hydrological dynamics, and leads to habitat fragmentation and loss. It also creates a barrier to the movement of elephants and other animals, disrupting their social activities apart from causing death due to train and vehicular collisions. Railway lines and an increase in road traffic operate in a synergetic way across several landscapes and cause not only an overall loss and isolation of wildlife habitats, but also split up the landscape in a literal sense. The area of forest habitats affected by roads and railways (ecological footprints) may be much larger than the actual cleared footprints due to negative effects that penetrate the forest to varying distances (*Goosem et al., 2010*). The response of an ecosystem to impacts is governed by many factors, and different ecosystems can be expected to adapt in different ways to road related impacts (*Rajvanshi et al., 2011*). It is seen that various developmental activities and human settlements also come up on either side of highways and rail tracks, further fragmenting corridor habitats and increasing biotic pressure.

Apart from roads, 20 corridors have a railway line passing through them and in four corridors, a railway line has been proposed or construction work is in progress. Almost 36.4% of the corridors in North-Western India, 32% in Central India, 35.7% in Northern West Bengal and 13% of corridors in North-Eastern India have a railway line passing through them (*Figure 9.10*). From 1987 to July 2017, 266 elephants have been killed by train-hits in different parts of the country. Some basic precautions need to be taken when a railway line passes through a corridor or habitat. Regulation of train speeds, preventing the dumping of food wastes in forest areas, realigning train schedules so that they cross important corridors during the day (when wildlife movement



Figure 9.11: Subarnarekha canal in Dalma Wildlife Sanctuary with an overpass for wildlife movement

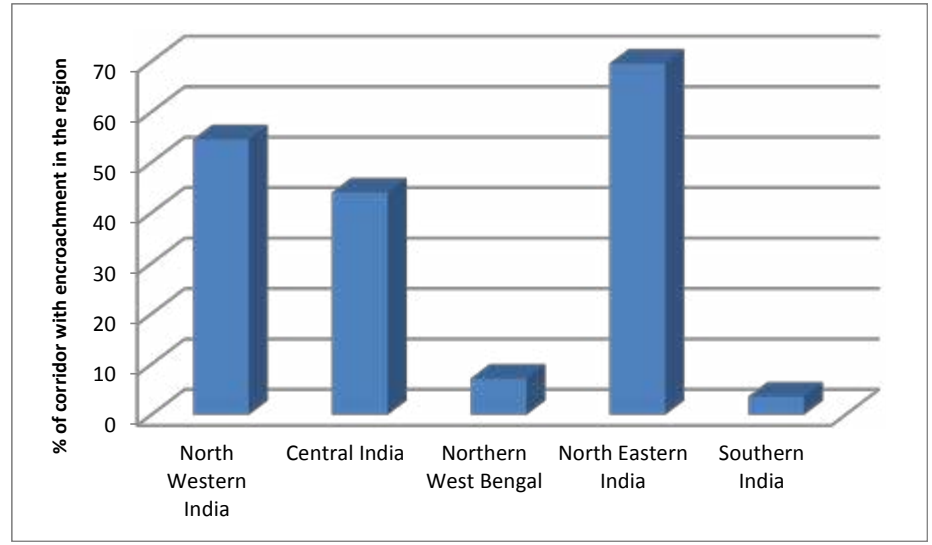


Figure 9.12: Percentage of corridors with encroachment

is less), widening of curves and embankments, and clearing of vegetation along the tracks (especially on curves) to increase vision of drivers, all need to be taken up. Sensor based Animal Detection Systems should be installed along the tracks to alert train drivers of animal movement in critical stretches. Overpasses or underpasses can also be constructed in corridors wherever possible to prevent accidents. Almost 20% of corridors require an overpass for vehicles on an urgent basis to facilitate the unhindered movement of elephants. WII (2016) has suggested overpass and underpass designs on highways and railway lines

Other linear infrastructure elements of major concern are the irrigation and power canals passing through corridors. The Rengali canal in Odisha and the Subarnarekha canal in Jharkhand and southern West Bengal have severely affected elephant movement in Central India, thereby isolating the population and increasing human-elephant conflict. Almost 40% of the corridors in Central India and 27% in North-Western India are affected by these irrigation canals.

Overall, almost 11% of corridors across the country are affected by canals. The negative impacts of these canals could have been drastically reduced if mitigation plans were undertaken during the planning stage itself. The canals could have been made underground or with appropriate overpasses to facilitate wildlife movement.

Apart from linear infrastructure, the corridors are also severely affected by various biotic factors. A large extent of corridor habitat is lost due to encroachment, which fragments the habitat. Among the identified corridors in India, 28.7% have been encroached upon. In North-Eastern India, 69.6% of corridors are affected by encroachment. Similarly, 44% of corridors in Central India and 54.5% in North-Western India are affected by encroachment.

Almost 12% of all corridors are affected by mining and boulder extraction. The corridors also pass through agriculture land and/or are encroached upon for cultivation. About 2/3rd of the corridors are affected by agriculture activities

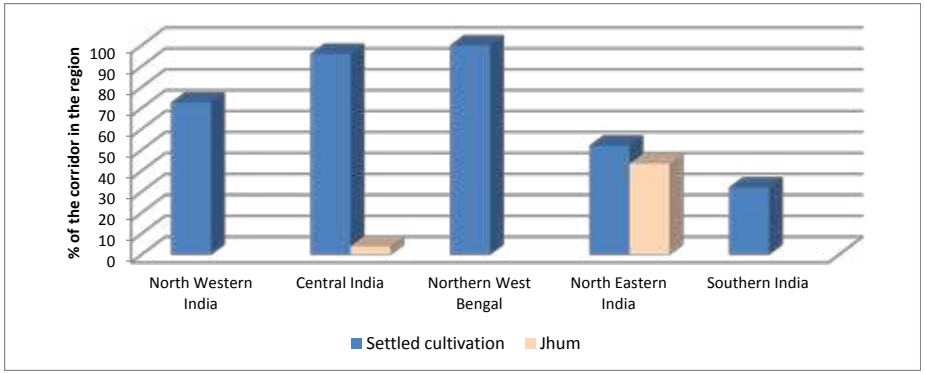


Figure 9.13: Percentage of corridors with agriculture land

of which 58.4% falls under settled cultivation and 10.9% under slash and burn (*jhum*) cultivation. All the corridors in Northern West Bengal (100%) and almost all in Central India (96%) and North-Eastern India (52.2% under settled cultivation and 43.4% under slash and burn cultivation) have agriculture land. About 72.7% of the corridors in North-Western India and 32% corridors in Southern India have agriculture land. Apart from these pressures, almost 40% of all corridors are also affected by Institutions/factories/industries/ restaurants (*dhabas*) etc. Almost half the corridors are also affected by deforestation, largely in Central, North-Eastern and North-Western India.

Corridors become more vital when they connect Protected Areas (PAs) or are close to Protected Areas, increasing the habitat available to elephants on the fringes of the PAs. It also helps the corridor during the securing process when the secured land is included as part of the Protected Area for better management, or if the corridor is secured through the extension of the Protected Area. Some 47.5% of corridors have a Protected Area at one or both ends or are within a Protected Area. Almost 81.8% of the corridors in North-Western India, 69.6% in North-Eastern India and 64.3% in Southern India have a Protected Area at one or both ends or are within a Protected Area.

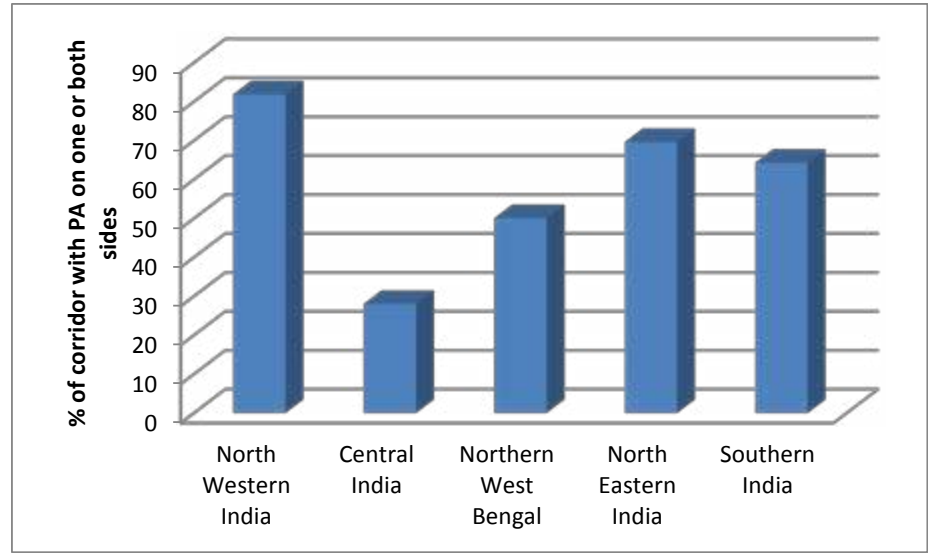


Figure 9.14: Protected Areas in and around corridors

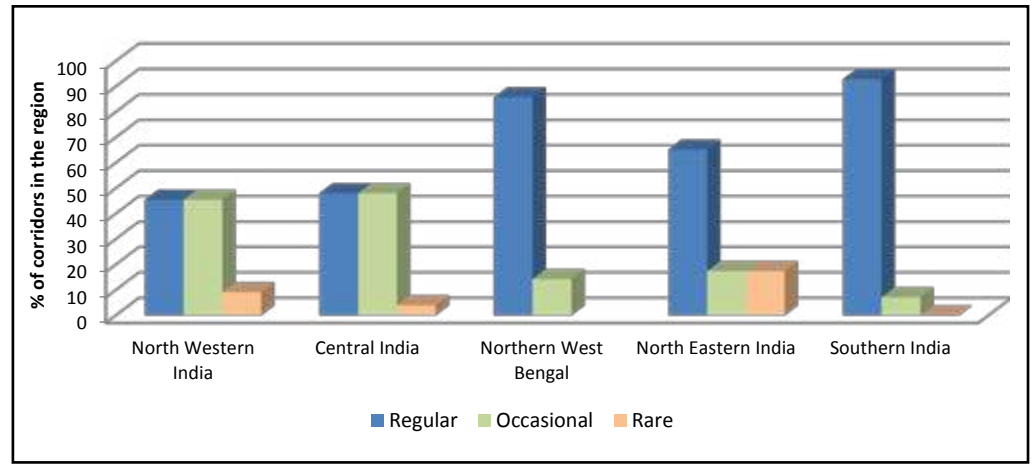


Figure 9.15: Usage of the corridors by elephants

One of the most important parameters that defines an elephant corridor is its functionality, that is, its usage by elephants. Almost 69.3% of all corridors are regularly used by elephants, either around the year or in a particular season. Some 24.75% of the corridors are used occasionally and 5.95% are rarely used. A large proportion of the corridors in Southern India (92.9%), Northern West Bengal (85.7%) and North-East India (65.2%) is regularly used by elephants. Hence, it is important that the identified corridors are secured for the free passage of elephants and other wild animals.

To ensure that corridors are protected and secured, it is important that they are legally protected to prevent further fragmentation of habitat and increased human-elephant conflict. To achieve this, state governments should first demarcate and notify these corridors as State Elephant Corridors, which could then be legally protected under appropriate sections of the Wild Life (Protection) Act, 1972. A corridor could also be secured by working with the local community and government (Autonomous District Council) to reduce local dependency on corridor land, and getting the corridor notified as a Village Reserve Forest by the Council, or as a Community Reserve by the relevant state forest department.

It is also important to inform people and developmental agencies about the importance of a particular corridor through the placement of scientifically designed signages in the corridor area. This will assist the local planning authorities to plan developmental activities in an ecologically sensitive manner. It will help vehicles passing through the corridor to take due precaution of speed limits. It will also prevent land use changes in the corridor area as the stakeholders are made aware of the criticality of the area. Wildlife Trust of India and state forest departments have together fixed signboards in almost all the identified elephant corridors (except in Odisha) over the last decade, but these now need to be fixed in all the 101 corridors, and the damaged/lost signages replaced.

Development policies in elephant habitats should be thoroughly discussed, involving various stakeholders to prevent further fragmentation and degradation and a consequent rise in human-elephant conflict. While planning infrastructure development in such regions, appropriate mitigation measures should be finalised during the planning stages to minimise impact. The overall policy in these areas should aim towards the long-term conservation of wildlife by ensuring the protection of larger forest areas.

Seven corridors have been impaired in last one decade and many more are on the verge of being impaired. This has been due to the lack of any agency keeping a close eye on these corridors so that land use changes could be detected in time and mitigation measures initiated. Hence, it is important to engage local community-based organisations in corridor areas as 'Green Corridor Champions' (GCCs), who will work as the eyes, ears and voice of corridors. GCCs will be charged with sensitising, motivating and mobilising local communities, and creating a sense of pride and ownership among them towards elephant corridors. They will work to secure and monitor the status of corridors by coordinating the actions of local self-governments, state and central governments, and other stakeholders.

APPENDIX 1

ECOLOGICAL PRIORITISATION OF IDENTIFIED CORRIDORS

S. NO.	CORRIDOR NAME	AREA OF HABITAT CONNECTED	POPULATION CONNECTED	USAGE OF CORRIDOR	PRESENCE OF ALTERNATE ROUTE	TOTAL POINTS	RANKING
	NORTH-WESTERN INDIA						
1	KANSRAU - BARKOTE	3	2	3	1	9	High
2	MOTICHUR - BARKOTE & RISHIKESH	3	2	2	1	8	High
3	MOTICHUR - GOHRI	3	2	1	1	7	Medium
4	CHILLA - MOTICHUR	3	2	3	1	9	High
5	RAWSAN - SONANADI (VIA LANSDOWNE FD)	3	3	3	1	10	High
6	RAWSAN - SONANADI (VIA BIJNOR FD)	3	3	2	1	9	High
7	MALANI - K0TA	3	3	3	1	10	High
8	CHILKIYA - KOTA	3	3	2	1	9	High
9	SOUTH PATLIDUN - CHILKIYA	3	3	3	1	10	High
10	FATHEHPUR - GADGADIA	3	1	2	2	8	High
11	KILPURA - KHATIMA - SURAI	2	1	2	2	7	Medium
	CENTRAL INDIA						
12	TAMORPINGLA – JASHPUR	2	1	3	2	8	High
13	SURGUJA - JASHPUR	2	1	3	2	8	High
14	MAHILONG - KALIMATI	2	1	2	2	7	Medium
15	CHANDIL - MATHA	1	1	1	1	4	Low
16	DALMA - CHANDIL	2	1	1	1	5	Medium
17	DALMA - RUGAI	1	1	2	1	5	Medium
18	DALMA - ASANBARI	1	1	2	1	5	Medium
19	JHUNJHAKA- BANDUAN	1	1	2	1	5	Medium
20	DALAPANI - KANKRAJHOR	2	2	2	1	7	Medium
21	DUMRIYA - NAYAGRAM	2	1	2	2	7	Medium
22	RAIBERA - PULBABURU	3	1	1	2	7	Medium
23	ANKUA - AMBIA	3	1	3	2	9	High
24	ANJADBERA-BICHABURU	1	1	3	2	7	Medium
25	KARO - KARAMPADA	2	1	3	2	8	High
26	BADAMPAHAR - DHOBADHOBIN	1	2	2	2	7	Medium
27	BADAMPAHAR - KARIDA EAST	2	2	1	2	7	Medium
28	SIMILIPAL - SATKOSIA	3	2	3	2	10	High
29	BAULA - KULDIHA	2	1	2	2	7	Medium
30	KANHEIJENA - ANANTAPUR	2	1	2	2	7	Medium

S. NO.	CORRIDOR NAME	AREA OF HABITAT CONNECTED	POPULATION CONNECTED	USAGE OF CORRIDOR	PRESENCE OF ALTERNATE ROUTE	TOTAL POINTS	RANKING
31	ANANTAPUR - ASWAKHOLA (VIA JIRIDIMAL)	1	1	2	2	6	Medium
32	ASWAKHOLA - SUNAJHARI	1	1	2	2	6	Medium
33	BUGUDA-CENTRAL	1	1	3	2	7	Medium
34	NUAGAON - BARUNI	2	1	3	2	8	High
35	TAL- KHOLGARH	2	1	3	2	8	High
36	KOTAGARH – PANKHALGUDI	3	1	3	2	9	High
	NORTHERN WEST BENGAL						
37	APALCHAND - MAHANANDA	1	1	3	2	7	Medium
38	APALCHAND - GORUMARA	1	1	3	2	7	Medium
39	APALCHAND - KALIMPONG AT MAL BLOCK (VIA SYLEE)	2	1	3	1	7	Medium
40	APALCHAND- KALIMPONG AT MAL BLOCK (VIA MEENGLASS)	2	1	3	1	7	Medium
41	CHAPRAMARI- KALIMPONG (MAL BLOCK)	1	1	3	2	7	Medium
42	RETHI - CENTRAL DIANA	1	1	3	1	6	Medium
43	RETHI - MORAGHAT	1	1	3	2	7	Medium
44	MORAGHAT – CENTRAL DIANA	1	1	3	2	7	Medium
45	TITI – RETHI VIA DUMCHI	1	1	3	1	6	Medium
46	TITI – RETHI	1	1	3	1	6	Medium
47	BUXA - TITI (VIA TORSA)	3	1	2	1	7	Medium
48	BUXA - TITI (VIA BEECH & BHARNOBARI TE)	3	1	3	1	8	High
49	NIMATI - CHILAPATA	3	1	2	2	8	High
50	BUXA - RIPU AT SANKOSH	3	2	3	2	10	High
	NORTH-EAST INDIA						
51	PAKKE - DOIMARA AT TIPPI	3	2	1	1	7	Medium
52	PAKKE- DOIMARA AT DADZU-LUMIA	3	2	2	1	8	High
53	PAKKE - PAPUM AT LONGKA NULLAH	3	2	3	1	9	High
54	PAKKE - PAPUM AT SEIJOSA NULLAH	3	2	3	1	9	High

S. NO.	CORRIDOR NAME	AREA OF HABITAT CONNECTED	POPULATION CONNECTED	USAGE OF CORRIDOR	PRESENCE OF ALTERNATE ROUTE	TOTAL POINTS	RANKING
55	DURPONG - DOIMUKH AT KHUNDAKHUWA	2	2	1	2	7	Medium
56	DULUNG - SUBANSIRI	3	1	1	2	7	Medium
57	D'ERING - MEBO AT SIGAR NULLAH	2	2	2	2	8	High
58	D'ERING – DIBRU SAIKHOWA	2	2	3	2	9	High
59	KOTHA-BURIHIDING	1	1	2	2	6	Medium
60	UPPER DIHING EAST - UPPER DIHING WEST BLOCK AT BOGAPANI	2	1	3	1	7	Medium
61	UPPER DIHING EAST - UPPER DIHING WEST BLOCK BETWEEN GOLAI - PAWAI	2	1	2	1	6	Medium
62	KALAPAHAR - DAIGRUNG	2	2	3	2	9	High
63	KAZIRANGA- KARBI ANGLONG AT PANBARI	3	3	3	1	10	High
64	KAZIRANGA – KARBI ANGLONG AT HALDIBARI	3	3	2	1	9	High
65	KAZIRANGA - KARBI ANGLONG AT KANCHANJURI	3	3	3	1	10	High
66	KAZIRANGA – EAST KARBI ANGLONG AT DEOSUR	3	3	3	1	10	High
67	KUKURAKATA - BAGSER AT AMGURI	3	2	1	1	7	Medium
68	BORNADI - KHALINGDUAR	1	1	3	2	7	Medium
69	RANGGIRA - NOKREK	3	1	1	2	7	Medium
70	NOKREK - IMANGRE	3	1	3	2	9	High
71	REWAK - IMANGRE	3	1	3	2	9	High
72	SIJU - REWAK	3	1	3	2	9	High
73	BAGHMARA-BALPAKRAM	3	2	3	2	10	High
	SOUTHERN INDIA						
74	KARADIKKAL - MADESHWARA	1	1	3	2	7	Medium
75	TALI-BILIKKAL	2	2	3	2	9	High
76	BILIKKAL – JAVALAGIRI	1	2	3	2	8	High
77	EDAYARHALLI – GUTTIYALATTUR	3	3	3	2	11	High
78	EDAYARHALLI - DODDASAMPIGE	3	3	3	2	11	High

S. NO.	CORRIDOR NAME	AREA OF HABITAT CONNECTED	POPULATION CONNECTED	USAGE OF CORRIDOR	PRESENCE OF ALTERNATE ROUTE	TOTAL POINTS	RANKING
79	CHAMARAJANAGAR - TALAMALAI AT PUNJUR	3	3	3	1	10	High
80	CHAMARAJANAGAR - TALAMALAI AT MUDDAHALLI	3	3	3	1	10	High
81	TALAMALAI - GUTTIYALATTUR	2	3	3	2	10	High
82	KALHATTI - SIGUR AT GLENCORIN	2	2	3	1	8	High
83	AVARAHALLA - SIGUR	3	3	3	1	10	High
84	KALMALAI - SINGARA AND AVARAHALLA	3	3	3	1	10	High
85	MOYAR - AVARAHALLA	2	3	3	1	9	High
86	KANIYANPURA - MOYAR	3	3	3	2	11	High
87	BEGUR - BRAHMAGIRI	3	3	3	1	10	High
88	TIRUNELLI - KUDRAKOTE	3	3	3	2	11	High
89	KOTTIYUR - PERIYA	1	1	3	2	7	Medium
90	PERIYA AT PAKRANTHALAM	1	1	3	2	7	Medium
91	NILAMBUR AT APPANKAPPU	2	1	3	2	8	High
92	NILAMBUR KOVILAKAM - NEW AMARAMBALAM	2	1	2	2	7	Medium
93	MUDUMALAI – NILAMBUR VIA O' VALLEY	3	3	3	2	11	High
94	JACCANAIRE SLOPE - HULIKAL DURGAM	3	3	3	2	11	High
95	ANAIKATTI NORTH – ANAIKATTI SOUTH	3	2	3	2	10	High
96	ANAIMALAI AT PUNACHI	3	3	3	1	10	High
97	ANAIMALAI AT WATERFALLS ESTATE	3	3	2	1	9	High
98	ANAIMALAI BETWEEN SILUVAIMEDU - KADAMPARAI	3	3	2	1	9	High
99	VAZHACHAL – ANAIMALAI VIA SHOLAYAR	3	3	3	1	10	High
100	VAZHACHAL - ANAIMALAI VIA RYAN	3	3	3	1	10	High
101	SRIVILLIPUTHUR - SAPTUR	2	1	3	2	8	High

ECOLOGICAL RANKING SCALE

ECOLOGICAL PRIORITY			
PARAMETERS	**SCORE**		
		2	**1**
Area of habitat being connected	250 sq km each or more than 500 sq km combining both	< 250 - 150 sq km each or 300 - 500 sq km combining both	< 150 sq km each or < 300 sq km combining both
Population connected	>400	200 - 400	< 200
Usage of corridor	Regular	Occasional	Rare
Presence of alternate route		No	Yes
Ranking	high (11- 8)	Medium (7-5) (36 - 70%)	Low (4 and below)



APPENDIX 2

CONSERVATION FEASIBILITY OF IDENTIFIED CORRIDORS

S.NO.	CORRIDOR NAME	MAJOR LAND USE	SETTLEMENTS INSIDE THE CORRIDOR	LINEAR INFRASTRUCTURE	ROAD TRAFFIC INTENSITY	RAIL TRAFFIC INTENSITY	POLITICAL WILL	COMMUNITY WILLINGNESS SCORE	PRESENCE OF ARMY/MILITARY/INSTITUTIONAL USERS/INDUSTRIES	CIVIL UNREST	ENCROACHMENT	AREA OF LAND FOR PURCHASE	RELOCATION OF PEOPLE	TOTAL COST	TOTAL SCORE	CONSERVATION FEASIBILITY
	NORTH-WESTERN INDIA															
1	KANSRAU - BARKOTE	3	3	2	1	3	2	3	3	2	3	3	3	3	34	High
2	MOTICHUR - BARKOTE & RISHIKESH	3	3	2	1	3	2	3	3	2	3	3	3	3	34	High
3	MOTICHUR - GOHRI	1	1	1	1	2	2	1	3	2	3	2	3	2	24	Medium
4	CHILLA - MOTICHUR	3	3	1	1	1	2	3	1	2	3	3	3	1	27	High
5	RAWSAN - SONANADI (VIA LANSDOWNE FD)	1	1	2	1	3	2	1	3	2	2	3	1	2	24	Medium
6	RAWSAN - SONANADI (VIA BIJNOR FD)	1	1	1	1	3	2	1	3	2	2	1	3	1	22	Medium
7	MALANI - KOTA	1	2	2	1	3	2	2	3	2	3	2	2	1	26	Medium
8	CHILKIYA - KOTA	1	1	2	1	3	2	2	3	2	1	1	1	1	21	Medium
9	SOUTH PATLIDUN - CHILKIYA	1	2	2	2	3	2	2	2	2	2	2	1	1	24	Medium
10	FATHEHPUR - GADGADIA	2	3	2	1	3	2	2	3	2	1	3	3	1	28	High
11	KILPURA - KHATIMA - SURAI	1	1	1	1	2	2	1	3	2	1	1	1	1	18	Low
	CENTRAL INDIA															
12	TAMORPINGLA – JASHPUR	1	1	1	1	3	1	2	2	1	3	3	2	2	23	Medium
13	SURGUJA - JASHPUR	1	1	1	1	3	1	2	2	1	3	3	2	2	23	Medium
14	MAHILONG - KALIMATI	1	1	1	1	2	1	1	2	2	2	2	2	1	19	Low
15	CHANDIL - MATHA	1	1	1	2	2	1	1	3	2	1	3	2	2	22	Medium
16	DALMA - CHANDIL	1	1	1	1	1	1	2	3	2	3	2	2	2	22	Medium
17	DALMA - RUGAI	1	2	1	1	3	2	3	2	2	3	2	2	1	25	Medium
18	DALMA - ASANBARI	3	3	2	1	3	3	3	3	2	2	3	3	3	34	High
19	JHUNJHAKA- BANDUAN	1	1	3	3	3	2	2	3	1	1	1	1	1	23	Medium
20	DALAPANI - KANKRAJHOR	1	1	3	3	3	2	2	3	1	1	2	3	1	26	Medium
21	DUMRIYA - NAYAGRAM	1	2	1	2	2	1	1	2	1	3	2	2	1	21	Medium
22	RAIBERA - PULBABURU	1	1	2	3	2	1	1	3	1	2	3	2	2	24	Medium
23	ANKUA - AMBIA	2	3	2	2	3	2	2	3	1	1	1	2	1	25	Medium
24	ANJADBERA- BICHABURU	1	1	1	1	1	2	1	3	1	2	2	2	1	19	Low

S.NO.	CORRIDOR NAME	MAJOR LAND USE	SETTLEMENTS INSIDE CORRIDOR	LINEAR INFRASTRUCTURE	ROAD TRAFFIC INTENSITY	RAIL TRAFFIC INTENSITY	POLITICAL WILL	COMMUNITY WILLINGNESS SCORE	PRESENCE OF ARMY/MILITARY/ INSTITUTIONAL USERS/INDUSTRIES	CIVIL UNREST	ENCROACHMENT	AREA OF LAND FOR PURCHASE	RELOCATION OF PEOPLE	TOTAL COST	TOTAL SCORE	CONSERVATION FEASIBILITY
25	KARO - KARAMPADA	1	1	3	2	3	1	1	1	1	3	1	3	1	22	Medium
26	BADAMPAHAR - DHOBADHOBIN	1	1	2	2	3	2	1	3	1	1	1	1	1	20	Medium
27	BADAMPAHAR - KARIDA EAST	1	1	1	1	3	2	1	2	1	2	1	1	1	18	Low
28	SIMILIPAL - SATKOSIA	1	1	2	2	3	2	2	3	1	1	1	1	1	21	Medium
29	BAULA - KULDIHA	1	1	2	3	3	1	1	3	1	2	1	1	1	21	Medium
30	KANHEIJENA - ANANTAPUR	1	1	1	1	2	1	1	2	2	3	1	1	1	18	Low
31	ANANTAPUR - ASWAKHOLA (VIA JIRIDIMAL)	1	1	1	1	1	1	1	2	2	2	3	2	1	19	Low
32	ASWAKHOLA - SUNAJHARI	1	1	2	2	3	1	1	2	2	3	3	3	1	25	Medium
33	BUGUDA-CENTRAL	1	2	1	1	2	1	1	2	2	2	1	1	1	18	Low
34	NUAGAON - BARUNI	1	1	2	3	3	2	2	3	2	3	1	2	1	26	Medium
35	TAL- KHOLGARH	1	1	2	1	3	2	2	2	2	1	1	2	1	21	Medium
36	KOTAGARH – PANKHALGUDI	2	1	2	3	3	2	2	3	1	1	1	1	1	23	Medium
	NORTHERN WEST BENGAL															
37	APALCHAND - MAHANANDA	1	1	2	1	3	1	2	2	2	2	3	2	2	24	Medium
38	APALCHAND - GORUMARA	1	1	1	1	3	1	2	3	2	3	3	1	2	24	Medium
39	APALCHAND - KALIMPONG AT MAL BLOCK (VIA SYLEE)	1	1	1	1	2	1	2	1	2	3	2	2	2	21	Medium
40	APALCHAND-KALIMPONG AT MAL BLOCK (VIA MEENGLASS)	1	1	1	1	2	1	2	1	2	2	2	1	1	18	Low
41	CHAPRAMARI-KALIMPONG (MAL BLOCK)	1	1	2	3	3	1	2	2	2	3	2	2	1	25	Medium
42	RETHI - MORAGHAT	1	1	1	1	2	1	2	1	2	3	3	1	1	20	Medium
43	MORAGHAT – CENTRAL DIANA	1	1	2	3	2	1	1	2	2	3	3	3	2	26	Medium
44	TITI – RETHI VIA DUMCHI	1	1	2	1	2	1	2	2	2	3	3	1	1	22	Medium
45	RETHI - CENTRAL DIANA	1	1	1	1	2	1	1	1	2	3	2	1	2	19	Low
46	TITI – RETHI	1	1	2	1	2	1	2	2	2	2	3	1	2	22	Medium
47	BUXA - TITI (VIA TORSA)	1	1	2	1	2	1	2	2	2	3	3	3	2	25	Medium
48	BUXA - TITI (VIA BEECH & BHARNOBARI TE)	1	1	2	1	2	1	2	2	2	2	2	2	1	21	Medium
49	NIMATI - CHILAPATA	1	1	2	1	3	1	2	2	2	2	2	2	1	22	Medium
50	BUXA - RIPU AT SANKOSH	1	2	2	2	3	2	1	1	2	2	2	2	2	24	Medium
	NORTH-EAST INDIA															
51	PAKKE - DOIMARA AT TIPPI	1	1	2	2	3	1	1	2	2	1	3	1	2	21	Medium
52	PAKKE- DOIMARA AT DADZU-LUMIA	2	3	2	2	3	2	2	2	2	1	3	3	2	29	High
53	PAKKE - PAPUM AT LONGKA NULLAH	1	2	3	3	3	2	3	3	2	3	3	3	2	33	High

S.NO.	CORRIDOR NAME	MAJOR LAND USE	SETTLEMENTS INSIDE CORRIDOR	LINEAR INFRASTRUCTURE	ROAD TRAFFIC INTENSITY	RAIL TRAFFIC INTENSITY	POLITICAL WILL	COMMUNITY WILLINGNESS SCORE	PRESENCE OF ARMY/MILITARY/ INSTITUTIONAL USERS/INDUSTRIES	CIVIL UNREST	ENCROACHMENT	AREA OF LAND FOR PURCHASE	RELOCATION OF PEOPLE	TOTAL COST	TOTAL SCORE	CONSERVATION FEASIBILITY
54	PAKKE - PAPUM AT SEIJOSA NULLAH	1	2	1	3	3	2	3	3	2	3	3	3	2	31	High
55	DURPONG - DOIMUKH AT KHUNDAKHUWA	1	1	2	2	2	1	1	2	2	1	3	2	2	22	Medium
56	DULUNG - SUBANSIRI	1	2	2	2	3	1	1	2	1	3	2	2	2	24	Medium
57	D'ERING - MEBO AT SIGAR NULLAH	1	1	3	3	3	3	3	3	2	2	3	3	2	32	High
58	D'ERING – DIBRU SAIKHOWA	1	1	3	3	3	3	2	3	2	2	3	1	2	29	High
59	KOTHA-BURIHIDING	1	1	3	3	3	2	1	2	2	1	2	1	2	24	Medium
60	UPPER DIHING EAST - UPPER DIHING WEST BLOCK B/W GOLAI - PAWAI	1	1	1	1	3	2	1	2	2	2	3	1	1	21	Medium
61	UPPER DIHING EAST - UPPER DIHING WEST BLOCK AT BOGAPANI	1	1	1	1	3	2	2	3	2	1	3	1	2	23	Medium
62	KALAPAHAR - DAIGRUNG	1	2	3	3	3	2	2	3	1	2	2	2	2	28	High
63	KAZIRANGA- KARBI ANGLONG AT PANBARI	1	2	2	1	3	3	2	3	2	3	1	2	2	27	High
64	KAZIRANGA - KARBI ANGLONG AT KANCHANJURI	1	2	2	1	3	3	3	3	2	3	3	3	3	32	High
65	KAZIRANGA – KARBI ANGLONG AT HALDIBARI	3	3	2	1	3	3	3	3	2	2	3	3	3	34	High
66	KAZIRANGA – EAST KARBIANGLONG AT DEOSUR	3	3	2	1	3	3	3	3	2	3	3	3	3	35	High
67	KUKURAKATA - BAGSER AT AMGURI	1	2	2	1	3	3	1	3	2	2	1	2	1	24	Medium
68	BORNADI - KHALINGDUAR	1	1	3	3	3	2	1	2	2	1	2	2	1	24	Medium
69	RANGGIRA - NOKREK	1	1	2	1	3	2	1	1	1	2	1	2	1	19	Low
70	NOKREK - IMANGRE	1	1	3	3	3			3	1	3	3	3	2	26	Medium
71	REWAK - IMANGRE	1	3	3	3	3	2	2	3	1	3	3	3	2	32	High
72	SIJU - REWAK	1	2	2	2	3	2	2	3	1	3	3	3	2	29	High
73	BAGHMARA-BALPAKRAM	1	1	3	3	3	2	2	3	1	3	3	3	2	30	High
	SOUTHERN INDIA															
74	KARADIKKAL - MADESHWARA	3	3	2	3	3	3	3	2	2	3	1	2	1	31	High
75	TALI-BILIKKAL	1	2	3	3	3	2	2	3	2	2	1	2	2	28	High
76	BILIKKAL – JAVALAGIRI	2	2	3	3	3	2	2	3	2	3	3	3	2	33	High
77	EDAYARHALLI – GUTTIYALATTUR	1	2	3	3	3	2	1	3	2	2	3	2	2	29	High
78	EDAYARHALLI - DODDASAMPIGE	3	3	2	2	3	3	3	3	2	3	3	3	3	36	High
79	CHAMARAJANAGAR - TALAMALAI AT PUNJUR	1	1	2	1	3	1	1	3	2	3	1	1	1	21	Medium

S.NO.	CORRIDOR NAME	MAJOR LAND USE	SETTLEMENTS INSIDE THE CORRIDOR	LINEAR INFRASTRUCTURE	ROAD TRAFFIC INTENSITY	RAIL TRAFFIC INTENSITY	POLITICAL WILL	COMMUNITY WILLINGNESS SCORE	PRESENCE OF ARMY/MILITARY/ INSTITUTIONAL USERS/INDUSTRIES	CIVIL UNREST	ENCROACHMENT	AREA OF LAND FOR PURCHASE	RELOCATION OF PEOPLE	TOTAL COST	TOTAL SCORE	CONSERVATION FEASIBILITY
80	CHAMARAJANAGAR - TALAMALAI AT MUDDAHALLI	1	2	2	1	3	2	3	3	2	3	2	3	2	29	High
81	TALAMALAI - GUTTIYALATTUR	1	2	2	1	3	2	2	3	2	3	2	2	2	27	High
82	KALHATTI - SIGUR AT GLENCORIN	1	3	2	2	3	2	1	2	2	3	2	3	1	27	High
83	AVARAHALLA - SIGUR	1	2	3	3	3	2	2	3	2	3	3	3	1	31	High
84	KALMALAI - SINGARA AND AVARAHALLA	3	3	2	2	3	2	2	3	2	3	1	3	1	30	High
85	MOYAR - AVARAHALLA	3	3	3	3	3	2	3	3	2	3	3	3	3	37	High
86	KANIYANPURA - MOYAR	3	3	3	3	3	2	3	3	2	3	3	3	2	36	High
87	BEGUR - BRAHMAGIRI	2	3	2	1	3	2	1	2	2	3	1	3	1	26	Medium
88	TIRUNELLI - KUDRAKOTE	3	3	3	3	3	3	3	3	2	3	3	3	3	38	High
89	KOTTIYUR - PERIYA	1	1	2	1	3	2	2	3	2	3	1	2	1	24	Medium
90	PERIYA AT PAKRANTHALAM	1	2	2	2	3	2	2	2	2	3	2	3	1	27	High
91	NILAMBUR AT APPANKAPPU	1	1	3	3	3	2	2	3	2	3	1	2	1	27	High
92	NILAMBUR KOVILAKAM - NEW AMARAMBALAM	3	3	2	2	3	2	2	3	2	3	3	3	3	34	High
93	MUDUMALAI – NILAMBUR VIA O' VALLEY	1	1	2	1	3	2	1	3	2	3	3	2	1	25	Medium
94	JACCANAIRE SLOPE - HULIKAL DURGAM	1	2	2	1	3	2	1	1	2	2	1	2	1	21	Medium
95	ANAIKATTI NORTH – ANAIKATTI SOUTH	1	3	2	2	3	2	2	1	2	2	1	3	2	26	Medium
96	ANAIMALAI AT PUNACHI	3	3	2	2	3	3	3	3	2	3	3	3	3	36	High
97	ANAIMALAI AT WATERFALLS ESTATE	2	3	2	2	3	3	2	3	2	3	2	3	2	32	High
98	ANAIMALAI BETWEEN SILUVAIMEDU - KADAMPARAI	3	2	2	1	3	3	3	3	2	3	3	3	3	34	High
99	VAZHACHAL – ANAIMALAI VIA SHOLAYAR	1	1	2	2	3	1	1	3	2	3	3	3	1	26	Medium
100	VAZHACHAL - ANAIMALAI VIA RYAN	1	1	2	2	3	1	1	3	2	3	3	3	1	26	Medium
101	SRIVILLIPUTHUR - SAPTUR	3	3	2	3	3	3	2	3	2	3	1	3	1	32	High

CONSERVATION RANKING SCALE

CONSERVATION FEASIBILITY			
PARAMETERS	**SCORE**		
	3	**2**	**1**
Major land use	Forest	Forest and agriculture OR Forest and plantation	Forest, agriculture, settlement OR Forest, plantation, settlement OR Forest, mining, settlement OR Forest and settlement
Settlements inside the corridor	0 settlements	1-5 settlements OR <50 families	>6-9 settlements OR >50 families
Linear Infrastructure (cemented irrigation canal, railway track, highway-SH/NH)	0 linear threats	1 linear threat	2-3 linear threats
Presence of Institutions/army establishments/ industries	No	<25 of corridor area threatened	>25%
Civil unrest		No	Yes
Encroachment	No	<25 of corridor area threatened	>25%

Political Will	High	Medium	Low
Community willingness	High	Medium	Low
Land Purchase Area for securing	No land purchase	1-50 acres	>51 acres
Total cost of securing	Under Rs 1 crore	Rs 1-8 crore	More than Rs 8 crore
Road traffic intensity	1- 50 vehicles per hour	51-100 vehicles per hour	>100 vehicles per hour
Railway traffic intensity	<10 trains per day	11 - 24 trains per day	>25 trains per day
Relocation of people for securing	None	2 settlements or <50 families	More than 2 settlements or > 50 families
High priority **Medium priority** **Low priority**	**38-27** **26-20** **19 and below**		

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APCCF	Additional Principal Chief Conservator of Forests
AsESG	Asian Elephant Specialist Group
AWLW	Assistant Wildlife Warden
CCF	Chief Conservator of Forests
CEO	Chief Executive Officer
CF	Conservator of Forests
CI	Central India
Cm	Centimetre
CWLW	Chief Wildlife Warden
DBH	Diameter at Breast Height
DCF	Deputy Conservator of Forests
DD	Deputy Director
DFO	Divisional Forest Officer / District Forest Officer
EPT	Elephant Proof Trench
EBA	Endemic Bird Area
EF	Elephant Family
FD	Field Director
FD	Forest Division
FIG	Figure
FRH	Forest Rest House
FSI	Forest Survey of India
FV	Forest Village
GBH	Girth at Breast Height
GCC	Green Corridor Champions
Ha	Hectare
HH	Household
HoFF	Head of Forest Force
HQ	Headquarters
IBA	Important Bird Area
IFAW	International Fund for Animal Welfare
ITBP	Indo-Tibetan Border Police
IUCN	International Union for Conservation of Nature
Km	Kilometre
LC	Labour Colony
MoEF	Ministry of Environment and Forests (Old Name)
MoEF&CC	Ministry of Environment, Forest & Climate Change
NCF	Nature Conservation Foundation
NEHU	North-Eastern Hill University
NE	North-East
NGO	Non Governmental Organisation
NH	National Highway
NP	National Park
NTFP	Non Timber Forest Produce
PA	Protected Area
PF	Protected Forest
PE	Project Elephant
PCCF	Principal Chief Conservator of Forests
PRF	Proposed Reserve Forest
RCCF	Regional Chief Conservator of Forests
RF	Reserve Forest
RFO	Range Forest Officer
RS	Railway Station
SF	State Forest
SI	Southern India
SH	State Highway
SSB	Sashastra Seema Bal
SSC	Species Survival Commission
SC	Scheduled Caste
ST	Scheduled Tribe
Sq km	Square Kilometre
T & CE	Tea and Coffee Estate
TG	Tea Garden
TE	Tea Estate
TR	Tiger Reserve
USF	Unclassified State Forest
VRF	Village Reserve Forest
WB	West Bengal
WL	Wildlife
WLD	Wildlife Division
WLS	Wildlife Sanctuary
WLT	World Land Trust
WLW	Wildlife Warden
WTI	Wildlife Trust of India
WWF	World Wide Fund for Nature

CONSERVATION REFERENCE SERIES #3 [2nd Edition]

RIGHT OF PASSAGE

ELEPHANT CORRIDORS OF INDIA



Elephants are large-bodied nomads. Surviving in the fragmented habitat that they have at their disposal in India today necessitates crossing human-dominated landscapes. This publication brings together, in its second edition, a comprehensive listing of India's elephant corridors as identified and mapped by elephant experts in consultation with all state forest departments that are part of the elephant range in the country. Securing these corridors so that elephants and other species can locally migrate between habitats is crucial to their survival. Developmental plans in these regions must also take the needs of elephants into consideration. This will ensure species survival, lessen conflict and ensure holistic conservation.

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Conservation of the Asian elephant in North-West India

A.J.T. Johnsingh, Qamar Qureshi, Dhananjai Mohan and Christy A. Williams

Introduction

The north-western elephant population in India once had a continuous range in Uttar Pradesh (UP), from Katerniaghat Wildlife Sanctuary (WLS) in Bahraich Forest Division (FD) in the east, to the Yamuna River in the west (Singh 1978). Over time, this continuity has been broken, and now the total population of about 1,000 elephants occurs in six isolated sub-populations. From east to west, these populations are in Katerniaghat Wildlife Division (WLD), 10-20 animals migrating to and from Nepal's Bardia National Park (NP), in and around Dudhwa Tiger Reserve (TR, 880km^2, *c.* 40 elephants) (Javed 1996), between Sharda River and Haldwani town, Haldwani and Khoh River, Khoh River and Ganga River, and between Ganga River and Yamuna River. Bulls, however, still cross Khoh and Ganga Rivers. The major breaks in this elephant range are along the Ganga River, along the Gola River that runs to the west of Kathgodam-Haldwani-Lalkuan Highway, across Khatima Range of Terai East FD and between Dudhwa NP and Katerniaghat WLD. Although isolated, Katerniaghat WLD is identified as an area to be managed along with Dudhwa TR. The Khatima Range has become unsuitable for elephants and other large mammals as a result of the construction of Sharda Main Canal, Tanakpur-Khatima Highway and enormous increasing biotic disturbances, from the human settlements in and around. Steep terrain and biotic disturbances deter the movements of elephant groups across Gwalgod *sot* in the hilly terrain of Rajaji-Corbett corridor (Sunderraj *et al.* 1995). Nevertheless, elephants use the stretch of forests south of Rajaji-Corbett corridor (parts of Haridwar and Bijnor Plantation Division, *c.* 300km^2) as a corridor between Rajaji NP and Corbett TR. But this forest belt is also under enormous biotic pressures. Sand and boulder mining started in the riverbeds of this area, in the recent years, have added to the pressures.

From east to west, the Protected Areas (PAs) and forest divisions in this elephant range are: Katerniaghat WLD, Dudhwa NP, Kishanpur WLS, North Kheri FD, Pilibhit FD, Haldwani FD, Champawat FD (South Pithoragargh), East Terai FD, Central Terai FD, West Terai FD, Ramnagar FD, Corbett TR (including Sonanadhi WLS), Bijnor FD, Lansdowne FD, Bijnor Plantation DIivision, Haridwar FD, Rajaji NP, Dehra Dun FD, Narendra Nagar FD (part), Shivalik FD and Kalsi FD. The elephant range here is about 500km long and narrow in most places.

Altitude varies between 200 and 1,000m a.s.l., and Kanda, which is situated on the northern boundary of Corbett TR, is the highest point. The total elephant habitat available is around 10,000km^2. The Outer Himalaya and the Shivaliks are the mountain and hill ranges that run through this tract.

West of Sharda River, the fertile water-rich *terai* tract has been lost to cultivation and monoculture plantations, and the elephant habitat is largely confined to the *bhabar* tract, which is full of boulders and has a low water table. *Terai* habitat is still available east of the Sharda River, in Pilibhit and North Kheri FD, Dudhwa TR and Katerniaghat WLD. Major rivers in this range are the Yamuna, Ganga, Ramganga, Sharda, Suheli and Geruwa. Besides these, there are numerous streams and ephemeral water courses known as *raus*, which in the *bhabar* tract remain dry during most parts of the year. See Johnsingh *et al.* (2004) for more details of this area.

Vegetation types

The vegetation in this tract is dominated by moist and dry sal (*Shorea robusta*) forests, interspersed with northern tropical dry deciduous forests, Northern tropical moist deciduous forests, and bamboo (*Dendrocalamus strictus*) clumps. Himalaya sub-tropical forests dominated by chir pine (*Pinus roxburghii*) occur on the peaks of the Shivaliks. Cane (*Calamus tenuis)* brakes, seasonal swamp forests dominated by *Syzygium*, riparian fringing forests dominated by *Trewia nudiflora*, *Ficus hispida* and *Putranjiva roxburghii* also occur at mesic sites. The *terai* grasslands east of the Sharda River are dominated by *Phragmites karka*, *Saccharum spontaneum*, *S. bengalensis*, *S. munja*, *Narenga porphyrocoma*, *Sclerostachya fusca*, *Themeda arundinaceae* and *Vetiveria zizanoides*. Several parts of this range, particularly the remaining *terai* belt, are planted with exotics like teak (*Tectona grandis*), gum (*Eucalyptus*), poplar (*Populus deltoides*), *Haplophragma heterophylla* and *Ailanthus excelsa*. The area is classified into six broad natural vegetation classes, Moist Sal Forest, Dry Sal Mixed Forest, Mixed Forest, Acacia-Dalbergia Forest, Open Woodland/Plantation and Open scrub and Grassland (Figure10.1).

Legal and management status

At present, there are six PAs in this range: Corbett NP (core of Corbett TR), Rajaji NP (still proposed), Sona Nadi WLS (part of Corbett TR), Dudhwa NP, Kishanpur WLS, and Katerniaghat WLD (the last three from the Dudhwa TR).

(a) Corbett NP (*c.* 521km^2), which forms the core area of the 1,288km^2 Corbett TR, has had a chequered

history. In 1936, it became India's first National Park under the United Provinces National Parks Act. Originally called Hailey NP, it became the Ramganga NP after independence. Finally, it was named Corbett NP in honour of late Jim Corbett, legendary hunter and author, and later a consultant to demarcate the limits of the proposed national park. On 1 April 1973, India's laudable conservation programme, Project Tiger, was inaugurated at the park headquarters in Dhikala.

(b) Rajaji NP, which encompasses three former wildlife sanctuaries – Rajaji, Chilla and Motichur – as well as parts of the Shivalik and Dehra Dun FDs, also has a history. In 1966, 90km^2 of the Dehra Dun FD was upgraded as Motichur WLS. An area of 247km^2 of the Shivalik FD and an area of 249km^2 of the Lansdowne FD were upgraded as Rajaji and Chilla WLSs in 1967 and 1974, respectively. In 1984, these three sanctuaries, and parts of the above mentioned FDs, were intentionally notified as Rajaji NP.

(c) Sonanadi WLS is contiguous to the Corbett NP, and along with it and some adjoining reserved forests (RFs), forms the Corbett TR. The Sanctuary was established in 1987 over an area of 301.76km^2. Lying between the Corbett NP and Rajaji NP, the Sanctuary is a part of the link between the two.

(d) In the *terai* region of Lakhimpur Kheri in UP, Dudhwa WLS, spread over an area of 212km^2, was created in the year 1958, to protect a population of swamp deer (*Cervus duvauceli duvauceli*). This was upgraded to National Park in 1977, and enlarged to an area of 490 km^2, along with a buffer of 124km^2.

(e) South of Dudhwa, on the southern bank of Sharda River, another PA, Kishanpur WLS, was established in 1972, over an area of 204km^2. In 1987, these two PAs of the UP *terai* were brought under the umbrella of Project Tiger. The Dudhwa TR so formed was further enlarged in 1994, by adding some buffer areas to the south, and extending the area of the reserve to 884km^2.

(f) Katerniaghat WLS was created in the forests of Bahraich FD in the year 1976. This Sanctuary had an area of 400km^2 on the eastern bank of the Ghaghra River. In 1997, along with 150km^2 of contiguous buffer, this Sanctuary was reorganized administratively as the Katerniaghat WLD, and in 2001, it was merged with Dudhwa TR.

The rest of the areas within this elephant range come under the category of Reserved Forests.

10.4 Density and status of elephant population

The elephant population in this range, from Yamuna to Katerniaghat, could be around 1,000 animals, giving a crude density of one animal per 10km^2. Area-wise population estimation is as follows: 150 to 200 elephants west of River Ganga (*c.* 1500km^2), 650 to 700 between Ganga and Gola River (Haldwani) (*c.* 4,000km^2), 50 between Gola and Sharda (*c.* 1,800km^2) which still a few years ago was reported to range into Nepal, may be into Sukhlaphanta Reserve, and 50 between Khatima Range and Katerniaghat (*c.* 2,500km^2) which moves between India and Nepal (Figure 10.2). Until recently, the population between Yamuna River and Haldwani had the best reported sex ratio in the entire Asian elephant range. Studies conducted by the Wildlife Institute of India in Rajaji NP and Corbett TR, have shown that the existing adult male:female sex ratio was 1:2-2.5, due largely to the absence of poaching for ivory. As a result, the effective population size of elephants in the forest patch between Yamuna River and Haldwani was higher than that of the southern Indian populations, despite their having a much larger number of individuals (Williams 2002). Recent poaching incidents (10 tuskers were poached in the Corbett-Rajaji area from December 2000 to December 2001) and the death of males (of the 11 elephants that died in December 2001 and January-February 2002 in the Rajaji area, including two bulls that were poached, eight were males) indicate that this healthy sex ratio can be drastically altered within a few years, if habitat degradation, deaths due to electrocution, poisoning and poaching are not brought under control.

Conservation problems

Since the steep Himalaya and Shivaliks bound this elephant range on the north, and the fertile *terai* on the south, fragmentation as a result of human habitations and associated developments, is the most serious problem. Equally serious is the problem of habitat disturbance and degradation due to overgrazing by domestic livestock, lopping of trees to feed the *Gujjar* buffaloes, and collection of *bhabar* grass (*Eulaliopsis binata*) for rope making. Overgrazing leads to proliferation of weeds and lack of regeneration of palatable plant species (Dabadghao and Shankarnarayan 1973; Johnsingh *et al.* 1990). Since October 2002, Uttaranchal Government has permitted large-scale sand and boulder mining in the river beds within the RFs. This mining brings in nearly 25,000 poor labourers from Eastern Uttar Pradesh and Bihar who camp on the riverbed for nine months (October to June) and their firewood needs combined with that of local people, cause enormous loss and disturbance to the elephant habitat.

Habitat fragmentation and threats to habitat connectivity

The once continuous elephant range is now fragmented in four places (along the Ganga and Gola Rivers, across Khatima Range and between Dudhwa NP and Katerniaghat WLD). There is a fragile connectivity between Dudhwa NP and Katernighat WLD along Bardia NP. In several other places the threats to habitat connectivity are increasing.

Kansrau-Barkote corridor

The connectivity between Kansrau Range of Rajaji NP and Barkote-Rishikesh Ranges (*c.* 120km² of elephant habitat) is a 2km-wide patch of disturbed forests, which is under enormous pressure, particularly wood-cutting from the adjacent villages (Lal Thapar and Chhidarwala). The corridor is being degraded at present. The Dehra Dun–Haridwar National Highway, passing through this corridor, is an additional source of disturbance. Bulls and groups occasionally use this corridor.

On the banks of Ganga River (Chilla-Motichur corridor)

As stated earlier, the habitat is almost completely fragmented for elephant groups, between Chilla and Motichur Ranges of Rajaji NP, on the banks of Ganga River. The factors that have led to fragmentation on the right bank of Ganga River are the expanding Haridwar Township, the Raiwala Army Camp, and the settlements of Tehri Dam oustees (Khand Gaon I, II and III) between Raiwala and Motichur *rau*. On the left bank of Ganga River, the 14km-long Kunaun-Chilla power channel has blocked the movement of elephants between Chilla and the river. All these developments occurred in the late 1960s and early 1970s. Now only a few bulls move at night between Chilla and Motichur, along the Motichur *rau* and through the army camp and the Khand Gaon III. The bridge on the channel near Suni *sot*, and the aqueduct built below the channel for the passage of water in Dogudda *rau*, are also occasionally used by the bulls (Johnsingh *et al.* 1990).

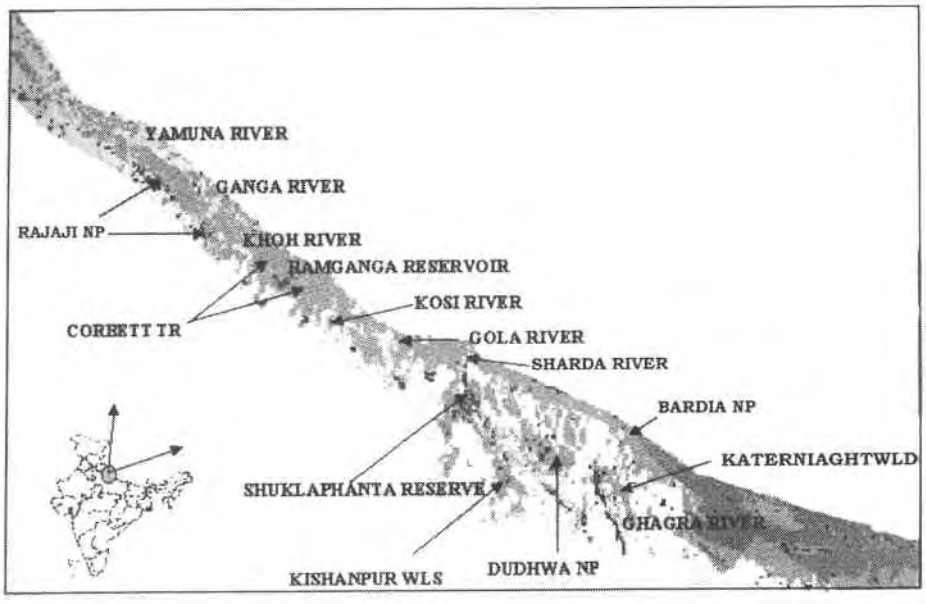
Between Rajaji NP and Corbett TR

In the past, there was a continuous stretch of forest south of the hilly tract that extends between Khoh River (west of Corbett TR) and the eastern end of Rajaji NP (Rawason River). In due course, forests closer to Khoh River were lost to cultivation and human settlements, forcing elephants to move across the hilly terrain in the eastern part of the corridor. Over the years, this narrow hilly corridor has come under immense biotic pressures from the *Gujjar* camps and villages situated on the northern and southern boundary. As a result of the growing biotic disturbances and the steep terrain, elephants have stopped using the habitat between Gwalgod *sot*, which is about 10 km west of Khoh River, and Khoh River (Sunderraj *et al.* 1995).The forests south of this hilly area, Haridwar and Bijnor Plantation Division, though under increasing biotic pressures, are still being used by elephants.

On the southern boundary of Corbett TR

The construction of a reservoir across the Ramganga River, and the building of the Kalagarh Township on the south-western boundary of Corbett TR in the early 1970s, has put an end to the movement of elephant groups across the Ramganga River, from Corbett NP to Kalagarh FD (Sona Nadi WLS and now part of Corbett TR). Only a few bulls occasionally cross the river along the southern boundary. Fortunately, the hilly habitat north of the Ramganga Reservoir is disturbance-free, and is used even by groups to move between the Park and the Sona Nadi WLS. The Kalagarh Project and associated township was built on 90km² of forest land and according to an agreement between the Irrigation and Forest Departments, 3.5km² of this area should have been vacated and returned to the Forest Department soon after the completion of the construction of the reservoir. After much persuasion 3.1km² were returned by the Irrigation Department. The remaining area (0.4km²) has colonies with about 4,000-5,000 encroachers. Now Forest Department, supported by NGOs, has filed cases against 724 individuals for evicting them and their families and the case is in the court of Sub-Divisional Magistrate, Kotdwar.

Fig. 1 The North - West elephant range, India



Kosi River corridor

The Kosi River flows between Corbett TR and Ramnagar FD, and although there are human habitations along the river, the connectivity is good in the following four places: (a) about 5km between Mohan and Kumaria; (b) 1.5km between Dhangari Gate and Sunder Khal; (c) 100m between the two blocks of Sunder Khal; and (d) 6km between Infinity Resorts and Bijrani. The growing problems of Sunder Khal, an encroachment since 1974, now 3.5km long, along the right bank of Kosi River, pose the most serious threat to this corridor.

Boar River corridor

This is the forest connectivity around Kaladhungi, in Ramnagar FD.

Nihal-Bhakhra corridor

The 4km-wide Nihal-Bhakhra corridor is between Boar River and Gola River connecting the Ramnagar FD with Terai Central FD, a plantation division. There are seven villages – Bedrampur, Pratappur, Kharakpur, Lachchampur, Rampur, Sakatpur and Sherpur – with about 700 families, and a human and cattle population of 4,000 and 3,000, respectively. However, the major threat to the corridor comes from the powerful landlords who have large land-holdings on lease. Large-scale farming means not only more biotic pressure on the corridor, but a direct threat to the forest – clear-felling for agricultural purposes, besides legal and illegal commercial felling.

Gola River corridor

The major break in the elephant range has occurred as a result of the growth of Haldwani Town situated at the base of the steep Shivalik Hills, and the various developments that have occurred south of Haldwani. Notable among them is the Lal Kuan Industrial Complex. Heavy traffic along Haldwani–Lal Kuan Road throughout the day and night, and large-scale sand and boulder mining from October-June by hundreds of labourers along the Gola River have also contributed to this fragmentation. The firewood demands of these labourers, who camp on the river bed, are eroding the forests in the Tanda Range of Terai Central FD and Doli Range of Terai East FD (Johnsingh *et al.* 2004).

Kilpura-Khatima corridor

The Haldwani-Sharda population of about 50 elephants range mostly in the Haldwani FD and in the Jaulasal and Kilpura Ranges of Terai East FD. During rains, some of these elephants from the Kilpura Range cross the Sharda Canal 2km upstream of Lalkhoti in the Navakhal block of Khatima Range. Beyond Khatima Range the status of forest in Nepal is unknown. There may be some connectivity with the Sukhlaphanta Reserve. The inhabitants of Devipura Majgaun in Khatima Range, an area encroached for about 20 years, report of occasional crop raiding by elephants during the rains. They also reported that the elephants, until recently, during the rains, used to migrate to Nepal, possibly to Sukhlaphanta Reserve. The Kilpura-Khatima corridor is severely threatened by enormous wood cutting and fodder collection by the inhabitants of Khatima Township, the encroached villages such as Devipura Majgaun, Pachoria and Patta and Nepali villages north of Khatima Range (Kanchanpur *teshil*, Mahendra Nagar District).

Lagga Bagga–Haripur–Belha–Kishanpur–Dudhwa corridor

Lagga Bagga lies in the Barahi Range of Pilibhit FD. It is a corridor of *c.* 6km^2, connecting the Pilibhit Forests with those of Royal Suklaphanta Reserve in Nepal. It is thus an important link in the movement of animals from Dudhwa and Kishanpur to Nepal, via Haripur range of Pilibhit FD, which is contiguous to Kishanpur WLS. While Lagga Bagga has the status of Reserved Forest, the forests of Belha (a stretch of forest bordering Pilibhit and South Kheri FD) are still in the process of being acquired by Government. Both these areas have serious problems of encroachment and other biotic pressures such as illegal felling, grazing (mainly by feral cattle), and poaching, which occur at a larger scale due to the proximity to the international border. The Bhira and Mailani Ranges of South Kheri FD, and the Khutar Range of Shahjahanpur FD, are also contiguous to Kishanpur WLS on the south and south-western side, and help provide a corridor to Pilibhit FD further west.

There is another break in this forested continuum, in the *terai* between Kishanpur WLS and Dudhwa NP. While the Kishanpur WLS extends to the southern bank of the Sharda River, the northern bank is devoid of forests. It is only after travelling 5-10km north of the river that one reaches the forests of Dudhwa NP. The area in between consists mainly of agricultural crops such as sugarcane, wheat and paddy, and small patches of forests/plantations and reed-covered water courses and ox-bow lakes. In early winter, from October-November, elephants are known to use these water courses and lakes while moving between the two PAs.

Dudhwa-Katerniaghat corridor

There is hardly any contiguity between these two PAs at present, except that of riverine corridors along Mohana and Suheli Rivers. Even the much better connectivity along the Mohana River is broken for about 5km. Both riverine corridors are quite patchy, nonetheless they provide some cover in the otherwise agricultural landscape. The distance and area between these two Protected Areas are between 15-20km^2 and 200km^2 respectively. Nearly 5% of this 200 km^2 has patches of RFs belonging to the North Kheri FD which are largely under *terai* marshes. The remaining area is under agriculture (mainly sugarcane) tenanted by nearly 20,000 people. Recreating a corridor here for elephants capable of causing enormous damage to crops in a landscape dominated by sugarcane, is difficult, as it would require

decades of dedicated conservation effort.

There exists a weak corridor between the Katerniaghat WLD and Royal Bardia NP of Nepal, which is a very narrow strip of riverine vegetation along the Geruwa River (the eastern branch of Karnali/Ghagara) and has been used by rhinos and elephants in moving into Katerniaghat WLD in recent years. This Division has enormous problems due to settlements inside and around the periphery.

Encroachments

These forests have suffered in many places as a result of large-scale Government-sponsored encroachment that took place in the early 1970s. Two examples are worth recording: one is Sunder Khal, and other in the Terai East FD.

In 1974, about 400 people, prompted by Parvati Shilpkar Samiti-Sunderkhal, encroached into the Western Kunkhet Beat, Dhulwa Block 5, 9 and 11, an area of 73.84ha in the Kosi Range of Ramnagar FD. The Forest Department filed cases in the Kashipur Court to evict these encroachers: 24 cases in 1974-75, 114 in 1989 and 131 in 1990, a total of 269. The Kashipur Court gave a verdict in 1992 that 172 families should leave, but no decision was made on the other 97 families. The 172 families refused to leave as they were not given alternative sites in one area for resettlement. According to the 1999 census, there are some 300 families with 1,500 individuals and they have built 100 *pucca* houses and 200 temporary huts. This entire population gets its fuel, fodder and timber from the surrounding elephant habitat. Resettlement of this entire population should be a priority to secure the future of this corridor.

The Terai East FD has an area of 820km^2 and of which 60km^2 are encroached. The Ranges affected are: Barkoli (encroached area 22.40ha), Doli (138.44), Gaula (4312.63), Khatima (373.9), Kishanpur (84.1), Ranshali (250.71), South Jaulasal (159.57 and Surai (497). Encroachment has occurred in other forest divisions, gradually growing in size as well. An early solution to mitigate this problem is urgently needed.

Habitat degradation

With the exception of the Corbett NP and parts of the Rajaji and Dudhwa NPs, all other forest areas in this tract are used by people for livestock grazing, and firewood and grass collection. Timber, bamboo, minor forest produce and cane are also extracted in some forest divisions. One major factor that has drastically reduced the habitat quality of this tract for elephants is the conversion of natural vegetation into monoculture plantations of eucalyptus, teak and *Haplophragma heterophylla*. The Divisions that have come under this conversion are: East *Terai*, Central *Terai*, West *Terai*, Bijnor, and Haridwar. Plantations are also common in Pilibhit, Kheri and Katerniaghat Divisions. Kalagarh FD (Sona Nadi WLS), Lansdowne FD, Rajaji NP, Shivalik FD and Terai East FD have the problem of pastoral *Gujjar*s and their buffaloes. Lopping by the *Gujjar*s and grazing by the buffaloes have contributed to habitat degradation resulting in the spread of weeds such as *Parthenium hysterophorus*, *Lantana camara* and *Adhatoda vasica*, and lack of regeneration of palatable tree species. *Gujjar* buffaloes urinate and defecate in waterholes making them unfit for use by elephants (Johnsingh and Joshua 1994).

Elephant mortality due to train accidents

One of the major problems of Rajaji NP is the death of elephants due to train accidents along 19km-stretch of railway track passing through the Park. The track extends 4 km into Haridwar Range, 7km into Motichur Range and 8km into Kansrau Range. Between 1987 and May 2002, 20 elephants were killed, of which 10 were adult females, one adult male, two sub-adult males, two sub-adult females, four juvenile males and one female calf. The length of track where the elephants are vulnerable to accidents is 1.5km in Haridwar Range, 5km in Motichur Range and the entire 8km in Kansrau Range. Comparatively more elephants died in Haridwar Range (8) than in Motichur (7) and Kansrau (5). Records for different months show that 16 animals died during the dry season, from January to June, with a peak in May (5). This dry season mortality is correlated with the water-induced movement of elephants. All accidents occurred between 1830 and 0530hrs. Trains responsible for accidents are the Doon Express, Mussoorie Express, Janta Express, Ujjain Express, Haridwar-Rishikesh Passenger, Sahranpur-Dehra Dun Passenger and goods trains (A. K. Singh pers. comm.).

Recommendations

Priorities for elephant conservation for this Range include the following:

(a) Maintenance of habitat continuity, by establishing and strengthening corridors, consolidation of habitat through translocation of *Gujjars* and several other human settlements including encroachments;
(b) Reducing biotic pressures through eco-development measures and conservation education;
(c) Total ban on sand and boulder mining in river beds crucial for establishing corridors;
(d) Creation of mini core areas;
(e) Converting plantations into better elephant habitats, by planting patches of browse species;
(f) Control of poaching; and
(g) Reducing mortality caused by trains.

Establishing and strengthening corridors

The first two corridors that need to be established and strengthened are the Chilla-Motichur corridor and Gola River corridor. Priority should go to the Chilla-Motichur corridor, which will help consolidate habitat

integrity from Yamuna to Gola River (Haldwani), an area of about 8,000km^2.

Chilla-Motichur corridor

Chilla-Motichur corridor across the Ganga River needs the immediate attention of the Government of Uttaranchal and the Government of India. Over the last 20 years, several discussions took place, and numerous reports submitted, but the corridor has not yet been established. Two major problems in this corridor area are due to the presence of the army ammunition dump and the settlements of the Tehri Dam oustees. What is urgently needed is the resettlement of Khand Gaon III of the oustees. Land has already been identified for resettlement in Bibiwala near Rishikesh, and the oustees are willing to move there as it is closer to a perennial spring, to the Haridwar-Rishikesh Road and to Rishikesh, where employment and educational opportunities are better. Bibiwala is in the north-western corner of the much-disturbed Elephant Range (Barkote and Rishikesh Range), and sacrificing this land for creating the corridor would go a long way in strengthening elephant conservation in its north-western range. This corridor will be beneficial for several other large mammals, particularly tiger.

It has often been suggested to build big bridges across the Kunaun-Chilla power channel, which runs parallel to the left bank of the Ganga — this is not necessary. What is urgently needed is to make the adjacent Suni *sot* and Dogudda *sot* totally free of *Gujjar* settlements. If this is done, even groups of elephants will start using the aqueduct built below the power channel for the flow of water from Dogudda, and the bridge across the channel near Suni *sot*. At present only the bulls use the bridge, and the aqueduct is only used when *Gujjars* do not camp in the *rau* near the aqueduct entry. Other measures for strengthening this corridor are the banning of further development around the place of worship between the army camp and Ganga River, banning of construction of an all-weather road to this place of worship and night traffic along Chilla-Rishikesh Road, keeping the islands on the Ganga River free of disturbances, and if possible, shifting the Gangabhagpur Thalla and Malla villages. More suggestions are given in Johnsingh *et al.* (2004).

Gola River corridor

There is a good possibility of restoring the continuity between East and Central *Terai* FD, which is broken due to development activities between Haldwani and Lal Kuan. This may be possible by translocating the timber depot of Uttaranchal Government just north of Lal Kuan, acquiring an equal amount of land east of the Haldwani-Lal Kuan Road and west of Gola River, which is fortunately only sparsely populated by illegal settlers of boulder collectors in Gola River. It will be crucial to ban sand and boulder mining along the entire stretch of Gola River. Intensive management of forests on either side of this corridor, particularly of Doli Range, by planting of suitable fodder tree species and bamboo, and protection from grazing and cutting should also be carried out.

Rajaji-Corbett corridor

The corridor forests between Rajaji NP and Khoh River (west of Corbett TR) need immediate attention to control growing biotic disturbances that emanate from the villages south of the corridor and Kotdwar Township. Through appropriate eco-development measures, villages along the northern boundary should be made ecologically self-sufficient in terms of their fodder and fuel requirements, or alternate fodder and fuel provided, so that the growth of their impact on the corridor forests can be minimized. *Gujjars* from this area should be resettled on a priority basis.

Kosi River corridor

In the Kosi River corridor, the forests between Mohan and Kumaria Villages should be kept free of disturbance, by shifting the Indian Medicines Pharmaceutical Corporation Limited from its present location, closer to Ramnagar Town, as most of the 200 or so employees come from this town, which is about 15km away. Gargia Chemicals, where less than 10 people work, should be immediately closed. There is a colony of 15-20 huts, *c.* 75m north of Mohan, on the way to Kumaria. The people in this colony depend on cutting firewood and transporting them to Ramnagar. Immediate attention is needed to address this problem. The encroachers at Sunder Khal could be resettled in Gabua forest patch (13km^2), between Ramnagar and Kaladhungi, in Terai West Forest Division. Gabua, surrounded by human habitations, may eventually be encroached or used by Government for some other purpose. Before this happens the encroachers should be settled in Gabua forest patch so that the elephant habitat can be protected. The connectivity between Infinity Resorts and Bijrani can be strengthened further if people in the two small villages, Ringora and Amdanda, are resettled.

One important habitat alteration immediately needed in the corridor patches identified (Kumaria-Mohan, Dhangari and the western block of Sunder Khal, and between Infinity Resorts and Bijrani) is the planting of the existing teak plantation with cover-giving and fodder species including bamboo (*Bambusa arundinacea* and *Dendrocalamus strictus*) and browse species including *Zizyphus mauritiana*. It is known that these species are heavily browsed by ungulates, but their survival could be improved by planting grown-up saplings in the beginning of the rainy season.

Boar River corridor

This corridor needs total protection from development, particularly from excess tourism. The buildings of Sterling Resorts, the construction of which was stopped by Supreme Court intervention, should be dismantled and taken away from the forest area. Uttaranchal

Government should acquire other private holdings in this corridor area.

Nihal-Bhakhra corridor

This area needs intense management input in the form of eco-development measures in the surrounding villages to control further degradation. If this corridor forest is lost, the connectivity between Ramnagar FD and Central Terai FD would go as well, and there will not be any opportunity to restore the Gola River corridor.

The corridors between Dudhwa NP and Kishanpur WLS, and between Katerniaghat WLD and Dudhwa NP, may be difficult to recreate, owing to large-scale private ownership of highly productive agricultural land there. Restoration of a 100-200m wide riverine corridor along Mohana River, with the involvement of local people, should be attempted. The patches of Government-owned forest land between Dudhwa NP and Katerniaghat WLD, including the marshy areas, should be intensively planted and managed with cover-giving species such as bamboo, *jamun*, cane and *Ficus hispida*. The fragile connectivity between Dudhwa NP–Bardia NP–Katerniaghat WLD is a hope.

Relocation of human settlements

Resettling of *Gujjars*

It is vital that the forests of this elephant range should be made as disturbance-free as possible. In this regard, relocation of pastoral *Gujjars* who live in the Shivalik FD, Rajaji NP, Lansdowne FD (including Rajaji-Corbett corridor), the western portion of Corbett TR (former Kalagarh FD or Sona Nadi WLS) and Terai East FD is a must. The presence of *Gujjars* within the forest has become incompatible with the conservation of the elephant, an endangered species, which needs enormous amounts of forage, clean water, and disturbance-free cool forests for resting during the day. *Gujjars* should be involved in every step in the resettlement process. Resettlement should be done following the model of Ghaindikatha where *Gujjars* have been resettled in fringe forest areas and are given incentives to build and live in their traditional huts.

Relocation of villages

It is imperative to translocate several villages and encroachments which will strengthen the corridors, habitat integrity and reduce biotic disturbances.

Chilla-Motichur corridor area

People in two villages (Khand Gaon III, and Ganga Bhagpur Thalla village between Ganga River and the power channel on the left bank of the river), in the Chilla-Motichur corridor area, have to be resettled. This latter village of about 30 families is close to the only patch of riverine forest about 2.5km long, along the entire length (2,500km) of the Ganga River that is still being used by elephants. If people from this village are not translocated, the riverine forest will eventually disappear, as a result of the firewood and timber needs of the village people. Translocation of this village would create at least 1km^2 of flood plain grassland habitat. Land for the resettlement of Ganga Bhagpur Thalla village can be found in Bibiwala, where Khand Gaon III is to be resettled. Johnsingh *et al.* (2004) even recommend the shifting of Ganga Bhagpur Malla and Kunaun *goth* villages to Barkote Range which has lost all the large mammal values because of the firewood needs of the Rishikesh population.

Corbett Tiger Reserve

Three villages from Corbett TR have to be shifted as soon as possible. These are Ringora between Dhangari and Bijrani, Amdanda near Bijrani, and Laldhang on the southern boundary. Ringora and Amdanda were once cattle camps but have now become established villages. They can both grow further, disturbing and destroying the contiguity between the reserve and Ramnagar FD. The villagers of Laldhang are willing to move out, and the Government of India has already approved their proposal for resettlement. The proposed relocation site in West *Terai* FD has already been clear-felled. The encroachers in the Kalagarh Colony should be evicted. This is possible only when the Government of India, the Government of Uttaranchal, Government of Uttar Pradesh and NGOs interested in the conservation of Corbett TR work together.

Ramnagar FD

Tedha Village near Bangajhala Valley (Ramnagar FD), which has about 50 families and 600 cattle, causing immense damage to the habitat, also needs translocation.

It is urged that all the above-mentioned villages be translocated as soon as possible. The successful resettlement of Jhirna, Dhara and Kothi Rau Villages, which was done in 1994, stands as an excellent model to be emulated. For the relocation of Ringora, Amdanda, and Tedha Villages, sufficient fertile land is available in Gabua forest patch of West *Terai* FD.

Terai East FD

There are numerous encroachments, *Gujjar* camps and Bengali villages in Terai East FD. Efforts should be made to resettle all these people in patches of forests along the southern boundary of the FD. Priority should be given to resettle the encroachments from Khatima Range (e.g., Devipura Majgaun, Pachoria and Patta) as the Range has to play a crucial role in corridor connectivity.

From Pilibhit and Katerniaghat FDs

The encroachments from Belha in Pilibhit FD need to be removed. In the Katerniaghat WLD, only one village, Bharthapur, is located in the very important trans-Girwa area of the Sanctuary. If this village could be removed,

the entire biodiversity-rich trans-Girwa area, which is of great importance for large mammals like rhino and elephant, would be free from permanent human inhabitation. No scheme, however, has been proposed to date.

Total ban on sand and boulder mining in crucial wildlife areas

Presently Uttaranchal Government may get Indian Rupees 30-50 crores annually from sand mining and this source of income may be important for this young State formed in November 1999. But the Government has to weigh its options whether to allow mining to totally degrade its reserve forests, or to stop mining to enable the reserve forests to contribute to the overall biodiversity conservation in the State which plans to carve out a future based on ecotourism. The Government of India could assist Uttaranchal by giving a special annual conservation subsidy of Indian Rupees 50 crores for several years with the agreement that no mining be allowed and Uttaranchal meanwhile will consolidate its revenue generation through other means such as ecotourism, sale of mineral water, etc.

Creation of mini core areas

As a result of the inability to create large tracts of undisturbed habitats, the establishment of 30-100km^2 mini core areas is suggested, which should be free from all forms of disturbance. The following areas are suggested to be managed as mini core areas:

(a) The Dholkhand, Malawali, Andheri, Ganjerban and Lakarkot forest blocks south of Shivalik Ridge in Rajaji NP

(b) The Motichur, Koelpura (east) and Koelpura (west), Danda and Behereda forest blocks on the northern side of the Shivalik ridge in Rajaji NP is an important area for elephants in summer, due to the availability of water.

The above forest blocks should be cleared of *Gujjars* and managed as a mini core.

(c) A few elephants use the forest blocks around Bulindwala and Phandowala areas in Ramgarh Range of Rajaji NP. There are few *Gujjars* in this area, and it will be fairly easy to clear this area of human presence and manage it as a mini core.

(d) The Dogudda, Suni and Mundal *sot* areas in Chilla, if cleared of human use by *Gujjars* and the people from Gangabagpur Thalla and Malla Villages, will form an excellent habitat for elephants on the east bank of River Ganga in Rajaji NP. Present resettlement of *Gujjars* being carried out by Uttaranchal FD may eventually create the mini-core areas mentioned here.

(e) The Rawasan catchment area, with its perennial water, can form the nucleus of another mini core. *Gujjars* from this area need to be relocated, and disturbances arising from the nearby Laldhang Village, including poaching, should be controlled.

(f) The forests on either side of Malin River in Rajaji-Corbett corridor should be made into a mini core, by controlling human use of this area.

(g) There are 20 to 30 *Gujjar* families in Koluchaur, Lansdowne FD, and they are willing to move if a proper resettlement package is offered. The main reason cited for their willingness to move is the difficulty in transporting milk over 20km to the nearest market (Kotdwar). Their ordeal becomes even more difficult during the rainy season. Steps should be taken to resettle these *Gujjars* to secure what is possibly one of the finest habitats not only for elephants, but also for other wildlife. Logging in this area should be banned and the revenue lost by this can be gained through the promotion of ecotourism in this wildlife-rich area.

(h) The Bangajhala Valley in Ramnagar FD can be another excellent mini core area which will necessitate shifting of Tedha Village with about 50 families and 600 cattle which cause enormous damage to the habitat.

(i) In Haldwani FD, the Nandaur Valley including the Durga-Pipal area, is suitable for forming a mini core. It is possible to create either a 300-400km^2 National Park or Wildlife Sanctuary in this area.

(j) The Lagga Bagga area of Pilibhit FD needs to be developed as a mini core because of its crucial value as a corridor between the Royal Sukhlaphanta Reserve and the Pilibhit FD. Intensive protection and participatory management with the villagers living on the right bank of Sharda River, who depend on Lagga Bagga for firewood and thatch grass, will be required to help the area recover.

(k) In Katerniaghat WLD, the entire trans-Girwa and Katerniaghat Ranges, along with the adjoining areas of Nishangarha Range, are well suited to be managed as a mini core area.

(l) The forests on the west bank of Sharda River, belonging to Champawat FD (South Pithoragarh FD), require special attention for conservation. Large mammals can move from this area to Nepal across Sharda River.

Planting monoculture plantations with species suitable for elephant

Presently, the monoculture plantations seen in and around the elephant range, offer very little to elephants in terms of forage and cover. This shortcoming of plantations as elephant habitat can be overcome through

the planting of other tree species in patches. It is suggested that, for example, for every square kilometre of eucalyptus plantation, one hectare be clear-felled, and planted with a patch of unpalatable species such as *Holoptelia integrifolia* and *Pongamia pinnata*. Once these patches establish themselves, then species such as bamboo can be planted in their cover. There will also be the growth of several other palatable species such as *Mallotus philippensis* from the original rootstock. This will benefit not only elephants but also several other ungulate species like sambar (*Cervus unicolor*), leopard (*Panthera pardus*) and tiger (*P. tigris*). The forest divisions that need this attention are Haridwar, Bijnor, West Terai, Central Terai, East Terai, Pilibhit, Dudhwa TR and Katerniaghat WLD. In the *terai* region of UP, the moist grasslands were planted with eucalyptus and teak in the past. These plantations should be gradually removed from these grasslands and care needs to be taken that weeds do not take over, once the overwood is removed. The grasslands, which are important habitats for species like the hispid hare (*Caprolagus hispidus*), Bengal florican (*Eupodotis bengalensis*) and swamp partridge (*Francolinus gularis*).

Eco-development and conservation education

Along its boundaries, this tract has a long interface with human settlements. An enormous number of people are dependent on the forests of this Elephant Range for their fuel and fodder requirements. To conserve and manage elephants in this area, such pressures need to be reduced. Therefore, eco-development activities in cooperation with the villagers need to be launched as early as possible. These should include fuel and fodder plantations, popularizing smokeless *chula* and solar cookers, and reduction of scrub cattle by the promotion of hybrid cattle. The corridor areas identified above, the villages along the northern boundary of Dudhwa NP, and the large enclave of Tharu Village in the Katerniaghat Range would need immediate attention. Conservation education emphasizing the importance of forests and wildlife should be an integral part of this eco-development programme (Johnsingh *et al.* 2004).

Anti-poaching measures

Poaching of tuskers for ivory needs the attention of the Government throughout this range. Vigilant anti-poaching measures are urgently required. Poaching has been a problem in the forests east of Haldwani (Haldwani, South Pithoragarh and East Terai forest divisions). As this forest tract is adjacent to Nepal, poachers have found it easy to poach in this area. Special efforts will be needed to protect this population, and enable young bulls to mature to create a genetic linkage with the elephants of Sukhlaphanta Reserve and Kheri FDs. Control of poaching should be the concerted efforts of the Uttaranchal and Uttar Pradesh forest and police departments.

Reducing mortality caused by trains

This can be achieved by the following:

(a) Build a mechanical steel barrier between Haridwar and Motichur *rau* on the western side of the railway track. There is no need for elephants to cross the railway track and come to the eastern side which is full of human habitation. The mechanical barrier should also prevent domestic livestock from entering the forests. This will lead to habitat recovery, enabling elephants to find sufficient forage in the forest. This would also reduce the pollution of waterholes by buffaloes, which is a major conservation problem in Rajaji NP (Johnsingh and Joshua 1994).

(b) As elephants often get killed in locations where the terrain on either side of the railway track is in the form of steep banks, efforts should be made to flatten these banks. This would enable elephants to move away when trains speed along the track.

(c) As elephants have the habit of feeding on the edible household wastes discarded by people, sustained efforts should be made to educate the public and railway employees not to leave garbage along the railway track.

(d) It has often been recommended to realign the railway track from Haridwar to Rishikesh, and then to Dehra Dun, bypassing Motichur and Kansrau Ranges. This is an expensive recommendation, involving nearly Indian Rupees 100 crores (US$20 million), and the track would go through Rishikesh and Barkot Ranges, which are also occasionally used by elephants. Therefore, this expensive option should be carefully considered.

Research

Although wildlife populations in the Rajaji NP have been well researched over the last two decades, much research needs to be carried out in other parts of this elephant range. Future research should focus on elephant use of corridors, human-elephant conflict, population dynamics of elephant food trees, and monitoring the habitat, population and population structure of elephants. In this regard, long-term monitoring of the elephant population dynamics in Corbett NP, and in the forest tract between Haldwani and Sharda River, should be taken up. A satellite-telemetry study of elephants in Dudhwa-Kishanpur-Suklaphanta and Katerniaghat-Bardia should also be a priority to understand the ranging patterns of elephants.

Training

The forest staff in this Elephant Range need training in assessing and monitoring the status of habitat and elephants. The methods taught should be simple, reliable, and consistent over time. The staff should also

be equipped and trained in anti-poaching measures.

Domestic elephant management

There are 18-20 domestic elephants in Uttaranchal, largely in the custody of the Forest Department, and 115-140 in Uttar Pradesh with the Forest Department and private ownership (Bist 2002).

Shivalik–Terai Elephant Range

This entire Elephant Range should be designated as the Shivalik–Terai Elephant Range, and managed by one senior-level forest officer in the rank of Chief Conservator of Forests (CCF), whose focus should be to solve the problems related to the corridors, and resettlement of *Gujjars* and villages. The CCF should also be entrusted with the task of converting the monoculture plantations to habitats suitable for elephant, strengthening protection across this elephant range, and ensuring the proper care of domestic elephants. Conservation of this elephant range should be combined with the planning of the Terai Arc Tiger Conservation Landscape (WWF 2000; Johnsingh *et al.* 2004).

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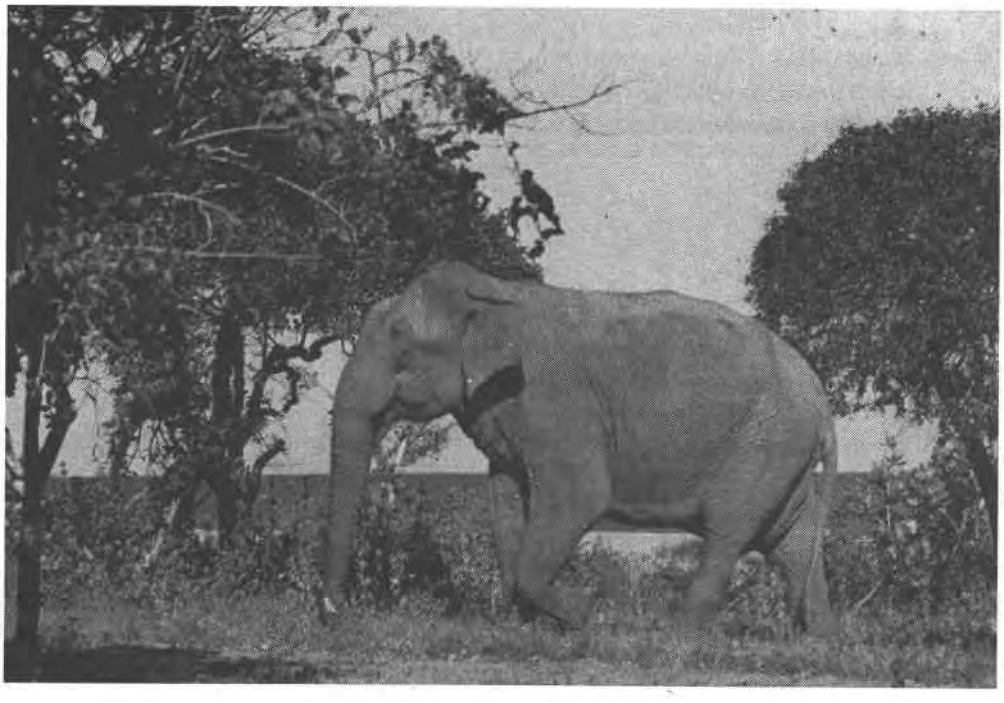


Photo: Dr. H. I. E. Katugaha

Conservation Status of Tiger and Associated Species in the Terai Arc Landscape, India











भारतीय वन्यजीव संस्थान
Wildlife Institute of India

RR-04/001, March 2004

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EXECUTIVE SUMMARY

"*All along the edge of the Himalayas, from Saharanpur and the Jumna River in the north-west, to Gorakpur and the Gandak River to the south east, is a belt of forest varying in width from twenty to fifty miles, which is home to many species of animals*" wrote Col. R.W. Burton in his diary in January 1924 (Toovey 1987).

The Indian portion of Terai Arc Landscape (TAL), stretching from Yamuna river in the west to Valmiki Tiger Reserve, Bihar in the east, spreads across five states along the Shivaliks and Gangetic plains. This unique Landscape consists of two distinct zones: (i) *bhabar,* characterized by a hilly terrain with course alluvium and boulders, and sal mixed & miscellaneous vegetation communities and (ii) *terai,* characterized by fine alluvium and clay rich swamps dominated by a mosaic of tall grasslands and sal forests. The *terai*, in particular, is listed among the globally important 200 ecoregions for its unique large mammal assemblage. Over the decades as a result of conquest of malaria, establishment of numerous settlements and consequent increase in human population, this Landscape has become highly fragmented and degraded. This has led to the local extinction of species such as one-horned rhinoceros (*Rhinoceros unicornis*), swamp deer (*Cervus duvauceli*) and hog deer (*Axis porcinus*), for example, west of Sharda river. Despite its ecological richness and faster rate of degradation and species extinction, conservation initiatives are far from desired in this Landscape, perhaps due to inadequate information and lack of coordinated efforts.

Given this circumstance, the Wildlife Institute of India (WII) submitted a proposal to **Save the Tiger Fund** (**National Fish and Wildlife Foundation, USA)** to carry out a survey of TAL on the Indian side, which is ca. 42,700km^2 with a forest area of ca. 15,000 km^2. Save the Tiger Fund allotted US $53,500 and an 18-month project was initiated in July 2002. The project objectives were to (i) develop spatial data base on the TAL, (ii) assess tiger (*Panthera tigris*) and large ungulate distribution and status, (iii) describe the status of the Landscape and its vegetation characteristics and (iv) document the socio-economic conditions of the local people and major disturbance factors. Indian Remote Sensing (1C/1D) satellite images with the spatial resolution of 188m (WiFS) and 23.5m (LISS III) pixel sizes, and Survey of India topographic maps were used for habitat mapping and other spatial database. The study team surveyed the entire Landscape twice between October 2002 and June 2003 for assessing the status of tiger and other associated large mammal species, and habitat conditions. Extensive sampling of 246 foot transects covering 1001.2km and 1530 circular plots, with nested design, were carried out across the TAL. Demographic and socioeconomic profiles of people were derived primarily from the raw data of 1991 Census. Owing to the applied nature of the project, it was decided to hold a two-day workshop to share the findings and to attain synergy among Forest Officials, NGOs and other conservation agencies for implementation in the field.

The study revealed that the TAL contains homogenous vegetation communities of eight broad types, but the structural components vary highly across the Landscape. The tiger habitats on the Indian side are in nine blocks (referred as Tiger Habitat Blocks, THB) and the largest block (ca. 4,000 km^2) is around Corbett TR. The forests in Kalsi, Dehradun and Haridwar Forest Divisions in Uttaranchal and Bijnor Plantation Division, Bahraich and Shrawasti Forest Divisions in Uttar Pradesh were devoid of tiger. Thirteen corridors that potentially connect these nine blocks have been identified. When connectivity with the Nepal side is taken into account, the nine THBs can be pooled into five larger units (referred as Tiger Units, TU). Among these, TU II, which is in the *bhabar* tract and includes Corbett TR, is the most intact one. TU IV (Pilibhit FD-Suklaphanta Reserve-Kishanpur WLS-Dudhwa NP- Bardia NP-Katernighat WLS) is the most extensive *terai* habitat. Each piece of habitat and connectivity in these Units are crucial and at the same time, are threatened by anthropogenic pressures. Ungulate distribution

and relative abundance in TAL corresponds to the high variation or heterogeneity in habitat features. However, the overall status of prey (ungulate) availability is reasonably better in this Landscape, largely owing to the interspersion of Protected Areas between Reserve Forests. The evidence is clear that tiger distribution and its abundance are linearly related to wild ungulate prey such as chital (*Axis axis*) that has wider spatial distribution. Sambar (*Cervus unicolor*) and wild pig (*Sus scrofa*) also contribute substantially in deciding the occurrence of tiger in *bhabar* and *terai* regions respectively. The domestic dog was identified as a reliable indicator of disturbance that impedes tiger occurrence.

Undisturbed hilly (*bhabar*) areas such as Corbett TR, which usually have many deep *nallahs*, providing hideouts and abundant prey (sambar, chital and wild pig) support substantial population of tiger. The *terai* tall grass habitats, which provide adequate cover, as in Kishanpur WLS and Dudhwa NP, with prey such as chital, pig and swamp deer, is the second best. It appears that in a few years time, tigers may cease to exist in habitats like Sohagibarwa-west (THB VIII), an isolated habitat patch in Uttar Pradesh, which is under enormous anthropogenic pressures. Leopards tend to avoid *terai* habitats and high-density tiger areas, but are still common in areas extirpated of tiger. Data from the Census of India 1991, for 33 tehsils (units of District) within the study area, indicated that the *bhabar*, largely west of Sharda river, had significantly lower human density (334/km^2) and higher percentage of forest cover (36%). The corresponding figures for *terai* (east of Sharda river) are 436/km^2 and 17% respectively. It appears that the *bhabar* areas, at present, are in a better position to buffer firewood dependency of the people.

Human population increase, ever growing habitat encroachments, poaching, firewood extraction and *bhabar* grass *(Eulaliopsis binata*) collection for rope making, stealing of tiger and leopard kills, and boulder mining causing enormous disturbances and fragmentation are the major problems identified. The extensive empirical information (distribution and abundance) collected on vegetation parameters, ungulates and tiger can be used as baseline data to initiate monitoring programmes. In addition, the monitoring should include establishment of adequate number of one-hectare plots and line transects for periodic evaluation of habitat conditions and prey abundance respectively.

The study recommends that Chilla-Motichur and Gola river corridors should be established on priority basis and the conservation status of THB IV containing Suklaphanta Wildlife Reserve-Pilibhit FD-Kishanpur WLS should be strengthened. If done, the former will constitute the largest (ca. 8000km^2) tiger and elephant habitat anywhere along the foothills of the Himalaya and the latter will ensure the future of one of the finest *terai* habitats (ca. 1200km^2). Initiation of a conservation programme like establishing Rajaji-Shivalik Tiger Reserve is urgently needed to eliminate boulder mining in Yamuna river to ensure the ranging and occurrence of tigers between Shivalik FD and the Kalesar-Simbalbara forests, the western most limit of tiger distribution range. Raising of fuel wood plantations with community participation, use of fuel-efficient *chulas*, resettling of *gujjars* (migratory pastoralists) and eight key villages, shifting of one factory and weaning people from *bhabar* grass collection and conservation education programmes are also recommended. There was a consensus in the two-day workshop held on 6-7 November 2003 in WII that the Nepal model, with a strong scientific foundation and involvement of local people, needs to be adapted for the Indian side of TAL. Cross border cooperation between India and Nepal is a must to ensure the long-term conservation of tiger and its habitat in this Landscape.

1. INTRODUCTION

It is well established that the tiger (*Panthera tigris*), with its special habitat needs such as large home range, abundant large wild ungulate prey and undisturbed habitats, cannot be saved in small forest fragments (Johnsingh and Negi 1998, Karanth and Stith 1999, Karanth *et al.* 1999, Seidensticker *et al.* 1999 and Sunquist *et al.* 1999). This realization led tiger biologists and conservationists in the late 1990s to design a framework for identifying key areas for the conservation of free-ranging tigers (Dinerstein *et al.* 1997). The Indian subcontinent, with almost half the world's wild tiger population (Jackson 1997, Thapar 1999), stood out as the prime bioregion for the long-term conservation of wild tigers. This bioregion has 11 of the 25 Level I Tiger Conservation Units (TCUs), 7 of the 21 Level II TCUs and 37 of 97 Level III TCUs (Dinerstein *et al.* 1997).

During a meeting held in Java in September 1999, WWF- International identified three areas in the Indian subcontinent – Terai Arc Landscape (TAL), Sundarbans and Satpura-Maikal Range (Central India) – for immediate conservation attention to save wild tigers (WWF 2000). Several valuable studies have been carried out in the Nepal part of the TAL, through years of excellent collaboration with renowned Institutions, especially foreign Institutions. Some of the key studies are on tigers (Seidensticker 1976b, Sunquist 1981, Sunquist and Sunquist 1988, Smith *et al.* 1987, Smith 1993, Smith *et al.* 1998, Stoen and Wegge 1996 and Bhatta *et al.* 2002). Studies on leopard (*Panthera pardus*) are fewer (Sunquist 1977, 1983 and Seidensticker *et al.* 1990). Publications on sloth bear (*Melursus ursinus*) are by Laurie and Seidensticker 1977 and Joshi *et al.* 1995, 1997 and 1999. Ungulates have been studied by Seidensticker 1976a, Schaaf 1978a, b, Dinerstein 1979a, b, 1980, 2003, Dinerstein and Wemmer 1988, Dinerstein and Gyawali 1993, Mishra and Wemmer 1987, Dhungel and O'Gara 1991, Moe and Wegge 1994 and 1997.

Research in the Indian part of TAL has focused on several aspects scattered across different parts of this Landscape. However, only published literature is cited in this review. Research on vegetation is largely on grasses and grasslands (Singh 1982, Chaturvedi and Mishra 1985, Rodgers *et al.*1990 and Rawat *et al.* 1997) and woody vegetation (Joshi *et al.* 1986, Singh *et al.* 1995 and Agni *et al.* 2000). Pant and Chavan (2000) mapped the vegetation types and land use patterns in Corbett NP using satellite data. Despite the area being highly rich in avifauna, only Bengal florican, *Hubaropsis bengalensis* (Rahmani *et al.* 1989), swamp francolin, *Francolinus gularis* (Javed *et al.* 1999) and raptors (Naoroji 1997a, b and 1999) have received some research attention. Pandey *et al.* (1994) published a very useful bird list for Rajaji NP, based on combined efforts of biologists from Wildlife Institute of India (WII).

Although this tract is home to nine species of ungulates (including rhino), studies are available for only five species. Pendharkar and Goyal (1995), and Johnsingh (2001) described the group size and composition, and its general ecology and behaviour of goral (*Nemorhaedus goral*) respectively. Hog deer

(*Axis porcinus*) has been studied only briefly (Tak and Lamba 1981). Chital (*Axis axis*) was studied in Corbett NP (De and Spillet 1966) and Rajaji NP (Bhat and Rawat 1995 and 1999). All the research on swamp deer, *Cervus duvauceli duvauceli* (Holloway 1973, Schaaf and Singh 1976, Singh 1978 and Sankaran 1990) has focused only on its conservation status. Sale (1986), Sale and Singh (1987) and Mishra (1989) have highlighted the reintroduction of rhinos (*Rhinoceros unicornis*) into Dudhwa NP. Sighting of rhino near Kotdwara on 20th April 1789 (Rookmaaker 1999) indicates its much wider range even in the recent past. Research on primates (Lindburg 1977, Makwana 1979, Pirta *et al.* 1980, Laws and Laws 1984 and Gupta and Kumar 1994) is very limited.

The most intensive studies are on elephants (*Elephas maximus*). Singh (1969 a, 1978 and 1989) assessed the status of elephants in Uttar Pradesh. Johnsingh *et al.* (1990) and Johnsingh (2002) recommended establishment of Chilla-Motichur corridor favouring elephant conservation. Johnsingh and Joshua (1994) suggested the possibility of conserving Rajaji-Corbett National Parks using elephant as a flagship species. Joshua and Johnsingh (1995) have explained the ranging patterns of elephants and highlighted its implications for reserve design. Sunderraj *et al.* (1995) evaluated the use of Rajaji-Corbett corridor by elephants. Javed (1996) has published a note on elephants in Dudhwa NP. Williams *et al.* (2001) made a detailed quantification on human-elephant conflict in Rajaji NP.

Singh (1969b) documented the status of tiger in Uttar Pradesh and more recently, Johnsingh and Negi (2003) evaluated the conservation status of tiger in the area between Yamuna and Sharda rivers. Other relevant works on tiger are by Singh (1971, 1973, 1981, 1982, 1984 and 1993), Bhadauria and Singh (1994) and Johnsingh *et al* (2003). Although this area is riddled with numerous conservation problems, published information on conservation issues is limited to Panwar (1985) and Tilak and Sinha (1987). Even research on people is only scanty (Khati 1993, Sharma 1995 and Badola 1998).

The present study is a part of larger initiatives to conserve wild tigers and associated elements in the TAL, and was carried out by WII, from July 2002 to December 2003, with financial assistance from Save the Tiger Fund and National Fish and Wildlife Foundation, USA. The study had the following major objectives:

1. **Prepare tiger distribution and habitat maps for the Indian side of the TAL, focusing on forest conditions, habitat gaps and priority corridors that require immediate conservation attention.**
2. **Establish a comprehensive spatial database using Geographical Information System (GIS) to help all agencies working in this area for tiger conservation.**
3. **Quantify the status of tiger, associated large mammal species and anthropogenic pressures across this Landscape using field-tested and user-friendly methods.**
4. **Establish permanent plots across the Landscape for monitoring vegetation change, and the status of tiger and prey base over time.**
5. **Train and motivate forest and wildlife staff in field survey methods and conservation.**
6. **Present the information collected in a two-day workshop to officials from Forest/Wildlife Departments and NGOs working in the Landscape, to stimulate further conservation action.**

2. STUDY AREA

2.1 Location

The study area (Indian portion of TAL) lies between the Yamuna river in the west (77 30' E & 30 30' N) and Valmiki Tiger Reserve (Bihar) in the east (84 45' E & 27 15' N). Kalesar Wildlife Sanctuary (Haryana) and Simbalbara Wildlife Sanctuary (Himachal Pradesh) on the west bank of Yamuna were added to the study area on observing that tigers ranged into these regions as well (Figure 2.1). The entire stretch is ca. 900km long and 50-60km wide, covering ca. 42,700km^2 with a forest area of ca. 15,000km^2. Administratively, it is spread across five states of India (Himachal Pradesh, Haryana, Uttaranchal, Uttar Pradesh and Bihar), and twenty-one districts (one each in Himachal Pradesh, Haryana and Bihar, seven in Uttaranchal and eleven in Uttar Pradesh) (Appendix I). The forests are managed under twenty Forest Divisions (FDs), eight Wildlife Sanctuaries (WLSs) and three National Parks (NPs). Three of India's twenty-seven Tiger Reserves are located in this Landscape, namely Corbett Tiger Reserve (Corbett NP and Sonanadi WLS) in Uttaranchal, Dudhwa Tiger Reserve (Dudhwa NP, Kishanpur WLS and Katerniaghat Wildlife Division) in Uttar Pradesh and Valmiki Tiger Reserve (Valmiki NP and Valmiki WLS) in Bihar (Figure 2.1). With reference to distribution of tiger, the Indian portion of TAL is in nine disjunct units (here after, referred to as Tiger Habitat Blocks, THBs, Appendix II), which in turn form five larger units (here after, referred to as Tiger Units, TUs) when considering the connectivity with Nepal side of the forests (Figure 2.2).

2.2 Physical characteristics

This Landscape consists of the Shivalik hills, the adjoining *bhabar* areas and *terai* plains. These three strata are in the form of narrow strips running parallel to the main Himalaya and there is a continuum of forests and wildlife populations across these zones. The Shivaliks, which run along the base of the Himalaya, are an uplifted ridge system formed from the debris brought down from the main Himalaya. The coarse material brought down by the Himalayan rivers is deposited immediately along the foothills to form a pebbly-bouldery layer referred to as the *bhabar*, while the finer sediments or clay is carried further to form the *terai*. The *bhabar* is characterized by low water table as the deposits are bouldery and porous and all but the major rivers and streams disappear into the ground on emerging from the hills. The streams reappear along the *terai*, which has fine alluvial soil resulting in high water table. Beyond the Teesta River, in north Bengal, these three layers are not continuous and the parallelism disappears. East of Sharda river, the *bhabar* lies in Nepal, while there is an extensive *terai* tract in India (Atkinson 1882, Tiwari and Joshi 1997). West of Sharda river, the *bhabar* tract is in the process of fragmentation and degradation due to emergence of numerous large towns. Altitude within the Shivaliks ranges from 750 to 1400 m. The *bhabar* zone exhibits an undulating topography with an altitude ranging

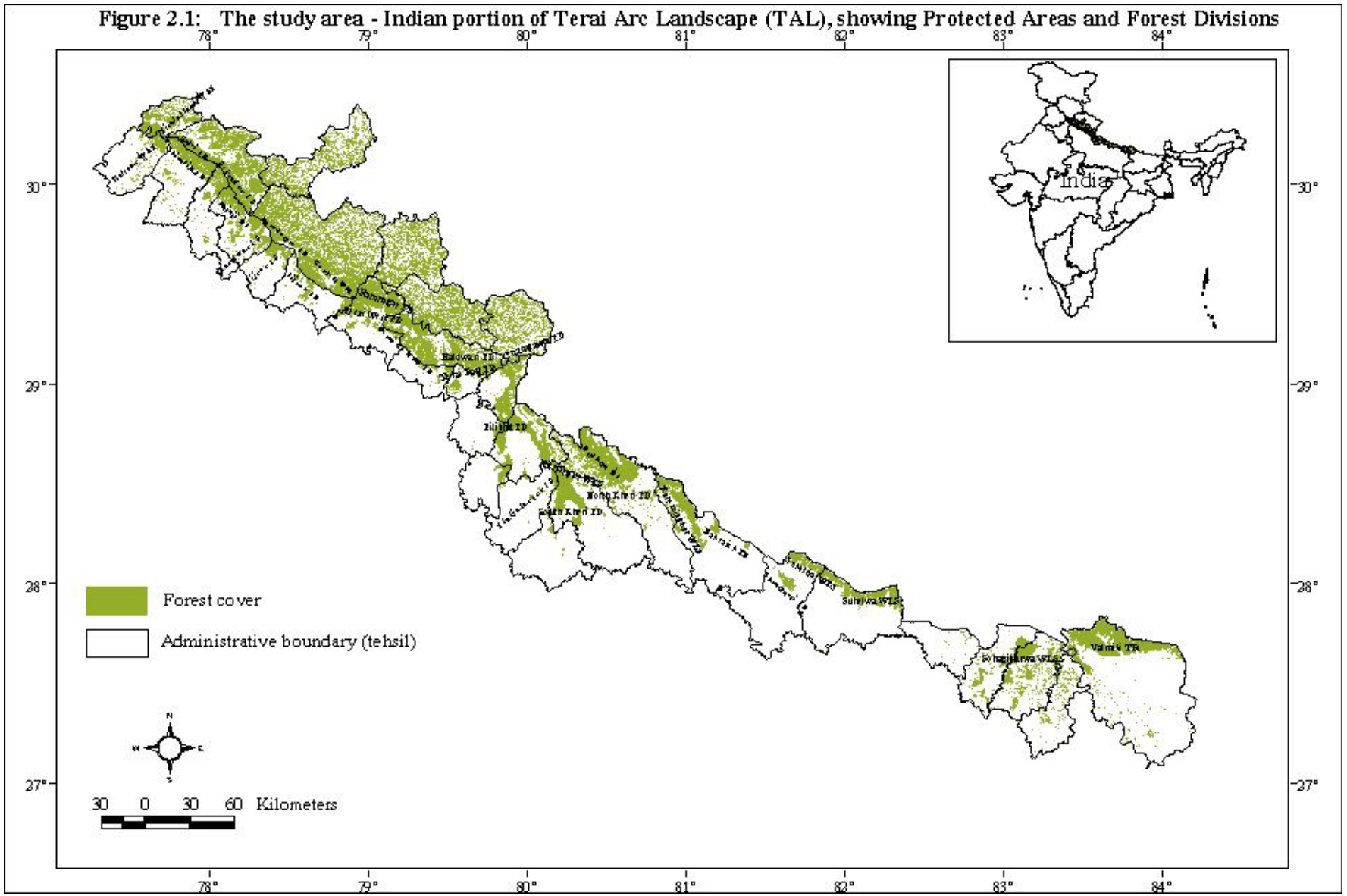
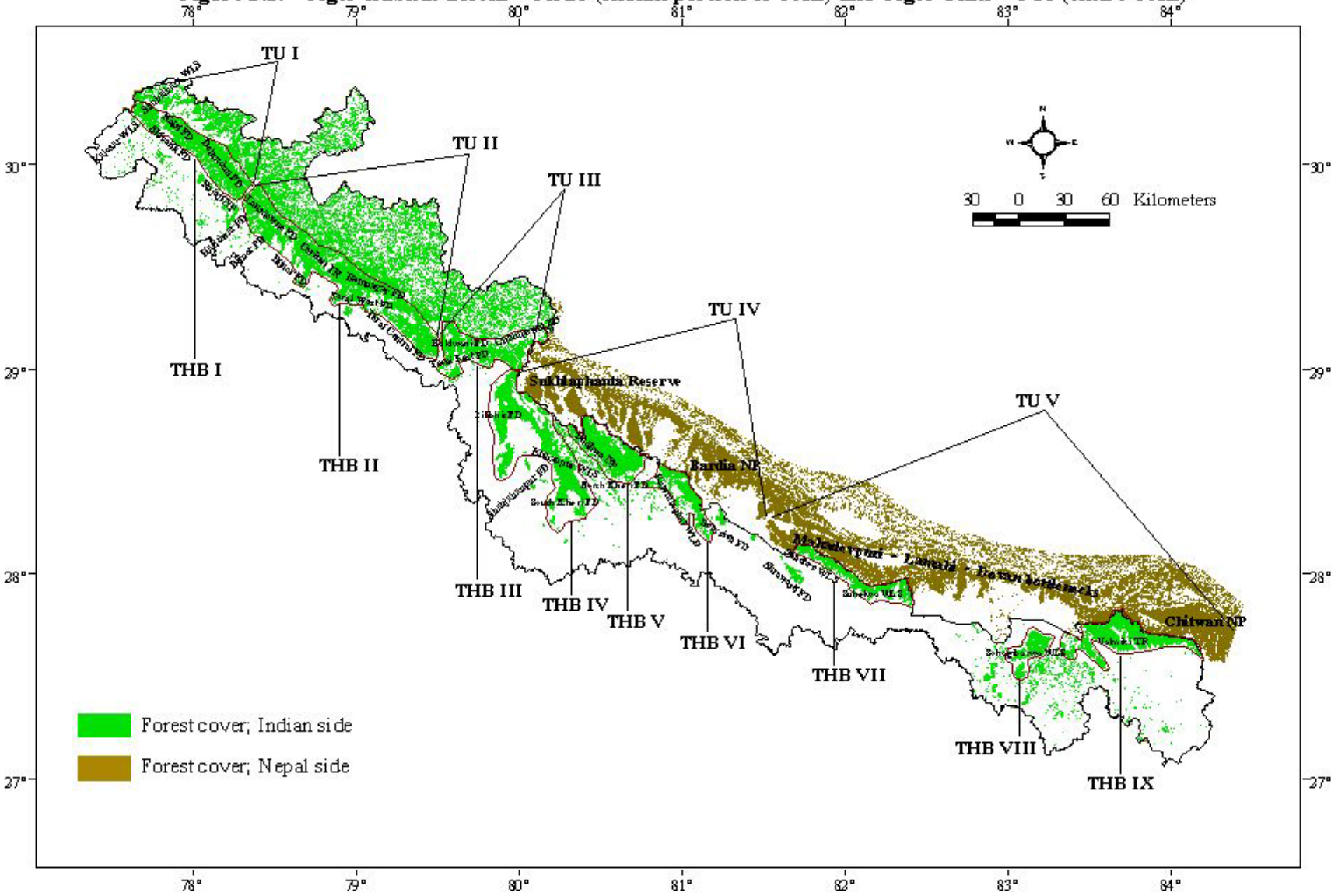


Figure 2.1: The study area - Indian portion of Terai Arc Landscape (TAL), showing Protected Areas and Forest Divisions

Figure 2.2: Tiger Habitat Blocks - THBs (Indian portion of TAL) and Tiger Units - TUs (entire TAL)



between 300 and 400 m. *Terai* is relatively flat with a surface gradient, which is slightly higher near Shivaliks.

According to the biogeographic classification by Rodgers and Panwar (1988), the study area represents two distinct zones – Himalayan and Gangetic Plain and includes three provinces: (i) Western Himalaya (areas in Himachal Pradesh, Haryana and Uttaranchal), (ii) Upper Gangetic Plain (southeastern part of Uttaranchal and the entire area in Uttar Pradesh) and (iii) Lower Gangetic Plain (area in Bihar). According to the recent classification proposed by Wikramanayake *et al.* (2001) that takes into consideration both biogeography and conservation values, the study area corresponds to three ecoregions – (i) Upper Gangetic Plains moist deciduous forest, (ii) *Terai-Duar* savanna and grasslands and (iii) Himalayan sub-tropical broadleaf forest. Of these, the *Terai-Duar* savanna is listed among the 200 globally important areas, due to its intact large mammal assemblage, even though it scores low on plant species richness and endemism. This Landscape also contains a large proportion of the Level I and Level II Tiger Conservation Units, which underscore global and regional priorities for the preservation of wild tiger (Wikramanayake *et al.* 1998).

2.3 Biological attributes

The vegetation in TAL comprises a mosaic of dry and moist deciduous forests, scrub savannah and productive alluvial grasslands that harbour diverse and rich fauna including several endemic and globally endangered species. Prominent among them are the tiger, Asian elephant, one-horned rhinoceros and swamp deer. Other endemic and obligate species found in this Landscape are hog deer, hispid hare (*Caprolagus hispidus*), Bengal florican and swamp francolin. Many of these species, surviving in small populations, have their last home in this Landscape.

2.4 Socio-economic attributes

This Landscape is also among the most populous regions in the country and as per the 2001 census, the total population of the study area is 2, 38, 94,443 persons, which is 2.32% of the country's total population. There has been rapid growth in human population ever since people began to occupy the fertile land after independence, resulting in heavy loss of forest and habitat fragmentation. The Landscape is again among the highest human density regions, with an average of 543 individuals/km^2 (range: 137 in Champawat tehsil to 1872 in Haldwani tehsil), much above the national average of 324 individuals/km^2. The proportion of rural population ranges from 23.5% in Dehradun tehsil to 97.2% in Shrawasti tehsil, with an average of 82%. About 23% of the population belong to Scheduled Castes and Tribes, among the major tribal groups residing within the study area are the *tharus* and *gujjars*; *kanjars* being classified under Other Backward Classes. Further, settlers especially refugees from erstwhile East

Pakistan, retired soldiers from the hills and other settlers from Punjab comprise part of the population influx observed over the last four decades. Human populations are dependent on several forest-based resources for their subsistence. Firewood and fodder, being the most significant resources extracted out of the forested areas, are regarded as the principle causes of disturbance and degradation within forests, besides forest loss to agricultural expansion. Further, non-timber forest products contribute significantly into the household economy, leading to conflicts with wild animals throughout the area. Crop raiding and injury or loss of livestock leads to added conflict, typical of the forest-human habitation interface.

3. STUDY DESIGN AND METHODS

The study was designed to describe quantitatively three major components: (i) distribution and status of tiger and its prey, (ii) landscape characteristics along with connectivities and vegetation attributes and (iii) demography and socio-economic attributes of people within the TAL. The sampling was done at hierarchical scales, in decreasing order represented by: 15x15 minute grids (equivalent to ca. 725 km^2), Forest Divisions and Forest Ranges. Field sampling was restricted to the regions left with *terai-bhabar* vegetation, which had the potential to support tiger populations. Data collection was carried out in two phases. The first phase involved sampling for tiger presence, prey availability and disturbance factors. This was carried out during winter (October 2002 - February 2003), the ideal time to locate pugmarks as riverbeds (*raus*) and unpaved roads are still moist. In the second phase (April - June 2003), vegetation sampling and ground-truthing for preparing land cover map were carried out. Census data and other secondary sources were used to describe demography and socio-economic status of the people residing in the TAL. The following specific approaches and methods were adopted for data acquisition.

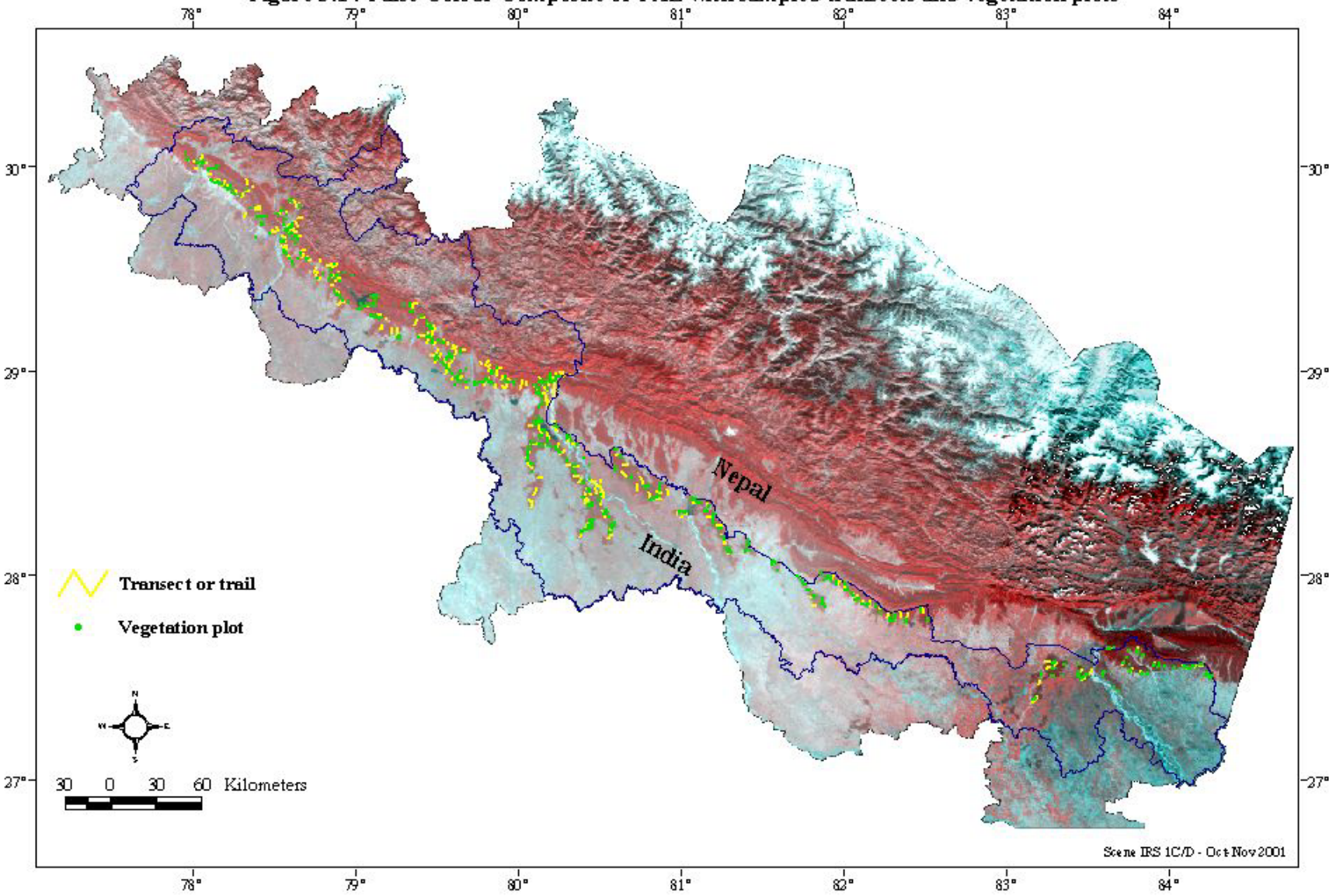
3.1 Distribution and status of tiger and prey species

Within 15-minute grids, forest cover distribution was identified using False Color Composite of WiFS imageries and Forest Division maps wherein the Forest Ranges are marked. The Ranges were taken as the basic sampling unit in each Forest Division and Protected Areas. The Range shape and size determined the number of transects or trails (*raus* in the *bhabar* region and forest roads in the *terai* region) to be surveyed. The transects ranged from 3 to 9km in length with an average of 4 km, and were spread 3 to 4 km apart. Three to four transects were surveyed each day in the morning hours (7.00am – 10.00am) by two well-trained field biologists and two field assistants, accompanied by Forest Staff who were simultaneously being trained on survey methods. In all, 246 transects totaling to 1001.2km were surveyed in the entire TAL (Figure 3.1). Geographic coordinates of start and end points of transects were recorded to map the transects for future referencing and monitoring. All other data collected in the field were recorded in a pre-designed data sheet (Appendix III).

3.1.1 Tiger distribution and status

The transects were divided into 250m segments and evidence of tiger presence (pug mark, scat and scrape marks) were recorded within each segment. Other carnivores such as black bear (*Ursus thibetanus*), sloth bear and leopard tracks were also recorded. Measurements were taken of length and breadth of tracks and pug marks to identify individuals on that trail. From this, an index of relative abundance of these carnivores occurrence was computed as pug mark encounter rate (no. of distinct pug marks / km). Intensity of use by these carnivores was established based on frequency of occurrence

Figure 3.1 : False Colour Composite of TAL with sampled transects and vegetation plots



Of signs in the surveyed segments (i.e. number of segments with carnivore signs / total number of segments surveyed).

3.1.2 Prey (wild ungulates) distribution and status

On the same transects, data on prey presence and frequency of occurrence was recorded within the 250 m segments. Presence of prey species was established largely based on indirect signs such as tracks and pellet groups and direct observations. In addition, 140 transects covering 2km each were laid across the Landscape and in each of the transects, circular plots of 5 m radius was laid at every 250 m to quantify pellet or dung group density of wild ungulates (Appendix IV and V). Prey Index for each transect, computed as: Prey Index = (species weightage x frequency of occurrence of species), indicates the status of transects with reference to preferred species. The weightage for each species was assigned on the basis of its preference ranking in tiger diet. Information on prey preference was compiled from five studies (Johnsingh 1983, Karanth and Sunquist 1995, Stoen and Wegge 1996, Biswas and Sankar 2002, Bagchi *et al*. 2003). These weightages are in descending order from the most preferred (e.g. sambar) to the least preferred (e.g. nilgai). In TAL, sambar, chital, hog deer, wild pig, barking deer and nilgai were assigned weightages of 0.93, 0.86, 0.83, 0.70, 0.26 and 0.20 respectively.

3.1.3 Disturbance index

Disturbance indicators such as dung and sightings of livestock (cattle and buffalo), tracks and sightings of domestic dogs and people, lopping and cutting signs were quantified within 250m segments along the transects. These signs were also recorded in the circular plots (10m radius for lopping and cutting signs, and 5m radius for cattle dung) at 250m intervals along the 2 km transects laid for vegetation sampling (see below, Appendix III, IV and V).

3.2 Vegetation and landscape characteristics

3.2.1 Communities and structural components

In 15x15 minute grids, 140 transects of two-kilometer each were laid across the Landscape. Concentric nested plots of ten-meter radius for trees, 5m radius for shrubs and $1m^2$ quadrats for ground cover were laid at every 250m on each transect. A total of 1150 such plots were sampled across the Landscape (Figure 3.1). Additional plots were laid in crucial areas such as corridors and highly disturbed areas (see Relev'e sampling below). Tree species composition, density, canopy cover, and lopping and cutting signs were quantified in 10-m radius plots, while 5-m radius plots and $1m^2$ quadrats, positioned at the centre of each plot, were used for recording shrub species composition and density, and ground cover (herb and grass cover) respectively (Appendix IV). In addition to information gathered from vegetation sampling, the relevé method (380 plots) was used to obtain ground-truthing points for interpreting the

satellite data. In each relev'e plot, vegetation type, dominant trees and shrubs, with maximum of five species for each group were noted in the order of their dominance (Appendix V).

3.2.2 Spatial database and landscape status

Remote sensing data and topographic maps were extensively used to develop spatial layers on the land use and vegetation characteristics of the study area. IRS (1C & 1D) – WiFS images (2 scenes) having 188m spatial resolution and two bands spectral resolution, were used to map and quantify broad categories of land use and land cover. For mapping forest cover and landscape pattern, 14 scenes of IRS IC & D – LISS III (23.6 m, 4 bands) were used. These imageries were from October 2001- January 2002. The procured imageries were then georectified, WiFS data had 50m of Root Mean Square Error and LISS III error ranged from 10 to 20m. A total of 1530 ground-truthing points were obtained from field data on vegetation sampling (concentric nested plots – 1150 and Relev'e plots – 380, Figure 3.2). The vegetation classification was done by hybrid method combining Unsupervised Isodata Cluster Analysis and Supervised Maximum Likelihood Classification. The overall accuracy for vegetation map is 85%. Grassland-Sugarcane, vegetation in and around the villages, and plantations contributed to the error considerably.

Spatial layers on various habitat features along with field data on vegetation characteristics provided the basis for describing landscape characteristics of TAL. Fragstats 3.3 software (McGarigal and Marks 1995) was used to ascertain the landscape composition and configuration. The indices used for landscape configuration include patch, class and landscape matrices, along with area, core and shape statistics (McGarigal and Marks 1995, Frohn 1998). Landscape cohesion model (Opdam *et al.* 2003) was used to evaluate landscape values.

3.3 Demography and socio-economic profile of people

The demographic profile of the TAL was derived primarily from the raw data of 1991 Census (Anon 1991). Data from Village Directories and Primary Census Abstract having 136 variables for over 19,000 villages and 40 variables for 118 towns and cities were pooled to tehsil level. Tehsils, districts and states within TAL have been subdivided or realigned in the two-decade period (1981 and 1991). All data was collapsed to 1981 administrative units as it is easier to pool units than to split them, given non-availability of appropriate administrative boundary maps. To examine patterns of development and dependency on natural resources, a subset of variables from the Census 1991 dataset was used. These included basic demographic attributes such as total, urban and rural population, occupation and fuel use, proportion of arable land and access to developmental amenities (medical, education, post and telegraph, road and rail, electricity and irrigation).

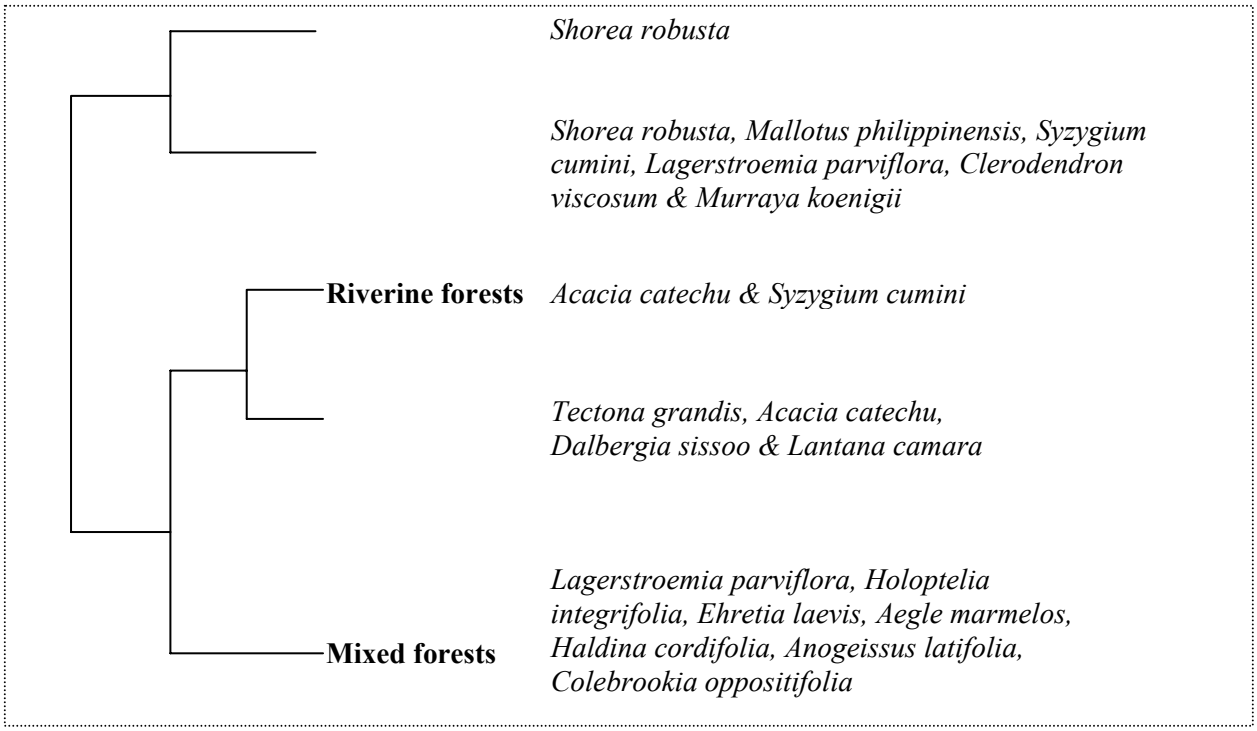
4. VEGETATION AND LANDSCAPE CHARACTERISTICS

The natural vegetation in the entire TAL (India and Nepal) covers 28,036km^2, of which, ca. 15,000km^2 is in the Indian portion of TAL. Broadly, the vegetation here comprises a mosaic of dry and moist deciduous forests, scrub savannah and alluvial grasslands. Even though this Landscape scores low on plant species richness and endemism, it harbours some of the most productive ecosystems in the world (Wikramanayake *et al.* 2001). On the basis of similarities in the woody vegetation, the Indian side of TAL is classified into three physiographic zones: (i) Western Himalaya, (ii) Northern plains and (iii) Eastern plains (FSI 2001). Champion and Seth (1968) have reported twenty-seven types and sub-types of vegetation from this region based on their associations with soil and rainfall (Appendix VI). Vegetation communities have been described in detail for parts of this Landscape based on both graminoid and woody vegetation (Singh 1982, Chaturvedi and Mishra 1985, Joshi *et al*. 1986, Rodgers *et al*. 1990, Singh *et al*. 1995, Rawat *et al*. 1997 and Agni *et al*. 2000). Most of the published literature on vegetation communities and their associations in the last two decades have been from locations in the western part of the landscape. Very little information exists for places east of Dudhwa NP. With the advent of remote-sensing techniques, there have been attempts to map and classify vegetation using satellite imageries, but only for parts of this Landscape (Pant and Chavan 2000, Hajra 2002 and Kumar *et al.* 2002). This study describes the vegetation communities, structural components and landscape configuration for the entire stretch of Indian portion of TAL, based on extensive field sampling and satellite data.

4.1 Vegetation communities

Cluster Analysis on the field data yielded five broad vegetation communities viz., (i) Sal forests (dominated by sal *Shorea robusta*), (ii) Sal-mixed forests (*Shorea robusta,* rohini *Mallotus philippinensis,* jamun *Syzygium cumini,* dhaura *Lagerstroemia parviflora,* bhant *Clerodendron viscosum* and kari-patta *Murraya koenigii*), (iii) Riverine forests (khair *Acacia catechu*, shisam or sissoo *Dalbergia sissoo* and *Syzygium cumini*), (iv) Mixed or miscellaneous forests (*Lagerstroemia parviflora,* papri *Holoptelia integrifolia,* chamror *Ehretia laevis,* bel *Aegle marmelos,* haldu *Haldina cordifolia,* bakli *Anogeissus latifolia* and binda *Colebrookia oppositifolia*) and (v) Plantations (teak *Tectona grandis, Acacia catechu Dalbergia sissoo, Eucalyptus* and lantana *Lantana camara*) (Figure 4.1). The relev'e data accounted for two additional vegetation types namely, Grasslands and Open Scrub. Besides the forest cover, the satellite-based classification resulted in 12 landcover classes, represented by eight vegetation communities, three non-forest classes (habitation, barren land and water) and one could not be classified, largely the shadow area in the hills (Figure 4.2 & Figure 4.3). Sal dominated forest and mixed forests occupy bulk of the forest cover in the TAL (25%), almost 70% area is under human habitation and agriculture and other vegetation types occupy rest of the area. The most dominant and widely distributed

tree species in this landscape is sal, followed by *Mallotus philippinensis* and *Syzygium cumini*. Plantations constitute a significant part of the landscape, which was reflected in the plantation species such as teak (*Tectona grandis*) and *Dalbergia sissoo*, figuring in the list of 10 dominant and widely distributed species in this Landscape. Kari-patta (*Murraya koenigii*) is the most dominant and widely distributed shrub species, followed by bhant (*Clerodendron viscosum*) and lantana.



The following description on the vegetation types in TAL corroborates with the Champion and Seth (1968) classifications for this area, excepting for sugarcane-grassland type which is due to patches of grasslands indistinguishable in satellite image from that of sugarcane and vice versa.

4.1.1 Sal forests

These represent the northern limit of dipterocarp forests having sal as the predominant species that occupies about 50% or more of the total basal area. Sal may reach 45m in height, but, it generally ranges between 25 and 40m. It is considered a dominant ecotype in this area, *albeit* several ecotypes governed by edaphic conditions are reported from the region. It constitutes one of the most important forest types throughout the TAL both in the *terai* and Shivaliks. Due to resistance to fire and adaptability to various soil and site conditions, sal continues to retain its hold as a major species. Common associates

Figure 4.2: Forest cover of TAL

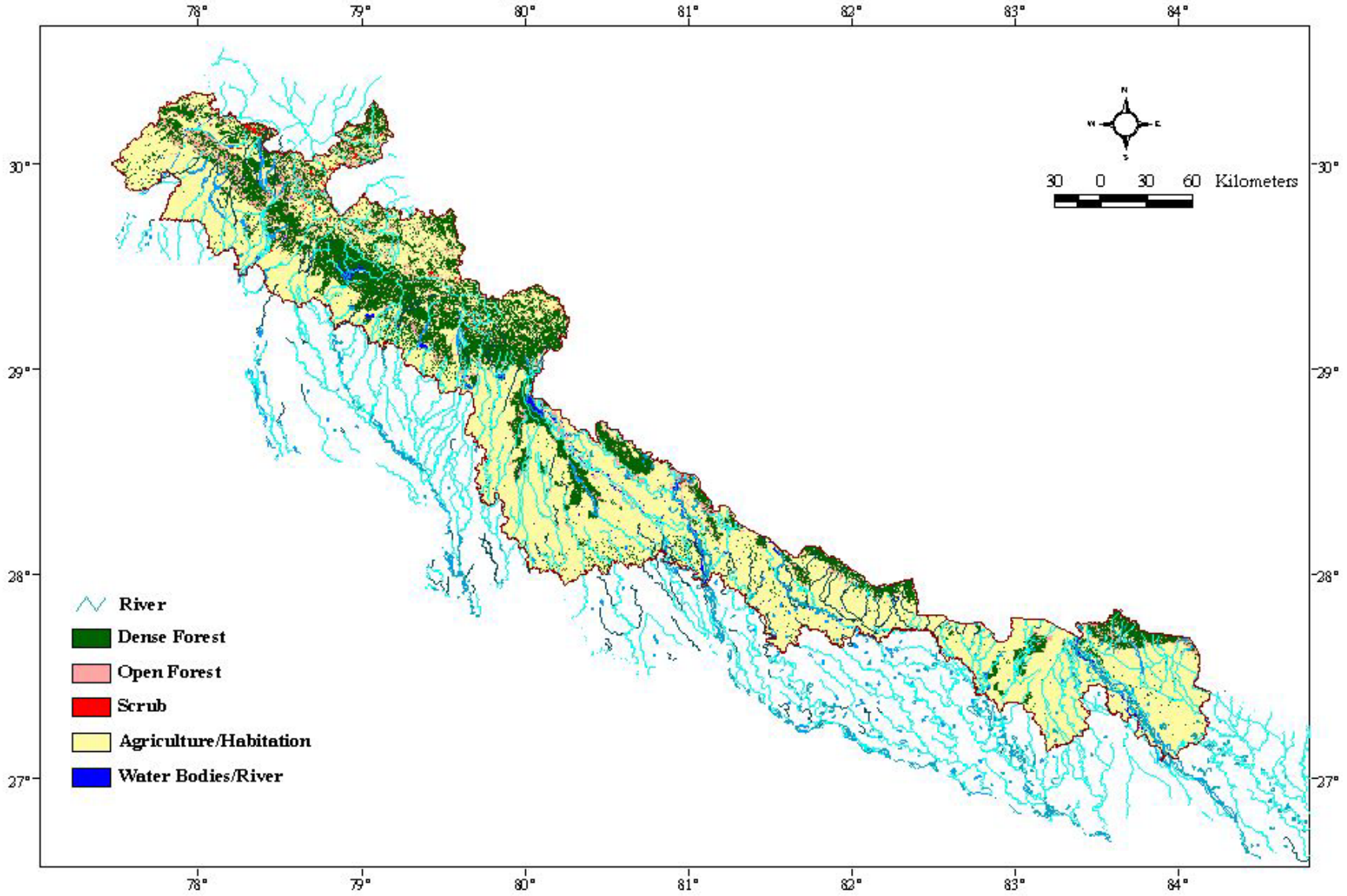
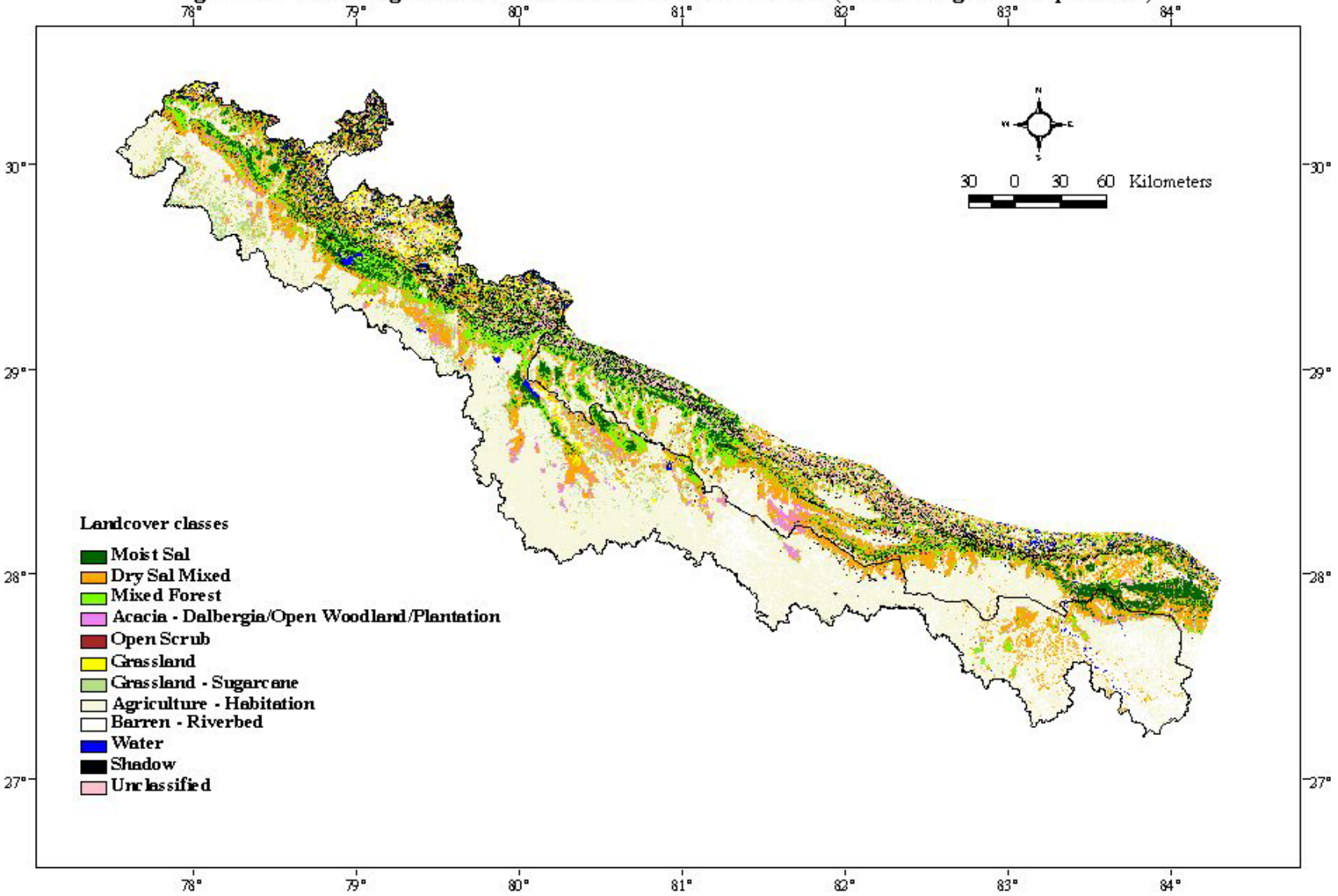


Figure 4.3: Broad vegetation and landcover classification of TAL (based on digitial interpretation)



of sal in the area include sain *Terminalia alata*, *Syzygium cumini* and bakli (*Anogeissus latifolia*). Three vegetation communities described by Champion and Seth correspond to this category (3C/C2/2b(ii), 3C/C2/2d(ii), 5B/C1/1b, refer Appendix VI). Other classes of sal mixed forest grade into this category, when worked to exclude other species and promote the growth of sal.

4.1.2 Sal mixed forests

Some of the most common associates of sal in these forests include *Terminalia alata*, *Syzygium cumini*, *Anogeissus latifolia* and *Haldina cordifolia.* These forests, which occur along both the Shivalik hills and *terai-bhabar* plains, range from very wet, swampy types with undergrowth of cane *Calamus tenuis*, to drier and more open types. Mixed stands of chir *Pinus roxburghii* and sal occur along the Shivalik ridges. Seven forest types identified by Champion and Seth (1968) correspond to this vegetation type (3C/2a, 3C/C2/2b(i), 3C/C2/2C, 3c/c3/3a, 3C/C2/2d(i), 3C/C2/2d(iii), 5B/C1/1a, see Appendix VI)

4.1.3 Riverine forests

Riverine areas, in the moist as well as dry deciduous forests constitute a distinct vegetation type. Characteristic overstorey includes *Syzygium cumini* and tumri *Trewia nudiflora*, replaced by paniala *Bischoffia javanica* along hilly ravines. The unique khair-sissoo formation is seen along gravelly streambeds in flatter terrain. This category forms mid seral stage in the successional trajectory of the TAL, the early stages being *Saccharum spontaneum – Imperata* grasslands followed by *Zizyphus mauritiana* and other shrubs. Five Champion and Seth classes correspond to this vegetation type (4C/FS2, 4D/SS3, 4E/RS1, 5/1S1 & 5/1S2, Appendix VI).

4.1.4 Mixed or miscellaneous forests

Several subgroups, in each of which one species is dominant, are represented in this type. Sain (*Terminalia alata*) stands are among the most important subtypes occurring throughout the *terai* on heavy, wet or clayey soil. Bakli (*Anogeissus latifolia*) stands, which occur on drier sites, are almost pure in the western *terai*. A total of nine mixed forest types identified by Champion and Seth (1968) classes correspond to these vegetation types (3C/E1, 3C/C3/3a, 4D/SS4, 4D,SS2, 5B/C2, 5/E6, 5/1S3, 8B/C1/1a & E1, Appendix VI).

4.1.5 Plantations

Considerable proportion of the landscape, mostly in *terai* region, is under plantation. These were set up as part of forestry operations to supply timber and generate income for the States. The most commonly occurring plantations are those of teak, eucalyptus and mixed plantations consisting of sal, teak, papri (*Holoptelia integrifolia*) khair and sissoo. About 250km^2 is under monoculture plantation of *Acacia catechu*, *Dalbergia sissoo* and *Syzygium cumini*.

4.1.6 Grasslands

The *terai* includes some of the tallest grasslands in the world. Today, these grasslands constitute less than 500km^2 of the landscape and are very patchily distributed. The grass community occurs in a succession along the flood plains. *Saccharum spontaneum* is among the first to colonize fresh alluvium and exposed riverbanks after floods. The next terrace is generally occupied by *Saccharum bengalense*. On intense grazing by herbivores, shorter grassland types appear with a mixture of grasses such as *Imperata cylindrica*, *Chrysopogon aciculatus* and *Eragrostis* spp. The tall grasses *Arundo donax* and *Phragmites karka* surround oxbows and lakes (Champion and Seth types 3C/1S1 and E1, Appendix VI).

4.1.7 Open scrubs

Open scrub can be seen on steep and drier hill slopes of Shivaliks dominated by karaunda *Carissa carandas* and dawi *Woodfordia fruticosa* or in the degraded sites in the plains (secondary scrub) mostly dominated by invasive species such as *Lantana camara*, and at times by khajur *Phoenix acaulis* and vasaka *Adhatoda vasica* (Champion and Seth – 5/DS1, 5/DS2, Appendix VI).

4.1.8 Grassland-Sugarcane patches

Sugarcane (*Saccharum officinarum)*, the popular cash crop in *terai* belt, largely mimics the tall grassland and therefore, the grassland patches, located at the fringe areas, were difficult to distinguish from the sugarcane. However, the contribution of grassland area in this type is minimal and in the entire landscape, this particular land cover category (grassland-sugarcane) constitutes a very small proportion (3.4%).

4.2 Structural components

The structural components in this landscape are heterogeneous and that the spatial arrangement appears as a mosaic of high (closed) and low (open) density areas (Table 4.1, also see Appendix VII). This is evident from the high variations in all the parameters (canopy cover, tree density and richness, shrub density and richness, sapling density and richness, herb cover and grass cover) across TAL. Species richness of tree and shrub species, and shrub density was significantly higher in *bhabar* areas compared to *terai* regions (Student t test, $p < 0.05$), while canopy cover, sapling species richness and density were higher in *terai* (Student t test, $p < 0.05$). *Bhabar* areas contain forests that are more open and harbour diverse plant species due to undulating topography and variable moisture regimes, whereas *terai* areas are largely dominated by sal, which forms large stretches of forest with dense cover. The status of these habitat features are specifically no better in Protected Areas and in fact, several Forest Divisions outside Protected Areas support relatively intact habitat as indicated by higher sapling, shrub and tree density and species richness (Student t test, $p < 0.05$, Appendix VII). This can be attributed to

the fact that some very disturbed areas such as Suhelwa, Sohagibarwa and Valmiki come under PAs, while Forest Divisions with more intact habitat such as Haldwani, Ramnagar and Pilibhit FDs are outside the PA network. This was further substantiated by Cluster Analyses (Bray-Curtis measure, group average) in that better protected Forest Divisions and very disturbed Divisions separated out as two end groups, and other Divisions experiencing moderate pressures were placed between these. Forest Divisions with extensive sal forests formed a distinct cluster, falling between the disturbed and undisturbed extremes (Figure 4.4). Between groups variance was found to be significant for sapling diversity, shrub density, richness and tree density for these clusters (Kruskal Wallis test, $p<0.01$). While disturbance factors such as lopping and usage by cattle were not significantly different between the clusters. However, the Forest Divisions and PAs exhibited an overall similarity of about 60% in the structural components.

Table 4.1: Vegetation structure of landscape and management units
(n = #of plots; values are means ± standard deviation/plot,
plot size = 10m radius for tree and 5m radius for shrub)

Variables	TAL (n = 1150)	*Terai* (n = 444)	*Bhabar* (n = 706)	PA (n = 646)	Forest Division (n = 504)
% Canopy cover	24.1 ± 11.6	25.2 ± 11.6	23.5 ± 11.5	24.3 ± 11.0	24.0 ± 12.2
Tree density	8.3 ± 4.8	8.3 ± 4.9	8.4 ± 4.7	7.9 ± 4.7	8.8 ± 5.0
Tree species richness	3.2 ± 1.5	3.0 ± 1.5	3.4 ± 1.5	3.3 ± 1.5	3.1 ± 1.6
Shrub density	13.4 ± 14.3	7.4 ± 15.8	17.2 ± 8.8	11. ± 12.3	15.8 ± 16.3
Shrub species richness	1.5 ± 1.2	1.0 ± 1.2	1.9 ± 1.0	1.3 ± 1.1	1.7 ± 1.3
Sapling density	8.6 ± 9.3	10.4 ± 8.1	7.4 ± 10.8	7.9 ± 8.4	9.4 ± 10.3
Sapling species richness	1.7 ± 1.4	1.9 ± 1.4	1.6 ± 1.3	1.7 ± 1.2	1.8 ± 1.5

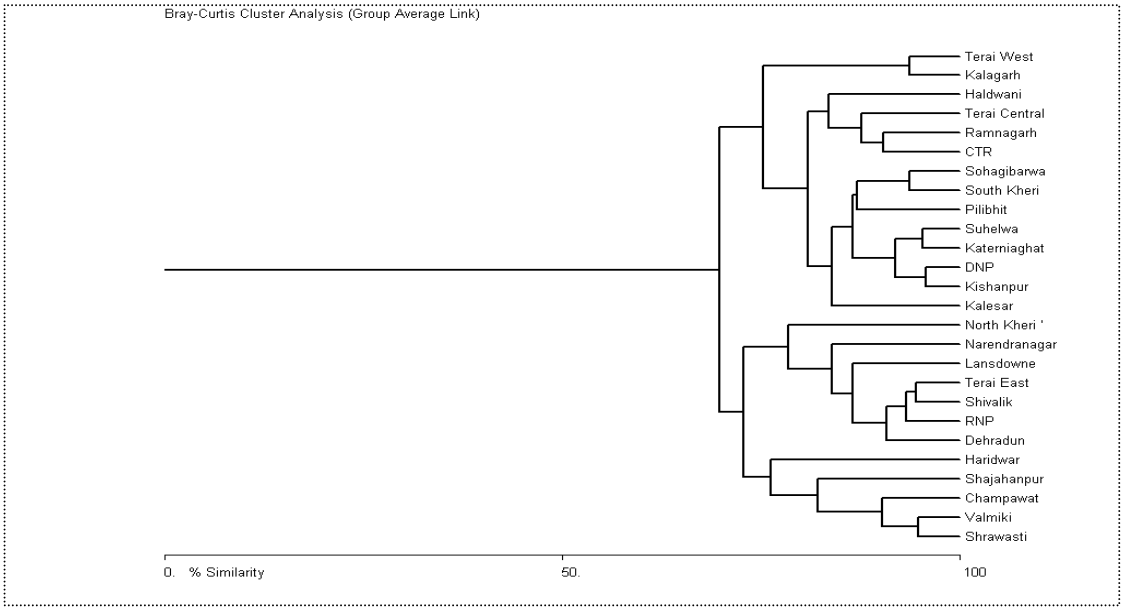


Figure 4.4: Dendrogram of Forest Divisions and PAs based on vegetation attributes

Each of the structural attributes varied significantly between the Tiger Habitat Blocks (THBs) (Kruskal Wallis test, $p<0.05$, Table 4.2). Tree density and species richness scored above average in THBs II, III, IV, VII and VIII (Ganges-Gola, Gola-Khatima, Pilibhit-Kheri, Suhelwa and Sohgibarwa-west). Sapling density and species richness was above the average in Gola-Khatima, Pilibhit-Kheri and Sohagibarwa-west. Shrub density and species richness were highest in the Ganges-Gola Block. Cluster Analysis (Bray-Curtis measure, group average) placed all THBs into three broad groups based on the structural attributes and disturbance level (Figure 4.5). The *terai* woodlands in Pilibhit-Kheri, Dudhwa NP and Sohagibarwa-west form one group and similarly, most of the *bhabar* habitats fall in one cluster. Katerniaghat WLD resembles *bhabar* areas in terms of more open habitats, high shrub density and high level of disturbance, and perhaps because of this, it has been placed along with *bhabar* areas (Figure 4.5). Although Valmiki TR and Shrawasti FD are dissimilar in terrain features, representing hilly and flat terrain respectively, the forests in these blocks appear similar in most of the structural attributes and disturbance level (Table 4.2, Figure 4.5, and Appendix VII).

In the entire TAL (*terai* and *bhabar*) regardless of PA status, invasives such as bhant (*Clerodendron viscosum*), lantana, adathoda and *Tiliacora acuminata* (in Dhudwa NP) dominate the understorey. These invasives figure in the top three shrubs of most Forest Divisions (Appendix VII). Bhant and lantana occupy 21% and 17% of 1150 plots respectively. On an average, there were 2 ± 6 bhant (mean ± SD) and 1 ± 5 lantana plants per plot. The extent to which such invasives alter plant species diversity, productivity and diversity of dependent fauna needs to be investigated.

Table 4.2: Vegetation structure of Tiger Habitat Blocks
(n = #of plots; values are mean ± SD/plot, plot size = 10m radius for tree and 5m radius for shrub)

Tiger Habitat Block	Canopy cover	Tree density	Tree species richness	Shrub density	Shrub species richness	Sapling density	Sapling species richness
Simbalbara-Ganges (n=86)	21.8 ± 12.4	7.9 ± 5.7	2.7 ± 1.2	17.1 ± 10.5	2.1 ± 1.1	5.5 ± 6.9	1.2 ± 1.2
Ganges-Gola (n=202)	23.2 ± 12.1	9.2 ± 5.4	3.4 ± 1.5	25.7 ± 19.8	2.3 ± 1.3	6.4 ± 6.7	1.4 ± 1.1
Gola-Khatima (n=145)	26.8 ± 13.2	9.8 ± 5.4	3.5 ± 1.9	16.9 ± 16.3	2.0 ± 1.3	11.7 ± 11.6	2.3 ± 1.8
Surai-Kheri (n=155)	24.7 ± 11.4	9.0 ± 4.5	3.1 ± 1.6	6.9 ± 8.9	0.9 ± 1.0	12.7 ± 11.9	2.2 ± 1.4
Dudhwa (n=61)	26.4 ± 10.8	8.1 ± 4.7	2.9 ± 1.3	7.3 ± 9.3	0.9 ± 0.8	8.6 ± 11.2	1.5 ± 1.3
Katerniaghat (n=97)	23.4 ± 11.6	7.8 ± 5.0	3.1 ± 1.5	10.9 ± 9.4	1.4 ± 1.0	7.8 ± 6.9	1.3 ± 0.9
Suhelwa (n=147)	24.6 ± 10.0	8.8 ± 3.7	3.8 ± 1.4	13.1 ± 10.1	1.5 ± 0.9	7.8 ± 6.6	1.8 ± 1.2
Sohagibarwa (n=95)	28.8 ± 12.4	8.6 ± 5.0	2.7 ± 1.6	3.6 ± 5.5	0.6 ± 0.9	12.7 ± 12.0	2.3 ± 1.4
Valmiki (n=126)	19.8 ± 8.3	5.2 ± 2.1	3.1 ± 1.3	8.8 ± 8.2	1.3 ± 0.9	5.1 ± 4.8	1.4 ± 1.2
No tiger area (n=36)	20.7 ± 7.4	6.6 ± 3.1	2.9 ± 1.2	10.5 ± 8.5	1.2 ± 0.7	5.2 ± 4.6	1.1 ± 0.8

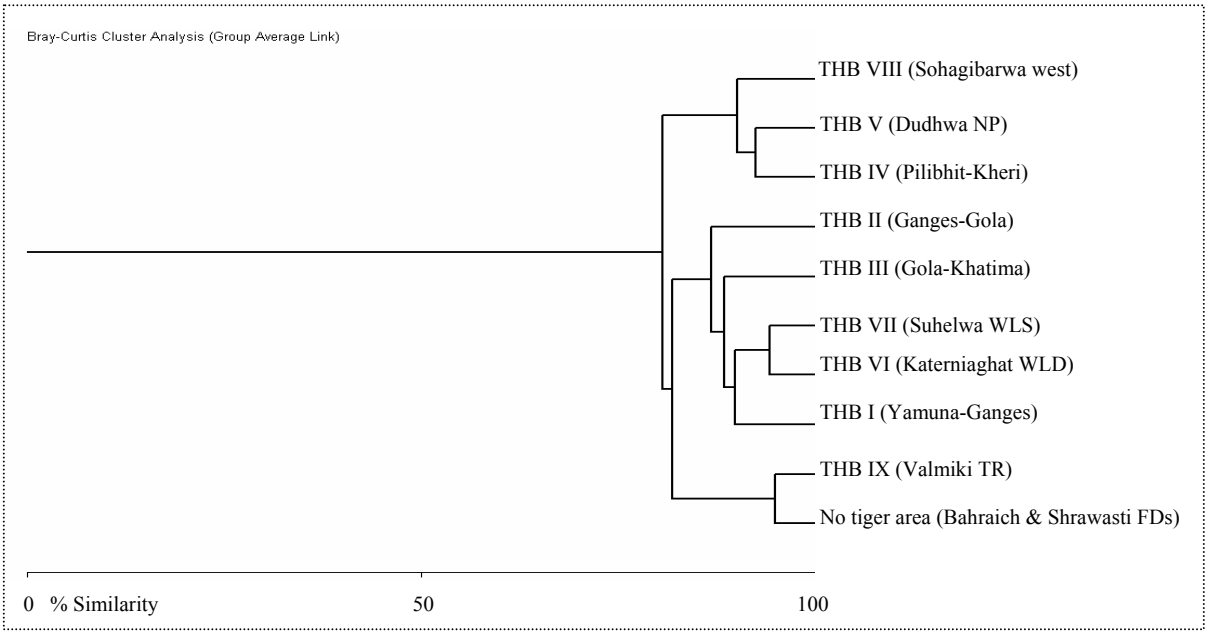


Figure 4.5: Dendrogram of Tiger Habitat Blocks based on vegetation attributes

4.3 Landscape characteristics and configuration

The total area in TAL including Nepal, having natural vegetation up to 1000m elevation, is 26,292 km^2. Within Indian limits, this area is 14,947 km^2, which includes 23% closed forest, 7% open forest and 0.4% scrubland. The dry sal mixed association dominates the Landscape (44%). Moist sal mixed and miscellaneous forests contribute 21% each, *Acacia* - *Dalbergia* 7%, grassland 4% and scrub occupy the least, 1%. While there are 17 patches of size >100km^2, forming almost 90% of the Landscape, the majority of the patches are <5km^2. Though there are lesser number patches per unit area (1.9 patches/100km^2), the Landscape is generally fragmented in nature, particularly in the eastern part (*terai*).

Although the tiger habitats on the Indian part of the TAL are in nine disjunct THBs, when the connectivities with the Nepal side are considered, these THBs form five larger units (Tiger Units, TU) (Figure 2.2). These units are: (TU I) Simbalbara WLS-Kalesar WLS-Shivalik FD-west bank of Ganges, (TU II) East bank of Ganges-Corbett TR-Gola river, (TU III) Gola river-Tanakpur:Khatima Highway, (TU IV) Surai Range (Pilibhit FD)-Sukhlaphanta WLR-Kishanpur WLS-Dudhwa NP-Bardia NP-Katerniaghat WLD and (TU V) Suhelwa WLS-Lamahi:Dovan bottlenecks-Sohagibarwa WLS-Chitwan NP-Valmiki TR (Figure 2.2). The TU I, TU II and TU III are in the *bhabar* tract and are largely in the state of Uttaranchal, TU IV, largely in *terai*, is in Uttar Pradesh and Nepal, and TU V, largely in *terai,* is in Uttar Pradesh, Nepal and Bihar. The proportion of habitat available for tiger in these units ranges between 15 and 39%.

Table 4.3: Landscape metrics (fragmentation and shape indices) derived for TAL (Fragstats 3.3)

Landscape parameters	Tiger Unit (TU)				
	TU I	**TU II**	**TU III**	**TU IV**	**TU V**
Potential habitat (km^2)	2925	4054	1410	8337	9077
Percent potential habitat	15.78	19.01	23.18	39.36	15.08
Patch/unit area (potential habitat/100km^2)	10.21	6.47	3.05	1.5	6.97
Large patch index	15.05	18.94	12.40	27.85	12.11
Splitting index	43.58	27.86	56.43	12.33	68.06
Total core area (up to 2km depth)	235.4	192.2	37.28	1017.75	378.46
Number of disjunct core areas	27	32	4	68	47
Number of patches having core areas	2	1	2	4	3
% of core area in potential habitat	8	4.74	2.64	12.20	4.17

The large patch index indicates the proportion of large patches in the total area and is indicative of compactness in a unit (Table 4.3). The splitting index, indicating level of habitat fragmentation, was highest in TU V, while TU IV was the lowest. As indicated by patch/unit area statistics (Table 4.3), larger number of small patches are prevalent in TU I, followed by TU V and TUII. Though the TUs were large connected networks, due to their narrow shape, considerable proportion of the forested areas of the Landscape are exposed to disturbances. The field data indicated that generally, anthropogenic pressure operates up to 2km depth from the forest edge and in some areas, as deep as 4km. The core area estimate (after excluding a 2km buffer from the patch) ranges from 4 to 13% of the size of individual patches. As the core areas of patches are relatively disturbance free, these are valued crucial for breeding of tiger and cervid populations, particularly sambar that prefers a disturbance free habitat. But, these core areas are small and disjunct in large parts of the TAL, particularly more so in TU IV and TU V, presumably making it less suitable for breeding of these species. Further, the number of patches having core (number of cores) are few and contribute a very small proportion of potential habitat. These core areas are largely contributed by patches of >500km^2 area and thus, even in fragmented landscape, these patches (>500km^2) assume greater conservation importance.

Forests in each TU have at least one key patch in which tigers can have higher probability of persistence and can act as a source for adjoining patches in the given landscape network. These key patches are the western portion of Rajaji NP in TU I, Corbett TR in TU II, Pilibhit FD-Sukhlaphanta Reserve-Kishanpur WLS- Dudhwa NP-Bardia NP in TU IV and Chitwan NP in TU V. Of these units, TU V can harbor demographically viable population of tigers only because of their contiguity with forests in Nepal.

5. UNGULATE DISTRIBUTION AND STATUS

Wild ungulates represent an important constituent of faunal assemblage in the TAL, contributing to diversity, biomass and conservation values. Including the one-horned rhinoceros, TAL supports nine species of wild ungulates; the other eight being sambar (*Cervus unicolor*), chital, nilgai *(Boselaphus tragocamelus),* wild pig (*Sus scrofa*), swamp deer, hog deer, goral and barking deer (*Muntiacus muntjak*). Domestic ungulates seen are cattle (*Bos indicus*), buffalo (*Bubalus bubalis*), goat (*Capra hircus*), sheep (*Ovis aries*) and pony (*Equus cabellus*). It is stated that the greatest ungulate biomass in south Asia is found in areas like the TAL, where grassland and forests form a mosaic and this juxtaposition of diverse vegetation types are capable of supporting rich ungulate communities (Eisenberg and Seidensticker 1976, Karanth and Sunquist 1992). Typically, the ungulate assemblage here includes both endemic (e.g. subspecies of swamp deer *Cervus duvauceli duvauceli*) and obligate species (e.g. hog deer, a grassland obligate) (Wemmer 1998). Being the major prey base, these species have a key role in the survival of tiger (Seidensticker 1976a, Stoen and Wagge 1996). The evidence on evolutionary history suggests that ungulate communities act as a determinant of tiger distribution and abundance across the distribution range (Seidensticker *et al*. 1999). According to Karanth and Stith (1999), the most important threat to tiger occurrence is the depletion of prey base. Herbivore and vegetation interactions and their specific role in structuring the vegetation communities and succession are also well known, particularly in grassland mixed ecosystems (Hobbs 1996, Augustine and McNaughton 1998, Hester *et al*. 2000, Gill and Beardall 2001). However, as indicated by anecdotal information and the present survey, the current status of these species in TAL is in fragmented populations and is subjected to enormous anthropogenic pressures including poaching (Sankaran 1990, Smith *et al.* 1998, Javed *et al.* 1999, Biswas and Mathur 2000). Prudent conservation measures ideally warrant empirical data on species distribution and abundance in the spatial context, along with the reasons for decline in population. In this study, efforts are made to document the status of ungulates in the entire TAL, and further, data collection at much finer scales enabled modeling the influence of these species on tiger occurrence in TAL.

5.1 Species association

Hierarchical Cluster Analysis revealed that the ungulates of TAL can broadly be classified into three assemblages; (i) sambar and chital, (ii) nilgai and wild pig, and (iii) swamp deer, hog deer and barking deer (Figure 5.1). However, at a finer scale, only swamp deer and hog deer show close association and all other species appear to have distinct distribution patterns, suggesting that they differ in habitat occupancy at micro scales. Sambar is largely restricted to the hilly terrain. Chital, although share the habitat with sambar to some extent, occurs more commonly in the flatter terrain. Similarly,

although both nilgai and wild pig are found in plains, the attachment of nilgai to the plains is much stronger. Sample size on barking deer was too low, most of which were in the forests close to grasslands in *terai*, and this could be the reason for barking deer being grouped along with swamp deer and hog deer (obligate species of grasslands) (Figure 5.1). However, the distance between barking deer and the grassland assemblage (swamp deer and hog deer) is considerably wider (Figure 10). Goral was not included in the analysis, because it is an outlier, exclusively restricted to steeper slopes in Shivalik hills. These variations clearly demonstrate that these ungulates represent different habitat units and therefore, tiger conservation has to accommodate these diverse habitats.

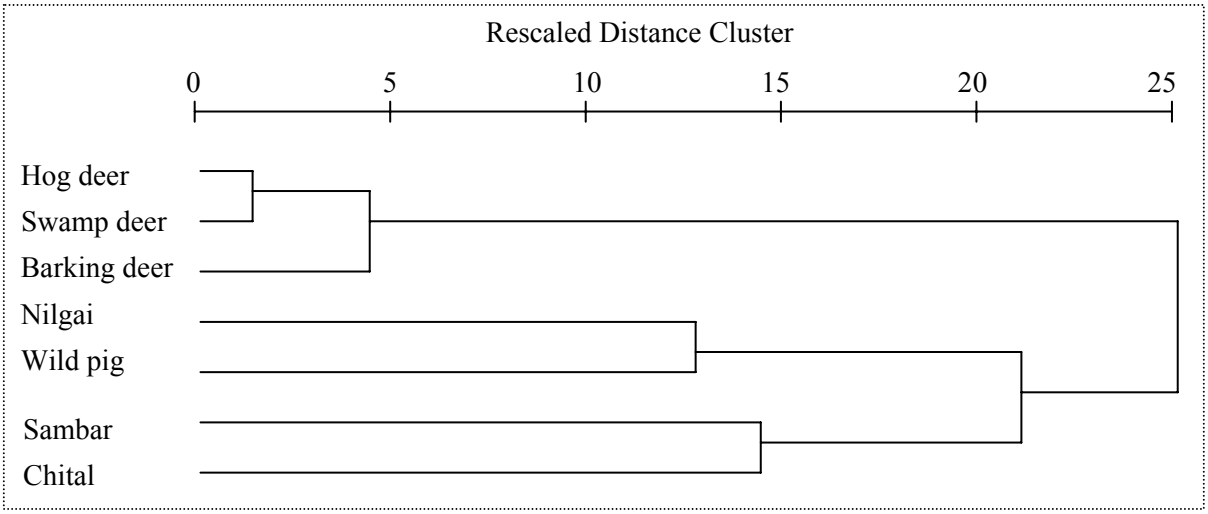


Figure 5.1: Dendrogram depicting ungulates association in TAL (Ward's method)

5.2 Distribution and relative abundance

Frequency of occurrence or proportional occurrence (number of segments with presence signs/total segments sampled), which is a potential surrogate for relative abundance, indicates that the habitat occupancy of wild ungulates varies highly between species (Table 5.1, Appendix VIII). Sambar is mostly restricted to *bhabar* habitats (Pearson ^{2} test, $p < 0.001$), whereas wild pig, chital and nilgai occupy significantly greater proportions in *terai* (^{2} test, $p < 0.001$). However, chital is found in substantial numbers in *bhabar* too. Most of the swamp deer and hog deer populations in the Indian side of TAL are confined to *terai* (Table 5.1), as exemplified in Dudhwa TR. Pilibhit FD also holds small populations of these two species. There are unconfirmed reports that few individuals of swamp deer occur in the swampy grass patches, in the southern part of Haridwar Forest Division. Barking deer is common in *bhabar* and its distribution in *terai* is largely restricted to areas receiving good protection, such as Dudhwa TR. Goral is obviously restricted to *bhabar* habitats and the steeper slopes of Shivalik hills and Outer Himalayas. When comparing the status of all these species between Protected Areas and

Reserved Forests, Protected Areas support more of chital, wild pig, swamp deer and hog deer (Table 5.1, ^{2} test, $p < 0.001$). Nilgai, on the contrary, occur significantly in higher proportion outside Protected Areas. This difference is not so apparent for sambar (^{2} test, $p = 0.14$), goral (^{2} test, $p = 0.11$) and barking deer (^{2} test, $p = 0.10$). Wild ungulate pellet group density (pooled for all the species) was marginally higher in *bhabar* (Table 5.2, Mann-Whitney U test, $Z = -1.871$, $p = 0.06$) and was similar across Protected Areas and Reserved Forests (Mann-Whitney U test, $Z = -0.797$, $p = 0.43$).

Table 5.1: Frequency of occurrence of wild ungulates in landscape and management units
(n = transects, s = segments, and the values are mean percentage ± standard deviation)

Species	Landscape (n = 246, s = 4012)	*Terai* (n = 79, s = 1366)	*Bhabar* (n = 167, s = 2646)	Protected Area (n = 85, s = 1451)	Reserved Forests (n = 161, s = 2561)
Sambar	38.5 ± 39.3	6.9 ± 17.6	53. 5± 37.8	40.7 ± 39.7	37.4 ± 39.1
Chital	54.2 ± 36.9	61.0 ± 35.7	51.0 ± 37.1	61.0 ± 36.3	50.7 ± 36.8
Nilgai	33.4 ± 37.9	56.8 ± 37.2	22.3 ± 32.9	24.2 ± 30.8	38.2 ± 40.4
Wild pig	46.4 ± 36.8	68.8 ± 33.5	35.8 ± 33.5	50.9 ± 36.0	44.0 ± 37.2
Swamp deer	0.4 ± 6.4	1.4 ± 11.3	0.0	1.2 ± 10.8	0.1 ± 0.7
Hog deer	2.1 ± 12.8	6.4 ± 22.0	0.0	5.7 ± 21.3	0.1 ± 1.1
Goral	1.4 ± 9.0	0.0	1.4 ± 7.7	1.1 ± 5.7	0.9 ± 6.7
Barking deer	7.9 ± 17.5	1.3 ± 6.5	11.1 ± 20.0	8.1 ± 18.7	7.9 ± 16.9

Table 5.2: Pellet group densities of wild ungulates (number of pellet groups/plot) in landscape and management units

	Landscape (n = 1150)	*Terai* (n = 444)	*Bhabar* (n = 706)	Protected Area (n = 639)	Reserved Forests (n = 511)
Mean	0.6	0.4	0.7	0.6	0.5
SD	1.27	0.96	1.43	1.36	1.15
SE	0.04	0.04	0.05	0.05	0.05

Among the THBs, there was a significant variation in relative occurrence of these ungulates (Pearson ^{2} test, $p < 0.001$). However, the general pattern of distribution and frequency of occurrence of these ungulates are encouraging in that, the prey availability is not wanting in most parts of TAL and at least, sambar, chital, nilgai and wild pig occur interchangeably in considerable proportion (ca. 50% and above) of the habitats (Table 5.3, Appendix VIII). Yamuna-Ganges and Ganges-Gola THBs in *bhabar* and Pilibhit-Kishanpur and Dudhwa in *terai* are currently the best areas for wild ungulates. Interestingly, despite being surrounded by human habitations and intense human activity, prey base in Suhelwa and Sohagibarwa THBs is relatively better, perhaps due to the robust habitat connectivity across Nepal and effective anti-poaching measures by the Forest Department. Rest of the THBs were either poorly represented by these ungulates or are restricted to certain parts of the blocks. For instance, in Katerniaghat WLD, only the northern portion supports relatively undisturbed, rich habitats for wild ungulates, whereas the southern portion is heavily disturbed by train and vehicular traffic and is also

under profuse human disturbance. Gola-Khatima THB experiences heavy disturbance from cattle grazing, wood cutting and lopping, and more significantly, poaching. It is likely that these factors collectively have resulted in low prey availability in this block. Similar situation exists in Valmiki TR, with poor prey base. It should be noted that the status of prey availability in Bahraich and Shrawasti Forest Divisions (THB X) was precariously low and that these areas are no more used by tiger.

Table 5.3: Frequency of occurrence of wild ungulates in Tiger Habitat Blocks
(n = transects, s = segments, and the values are mean percentage ± standard deviation)

Tiger Habitat Blocks	Sambar	Chital	Nilgai	Wild pig	Swamp deer	Hog deer	Goral	Barking deer
Simbalbara-Ganges (n=27, s= 404)	78 ± 27	67 ± 29	5 ± 18	34 ± 34	0.0	0.0	3 ± 9	14 ± 22
Ganges-Gola (n = 73, s= 1209)	58 ± 39	58 ± 38	34 ± 39	39 ± 34	0.0	0.0	2 ± 9	11 ± 21
Gola-Khatima (n = 35, s = 530)	43 ± 38	33 ± 35	13 ± 26	21 ± 27	0.0	0.0	2 ± 7	8 ± 12
Surai-Kheri (n = 47, s = 820)	6 ± 17	66 ± 32	68 ± 36	78 ± 26	2 ± 15	2 ± 14	0.0	2 ± 8
Dudhwa NP (n = 9, s = 172)	20 ± 29	83 ± 33	24 ± 27	83 ± 16	0.0	26 ± 43	0.0	4 ± 12
Katerniaghat WLD (n=13, s = 158)	3 ± 11	55 ± 37	40 ± 36	56 ± 36	0.0	8 ± 25	0.0	0.0
Suhelwa WLD (n = 13, s = 259)	34 ± 26	48 ± 30	30 ± 29	61 ± 29	0.0	0.0	0.0	8 ± 17
Sohagibarwa WLS (n = 6, s = 115)	9 ± 11	46 ± 29	62 ± 19	46 ± 51	0.0	8 ± 20	0.0	0.0
Valmiki TR (n = 20, s = 321)	31 ± 34	33 ± 34	20 ± 28	30 ± 34	0.0	0.3 ± 1	0.0	14 ± 26
No tiger area (n = 3, s = 24)	0.0	0.0	29 ± 32	33 ± 7	0.0	0.0	0.0	0.0

5.3 Influence of ungulates on tiger occurrence

In the conceptual space on two dimensions (Nonmetric Multidimensional Scaling-NMDS, stress value = 0.16, R^2 = 0.9), chital measures significantly closer to tiger indicating that tiger distribution is more closely related to chital than the other species (Figure 5.2). Sambar and wild pig are almost equidistant from tiger and given the distribution of these two species, tiger has other important prey as sambar in *bhabar* and wild pig in *terai*. Both the ungulates and tiger are placed away from disturbance indicators (domestic dog, cattle and lopping) meaning that they avoid areas of disturbance. Logistic regression analysis revealed with 74% classification accuracy that tiger occurrence is strongly influenced by cervid distribution, particularly chital followed by sambar (Figure 5.3). The domestic dog represents a disturbance regime that is unsuitable to tiger, as dogs are consistently associated with human activities such as livestock grazing, firewood collection and poaching. This reflects that on the one hand, large ungulates having wider spatial distribution determine tiger occurrence, while anthropogenic disturbances induce negative influence, on the other.

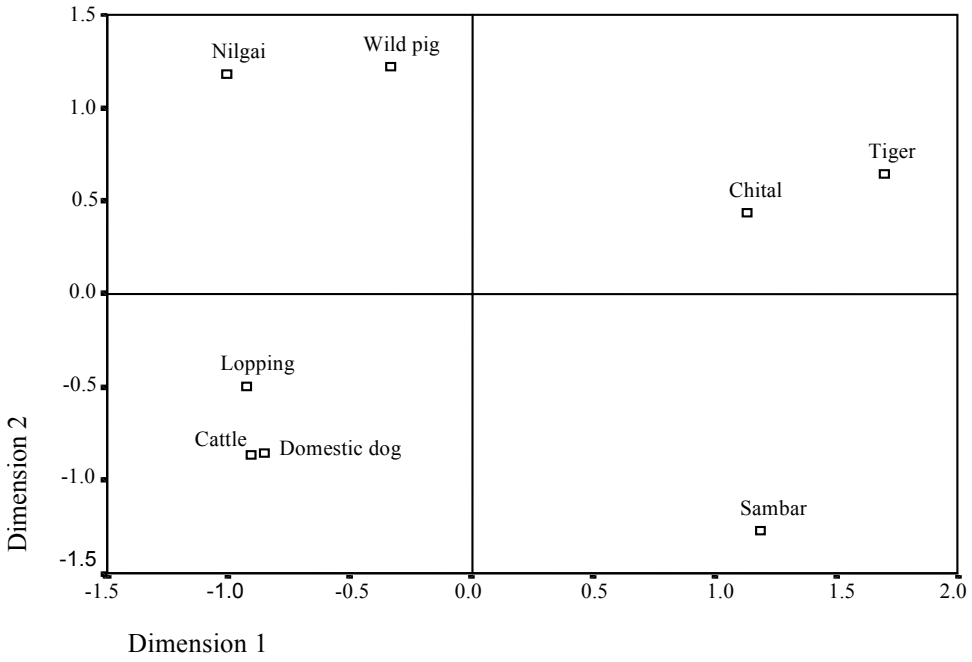


Figure 5.2: Distribution of tiger, ungulates and disturbance indicators in two dimensional space (NMDS) in TAL

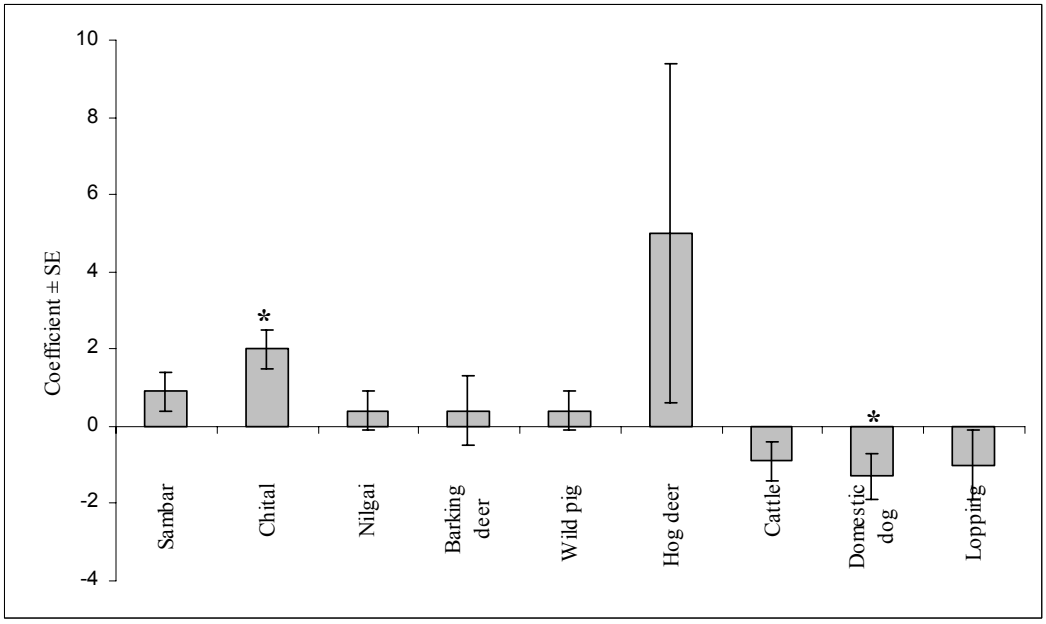


Figure 5.3: Results of logistic regression depicting relationship of ungulates and disturbance indicators with tiger in TAL (* statistical significance at $p < 0.05$)

Specifically for the *bhabar* region, all the large prey species (sambar, chital and nilgai) together positively influence tiger occurrence, whereas the domestic dog has negative influence on tiger occurrence. However, in *terai*, tiger distribution is related primarily to chital followed by wild pig. The negative influence of disturbance indicators is negligible here, perhaps because, most of the forests in *terai* are under PA network, and even the non-protected areas such as Pilibhit FD are relatively well protected from human disturbance.

6. DEMOGRAPHY AND SOCIO-ECONOMIC PROFILE

The Terai Arc Landscape has experienced a varied history of settlement and land use by people. Throughout the 19th and 20th centuries, and in significant measure even to the present day, population growth driven quest for agricultural frontier expansion are in apparent conflict with forest management. For large parts of the TAL, Flint (1998) and Habib (1999) provide a detailed account of the forest – agricultural frontier configuration from the Mughal period onwards. During the colonial administration, increased provisioning for forest products (primarily timber), added another dimension to the anthropogenic influences on TAL forests. This led to the emergence of many economically significant market towns (Tucker 1998). The main centres to emerge were Ramnagar, Kaladhungi, Haldwani and Tanakpur in the *bhabar* region, and Kashipur, Bazpur, Gadarpur, Lalkuan, Kichha and Sitarganj in the *terai* areas. From 1881 to 1981, human population has reportedly grown by 130% (Flint 1998). Development of road and rail communication infrastructure added newer and more efficient lines of export for timber and forest products, and agricultural produce. Demand for labour for agricultural commodity production, construction of the Ganges Canal (1836-1854), and expansion of the rail network in the plains placed additional pressures on these forests. A gradual process of increased monetization of the regional economies that had already begun under the colonial administration was further augmented by the developmental thrust of independent India's governments. Post colonial development of infrastructure in the form of rail and road expansion, dams and irrigation canals and the growth in human population have contributed to the present configuration of the forests - agricultural frontier.

6.1 Ethnic groups of the TAL

Malaria was a major impediment to settlement in the TAL. Being resistant to malaria, the *tharus* are among the earliest tribal settlers of forests in the TAL (Tucker 1998). They trace their origin to *rajput* forefathers (Singh 1994) and are widely dispersed in the districts of Bharaich, Gonda, Gorakhpur, Kheri, Bettiah and Nainital practicing settled agriculture. *Gujjars* lead a semi-pastoral existence, subsisting by selling milk and milk products across the western part of TAL. Dependency of *gujjars* on fodder for their livestock is of continued concern for wildlife management. Efforts to resettle *gujjars* outside PAs such as in Rajaji NP are ongoing. *Oraons* are a tribal group occurring in Gorakhpur and Bettiah districts (Singh 1994). Origins of *oraons* can be traced to the Chhotanagpur plateau of Bihar and they are mainly settled cultivators and wage labourers. Another major endogamous group that settled in the western TAL after the 1950's, are the *rai sikhs*. They are not a tribal group, but followers of the Sikh pantheon and have contributed much to the agrarian economy of these areas. *Kanjars* are a small and scattered nomadic group (largely blacksmiths). We also need to note the professional group called *taungyas.* The British

introduced the *taungya* system of forestry practice wherein people were engaged in timber tree plantations and in exchange, were allowed to grow crops within forest areas. Across the TAL, there are a number of unsettled *taungya* villages within forests and the fringe areas. Further, settlers in the form of erstwhile East Pakistan refugees, retired soldiers from hills and agriculturists from Punjab comprise large part of the population influx observed over the last four decades (Randhawa 1986).

6.2 Demography of the people

The landscape is among the most populous regions of the country, with an average of 543 individuals/km^2 (range: 137 in Champawat tehsil to 1872 in Haldwani tehsil) (Figure 6.1), which is much above the national average of 324 individuals/km^2. According to provisional figures released by the Census Directorate for 2001, 2, 38, 94,443 persons reside within TAL (Table 6.1). There has been rapid growth in human population ever since people began to occupy the fertile *terai* plains after independence. Between the year 1981 and 2001, the population within TAL has grown by a phenomenal 54.19%, which is 9% above the national average for the same period. The density for TAL was 425 individuals/km^2 in 1991, which has increased to 543/km^2 in 2001. The proportion of rural population ranges from 23.5% in Dehradun tehsil to 97.2% in Shrawasti tehsil, with an average of 82%. Scheduled Castes and Tribes comprise 23% of the population.

Table 6.1: Human population and density for TAL

Year	Total	Density (Persons/km^2)	Maximum Density (Tehsil)	Minimum Density (Tehsil)
1981	1,54,96,554	346	813 (Haldwani)	76 (Champawat)
1991	1,90,44,166	425	1120 (Haldwani)	91 (Champawat)
2001*	2,38,94,443	543	1872 (Haldwani)	137 (Champawat)

Source: Census Directorate, New Delhi, * Provisional figures

6.3 Dependency on natural resources and access to services

The existing forest cover is highly variable across TAL ranging from 72% (Haldwani tehsil, Nainital district, Uttaranchal) to 2% (Naugarh tehsil, Sidddarthnagar district, Uttar Pradesh) and significantly higher in *bhabar* areas, in particular. On considering the proportion of arable land to the total area, Dehradun tehsil that has high urbanization (55%) and forest cover (65%), had only 18% of its area arable . In contrast, Hata and Nauagarh tehsils in *terai* had 89% of their total area amenable to agriculture.

All figures in the section pertain to Census of 1991 aggregated rural data

Among the ten occupational categories recorded in the Census 1991, proportion of the total work force engaged in transport and communication, trade and commerce, manufacturing and processing indicate the degree of monetisation of the economy. Categories such as cultivators, agricultural labourers and people engaged in livestock, forestry and fishing are associated with natural resource dependency. Natural resource based occupations are predominant across TAL, averaging 669/1000 workers and ranging from 264/1000 (Dehradun tehsil, Dehradun District, Uttaranchal) to 895/1000 (Powayan tehsil, Shahjahanpur District, Uttar Pradesh) (Figure 6.2). Monetized occupations formed a smaller proportion, with an average of 331/1000 workers across TAL and Dehradun tehsil had the largest proportion of people engaged in monetized occupations (736/1000 workers).

The fuel use profile for people of TAL revealed a heavy reliance on the subsistence fuels such as dung and firewood, ranging from 99% (Dehradun tehsil) to 67% (Kashipur tehsil, Nainital district, Uttaranchal) of the households. Only 73 households/1000 relied on purchased fuels such as LPG, coal and kerosene in the entire TAL, indicating high levels of dependency on natural resources. Further, relationship between land use, occupation and fuel use illustrate patterns of dependency on natural resources. As expected, natural resource related occupations and proportion of households dependent on subsistence fuels such as dung and firewood showed a positive relationship ($r = 0.136$, $p < 0.01$) and also between monetized occupations and purchased fuels. This seems to point towards a decreasing reliance on subsistence fuels as monetization increases. Natural resource based occupations had a high positive correlation ($r = 0.421$, $p < 0.01$) with proportion of arable land. However, this was highly negatively correlated with forest proportion ($r = – 0.758$, $p < 0.05$). This negative relationship is probably due to the fact that agricultural frontier expansion was at the cost of forest cover and also because *bhabar* areas have a higher proportion of forest cover and monetized occupations. There was a significant difference in human density between *bhabar* and *terai*, with *bhabar* being lower at 334/km^2 and *terai* at 436/km^2. In spite of comparable fuel use profiles, higher forest cover and lower human density in *bhabar* areas, as against *terai* area, *bhabar* areas are in a better position to buffer firewood dependency of people.

Principal Component Analysis (PCA) and Hierarchical Clustering (using Ward's method and Euclidean distances) were done for characterization of tehsils in terms of the development and dependency attributes. The variables used include proportion of villages having access to educational, medical, post and telegraph facilities (within 5km radius), communication facilities (paved or unpaved roads) along with the demographic and fuel use attributes. PCA extracted four factors relating to (i) forest-agricultural frontier interface, (ii) agricultural development, (iii) access to developmental services and (iv) energy provision. Cluster analysis on these variables revealed three broad homogenous groups of tehsils within TAL (Figure 6.3). The first cluster was composed largely of *terai* tehsils (e.g. Pilibhit, Maharajganj and Bharaich) and the second was of *bhabar* tehsils (e.g. Dehradun, Hardwar and

Figure 6.1: Human population density (2001) for tehsils of TAL

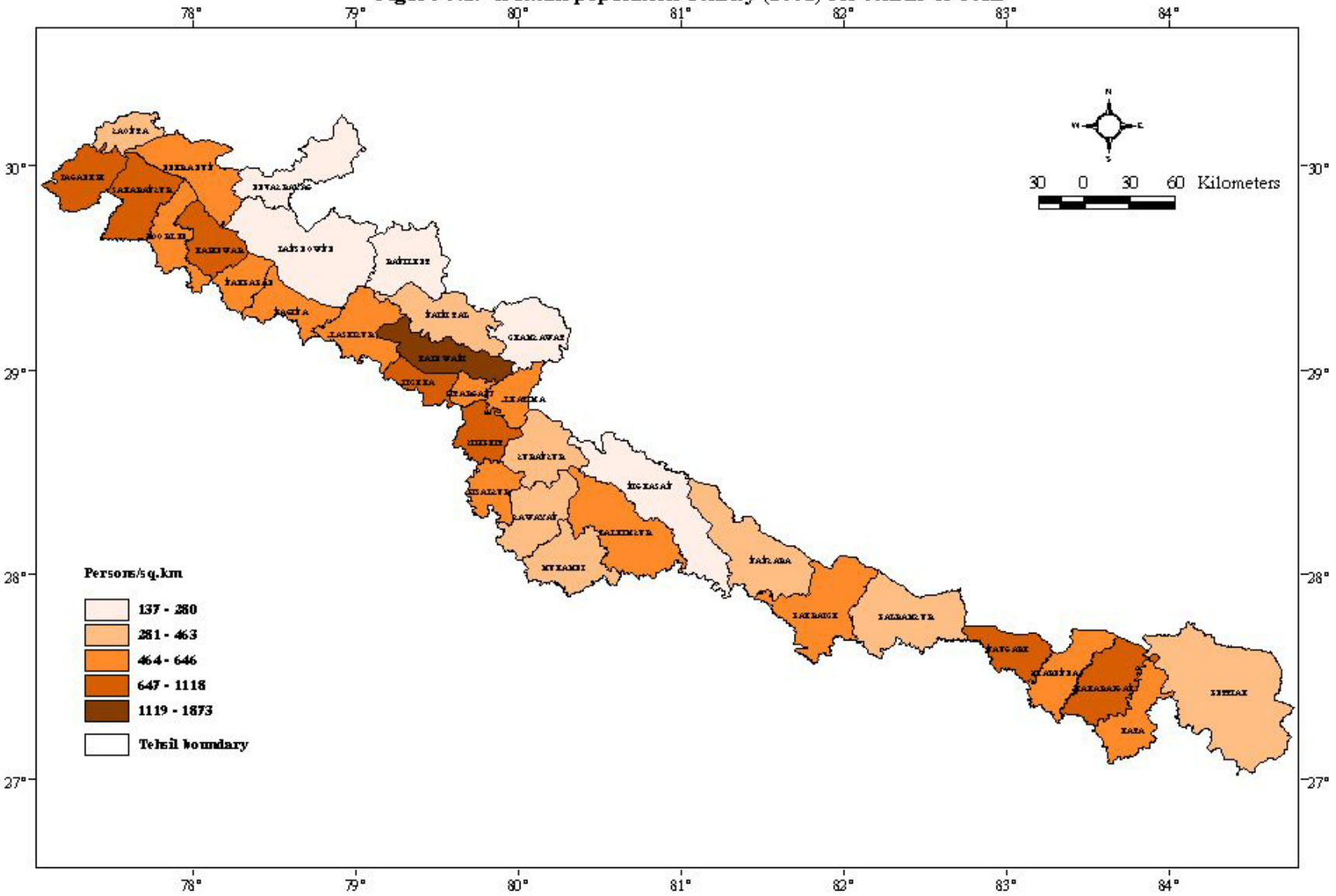
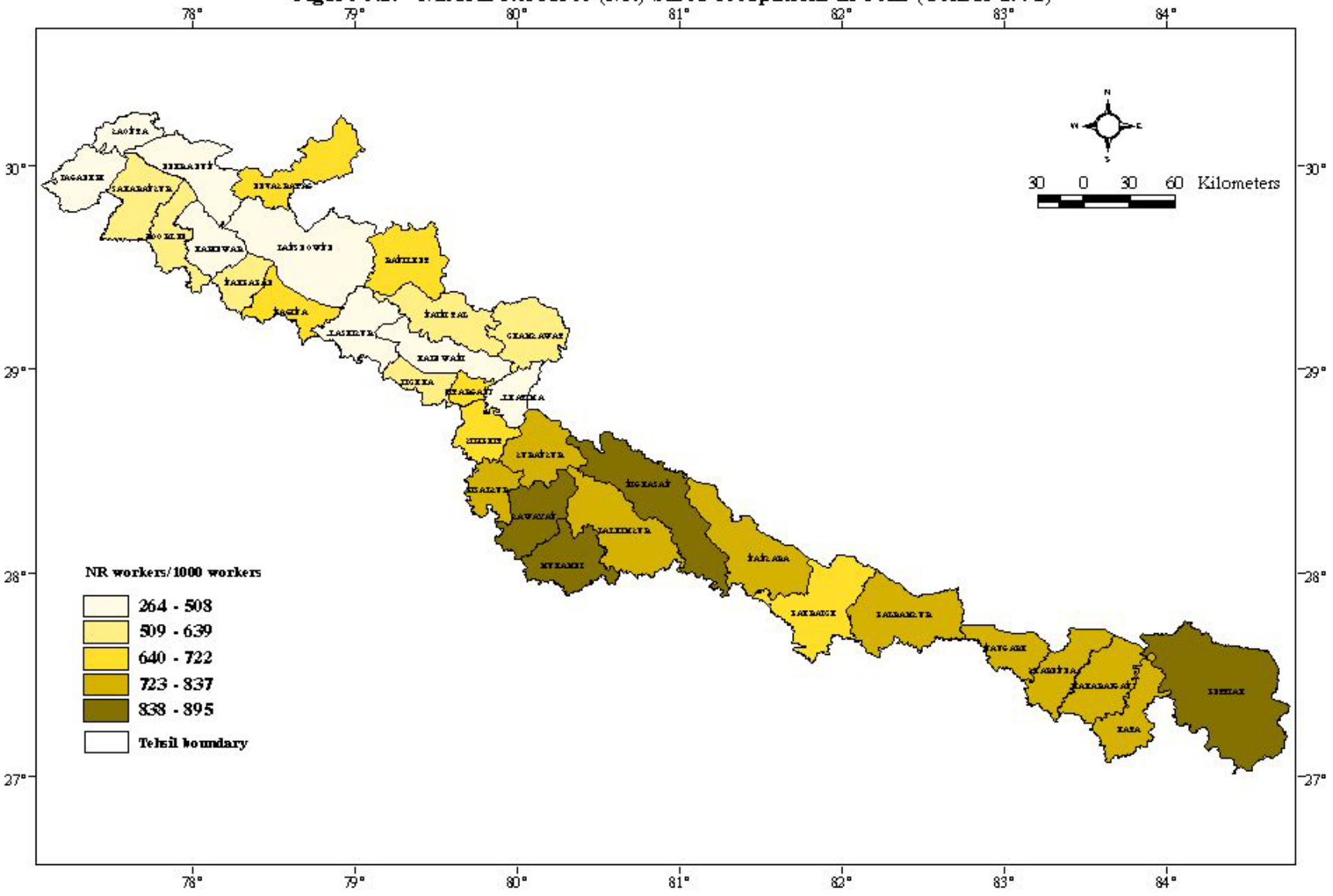


Figure 6.2: Natural Resource (NR) based occupations in TAL (Census 1991)



Haldwani). The *terai* tehsils had relatively higher natural resource related occupations and connectivity by unpaved roads along with lower urbanization and forest cover as compared to *bhabar* tehsils. The third cluster was of hill tehsils such as Lansdowne and Devprayag that had high forest cover and lowest road connectivity and urbanization. This broad characterization in terms of the socio-economic attributes clearly points to the wide variation in the socio-economic context that any tiger conservation effort within TAL has to contend with.

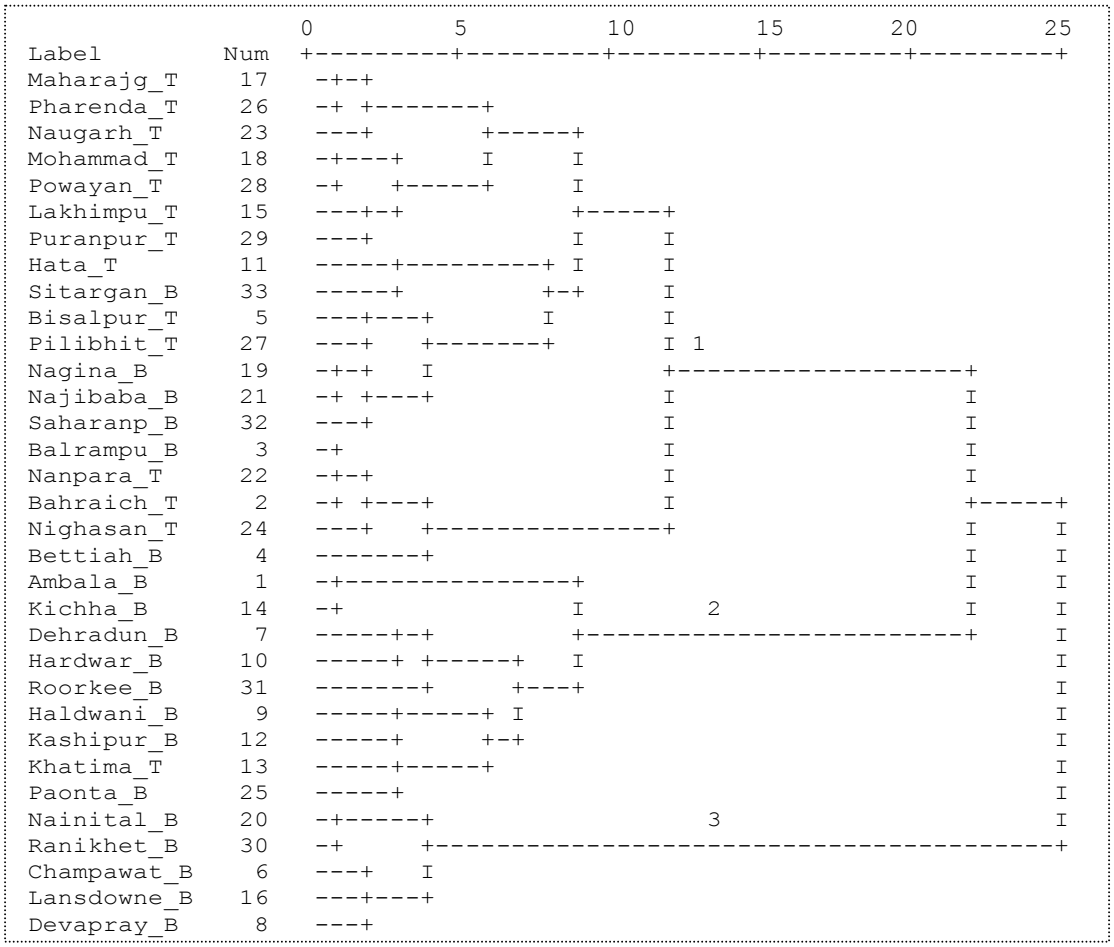


Figure 6.3: Hierarchical Clustering of TAL tehsils based on socio-economic variables
(_B: *bhabar*, _T: *terai*)

In a nutshell, the Indian side of TAL is one of the most densely populated regions of the country and the population is growing at a much higher rate than the rest. Agricultural frontier expansion into the forested tracts occurred at varying extents across TAL, largely determined by the ease of access and arability. Most of the fertile *terai* plains have been taken over by agriculture and only *bhabar*-shivalik belt retains a large proportion of its area under forests. Most of the workforce here is engaged in natural resource dependent occupations and only about 10% are engaged in monetized occupations. Purchased

fuels are used by only 7% of the households and there is heavy reliance on subsistence fuels, even in highly urbanized regions (e.g. Dehradun tehsil: 55% urbanized and 99% dependent on subsistence fuels). Higher monetization levels of the economy are generally associated with lower dependency on natural resources. However, varying levels of economic integration into the larger market economy needs to be balanced with high reliance on forest based resources. While the relative advantage of *bhabar* areas to buffer natural resource dependency over the *terai* areas is evident, the question of leveraging such advantages is largely open.

7. CONSERVATION STATUS OF TIGER

Tiger populations in the Indian portion of TAL are distributed in nine disjunct forest blocks (named as Tiger Habitat Blocks - THBs). Linear breakages in the habitat caused by alignment of canal and road networks, and in some cases, complete isolation of habitat (e.g. Dudhwa NP) due to anthropogenic factors have resulted in the insularization of these populations. An index of relative abundance and the extent of habitat use, documented based on encounter rate (ER) and relative frequency of occurrence (Frq.Occ) respectively provide an insight to the status of tiger in these blocks. Note that the validity of using pug marks to enumerate population size has been questioned even in recent literature (Karanth *et al.*2003). In the present study, pug mark encounter rate is treated only as an index and there was no attempt to estimate tiger populations. Further, we recognize that the encounter rate is possibly inflated due to the difficulties in accurately differentiating pug marks of different individuals. Therefore, frequency of occurrence was largely relied upon as an effective surrogate for ascertaining the status of tiger and associated species in TAL. In addition, prey index presents an overall status prey base in the sampling units. Given the vast area of the landscape and time constraint, the present survey had to be content with one time sampling. The findings, though, could form a baseline for monitoring the status of tiger and prey species, adequate psuedoreplicates (repeated measures) would increase the validity of the results and interpretation.

On an average, tiger used only about 12% of the area in TAL and even within better tiger habitats; the proportion of habitat use did not exceed 50% (Table 7.1 & 7.2, Appendix VIII). These figures roughly correspond to the potential habitat and prey availability in the entire TAL (Table 4.3, Figure 7.1). Pug mark encounter rate for the entire TAL was 0.3 ± 0.4/km (mean ± SD) and did not vary significantly between *terai* and *bhabar* regions (Mann-Whitney U test, $Z = -0.41$, $p = 0.7$). Both the frequency of occurrence and encounter rate had much higher variance around the mean, indicating that tiger distribution is patchy across the Landscape. PA network had relatively higher space use by tiger (13.7 ± 21.8, n = 85) than the Reserved Forests (10.7 ± 15.8, n = 161), substantially contributed by PAs such as Corbett NP (41.2 ± 22.0), Kishanpur WLS (31.9 ± 31.1) and Dudhwa NP (35.2 ± 36.6). These PAs are of greater significance at the landscape level, contributing to the higher occurrence of tiger in Ganges-Gola, Pilibhit-Kheri and Dudhwa THBs (Table 7.1). Among the non-PAs, the Lansdowne, Ramnagar and Terai West FDs that are contiguous with Corbett TR had higher proportion of tiger use (Table 7.2), implying that these areas benefit from Corbett TR. Prey Index ranged between 0.3 ± 0.03 (Bahraich-Shrawasti FDs) and 1.8 ± 0.5 (Dudhwa NP). In terms of disturbance status, as indicated by frequency of occurrence of domestic dogs, THB I and Bahraich-Shrawasti FD scored the highest and the lowest was in THB V (Dudhwa NP) (Table 7.1).

Figure 7.1: Spatial distribution of tiger and wild prey (chital, sambar and wild pig) in TAL

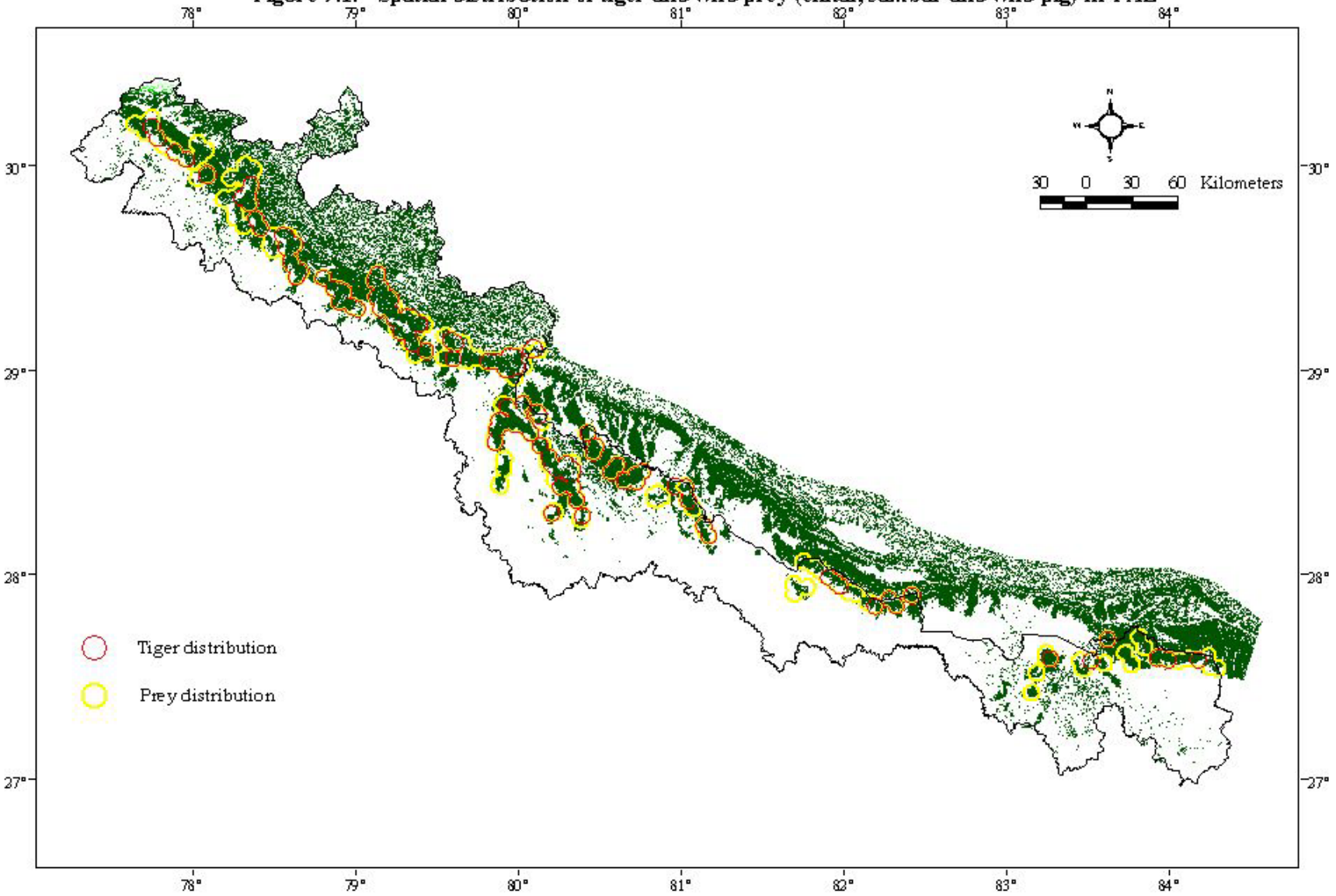


Table 7.1 Mean (± SD) pug mark encounter rates (No./km) and frequency of occurrence (%) of tiger and associated species across sampling units

Sampling Units (n = # of transects)	Tiger		Leopard		Prey Index	Cattle		Dog	Human
	%	No./km	%	No./km		%	No./km	%	No./km
Entire TAL (n = 246)	11.8 ± 18.1	0.3 ± 0.4	11.1 ± 15.1	0.2 ± 0.3	1.3 ± 0.6	73.8 ± 34.4	5.1 ± 8.9	16.8 ± 27.4	2.9 ± 3.7
Terai (n = 79)	13.8 ± 20.9	0.3 ± 0.4	2.3 ± 6.2	0.05 ± 0.1	1.2 ± 0.6	71.3 ± 34.5	4.2 ± 7.4	12.9 ± 23.9	4.0 ± 4.2
Bhabar (n = 167)	10.8 ± 16.6	0.3 ± 0.4	15.3 ± 16.3	0.3 ± 0.3	1.3 ± 0.6	75.0 ± 34.4	5.6 ± 9.6	18.6 ± 28.8	2.3 ± 3.2
Yamuna-Ganges (n = 27)	4.4 ± 8.3	0.1 ± 0.2	26.1 ± 21.7	0.5 ± 0.3	1.6 ± 0.5	82.7 ± 30.4	6.8 ± 8.1	30.1 ± 25.8	2.3 ± 2.0
Ganges-Gola (n = 73)	15.8 ± 20.4	0.4 ± 0.4	16.3 ± 15.9	0.3 ± 0.3	1.4 ± 0.7	76.6 ± 34.1	5.8 ± 10.2	19.1 ± 30.9	1.9 ± 2.6
Gola-Khatima (n = 35)	8.3 ± 12.3	0.3 ± 0.4	12.6 ± 13.8	0.2 ± 0.2	0.9 ± 0.6	68.9 ± 35.6	7.6 ± 11.6	18.4 ± 33.1	3.9 ± 5.1
Surai-Kheri (n = 47)	15.4 ± 18.5	0.3 ± 0.3	2.6 ± 6.8	0.1 ± 0.1	1.3 ± 0.5	65.5 ± 34.7	2.8 ± 6.1	16.0 ± 28.8	3.9 ± 4.0
Dudhwa (n =9)	31.8 ± 35.7	0.4 ± 0.1	1.1 ± 3.3	0.02 ± 0.1	1.8 ± 0.5	46.7 ± 37.7	0	0	0.1 ± 0.4
Katerniaghat (n = 13)	8.4 ± 16.6	0.3 ± 0.6	1.5 ± 4.1	0.1 ± 0.2	1.0 ± 0.5	90.0 ± 23.6	8.0 ± 10.9	12.1 ± 16.9	3.9 ± 2.9
Suhelwa (n = 13)	5.4 ± 7.2	0.2 ± 0.2	8.2 ± 7.8	0.2 ± 0.2	1.2 ± 0.4	91.3 ± 18.5	4.6 ± 7.0	11.4 ± 14.8	0.8 ± 1.0
Sohagibarwa (west) (n = 6)	3.3 ± 8.2	0.1 ± 0.2	1.7 ± 4.1	0.03 ± 0.1	1.0 ± 0.6	84.2 ± 38.8	7.5 ± 5.6	1.7 ± 4.1	8.4 ± 6.3
Valmiki (n = 20)	6.2 ± 13.8	0.1 ± 0.2	5.2 ± 6.3	0.2 ± 0.2	0.9 ± 0.5	67.1 ± 38.6	2.3 ± 5.8	5.8 ± 10.4	2.7 ± 3.6
Bahraich-Shrawasti (n = 3)	0	0	8.3 ± 7.2	0.3 ± 0.3	0.3 ± 0.03	75.0 ± 43.3	1.7 ± 1.5	29.2 ± 26.0	4.5 ± 2.3
Protected Area (85)	13.7 ± 21.8	0.3 ± 0.4	9.7 ± 15.9	0.2 ± 0.3	1.4 ± 0.6	70.8 ± 37.6	4.0 ± 6.8	11.1 ± 18.2	2.5 ± 3.5
Reserved Forest (161)	10.7 ± 15.8	0.3 ± 0.4	11.9 ± 14.7	0.3 ± 0.3	1.2 ± 0.6	75.4 ± 32.6	5.7 ± 10.0	19.8 ± 30.8	3.1 ± 3.7

Table 7.2 Frequency of occurrence of tiger, leopard, wild prey species and disturbance indicator (domestic dog) in management units

Management Units	Distance (km)	Tiger	Leopard	Sambar	Chital	Nilgai	Wild pig	Domestic Dog
Bijnor FD (n = 2)	5	**22.6 ± 8.4**	7.1 ± 10.1	39.3 ± 55.6	**100.0 ± 0.0**	**75.0 ± 35.4**	32.1 ± 45.5	**48.8 ± 48.8**
Bijnor PD (n=3)	12.3	0.0	**26.3 ± 11.6**	6.7 ± 11.5	47.7 ± 37.1	**79.4 ± 18.3**	39.7 ± 31.9	15.0 ± 26.0
Corbett TR (n = 4)	18.8	**41.2 ± 22.0**	2.6 ± 5.3	**93.6 ± 7.8**	**80.0 ± 22.0**	0.0	24.7 ± 19.9	0.0
Champawat FD (n=7)	14.9	10.0 ± 9.4	7.0 ± 9.8	31.0 ± 35.3	9.5 ± 25.2	0.0	8.3 ± 18.6	0.0
Dudhwa NP (n=8)	37.9	**35.2 ± 36.6**	1.3 ± 3.5	22.6 ± 29.8	**84.5 ± 34.6**	19.1 ± 23.2	**82.4 ± 16.9**	0.0
Dehradun FD (n=5)	17	0.0	18.1 ± 20.8	**63.0 ± 41.0**	**79.7 ± 21.0**	0.0	35.4 ± 48.5	14.8 ± 16.7
Haldwani FD (n=18)	73.9	8.3 ± 12.7	15.5 ± 14.1	**54.0 ± 37.6**	34.8 ± 32.1	8.4 ± 15.7	18.6 ± 20.9	21.3 ± 34.0
Haridwar FD (n=7)	29	0.0	27.5 ± 18.2	45.5 ± 34.3	**73.8 ± 20.0**	45.2 ± 38.7	**63.1 ± 37.9**	**37.3 ± 35.2**
Sonanadi WLS (n=2)	5	12.5 ± 17.7	**47.9 ± 20.6**	**79.2 ± 5.9**	**100.0 ± 0.0**	**68.8 ± 44.2**	33.3 ± 47.1	8.3 ± 11.8
Kalesar FD (n=3)	8.9	0.0	13.9 ± 12.7	**94.4 ± 9.6**	**63.9 ± 48.8**	33.3 ± 50.7	41.7 ± 38.2	**30.6 ± 17.3**
Kalsi FD (n=2)	6.1	0.0	7.7 ± 10.9	**64.7 ± 26.3**	24.0 ± 1.4	3.8 ± 5.4	27.9 ± 4.1	**69.2 ± 43.5**
Katerniaghat WLD (n=9)	30.7	12.1 ± 19.1	0.6 ± 1.7	4.4 ± 13.3	**58.9 ± 38.8**	29.6 ± 33.2	**64.9 ± 36.4**	11.5 ± 18.3
Kishanpur WLS (n=6)	25.1	**31.9 ± 31.1**	0.0	0.0	**80.0 ± 23.5**	**51.9 ± 45.3**	**84.7 ± 18.8**	6.9 ± 9.8
Lansdowne FD (n=15)	65.75	16.8 ± 28.3	14.3 ± 12.7	**55.5 ± 41.4**	28.1 ± 36.6	1.5 ± 4.6	23.1 ± 33.1	1.4 ± 4.2
North Kheri FD (n=12)	47.4	13.7 ± 20.1	3.2 ± 5.8	9.6 ± 23.6	**50.5 ± 29.2**	**54.6 ± 31.6**	**61.1 ± 31.4**	17.3 ± 24.0
Narendranagar FD (n=1)	2.7	0.0	9.1 ± 0.0	9.1 ± 0.0	27.3 ± 0.0	0.0	0.0	**36.4 ± 0.0**
Pilibhit FD (n=22)	90.8	12.0 ± 12.9	3.1 ± 9.0	4.7 ± 16.0	**77.6 ± 30.5**	**68.6 ± 34.8**	**84.4 ± 22.5**	19.3 ± 36.0
Rajaji NP (n=16)	67.3	12.9 ± 17.6	**33.4 ± 21.8**	**90.6 ± 10.5**	**88.3 ± 19.8**	4.5 ± 11.5	42.0 ± 29.8	27.0 ± 27.6
Ramnagar FD (n=16)	63.4	**20.7 ± 18.0**	9.1 ± 10.4	**80.5 ± 22.1**	**58.8 ± 36.5**	19.4 ± 28.5	36.0 ± 30.7	14.6 ± 31.2
South Kheri FD (n=7)	30.9	7.1 ± 9.1	1.2 ± 3.1	6.1 ± 16.2	44.8 ± 36.8	**99.2 ± 2.1**	**70.4 ± 42.0**	8.7 ± 11.9
Shahjahanpur FD (n=2)	9.2	0.0	0.0	0.0	41.9 ± 23.9	**100.0 ± 0.0**	47.4 ± 24.5	0.0
Shivalik FD (n=7)	30.5	7.0 ± 7.4	**36.5 ± 18.9**	**78.8 ± 15.6**	**58.4 ± 15.9**	2.8 ± 5.4	31.8 ± 31.6	26.9 ± 18.4
Shrawasti FD (n=3)	6	0.0	8.3 ± 7.2	0.0	0.0	29.2 ± 31.5	33.3 ± 7.2	29.2 ± 26.0
Sohagibarwa FD (n=10)	47.7	3.0 ± 6.7	3.0 ± 6.7	6.2 ± 9.3	42.3 ± 28.5	**60.7 ± 27.5**	40.2 ± 45.3	9.0 ± 13.5
Suhelwa FD (n=13)	64.7	5.4 ± 7.2	8.2 ± 7.8	34.3 ± 26.4	48.3 ± 29.5	30.0 ± 29.4	**61.3 ± 29.4**	11.4 ± 14.8
Terai Central FD (n=10)	43.4	9.7 ± 16.7	8.2 ± 6.7	22.4 ± 38.0	29.0 ± 31.0	**80.0 ± 25.7**	33.5 ± 39.2	**33.3 ± 37.1**
Terai East FD (n=13)	58.2	10.1 ± 15.2	10.4 ± 13.6	25.8 ± 35.3	48.7 ± 37.4	31.6 ± 37.7	42.5 ± 39.1	25.5 ± 37.8
Terai West FD (n=7)	27.7	14.1 ± 9.0	16.7 ± 12.8	44.7 ± 33.0	**75.6 ± 32.8**	**63.4 ± 35.5**	**65.6 ± 21.5**	**34.4 ± 44.7**
Valmiki TR (n=16)	60.9	7.1 ± 15.2	5.2 ± 5.5	38.9 ± 33.7	32.6 ± 35.9	10.0 ± 11.3	29.9 ± 34.2	2.3 ± 4.4

The status of tiger, the problems and the possible mitigation measures specific to each subpopulation in each of the THBs are discussed in detail below. Further, over 10 corridors or connectivity potentially enabling movement of tigers between these subpopulations have been identified in TAL (Appendix IX, Figure 7.2a, Figure 7.2b), which have significant management implications. West to east (Figure 4.5), the subpopulations in the THBs are:

7.1 THB I (Simbalbara WLS to west bank of Ganges)

This subpopulation is restricted to Simbalbara WLS and Kalesar WLS, Shivalik FD, Kalsi FD, part of Narendranagar FD, Dehradun FD and part of Rajaji NP (west of Ganges). There is no record of tigers ranging beyond Simbalbara and Kalesar WLSs. Similarly, in the eastern end of THB, tigers do not move across the Ganga river (Johnsingh and Negi 2003, Appendix IX). Three transects covering 8.9km were surveyed in Kalesar WLS with no sign of tiger use, though leopard tracks (3 tracks) were found. However, in the afternoon of 25th January 2003, fresh pug marks of a large male tiger were observed in Langadiwala *nallah* of Ambawali *rau* (south-eastern part of Kalesar WLS). On the following morning, fresh tracks of a large tiger/tigress were recorded in Kaludeo *rau* in Simbalbara WLS. These two locations are about 15km apart, separated by dense jungle and Shivalik hills, and therefore, both these observations were possibly of different tigers. In Shivalik FD, seven transects covering 30.5km were surveyed, and pug marks of a male, and a female with a large cub were observed to use five *rau*s (overall pug mark ER: 0.2/km, Frq.Occ: 7.0 ± 7.4). The tigers here are likely to be moving from the adjacent Rajaji NP. The Division is highly disturbed by people (human encounter rate, 2.4/km) and livestock (7.2/km). However, the prey status was relatively better, with prey index of 1.5, largely contributed by high frequency of sambar and chital (Table 7.2). Three years earlier, when a similar effort was made in this Division, with the assistance of Forest Staff, no evidence of tiger was recorded (Johnsingh and Negi 2003). It is likely that either the pug marks were missed or tigers were not using Shivalik FD then. Two transects were surveyed in Kalsi FD (one in Mundiawali *kala*, 3km and the other in Binaul *rau*, 3km which is between Kalsi and Shivalik FDs) and there was no sign of tiger use. Woodcutters and *gujjars* heavily disturb Mundiawali *kala*. Poaching is also reported to be a regular phenomenon. Although Binaul *rau* was under heavy disturbance from *gujjar* camps, sambar continue to use this area considerably (64.7 ± 9.6) and the area benefits from the location of a forest check post here. No evidence of tiger was recorded in both Dehradun FD (5 transects: 17km) and in Narendranagar FD (one transect: 2.7km). However, the prey index in Dehradun FD was relatively higher at 1.6 (also see Table 7.2), but is under heavy human (ER, 1.5/km) and livestock disturbances (ER: 10.5/km). Leopards were observed to use these two FDs (ER: 0.3/km and 0.4/km respectively). In the western portion of Rajaji NP, areas around Dholkhand support relatively higher abundance of tiger and wild ungulates. Tiger pug mark ER

Figure 7.2a: Location of corridors in TAL

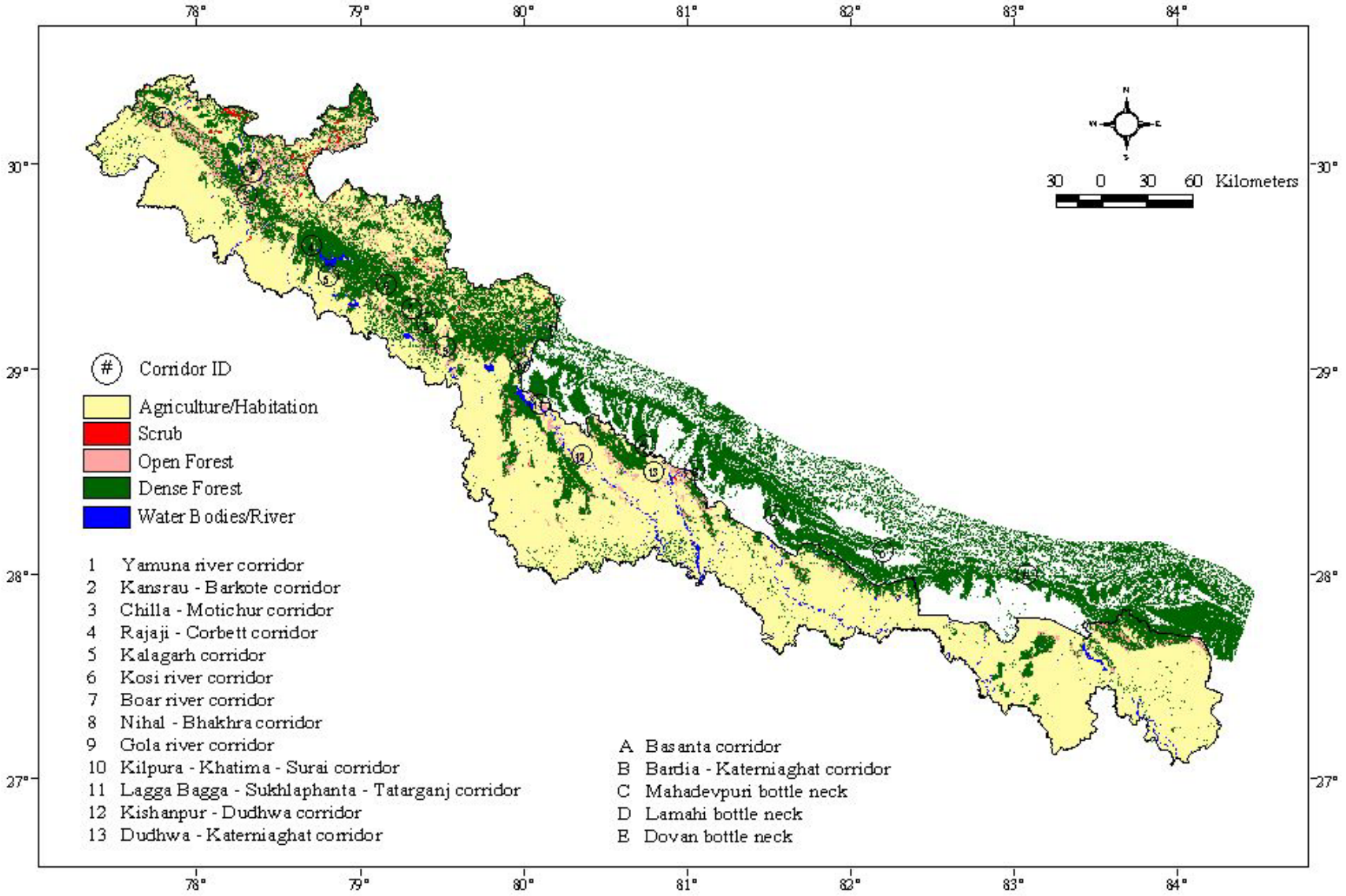
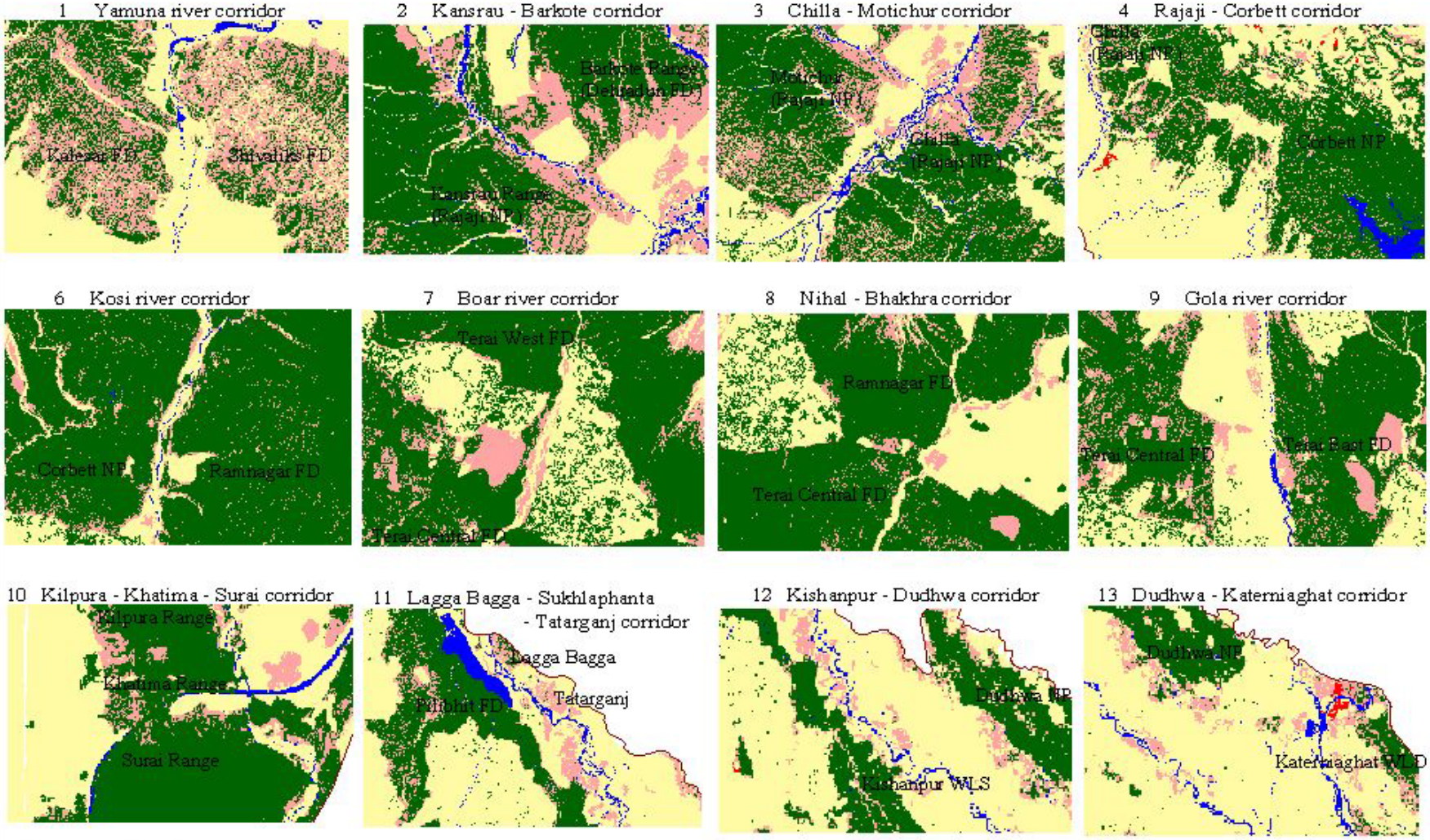


Figure 7.2b: Corridors identified in TAL



for the best areas in three *raus* in Dholkhand (15km) was 0.6/km. The overall frequency of occurrence of tiger signs in these *raus* was 23% and, for sambar and chital, these were 93% and 95% respectively.

In general, the status of tiger in this THB is poor, in spite of better wild prey availability (Table 7.1 and also see, Table 5.3). It appears that disturbance indicators (such as cattle, human and domestic dog) play a decisive role more on tiger and also, potential habitat available for tiger in this THB is relatively less (15.8%). The canal along the Yamuna river has created a linear break between Shivalik FD and the forests, west of Yamuna (Kalesar and Simbalbara WLSs) and the movement of tigers which is largely observed during winter months, is only through aqueducts below the canal (see Appendix IX). Even these areas are under disturbance from boulder mining and other human activities. To enable continued movement of tiger across Yamuna and to sustain this subpopulation to remain as one unit, initiatives such as establishment of 'Rajaji-Shivalik Tiger Reserve' are required (Johnsingh *et al.* 2003, Johnsingh *et al.* in press). The disturbances along Yamuna river such as boulder and sand mining in the western part of TAL should be controlled (Appendix X). It is reiterated that the Chilla-Motichur corridor between Chilla (east bank of Ganges) and Motichur (west bank of Ganges) should be established to enable tigers to move across the Ganga river (Appendix IX).

7.2 THB II (East bank of Ganges to west bank of Gola river)

This is the most intact and extensive forest block in TAL, with 4053.5km^2 potential habitat for tiger. This THB includes the Chilla portion of Rajaji NP, Lansdowne FD, Haridwar FD, Bijnor Plantation Division, Bijnor FD, Corbett TR (inclusive of Sonanadi WLS and Corbett NP), Ramnagar FD, Terai West FD, southern border areas of Nainital FD and Terai Central FD. There was no evidence of tiger along the west (1 transect: 2km) and east bank (1 transect: 5.9km) of the river Ganga. Besides, two other transects covering 12km surveyed along the east bank for bird count, also resulted in no evidence of tiger. Absence of tiger pug marks along the east bank, where frequently encountered until a few years ago, is perhaps due to increasing anthropogenic disturbances from the west bank of Ganges. The subsistence demands from Ganga-Bhogpur *Talla* and *Malla*, and Kunaun *goth* settlements (together about 250 families) are increasingly putting pressure on the forests, which need to be addressed to save the tiger habitat on the east bank of Ganges.

In the interiors of Chilla Range, a 5km transect along the Amgaddi *sot* (narrow valley with perennial water) where the anthropogenic pressures were low, had much high evidence of tiger (frequency of occurrence: 65%), elephants (100%) and wild ungulates (e.g. sambar: 95%, & chital: 95%). This exemplifies what these forests are capable of supporting if anthropogenic disturbances are either low or absent. There were tracks of two tigresses, one tiger, 2-3 leopards, a large Himalayan black bear (possibly a male; right hind foot track measured 22cm), and elephants. Besides, there were wide

varieties of avifauna and signs of other wildlife activities (track of a large python, drag marks of a chital killed by a leopard and tiger at a kill were seen), indicating significance of this tract. This wildlife abundance was possible only because there were no *gujjar deras*, and firewood, fodder and *bhabar* grass collectors (all of whom are known to steal kills) not venturing into the valley. In Chilla portion of Rajaji NP, 7 transects (31.6km) were surveyed and tiger pug mark ER was 0.3/km and leopard pug mark ER was 0.6/km. The overall FO of tiger signs in these transects was 20%.

Tiger pug mark ER for the hilly portion of Rajaji-Corbett corridor (8 transects: 35.2km), which falls in Lansdowne FD, was 0.1/km. Leopard pug mark encounter rate was 0.2/km. Prey index here was 0.4, human and cattle ERs were 3.6/km and 4.5/km respectively. Johnsingh and Negi (2003) observed that use of the heavily disturbed Rajaji-Corbett corridor by tiger is occasional. Outside the corridor area in Lansdowne FD, seven more transects (30.6 km) were surveyed and the tiger pug mark encounter rate was 0.4/km, leopard pug mark encounter rate 0.2/km, human encounter rate 2.1/km, and cattle encounter rate 3.6/km. Prey index was 1.6. There was no evidence of tiger in Haridwar FD (7 transects: 26 km) and the Bijnor Plantation Division (3 transects: 12.5 km). Both are located south of the hilly portion of Rajaji-Corbett corridor. Both the Divisions, however, had high leopard pug mark ER: 0.6/km for Haridwar FD and 0.7/km for Bijnor Plantation Division. Prey index in Haridwar FD was 1.6, human ER 4.8/km and cattle ER 20.7/km, the highest in the entire Landscape. It is obvious, even too much of cattle grazing keep tigers away. In Kalagarh FD (Sonanadi WLS, part of Corbett TR), two transects (5km) were surveyed and the tiger pug mark ER was 0.6/km and leopard pug mark ER was 0.8/km. Tiger pug mark ER in Bijnor FD (2 transects: 5 km), just south of Corbett TR, was 0.8/km and leopard pug mark ER was 0.2/km. The prey index was 1.6 and human ER was 1.2/km. Four transects (18.8 km) in the core area of Corbett TR, all in the hilly area, were surveyed and tiger pug mark ER was 1.1/km (Frq.Occ: 41.2 ± 22.0), the highest recorded in the entire Landscape (Table 7.2). Human and cattle were not encountered and prey index was 1.8. However, use of this hilly area by leopard was negligible (ER: 0.1/km, Frq.Occ: 2.6 ± 5.3).

Kosi river flows between Corbett TR and Ramnagar FD, and certain stretches of forests along the river provide connectivity between these two areas. Tiger pug mark ER along the river (3 transects: 13km, all in Ramnagar FD) was 0.8/km and Frq.Occ was 25%. Human and cattle ER were 2.4 and 3.6 respectively. Prey index was 1.9 (Frq.Occ: sambar = 80%, chital = 89%). Perennial water is the major attractant here for the prey. Interestingly, no leopard signs were seen. Thirteen more transects (50.4km) were surveyed in Ramnagar FD and the tiger pug mark ER was 0.4/km. Human and cattle ERs were 1.0/km and 3.1/km respectively. Prey index was 1.5, substantially contributed by sambar (Frq.Occ: 80.5%). Terai West FD, adjoining Corbett TR, had relatively high ER and frequency of occurrence of tiger and wild prey species. From 7 transects (27.7 km) surveyed, tiger pug mark ER was 0.4/km

(Frq.Occ: 14.1 ± 9.0) and leopard pug mark ER 0.3/km (Frq.Occ: 16.7 ± 12.8). However, there was high amount of anthropogenic disturbance in this FD (Frq.Occ: domestic dog = 34.4 ± 44.7). Prey index was 1.7 (Frq.Occ: sambar = 44.7 ± 33.0, chital = 75.6 ± 32.8, wild pig = 65.6 ± 21.5).

Ten transects (43.4km) were surveyed in Terai Central FD. Both tiger and leopard were observed to use the area in almost similar proportion (Frq.Occ: tiger = 9.7 ± 16.7, leopard = 8.2 ± 6.7) which is relatively low as compared to other FD in *bhabar* region. This FD is heavily disturbed from all sides and there is extensive human and cattle use (human ER: 1.9/km, cattle ER: 1.7/km), which is further substantiated by high presence of domestic dog in this FD (Frq.Occ: 33.3 ± 37.1). Prey availability was poor, except for nilgai (Frq.Occ: 80.0 ± 25.7) that presumably compensate for other wild prey species (Table 7.2). There are two small corridors that enable tiger movement between Ramnagar FD and Terai Central FD, which otherwise would be an isolated forest block, as there is no connectivity with Terai East FD across Gola river. These corridors are Nihal-Bhakra and Gadappu *nallah.* Tiger and elephant populations continue to use these corridors for ranging into Terai Central FD. Four transects (13.4km) were surveyed along Nihal-Bhakhra, and the tiger pug mark ER was 0.3/km. In the heavily disturbed Gadappu *nallah* (2 transects: 10km), only one pug mark of tiger was recorded. Near Lalkuan (Terai Central FD) along Gola river at eastern end of the FD, two transects (7.4km) were surveyed, but use of tiger here was very low and there was only one pug mark recorded. However, this is the area where there is a possibility of restoring connectivity with Terai East FD across the Gola river, which at present is ravaged by boulder and sand mining.

Overall, 73 transects covering 302km were surveyed in this THB, and the frequency of occurrence of tiger was 15.8% (±20.4 SD), and encounter rate was 0.4/km (±0.4 SD). High variation in these two parameters is largely contributed by high density areas such as Corbett TR, in contrast to some of the FDs having very poor tiger distribution. Tiger movement between forest patches of this THB are facilitated by corridors such as Rajaji-Corbett, Kosi river, Boar river, Nihal-Bhakra and Kadappu, and anthropogenic disturbances on these corridors need to be curtailed so as to enable this population to remain as a unit. Large-scale boulder mining and human habitation along Gola river obstructs tiger movement between Terai Central FD and the forests across Gola river (Terai East FD).

7.3 THB III (East bank of Gola river to Tanakpur-Khatima Highway)

This THB includes the major portion of Terai East FD, entire Haldwani and Champawat FDs. The latter has a tenuous connectivity with the forests of Nepal along the Sharda river (Figure 4.5). Tanakpur and Khatima townships, infrastructure development related to Sharda irrigation project and encroachments of the past that are gradually spreading, largely confine this subpopulation to Terai East and Haldwani FDs (Appendix IX, Appendix XI). Tiger and wild prey species were poorly represented in

this THB. Frequency of occurrence and encounter rate of tiger in this THB were 8.3% (±12.3 SD) and 0.3/km (±0.4) respectively. Frequency of occurrence of sambar and chital were 43.6% and 38.5% respectively. Poaching seems to be a serious problem here (Appendix XII). However, in Champawat FD, while surveying along the Ladhya river (a tributary of Sharda river) and on interviewing the villagers of Chuka, it was learnt that poaching is minimal from the Nepal side, as the Mao insurgents have taken guns away from most of the Nepalese villagers. The rest have deposited the guns with the police to avoid them being taken away by the insurgents. Patrolling by Indian para-military forces along the border has also helped in the reduction of poaching. Along the Ladhya river bed, two black bear and an impressive number of sambar tracks were recorded. In addition, an elephant population numbering ca. 30-40 are restricted to this THB. This population is completely isolated from other elephant populations and rarely, one or two bulls manage to cross over to Nepal through Khatima forests, which was a regular phenomenon until a few years ago.

Terai East FD was poorly represented in tiger and wild prey species distribution (Table 7.2). From a total of 13 transects covering 58.2km, tiger and leopard pug mark ERs was 0.2/km. Prey index was 1.1. The area was under tremendous anthropogenic disturbance from cattle grazing and fire wood collection, particularly Doli Range (along Gola river), which has potential to enable tiger movement between forests of western and eastern banks of Gola river. During the survey, the ER of people and cattle were 3.8/km and 6.5/km respectively. Frequency of occurrence of dog here was 25.5 ± 37.8. No tiger pug mark was seen in Khatima and Ranshali Ranges, largely due to extensive human activities in these areas. There was, however, evidence of leopard in Khatima Range. Three tracks of leopard were recorded along Jhagbora river (1 transect: 5km) in this Range. Similarly Haldwani FD was heavily disturbed. At present, this FD does not support extensive tiger population (Frq.Occ: 8.3 ± 12.7), largely owing to anthropogenic disturbances. This FD is heavily exploited for firewood requirement of Haldwani township and people around the area. Though the habitat has potential to support reasonable populations of prey species, only sambar fares relatively better (Table 7.2) and there was strong indication that poaching takes a major toll of wild prey species in this Division. Given the better habitat condition including wide spread perennial water sources; this FD has potential to harbour more tigers, if the problems cited are controlled. Despite being relatively less disturbed, wild prey availability is poor in Champawat FD (Table 7.2) and this perhaps has resulted in low occurrence of tiger here (Frq.Occ: 10.0 ± 9.4). The habitat condition is less supportive of wild prey species, particularly because, the landscape here is dominated by moist sal (*Shorea robusta*) and considerable proportion of weedy species such as *Lantana camara* occupy the under storey (also see, Figure 4.3, Appendix VIII). Only the forests that are closer to Haldwani FD support tiger and there is no possibility of tiger movement from Pilibhit FD through Surai and Khatima Range of Terai East FD, since the human settlements along Sharda canal and Tanakpur-Khatima Highway have broken the connectivity between these forests. Presently, Surai Range,

the eastern part of Terai East FD, is cut off from rest of the Ranges of this Division, but is contiguous with Pilibhit FD.

7.4 THB IV (Surai Range of Terai East FD to South Kheri FD)

Surai Range of Terai East FD is contiguous with the Mahof and Mala Ranges of Pilibhit FD. On the eastern part of the Pilibhit FD, a narrow strip of forest (4 – 7 km wide and 25km long) from Barahi and Haripura Ranges of Pilibhit FD provides connectivity with Shahajahanpur FD and Kishanpur WLS, which in turn is contiguous with South Kheri FDs on the south and part of North Kheri FD on the north. Unlike the situation along the Ganga and Sharda rivers, where anthropogenic pressures from large towns caused disruption to habitat connectivity, this narrow belt of forest is still intact and serves as a corridor between Pilibhit FD and Kishanpur WLS. During the survey, tiger and wild prey were observed to use most parts of this narrow stretch, indicating that this corridor is functional. In addition, this stretch has the potential to facilitate movement of tiger and other large mammals from Sukhlaphanta Reserve in Nepal through Lagga Bagga (Barahi Range, Pilibhit FD) and Tatarganj Block (left bank of Sharda, Sampurnanagar Range of North Kheri FD) to Kishanpur WLS and surrounding forests. However, except for Chuka Block (Haripura Range of Pilibhit FD) on the right bank of Sharda, which has *terai* grasslands, this narrow stretch dominated by *Shorea robusta* is unlikely to provide suitable habitat conditions for tiger to establish a population in this forest stretch.

Pilibhit FD, despite being under Reserved Forest category, showed exemplary wildlife values and field observation indicated that this FD supports reasonable populations of tiger, sloth bear and wild prey species including hog deer. Lagga Bagga forest block, in particular, supports populations of hog deer, rhinos (coming from Sukhlaphanta Reserve), swamp deer and the rare, hispid hare. Mahof and Mala Ranges (an area of ca. 300 km^2), with tall grass habitat along Mala river and on either side of Sharda canal, together have potential to support a breeding population of 10-15 tigers and 30-50 rhinos. In addition, a population of ca. 50 swamp deer is reported to occur in these two ranges. A total of 22 transects covering 90.8km surveyed in Pilibhit FD and all Ranges except Deoria, which is an isolated block on the south, had tiger. Deoria was devoid of even leopard signs. Excluding the data from Deoria Range, the tiger pug mark ER was 0.3/km and prey index was 1.5. Although this FD is surrounded by settlements, the human ER (4.2/km) and cattle ER (1.2/km) are comparable with other PAs (Table 7.1). As expected, leopard use of this FD was relatively low (ER: 0.03/km, Frq.Occ: 3.1 ± 9.0). The overall frequency of occurrence of tiger was 12.0 ± 12.9, and wild prey availability was substantially higher (Frq.Occ: chital = 77.6 ± 30.5, nilgai = 68.6 ± 34.8 and wild pig = 84.4 ± 22.5). The frequency of occurrence indicates that the disturbance indicator (domestic dog) was highly variable (19.3 ± 36.0), with Mahof and Mala Ranges being less disturbed as compared to Deoria Range and a portion of Barahi

Range. On the border of Lagga Bagga block (which abuts Sukhlaphanta Reserve on its southwestern side), two transects (9km) were surveyed on the left bank of Sharda river. In the upstream transect (4km), two tiger pug marks were recorded close to Nepal's Sukhlaphanta Reserve, but there were no tiger pug marks along the downstream transect. Interestingly, along the upstream transect in the Indian part (first 2km), there was high human (60) and cattle (20) use. In contrast, the Nepal side had no people, but 20 cattle were seen. There were 88 people and 47 cattle recorded in the downstream transect. Tracks of a tigress and its grown up cub were recorded inside Lagga Bagga during an opportunistic search of 5km, indicating its potential for tiger survival. Controlling human disturbance on Lagga Bagga is a huge challenge; as large number of people on both sides of Sharda river rely on Lagga Bagga for firewood, thatch grass and fodder. Intensive protection and participatory management with these people are required to restore the area.

Kishanpur WLS (203km^2), being one of the few remnant terai habitats in India, has significant wildlife values, supporting considerable number of tiger, swamp deer and hog deer. This WLS is believed to harbour a source population of tiger that range into North Kheri and South Kheri FDs, and perhaps move as far as Pilibhit FD. The frequency of occurrence recorded for tiger in this WLS was the third highest (31.9 ± 31.1, n = 6 transects, 25km) in the entire Landscape (Table 7.2). Tiger pug mark was 0.5/km and there was no leopard sign in this WLS. Human and cattle ERs were 1.9/km and 1.1/km respectively. Prey index (1.5), largely contributed by chital (80.0 ± 23.5) and wild pig (84.7 ± 18.8) was among the highest in TAL (Table 7.2). Sampling was done to ascertain the movement of tigers from Kishanpur WLS crossing Sharda river (through Palia or Sampurnanagar Ranges) to Dudhwa NP in the east. A total of 10km were surveyed (5km upstream and 5km downstream) and tracks of a tigress with two cubs were recorded on the left bank of Sharda. The survey team also tracked pug marks of a tiger from Kishanpur WLS to left bank of Sharda river. Extensive disturbance (lopping and grazing) in Sampurnanagar and Palia Ranges (North Kheri FD), which are left with a narrow stretch of *khair* (*Acacia catechu*) dominated forests, indicates that the tigers may not permanently reside in these ranges. It is likely that one or two tigers from Kishanpur WLS may range into Satiyana Range of Dudhwa NP, through Sampurnanagar Range and the bordering sugarcane fields. Survey along the left bank of Sharda river (seven transects, 33.8km) towards Lagga Bagga revealed that tigers may not be directly ranging between Lagga Bagga and Kishanpur WLS, as the forests along the left bank of Sharada river are fragmented, interspersed with human habitation. However, there was an indication that tigers move between Chuka block (Haripura Range) and Sukhlaphanta Reserve, through Tatarganj. Further, a few elephants are reported to move between Tatarganj and Sukhlaphanta Reserve. It is possible to strengthen the habitat connectivity of Sukhlaphanta Reserve–Tatarganj–Chuka, as this stretch has very few human

settlements. The tendency of Sharda river to change course makes this area unviable for permanent human settlement.

Shahajahanpur FD, on the southwestern border of Kishanpur WLS across Kheri canal, provides a buffer to the Sanctuary. The forests here are narrow (2-3km) along the Kheri canal and are heavily disturbed by human and cattle populations from southern boundary. There was no tiger pug mark within 2 transects (9.2km) surveyed in Khuttar Range of this FD. Chital (Frq.Occ: 41.9 ± 23.9) and nilgai (Frq.Occ: 100 ± 0.0) were the major prey species available here. Efforts need to be undertaken to keep this forest disturbance free so as to enable this stretch to remain as a buffer.

South Kheri FD (415 km^2) has extensive forest cover, but mostly plantations of teak (*Tectona grandis*) and *sal*, with insufficient cover for wild prey species. Tigers (Frq.Occ: 7.1 ± 9.1) frequent these areas, but the habitat appears to be shrinking and becoming increasingly unsuitable due to growing anthropogenic pressures from south, east and west. Prey index was 1.1. Only nilgai (FO: 99.2 ± 2.1) and wild pig (Frq.Occ: 70.4 ± 42.0) were widely found here, while chital (Frq.Occ: 44.8 ± 36.8) was largely restricted to the northern part (Mailani and Bhira Ranges), adjoining Kishanpur WLS. Overall tiger pug mark ER in this FD was 0.2/km (n = 7 transects, 30.9km). Human and cattle ER were 3.3/km and 3.2/km respectively. Gola and Mohamadi Ranges were highly exposed to anthropogenic pressures, largely due to proximity of the villages and narrow shape of the forest. Mohamadi Range, in particular, is fragmented and wildlife signs in these forests were poor. There was a report that during 2001-2002, two tigers came into conflict with people in Mohamadi Range, and one was shot dead after it had injured a few and killed two persons (*pers*. *com*. Field Director, Dudhwa TR).

7.5 THB V (Dudhwa National Park)

Dudhwa NP (680km^2) is an isolated tiger habitat and though this THB has tenuous connectivity with Katerniaghat WLD to the east and Basantha forests in Nepal to the north, tiger movement between these forests is reported to be only occasional. Within the NP, distribution of tiger was uneven (Frq.Occ: 35.2 ± 36.6), largely concentrated in the southern and southeastern part (Satiyana, Dudhwa, South Sonaripur and Belrayan Ranges). In these four ranges, 24.6km were surveyed and the tiger pug mark ER was 0.4/km, among the highest in TAL (Table 7.1). These Ranges experience low anthropogenic disturbance (Human and cattle ER: 0/km). Prey index was 1.7, again among the highest in the entire TAL. In the other ranges (Gauriphanta, Bankatti and North Sonaripur), in spite of high prey index of 1.4, tiger pug mark ER was lower at 0.2/km (13.3km), human and cattle ER being 0.3/km and 0/km respectively. This apparent variation in tiger occurrence can be attributed to habitat quality and lack of disturbance in the southern Ranges. Satiyana, Dudhwa, South Sonaripur and Belrayan Ranges have more of *terai* grasslands when compared to the rest that are largely characterized by *sal* as dominant species.

Absence of palatable shrub cover in sal forests and abundance of *Tiliacora acuminata* (Menispermaceae), an unpalatable climber, are also problems in this area. Presently, the prey availability in Dudhwa NP is the highest recorded for the TAL with the prey index of 1.8 (Table 7.1). Large proportion of area was observed to be used by chital (84.5 ± 34.6) and wild pig (82.4 ± 16.9). Nevertheless, both tiger and prey populations are vulnerable to habitat isolation and factors related to habitat quality.

The subpopulation in this THB has been isolated in the recent past by habitation and agricultural expansion, and forest clearing along the international border. There is tenuous connectivity between Dudhwa NP and Katerniaghat WD to the north, in the form of an arc from Belrayan Range (Dudhwa NP) along Basanta forests, *Churia* hills, Bardia NP and the northeastern part of Katerniaghat Range. The gap between Belrayan Range and Basanta forests is less than a kilometer, and here, the chances of establishing connectivity are greater. Efforts to restore this connectivity by colleagues in Nepal are underway. There is also a possibility of establishing corridors between these forests on the Indian side through the forests of North Kheri FD (see Appendix IX).

7.6 THB VI (Katerniaghat Wildlife Division)

Katerniaghat WLD (400 km^2) and eastern parts of North Nighasan Ranges (Latwa-Batwa and Majra Blocks) constituting this THB is another disjunct tiger habitat on the Indian side. The northern portion of this WLD (Katerniaghat Range) between Geruwa and Kaudiala rivers is the Indo-Nepal border, which runs east west. The area, further north on the Nepal side between the Kaudiala and Geruwa, is devoid of forests except for few small-degraded patches, and much of the area is essentially under agriculture. Bardia NP (Nepal) is located east of Geruwa and its southern boundary along the Geruwa river is about 12km from the northern boundary of Katerniaghat WLD. Geruwa is a large river and its riverine forests may be able to provide a corridor for the movement of tigers, rhinos and elephants between these two Protected Areas (Appendix IX). Although this THB is unique in terms of species diversity, supporting substantial populations of Gangetic dolphin, two species of crocodiles (Gharial and Mugger), hog deer, swamp deer and immigrant populations of rhino and elephants from Nepal, tiger distribution was poor (Frq.Occ: 8.4 ± 16.6, n = 13 transects) and it was one of the highly disturbed THBs in the entire TAL (Table 7.1).

During the field survey, Katerniaghat WLD provided an initial impression of being a better habitat for tiger than Dudhwa NP, but exploration in all the forest ranges revealed that suitable tiger habitats exist only in the northern part of the Division, in Katerniaghat and Nishangara Ranges. In comparing the overall frequency of occurrence of tiger in the entire WLD (12.1 ± 19.1, n = 9 transects; 30.7km), these two Ranges scored above the average (Frq.Occ: 19.2 ± 18.9, n = 5 transects; 15.7km),

while rest of the Ranges together had much low Frq.Occ. (3.3 ± 3.9, n = 4 transects; 15km). Similarly, tiger pug mark ER was relatively high in the two northern Ranges (0.3/km) as compared to the rest (0.1/km). Human and cattle ERs were 1.5/km and 2.5/km respectively. Interestingly, prey base was marginally higher in southern Ranges (prey index = 1.2, Frq.Occ: chital = 76.3 ± 16.1, nilgai = 46.5 ± 34.0, wild pig = 70.0 ± 23.2) indicating that prey availability was not a factor contributing to low use of these Ranges by tiger. The prey index in the northern Ranges was 1.1, and the Frq.Occ. of chital, nilgai and wild pig were 45.2 ± 40.4, 44.1 ± 16.2 and 76.0 ± 37.5 respectively. The southern Ranges (Kakraha, Dharmapur, Motipur & Mutihar) form a narrow conical patch dominated by plantations of teak and *sal*, and are bordered by villages from three sides. Further, motor and rail tracks cut through the forests in the middle, dividing the forests into two spatial units. All these have increased human activity in the forests, creating unfavorable conditions for tiger to move and establish a population in these Ranges. Human and cattle ERs were 5.3/km and 4.4/km respectively.

An elephant group (5-8 individuals) and two rhinos that have emigrated from Bardia NP (Nepal) to Katerniaghat WLD appeared to have taken refuge in Katerniaghat Range (Sinha 2003). It appears that in the years to come only Katerniaghat and Nishangara Ranges may be able to support tigers. Reducing pressures and making the habitat suitable for tiger in other parts of Division is a demanding challenge. It should be noted that the entire Division is probably also subjected to heavy poaching. In the Katerniaghat WLD, only one village (Bharthapur) is located in the very important trans-Geruwa area of the Sanctuary, and if this village could be translocated, the entire biodiversity-rich trans-Geruwa area would be free from permanent human habitation. It should be possible to persuade the people to move out, as this village is situated between Geruwa and Kaudiala rivers that destroy crops and other assets, while changing course occasionally.

7.7 THB VII (Suhelwa Wildlife Sanctuary)

Suhelwa WLS (482 km^2), falling under *bhabar* zone, has seven Forest Ranges and the forest is somewhat rectangular, extending along an east-west axis, about 80km long and 5-6km wide. It is not connected with any other forests on the Indian side. This THB is characterized by mixed vegetation of *Shorea robusta-Anogeissus latifolia-Syzygium cuminii*. The entire stretch was surveyed along 13 transects (64.7 km) and overall frequency of occurrence of tiger was 5.4 ± 7.2, among the lowest in the TAL (Table 7.1). This THB is highly disturbed by human population on the southern boundary and also by scattered settlements on the Nepal side along Indo-Nepal border. Cattle usage was extensive and consistently high across the entire THB (Frq.Occ: 91.3 ± 18.5). This frequency of occurrence recorded of cattle here was the highest in the entire TAL. The prey base was relatively poor (prey index = 1.2) and was largely contributed by wild pig (Frq.Occ: 61.3 ± 29.4) followed by chital (Frq.Occ: 48.3 ± 29.5). As

a result of high anthropogenic pressures and low prey base, evidence of tiger use was largely restricted to Suhelwa and Bankatwa Ranges, towards the western part of this Sanctuary. One or two tigers stray as far as Bhambar Range in the eastern-most part of the Sanctuary, where habitat conditions do not appear to be conducive for tiger survival. Tiger and leopard pug mark ER in Suhelwa was 0.2/km. Human and cattle ER were 0.8 ± 1.0/km and 4.6 ± 7.0/km respectively. Further details on the wild prey and disturbance status are given in Table 7.1 & 7.2.

The positive aspect of this THB is that its northern part is contiguous with Nepal forests, which along Lamahi and Dovan bottlenecks reportedly continue as far as Chitwan NP in the east. Similarly, there is also connectivity between the Sanctuary and Bardia NP along Mahadevpuri bottleneck (WWF Nepal Program 2003). This connectivity, in October 2003, has evidently enabled movement of a few elephants from Nepal to the western part of this Sanctuary possibly from Bardia NP. Anthropogenic pressures on this Sanctuary include poaching, cattle grazing and firewood collection, by people on both sides of the border. If the disturbances are brought under control, this THB, in conjunction with the forests on the Nepal side, can significantly contribute to tiger conservation.

7.8 THB VIII (Western portion of Sohagibarwa WLS)

Sohagibarwa WLS (405 km^2) is highly fragmented and is distributed in four major forest patches. West to east, these patches are represented by (i) Pakri Range, (ii) South Chauk, North Chauk, Lachimipur and Maduvalia Ranges, (iii) Nichlaul Range and (iv) Shivpur/Sohagibarwa Range. Lachimipur, North Chauk, Madhuvalia and South Chauk Ranges form the largest forest patch and a kilometer away to the south, Pakri Range is another isolated patch (Figure 2.2). These two forest patches, west of Nichlaul town, constitute THB VIII, on account of their proximity and reported movement of tiger between these patches. This THB is separated distinctly from Nichlaul and Shivpur/Sohagibarwa Ranges by extensive human habitation, agricultural land and Nichlaul township and the gap is about 10km wide. Further east, Gandhak river that forms the eastern boundary of Nichlaul Range bisects Shivpur/Sohagibarwa Range, which is contiguous with forests of Valmiki TR.

It appears that only a handful of tigers are left in this THB, mostly along the Payas river in North Chauk and Maduvalia Ranges. The frequency of occurrence (3.3 ± 8.2, n = 6 transects; 28.7km) and pug mark encounter rate (0.1 ± 0.2) estimated for tiger in this THB were the lowest in the entire TAL (Table 7.1). Leopard also was poorly represented (Pug mark ER: 0.03 ± 0.1, Frq.Occ: 1.7 ± 4.1) in this THB. Anthropogenic pressures are enormous, from the *taungya* villages located inside the forest and villages on the fringes, and there was intense human and cattle usage of the forests (Table 7.1). Specifically, Pakri Range has large tract of *terai* short grasslands, but given the heavy pressure on this patch from fodder collection and cattle grazing, the existence of this unique vegetation type and associated species in

the future is uncertain here. However, overall prey base of this THB was moderate, perhaps due to stringent anti-poaching measures by the Forest Department. The prey index was 1.0 ± 0.6 and the frequency of occurrence of chital, nilgai and wild pig were 46.3 ± 29.3, 62.0 ± 18.6 and 46.2 ± 50.9 respectively.

Reducing anthropogenic pressures, translocating *taungya* villages located right inside the forests and restoring the habitat connectivity between the forest patches are important management interventions if the tiger population has to survive and expand in this THB. However, the Forest Staff struggling to mitigate the problems are faced with an uphill task. For instance, the activities pertaining to translocation of the *taungya* villages initiated several years ago are yet to get off the ground. The small size and patchiness of habitat with severe anthropogenic pressure and lack of connectivity (functional and potential) with other THBs indicate that if the current populations of tiger in TAL are to become extinct, it is likely to begin from this THB.

7.9 THB IX (Eastern portion of Sohagibarwa WLS to Valmiki TR)

As the eastern Ranges of Sohagibarwa (Nichlaul and Shivpur/Sohagibarwa) are contiguous with Valmiki TR and as tiger movement is reported between these forests, these Ranges together with Valmiki TR are regarded as one habitat block, *i.e.* THB IX. Within this THB, although Gandhak river bisects Nichlual and Shivpur Ranges, there is possibility that tigers can range between these forests and the adjoining forests (Madanpur Range) of Valmiki TR. Three transects (14.8km) were surveyed in the Nichlaul Range and tiger pug mark ER was 0.1/km, the only pug mark recorded being along the west bank of Gandhak river. Leopard also was poorly represented in this Range (pug mark ER: 0.1/km). This Range was among the highly disturbed areas (Human ER: 5.9/km, Cattle ER: 7.0/km) and was with relatively low prey base (prey index: 0.9). The frequency of occurrence of chital, nilgai and wild pig were 46.7 ± 28.4, 78.3 ± 14.4 and 41.7 ± 42.5 respectively. The situation was worse in Shivpur Range, with no evidence of tiger (1 transect, 4.2km) and except for few records of chital tracks (Frq.Occ: 6%), there was no other prey species recorded in this transect.

Valmiki TR (880km^2) represents extensive *bhabar-dun* landscape, located along the northern boundary of West Champaran District of Bihar, bordering Nepal. There are seven Forest Ranges within the Reserve, administered under two Forest Divisions. Division I includes Forest Ranges in the eastern sector of the Reserve (from east to west: Manguraha, Govardhana and Ragia) and Harnatan, Chutaha, Ganoli and Madanpur Ranges constitute Division II. The entire forest stretch is conical on west-east axis, with the western boundary tenuously connected to Shivpur/Sohagibarwa Range of Sohagibarwa WLS and there is no forest cover beyond the eastern boundary. However, Chitwan NP (Nepal) across the hill ridges, forms strong contiguity on the northern side. Between the forests of Harnatan-Chutaha Ranges to

the south and Ragia-Govardhana Ranges to the north, there is a huge forest gap (6-8km wide and 15-20km long), forming a *dun* dominated by short grasslands. *Tharu* tribals among others inhabit both the *dun* and the southern and eastern boundaries of the Reserve, placing heavy pressures on the Reserve. Madanpur Range, the western limit of the Reserve, is narrow in shape along the Gandhak river and the vegetation here is a mix of tall grasslands and degraded forests. Rhino from Chitwan NP apparently stray into this Range, as deep as 10km from the Nepal border. Although this Range forms contiguous habitat along with Shivpur Range of Sogahibarwa WLS, it largely remains as an isolated patch, except for the fragile connectivity to the east with Ganoli Range. The entire Range is enveloped by human population, even along the Gandhak river, and the habitat destruction has been further aggravated by construction of road and railway line through this Range. At present, this Range is reportedly supporting a substantial population of swamp francolin and few hog deer, and there are extensive tall grasslands having potential to support rhinos and other endemic or obligate species. In order to save the existing species populations and augment tiger and wild ungulates occurrence including rhino, this Range needs enhanced management intervention.

The status of tiger in general was not encouraging in Valmiki TR as indicated by pug mark ER (0.1/km) and Frq.Occ. (7.1 ± 15.2, n = 16 transects, 61km), which are among the lowest in the entire TAL (Table 7.2). Tiger occurrence was patchy in the Reserve and was largely found in the Ganoli, Ragia and Govardhana Ranges that have better connectivity with Chitwan forests and had relatively higher prey base (Appendix VIII). During the survey, only one tiger pug mark in Manguraha Range and none in Harnatan and Chutaha Ranges was recorded. Harnatan and Chutaha Ranges, almost surrounded by settlements, have perhaps become unsuitable for tiger survival. Though evidences of human activity and cattle use were relatively lower inside the Reserve (Human ER: 1.8/km and Cattle ER: 0.1/km), poor habitat condition (Figure 4.3) including low prey availability (prey index 0.9, Table 7.2) possibly explains the low occurrence of tiger in Valmiki TR. However, the forest cover and species richness remains relatively superior as compared to several patches surveyed in Uttar Pradesh and it represents one of the last patches of forests having unique combination of *terai-bhabar* vegetation. With adequate protection, the current status of tiger here can be improved and that this Reserve may function as a buffer to Chitwan NP.

7.10 Bahraich and Shrawasti FDs (no tiger areas)

Forests in Bahraich and Shrawasti FDs are distributed in relatively small and isolated patches, surrounded by densely populated human habitations and are no more used by tigers. The isolated patches east of Katerniaghat WLD are under Bahraich FD and another isolated patch (Bhinga forest), south west of Suhelwa WLS, is under Shrawasti FD (Figure 2.1). It appears that tigers extirpated from these patches

only recently, substantiating the widely held observation that habitat fragmentation compounded with anthropogenic pressure cause local extinction of species. Leopard, however, used this area, though in small proportion (Frq.Occ: 8.3 ± 7.2, n = 3 transects, 6km). Among the prey species, only nilgai (Frq.Occ: 29.2 ± 31.5) and wild pig (Frq.Occ: 33.3 ± 7.2) were found, and these forest patches were under profuse anthropogenic pressures (Human ER: 4.5 ± 2.3, Cattle ER: 1.7 ± 1.5, Cattle Frq.Occ: 75.0 ± 43.3). Two years ago, a tiger reportedly strayed into the forests in Bahraich FD, close to Katerniaghat WLD. However, given the high human pressures and low prey availability, enabling tigers to breed and establish a population in Bahraich and Shrawasti FD is a remote possibility.

The above discussion clearly reveals that the tiger populations in TAL are in several fragments (nine THBs in India, and including Nepal, in five TUs) and wherever, the forests are in small patches with heavy anthropogenic pressure, the tigers have extirpated. Further, distributions of these populations are largely centered around one or two source populations receiving better habitat protection and management inputs. In the current scenario, tiger conservation in TAL needs to focus on two broad aspects. (i) Existing source populations must be protected and reinforced, and appropriate conditions in other potential areas need to be created for tigers to establish and expand viable populations. This would involve accurately estimating population size of tiger and prey species along with demographic characteristics and their spatial arrangement. (ii) Habitat connectivity needs to be established and strengthened between the fragmented tiger populations. It should be noted that movement of tigers between these subpopulations are presumably stray incidents, and there is uncertainty regarding the functional status of the corridors connecting these populations. Therefore, further investigations as to whether or not there has been genetic exchange between these populations and the status of the existing corridor are required. Answers to these questions would provide greater insights into conservation strategies and enable effective use of conservation funds. At the landscape scale, even within the fragmented populations (THBs or TUs), some of the forest patches are more crucial than the rest, and identifying these patches and undertaking appropriate management intervention(s) is of greater consequence to tiger conservation.

8. SUMMARY AND RECOMMENDATIONS

Tiger populations in TAL are in fragmented spatial units, distributed in nine THBs in the Indian side of TAL. Given the forest connectivities along the Indo-Nepal border, these THBs together with Nepal side of TAL areas constitute five larger units (Tiger Units or TUs) of varying sizes and configurations. The TU I, TU II and TU III are in the *bhabar* tract, largely in the state of Uttaranchal (India) and the other two are in *terai*. TU IV is largely in Nepal and TU V is distributed along Indo-Nepal border, covering parts of Uttar Pradesh, Nepal and Bihar. It was found that each TU has at least one key patch in which tigers have higher probability of persistence and can act as a source for adjoining patches in the landscape network. These key patches include the western portion of Rajaji NP in TU I, Corbett TR in TU II, Pilibhit FD-Sukhlaphanta Reserve-Kishanpur WLS-Dudhwa NP-Bardia NP in TU IV and Chitwan NP in TU V (Figure 2.2). The shape and configuration of most patches in these TUs are narrow rectangles, exposed to anthropogenic pressures and consequently, the effective area (potential habitat) available for tiger in TAL is only between 15 and 39%. The fact that TU V can harbor demographically viable population of tigers is only because of its contiguity with forests in Nepal, making it imperative to have joint Indo-Nepal efforts for long term survival of tiger here. An overview of habitat condition and status of tiger in TAL including its relationship with terrain, configuration of forests, associated species (prey species and leopard) and disturbance indicators are given below. Further, the areas where our conservation efforts need to be focused are highlighted, along with specific recommendations and potential implementing agencies.

8.1 Terrain, status of forests and tigers

The Indian side of TAL has two major forms of terrain (hilly *bhabar* and flat *terai*) and is under two broad levels of management status (Protected Areas and Reserve Forests/Non-PAs). There was distinct variation in human population density and forest cover in TAL, with *bhabar* having a human density of 334/km^2 and a forest cover of 36%, while the corresponding figures for *terai* are 436/km^2 and 17% respectively. Analysis of pug mark frequency of occurrence and encounter rates revealed that tiger occurrence is patchy and varies significantly across the Landscape, largely decided by prey availability, cover and disturbance levels. The overall pug mark frequency of occurrence and encounter rate in the hilly terrain (*bhabar*) that supports many deep *nallahs* offering hideouts to the tiger were 10.8 ± 16.6 (n = 167 transects, 617.3km) and 0.3 ± 0.4/km respectively. These estimates for *terai* were 13.8 ± 20.9 (n = 79 transects, 383.9km) and 0.3 ± 0.4/km respectively. Although the overall results dot no provide clear support to the general perception that tigers fare better in *bhabar* tract, data from four transects in Corbett TR (18.8km), the best in the entire study area in terms of prey availability and protection level, accounted for the highest pug mark encounter rate of 1.1/km (Frq.Occ: 41.2 ± 22.0), implying that if

disturbances are minimized or eliminated, most of the *bhabar* areas, with sufficient prey, have potential to support high densities of tiger.

In general, populations at the extreme end or the periphery of the range of a species are usually sparse (Hengeveld and Haeck 1982) and have a greater chance of going extinct (Beddington *et al.* 1976, Lawton 1995). More over, smaller populations are at a higher risk of extinction than larger ones, on account of greater vulnerability to demographic, genetic and environmental changes (Gilpin and Soule 1986), and other stochastic events. The situation in TAL is in concurrence with these views that areas at the periphery of the range (e.g. Kalesar and Simbalbara WLS) and those that are isolated and small (Sohagibarwa WLS, Shrawasti FD and Bahraich FD) have either lost the tiger or are in the process of losing it. Suhelwa WLS would also have lost its tiger population, but for its habitat connectivity along the Churia hills to Chitwan NP. Similarly, the survival of tiger in THB IX (Sohagibarwa east-Valmiki TR) is also due to its connectivity with Chitwan NP. While THB IX may continue to have tigers for a few more decades, the same can not be vouched for Suhelwa WLS, as the forest connectivities (Lamahi and Dovan bottlenecks) may not remain for long. In the western most part of TAL, occasional ranging of tigers in the forests, across Yamuna river (Kalesar and Simbalbara WLS), may cease to continue if appropriate conservation actions like banning boulder mining in Yamuna river and establishment of Rajaji-Shivalik TR are not initiated at the earliest.

Of the total forest area of Indian part of TAL (ca. 15,000 km^2), only 4640.6km^2 (31%) are under Protected Area status, whereas the rest are classified as Reserve Forests. The pug mark frequency and encounter rate in the PAs were 13.7 ± 21.8 and 0.3 ± 0.4 (n = 85 transects; 367km) respectively, which were 10.7 ± 15.8 and 0.3 ± 0.4 (n = 161 transects; 634.2km) for non-PAs/Reserved Forests. In spite of higher disturbance, tiger occurrence in the non-PAs is comparable with the PAs. The major reason for this could be that PAs and non-PAs are interspersed in such a way that Non-PAs greatly benefit from PAs.

8.2 Prey availability, disturbance and tigers

The spatial variation in ungulate distribution corresponds to the differences in terrain features and vegetation characteristics in TAL. The analysis has revealed that these prey species occupy distinct habitat units at a micro scale, and therefore, tiger conservation has to consider these diverse habitats. Sambar, goral and barking deer showed high affinity to hilly terrain, whereas swamp deer and hog deer are restricted to flat terrain mostly in the *terai*. Species such as chital and wild pig use both hilly and flat habitats, and because of their greater adaptability to diverse habitats, they are widely distributed in this Landscape. The differences in habitat choice exhibited by these ungulates are not confined only to this Landscape, such patterns have been widely observed across their distribution range (De and Spillett

1966, Schaller 1967, Seidensticker 1976a, Bhat and Rawat 1995). Sambar, chital and wild pig are the key prey species for tiger in the *bhabar* tract, while chital, swamp deer, hog deer and wild pig constitute the major prey base in *terai*. Besides poaching of these species, the fact that swamp deer and hog deer now have a much reduced range and are restricted to isolated localities (Rahmani *et al.* 1988, Sankaran 1990, Biswas and Mathur 2000) is a cause for concern. Studies have demonstrated that these two species contribute significantly to tiger diet in *terai* region (Seidensticker 1976a, Stoen and Wegge 1996). The findings clearly demonstrate that large wild ungulates with wider spatial distribution (e.g. chital) play a significant role in deciding the occurrence of tiger. Interestingly, the domestic dog has emerged as a reliable indicator of disturbance that negates tiger and prey occurrence. Therefore, monitoring protocols in the future should include domestic dog while designing strategies for discerning disturbance status in TAL forests.

8.3 Leopards shun *terai* and high tiger density areas

Social dominance, habitat structure and abundant prey in the smaller size classes are the three factors that play major roles in deciding the co-existence of tiger and leopard (Seidensticker 1976b). Due to the availability of escape terrain in the form of steep hill slopes and many climbable trees, and prey species such as sambar, chital, barking deer, goral, wild pig, porcupine and langur, leopards would be expected to hold ground against the socially dominant tiger in the *bhabar* tract. In the *terai*, in spite of optimal prey base (swamp deer, chital, hog deer, barking deer, wild pig, porcupine and langur), absence of steep hills and trees largely in the form of 'difficult to climb' sal trees, cause difficulties for leopards to coexist with tiger here. The field data corroborate these observations that presence of leopard and tiger was inversely related (Figure 8.1). Both leopard and tiger pug mark Frq.Occ. and ER were higher in *bhabar* tract (Leopard FO: 15.3 ± 16.3, ER: 0.3 ± 0.3; tiger Frq.Occ: 10.8 ± 16.6, ER: 0.3 ± 0.4), while in *terai*, leopard was poorly represented (Frq.Occ: 2.3 ± 6.2, ER: 0.05 ± 0.1) as compared to tiger (Frq.Occ: 13.8 ± 20.9, ER: 0.3 ± 0.4). Wherever tigers occur at high densities, they may spatially exclude leopards through social dominance (Seidensticker *et al.* 1990), which was very much in evidence for the *terai* habitats such as Pilibhit-Kheri and Dudhwa THBs (Figure 8.1). Interestingly, this was seen even in the high tiger density *bhabar* area. Eight transects (four in Rajaji NP and four in Corbett TR) covering 38.8km had a tiger pug mark ER of 0.85/km, which is much higher than leopard pug mark ER (0.23/km). Significantly, the ER obtained for leopard in these transects was relatively lower than the estimate for entire *bhabar* tract (Table 7.1). Of the 122 transects (464.1km) where there was no tiger pug marks, leopard pug mark ER was 0.3/km, higher than the ER recorded for the entire TAL (0.2 ± 0.3/km). These areas also had high human and cattle ERs (4.1/km and 7.8/km) and high frequency of dog occurrence (21.8 ± 30.2), implying that leopard can tolerate disturbance and/or they are forced to such areas by tiger.

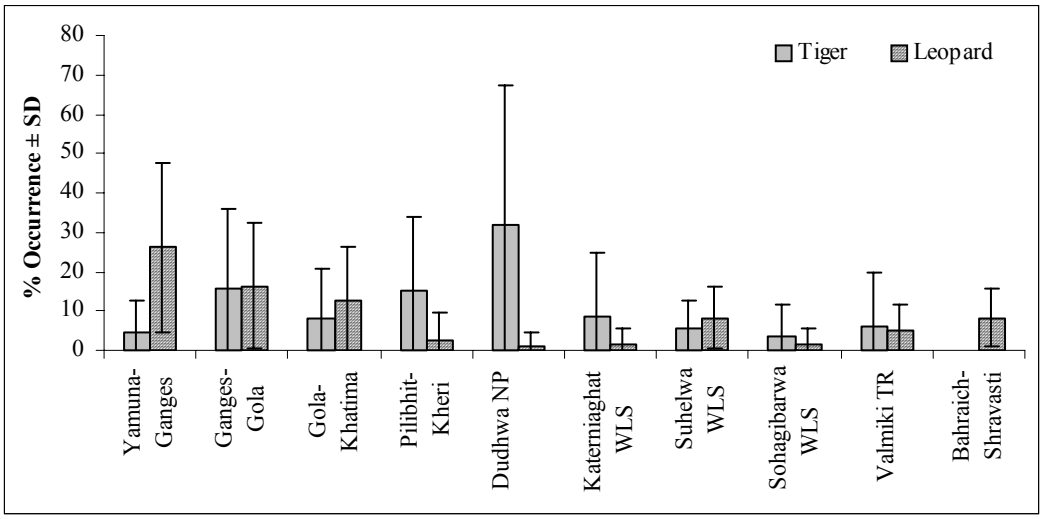


Figure 8.1: Frequency of occurrence of tiger and leopard across THBs

It is, therefore, plausible that in the event of tiger decline and continued availability of sufficient prey, leopard may expand its range and increase in abundance in these areas.

8.4 Where should the conservation efforts be focused in TAL?

Although every small population of tiger deserves maximum conservation inputs, it will be prudent to focus our efforts between Yamuna and Sharda rivers, covering THBs I (Yamuna-Ganges), II (Ganges-Gola), III (Gola-Khatima) and IV (Pilibhit-Kheri). The THBs (I, II & III) in the *bhabar* tract will constitute the largest contiguous tiger habitat of ca. 8,000km^2 anywhere along the foothills of the Himalaya, provided Chilla-Motichur and Gola river corridors are established, and Rajaji-Corbett and Nihal Bhakhra corridors are protected and strengthened. Similarly, one of the largest and finest *terai* habitats could be secured for tiger if strong connectivity is established between Pilibhit FD-Kishanpur WLS and Sukhlaphanta Reserve, Nepal. When compared to *terai* habitats, the western part of TAL has less people and more forest cover, but suffers from the growth of many large towns that exert enormous pressure on the forests. In addition, growth of habitations and encroachments (e.g. Ramnagar and Khatima Ranges), boulder mining, unrestricted use of forests for firewood, fodder and *bhabar* grass, and infrastructural development (widening and building more roads and increasing the frequency of trains) may gradually negate the advantage that the *bhabar* tract currently holds. Although this area supports significant populations of elephants (ca. 800), it has already experienced local extinctions of rhino and swamp deer due to various anthropogenic factors. Tiger conservation in this *bhabar* tract should accord adequate attention to Corbett TR, one of the finest reserves in Asia, which arguably functions as source population of tiger for western part of TAL.

Unlike the western most part of TAL, THB IV is free from large towns, and shifting course of Sharda river maintains patches of shrub and tall grass along the banks, enabling occasional movement of large mammals between Sukhlaphanta Reserve and Pilibhit FD-Kishanpur WLS. The major challenge in this area lies in creating a functional corridor between Lagga Bagga- Sukhlaphanta and Pilibhit FD-Kishanpur WLS. The efforts already underway in this area by the Forest Department and WWF-India should continue and need further intensification. Immediate conservation efforts are required in the Basanta corridor area to establish the connectivity between Dudhwa NP and Basanta forests in Nepal.

8.5 Recommendations

Based on the study findings and interactions with Forest Staff and others involved in the conservation of TAL, we propose the following specific measures along with potential implementing agencies for tiger conservation in TAL. We also recognize that there are several NGOs locally active across TAL and it would be useful to explore and involve such agencies for specific purposes.

Controlling of poaching

Poaching, although could not be quantified, is certainly a factor contributing to the status of tiger and prey base in TAL, and needs to be brought under control (Appendix X). The measures suggested by Johnsingh and Negi (2003), such as replacing the guns belonging to people around tiger habitats with specially made guns that cannot be used for poaching, giving substantial rewards to persons who apprehend poachers and recruiting and training staff for protection are useful in this direction. The involvement of local people, through conservation education and conservation programmes, is critical in bringing about their transformation, from being providers of expertise and logistical assistance to poachers, to protectors of wildlife. Employment opportunities need to be created for *kanjars* and persuade *rai sikhs* to give up poaching.

There might be a necessity to restructure the existing set up of Forest Department on the lines of police personnel, operating in a team, so that Forest Staff get required support and infrastructure to carry on patrolling and other anti-poaching and habitat protection activities. By doing so, the apprehensions of certain staff being targeted by poachers would be removed and their safety (including family) is taken care of, which are prerequisite for efficient protection measures. Many of the Range Officers interviewed in the field expressed a similar view. **Agencies:** Government of India; Government of Nepal; State Governments of Himachal Pradesh, Haryana, Uttaranchal, Uttar Pradesh and Bihar; WWF-India; Wildlife Protection Society of India.

Reclaim land and prevent encroachment

There is a dire need to remove encroachments at least from some crucial areas to arrest the growing threat to wildlife habitats (e.g. Sundar Khal in Ramnagar FD; Belha in Pilibhit FD) and to establish corridors (e.g. Kilpura-Khatima-Surai corridor) (Appendix XI). This would require an immediate attempt to map encroachments in the entire TAL. Intervention of **Central Empowered Committee** (CEC), constituted by the Supreme Court of India, should be sought to evict encroachments. **Agencies:** Government of India; Governments of Uttaranchal and Uttar Pradesh; Forest Department; Revenue Department; local NGOs.

Raising of fuel wood plantations and distribution of fuel-efficient *chulas*

Firewood demand in the TAL area, particularly during winter, is enormous. It is, therefore, necessary to raise fuel wood plantations in Reserve Forests and even along the periphery of Protected Areas to meet the firewood needs of the adjoining population. The people around TAL forests should be provided with fuel-efficient *chulas* and encourage their use, so that the pressure on the natural forest would be gradually reduced. **Agencies:** Government of India; Government of Nepal; Governments of Himachal Pradesh, Haryana, Uttaranchal, Uttar Pradesh and Bihar; WWF-India; Forest Research Institute; The Energy and Research Institute (TERI); Wildlife Institute of India.

Relocation of villages and industries

Gangabhogpur Talla and Malla villages and Kunaun *goth* (total number of families 250) on the east bank of Ganga river need to be translocated, which should be possible since there is land available for these people in Barkot Range of Dehradun FD. Ringora and Amdanda villages, and Tedha villages (these three villages originated as cattle camps and now have about 80 families) located on the west and east banks of Kosi river respectively should be translocated and the Gabua forest block (13 km^2) in Terai West FD is one such area available for resettlement. The Indian Medicines Pharmaceutical Corporation Limited on the west bank of Kosi river could be shifted closer to Ramnagar town, about 15km away from the present location of the factory, as most of its 200 or so employees come from this town. Gargia Chemicals (situated close to the Pharmaceutical Corporation) where less than 10 people work now, should be immediately closed. Otherwise, there is a danger of this area developing into an industrial complex.

Relocation of Laldhang village (100 families) on the southern boundary of Corbett TR, initiated in 1994, should be completed at the earliest. Most families have already moved to the relocation site in the Terai West FD. The population of Bharthapur (100 families), in the trans-Girwa area of Katerniaghat WLD, should be encouraged to move out to one of the isolated south-western forest patches in the

Kakraha Range. **Agencies:** Government of India, Central Empowered Committee, Governments of Uttaranchal and Uttar Pradesh, WWF-India, Wildlife Protection Society of India, Wildlife Trust of India, Centre for Environment Education, Wildlife Institute of India.

Improve trans-border cooperation

The Indo-Nepal border is a hotbed for smuggling of wildlife products and poaching. Concerted efforts of both the countries (India and Nepal) and all the border States (Uttaranchal, Uttar Pradesh and Bihar) are needed to curb all illegal activities. Such efforts are also required to strengthen corridors (e.g. Kilpura-Khatima-Surai, Lagga Bagga–Sukhlaphanta–Tatarganj and Dudhwa–Katerniaghat). **Agencies:** Government of India; Government of Nepal; Governments of Uttaranchal, Uttar Pradesh and Bihar; WWF-India; WWF-US (Nepal Program); Wildlife Protection Society of India; Wildlife Trust of India; Wildlife Institute of India.

Establishment of Chilla-Motichur and Gola river corridors

The decision to establish Chilla-Motichur corridor was made in 1984, but since then, regretfully, there has been very little progress. Shifting of the Army ammunition dump, resettling of Khand *Gaon* III village, freeing of islands on the Ganga from encroachers, and building a fly-over between Haridwar and Raiwala for vehicular traffic, are essential to establish this corridor. Establishment of the Gola river corridor will require enormous political will. This includes shifting the Uttaranchal Government timber depot, totally banning boulder mining between Haldwani and Lalkuan, and afforesting the degraded habitats between the Doli Range of Terai East FD and Tanda Range of Terai Central FD. **Agencies:** Government of India, Central Empowered Committee, Indian Army, Government of Uttaranchal, WWF-India, Wildlife Protection Society of India, Wildlife Trust of India, Wildlife Institute of India.

Ban boulder and sand mining in crucial wildlife corridors

Some of the crucial areas (e.g. Yamuna, Rawason and Gola rivers) are under extensive human activities, causing disruption to animal movement (Appendix XII). Boulder and sand mining rapidly accelerates the process of fragmentation and degradation, but it could be permitted in locations like the stretch of Song river north of Doiwala, far away from tiger habitats. Intervention of the **Central Empowered Committee** should be sought in this regard. **Agencies:** Government of India, Central Empowered Committee, Government of Uttaranchal, WWF-India, Wildlife Trust of India, Wildlife Protection Society of India, Wildlife Institute of India.

Resettle the *gujjars* in fringe forest areas

The lifestyle of *gujjars* residing within forests is incompatible with wildlife conservation. Following the resettlement model of Ghaindikatha (where *gujjars* have been resettled in fringe forest areas), the *gujjars* from Yamuna to Sharda river should be resettled. The ongoing recovery of Chilla Range after *gujjar* resettlement should inspire us to accomplish this recommendation with greater vigor. Land for Shivalik FD *gujjars* could be found in Bijnor Plantation Division. **Agencies:** Government of India, Central Empowered Committee, Government of Uttaranchal, WWF-India, Wildlife Trust of India, Wildlife Protection Society of India, local NGOs; Wildlife Institute of India.

Wean people from *bhabar* grass collection

This needs to be done on a priority basis, as the grasscutters wander throughout winter, collecting *bhabar* grass, disturbing habitats and stealing fresh tiger and leopard kills whenever they locate them. These people are known to use jungle crows (*Corvus macrorhynchos*), which look for and feed on kills, for locating kills. It should be taken cognizance of that these grasscutters live in abysmal poverty, and may earn Rs. 1200-1500 (US$25-30) annually from *bhabar* grass, and any programme to wean them should have a great concern for them and should have an acceptable alternative. **Agencies:** Government of India, Government of Uttaranchal, WWF-India, Wildlife Protection Society of India, Wildlife Trust of India, local NGOs; Wildlife Institute of India.

Monitor habitat and wildlife populations

The previous sections on habitat, tiger and prey base provide the baseline (both empirical data and methods) for initiating monitoring programmes in TAL. Besides the circular plots sampled during this survey, monitoring of habitats by establishing one hectare plots in PAs and FDs would be important. Changes in habitat conditions at landscape level could be ascertained using Remote Sensing and GIS. Monitoring of ungulates should be done along line transects, by counts along roads and pellet counts. The strategies adopted in this study could be improved by carrying out repeated measures on the same sampling units (trails/transects). Space use by tiger and other carnivores (leopard and sloth bear) could be assessed by monitoring the tracks and other signs along the transects and trails. However, it would be necessary to use advanced field (e.g. camera trap) and analytical (e.g. capture and recapture models) methods for detecting the change at population level. Following the Nepal model, recording and monitoring other biodiversity components (birds, mammals, insects and fish fauna, etc) would add value to the landscape units. **Agencies:** Forest Departments of Himachal Pradesh, Haryana, Uttaranchal, Uttar Pradesh and Bihar, Indian Institute of Remote Sensing, Forest Survey of India, Aligarh Muslim University, WWF- India, Wildlife Trust of India, Wildlife Institute of India.

Conservation education and awareness

Unless the local people recognize the significance of wildlife values of their immediate surrounding and the Landscape as a whole, implementing many of the recommendations that involve local participation would not yield desirable success. Both local and national media, print (news paper and magazines) and electronic (radio and TV), should extensively be made use of in highlighting the issues concerning the Landscape and the people. Involvement of local college students, specifically 2nd year undergraduates, for awareness campaign and wildlife monitoring would be effective. Not only would they get to understand the issues, but also form an valuable resource for spreading the conservation message. The preference for second year students is on account of them being better familiarized with the issues their seniors would have been exposed to and a relatively less demanding academic calendar. Carefully planned ecotourism would be a viable option for creating awareness among the people. **Agencies:** Centre for Environment Education; Garhwal University; Kumaon University; Pant Nagar University; WWF-India; Wildlife Institute of India and other local colleges and NGOs.

8.6 Strategies evolved in TAL Workshop

Following the mandate of the project, a workshop was organized at the Wildlife Institute of India on 6-7 November 2003, with the objective of sharing the research findings with the Forest Department, NGOs and various institutions involved in TAL conservation. The workshop was also used as a medium to plan strategies and to stimulate concerted efforts to carry on conservation activities in the field. The participants (Appendix XIII), forming four groups, deliberated on (i) people-related issues, (ii) habitat-related issues, (iii) Indo-Nepal border current conservation scenario & cooperation, and (iv) conservation of tiger and its prey.

The people-related group stressed on the need for context-specific socio-economic programmes, including capacity building of all the stakeholders, and reiterated the need for long-term interventions for making any significant mitigatory impact on the diverse human-wildlife interface conflicts being experienced across the TAL. Experiences of the Nepal TAL programmes need to be examined carefully, in order to provide meaningful insights for the Indian TAL initiatives.

The habitat-related issues group recognized the Tiger Habitat Blocks (THBs) identified by this study to be taken as basic conservation units in the Indian TAL. They specifically highlighted the need to (i) maintain, restore and monitor habitat quality and quantity, (ii) strengthen linkages between these habitat blocks, (iii) identify functional corridors and relevant corridor characteristics, and (iv) identify and recognize riverine habitats that often provide habitat connectivity (e.g. Lagga Bagga-Tatarganj-Chuka, and Mohana and Suheli rivers between Dudhwa NP and Katerniaghat WLD).

The third group identified stakeholders at various levels in India and Nepal involved with the TAL programme. They stressed upon the need for coordinated governance, research and monitoring, and through this, address trans-boundary issues such as (i) identification of connectivity of wildlife habitats, (ii) illegal trade – poaching, timber and forest produce smuggling, and (iii) impacts of large-scale development projects. They specifically suggested holding direct meetings of field enforcement staff at borders with appropriate encouragement from the center, coordinated research and joint monitoring programmes, devise mechanisms to avoid overlap (donors, facilitated by NGOs), exchange visits and sharing programs at field level (ministries & NGOs at appropriate levels), develop joint funding strategies especially at NGO level, increase enforcement staff presence at sensitive areas, train and apply important skills to transboundry staff, transboundary Environment Impact Assessment to be made mandatory for development projects, and day-to-day information sharing of animal movements such as elephants and rhinos.

The fourth group also recognized the nine THBs as basic conservation units and reinforced the conservation measures suggested by other groups at the landscape level. The specific issues considered important and urgent are; (i) controlling poaching of tiger and prey, and to do this, the group suggested that a database needs to be created to identify the affected areas and reasons for poaching, and efforts need to be prioritized accordingly, (ii) identify source and sink, and isolated populations within the Landscape, and activate or strengthen conservation efforts, (iii) employ scientifically conceived monitoring protocols for tiger and prey, and suggested that besides the data collected from this project, the tiger and prey populations need to be estimated with adequate confidence so that monitoring of these populations would be unbiased, and (iv) monitor health condition of wildlife in TAL.

All the participants unanimously agreed that Forest Department should co-ordinate, facilitate and spearhead all the conservation programmes in TAL with the able assistance of all identified agencies.

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Appendix I: States, districts and tehsils that cover the study area

STATE	DISTRICT	TEHSIL
HIMACHAL PRADESH		
	1. Sirmaur	Paonta Sahib
HARYANA		
	2. Yamunanagar	Chhachhrauli & Jagadhri
UTTARANCHAL		
	3. Dehradun	Vikasnagar, Dehradun & Rishikesh
	4. Haridwar	Roorkee & Hardwar
	5.Tehri Garhwal	Narendranagar
	6. Pauri Garhwal	Kotdwara, Lansdowne & Dhoomakot
	7. Nainital	Haldwani
	8. Udham Singh Nagar	Kashipur, Kichha, Sitarganj & Khatima
	9. Champawat	Champawat
UTTAR PRADESH		
	10. Saharanpur	Behat
	11. Bijnor	Najibabad & Nagina
	12. Pilibhit	Pilibhit, Puranpur & Bisalpur
	13. Shahjahanpur	Powayan
	14. Kheri	Nighasan, Gola, Mohammadi, Dhaurahara & Lakhimpur
	15. Bahraich	Nanpara
	16. Shrawasti	Bhinga
	17. Balrampur	Balrampur & Tulsipur
	18. Siddharthnagar – No terai forest exist in this district	Shohratgarh & Naugarh
	19. Maharajganj	Pharenda, Nataunwa, Maharajganj & Nichlaul
	20. Kushinagar	Padrauna
BIHAR		
	21. Pashchim Champaran	Sidhaw, Ramnagar, Gaunaha & Mainatanr – Blocks

Appendix II: Management units and Tiger Habitat Blocks within Indian portion of TAL

Block No.	Tiger Habitat Block (THB)	Protected Areas and Forest Divisions
I	Simbalbara WLS – west bank of Ganges	Simbalbara WLS Kalesar WLS Kalsi FD Shivalik FD Dehradun FD Narendranagar FD Western portion of Rajaji NP
II	East bank of Ganges – west bank of Gola river	Eastern portion of Rajaji NP Haridwar FD Lansdowne FD Bijnor FD (Plantation) Bijnor FD Corbett TR Ramnagar FD Terai West FD Terai Central FD
III	East bank of Gola river – Tanakpur: Khatima Highway	Terai East FD Haldwani FD Champawat FD
IV	Surai Range (Pilibhit FD) – South Kheri FD	Pilibhit FD Shahjahanpur FD Kishanpur WLS Part of North Kheri FD South Kheri FD
V	Dudhwa National Park	Dudhwa NP Part of North Kheri FD
VI	Katerniaghat Wildlife Division	Katerniaghat WLD Part of North Kheri FD
VII	Suhelwa Wildlife Sancturay	Suhelwa WLS
VIII	Sohagibarwa west	Western portion of Sohagibarwa WLS
IX	Sohagibarwa east – Valmiki Tiger Reserve	Eastern portion of Sohagibarwa WLS Valmiki TR
X	Tiger absent	Bahraich FD Shrawasti FD

Appendix III: Data sheet for recording tiger, prey species and disturbance status

Date: **Place:** **Survey Route:** **Observer:**
GPS Location (start point): **GPS Location (end point):**
Time (start): **Time (end):** **Total dist. (km):**

Segment (km)	Indirect evidences (pug marks, track, signs and dung or pellet groups)																						Direct counts	
	Tiger	Leopard	Sambar		Chital		Nilgai		Barking deer		Wild pig		Swamp deer		Hog deer		Goral		Cattle		Dog	Lopping	Species, *gujjar* dera and people	No.
			T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	P	T	D				
0 - 0.25																							Tiger	
0.25 - 0.5																							Leopard	
0.5 - 0.75																							Sambar	
0.75 - 1.0																							Chital	
1.0 - 1.25																							Nilgai	
1.25 - 1.5																							Braking deer	
1.5 - 1.75																							Elephant	
1.75 - 2.0																							Goral	
2.0 - 2.25																							Wild pig	
2.25 - 2.50																							Rhesus	
2.50 - 2.75																							Langur	
2.75 - 3.0																							Cattle	
3.0 - 3.25																							Domestic dog	
3.25 - 3.5																								
3.5 - 3.75																								
3.75 - 4.0																								
4.0 - 4.25																							People	
4.25 - 4.5																							*Gujjar*	
4.5 - 4.75																							*dera*	
4.75 - 5.0																								

T – Track P – Pellets D – Dung Absent – 0 Present – 1 Common – C (>5) Abundant – A (>10)

Appendix IV: Data sheet for vegetation sampling and monitoring

Date:	**Toposheet / Grid ID** **Plot No:**
Forest Division:	**Latitude:**
Range:	**Longitude:**
Block:	**Major Landmarks:**
Habitat type:	**Transect Name:**

10 m radius plot (Tree layer)					**5 m radius plot (Shrub layer)**		
Species	**GBH class**	**Lop**	**Cut**	**Notes**	**Species**	**Cut**	**Notes**

Canopy cover		**1 m radius plot (Ground layer)**	
No. of cattle dung		**Cover Category**	**Percentage**
Wild ungulate pellets		**Bare ground**	
		Herb	
		Grass	
		Weeds	

Appendix V: Data sheet for vegetation sampling (Relevé plot)

Date:	**Toposheet / Grid ID** **Plot No:**
Forest Division:	**Latitude:**
Range:	**Longitude:**
Block:	**Quantified by:**
Habitat type:	

10 m radius plot (Tree layer)					**5 m radius plot (Shrub layer)**			
Species	**Dominance Rank / No**	**GBH class**	**Lop**	**Cut**	**Species**	**Dominance Rank / No**	**GBH class**	**Cut**
1					**1**			
2					**2**			
3					**3**			
4					**4**			
5					**5**			

No. of cattle dung		**Tree cover**	
Wild ungulate pellets		**Shrub cover**	

Appendix VI: Champion and Seth (1968) forest types, corresponding to TAL vegetation

S.No.	Forest Type		Distribution	Vegetation Characteristics	Soil Characteristics
1	Moist Shiwalik sal	3C/2a	Shiwalik hills; Saharanpur Division	Typical associates include *Anogeissus latifolia*, *Terminalia alata*	On Nahan sandstone with light soil.
2	Moist bhabar sal – Bhabar-dun sal forest	3C/C2/2b(i)	Dun and gentle Bhabar slopes Dehradun and Kumoan.	*Lagerstroemia parviflora*, *Terminalia alata*	Gravelly, underlain by gravels and boulders fairy close to the surface.
3	Moist bhabar sal – Damar sal forest	3C/C2/2b(ii)	On high alluvial terraces or damars (high river bank) jutting out in the terai and plains; North Kheri Division	*Haldina cordifolia*, *Syzygium cumini*, *Schleichera oleosa*	Good loamy soils without pebbles.
4	Moist tarai sal forest	3C/C2/2c	Haldwani Division	*Syzygium cumini, Trewia nudiflora, Ardisia solanacea, Calamus tenuis*	Grey clayey alluvium with wet subsoil
5	Moist plains sal forest - Western light alluvial plains sal	3C/C2/2d(i)	North Kheri and South Kheri Division	*Terminalia alata, Terminalia bellirica, Lagerstroemia parviflora*	Sandy alluvium with dry subsoil
6	Moist plains sal forest - Chander sal	3C/C2/2d	Low lying chanders of the sub-Himalayan tract; Pilibhit	*Syzygium cerasoides*	Light to heavy alluvium on a dry subsoil
7	Moist plains sal forest - Eastern heavy alluvium plains sal	3C/C2/2d	Gorakhpur Division	*Terminalia alata, Dillenia pentagyna, Lagerstroemia parviflora*	On yellow clayey alluvium
8	Moist mixed deciduous forest – Western Gangetic moist deciduous forest	3C/C3/3a	Scattered freely through the hills occupied by moist sal type and more locally in the plains	*Albizzia procera, Haldina cordifolia, Terminalia alata, Terminalia bellirica, Toona ciliata, Garuga pinnata*; local variation Bauhinia forest with *Bauhinia retusa, B.variegata* and *B.vahlii*; on moister, higher riverain alluvium – *Trewia*, *Putranjiva*, *Aphanamixis*, *Bischofia*, *Alangium salvifolium* also occur	

9	Terminalia alata forest	3C/E1	Throughout the sal region	*Shorea robusta, Bombax ceiba, Syzygium cumini*	On heavy wet soils and on clayey alluvial patches.
10	Low alluvium savannah woodland	3C/1S1	Throughout the Gangetic plains	*Themeda*, *Erianthus*, *Saccharum*, with scattered trees of *Bombax* ceiba, *Albizzia procera*	Alluvial, mainly sandy with local clay patches, seasonal inundation.
11	Cane breaks	E1	Locally in moist deciduous forests	*Calamus* spp. (*C.tenuis* in moist sal forests) and other associates which vary with locality	Soil is permanently wet and usually fine clay, rich in humus
12	Sub-montane hill valley swamp forest	4C/FS2	Along sub-montane tract; Dehradun and Haldwani Division	Low-crowned evergreen trees, dense Calamus; *Ficus glomerata*, *Terwia nudiflora, Syzygium cumini, Pterospermum acerifolium, Toona ciliata, Bischofia javanica, Diospyros peregrina, Carallia brachiata, Putranjiva roxburghii, Phoebe lanceolata, Machilus gamblei, Salix tetrasperma, Achronychia pedunculata, Ardisia solanacea, Desmodium caudatum;* Ferns no grass	Soil is wet, stream beds gravelly and rich in humus
13	Barringtonia swamp forest	4D/SS2	Swampy areas in the Gangetic flood plains; South Kheri Division	*Barringtonia acutangula, Syzygium cumini, Salix tetrasperma, Calamus tenuis*	Prolonged annual summer flood. Soil rich in humus, heavy and poor in aeration.
14	Syzygium cumini swamp low forest	4D/SS3	Along stream banks in Gangetic alluvium; typically seen in eastern U.P.	Almost pure stands, occasionally *Barringtonia* or *Trewia nudiflora*.	Seasonally flooded, along banks of sluggish streams
15	Easter seasonal low swamp forest	4D/SS4	Gangetic valley from Pilibhit eastwards, south Kheri division	*Syzygium cumini, Cephelanthus occidentalis*	Swampy depressions in sal zone, with deep black heavy waterlogged soil.
16	Eastern wet alluvial grassland	4D/2S2	Gangetic flood plains	*Vetiveria zizanioides, Erianthus arundinaceus, E.munja, Phragmites karka, Themeda arundinacea, Arundo donax, Saccharum spontaneum, Imperata cylindrica,*	Alluvial deposits which dry out completely after the floods recede.

17	Riparian fringing forest	4E/RS1	Along banks of large streams in the hilly regions	*Bischofia javanica, Mangifera indica, Lagerstroemia speciosa*	Soil coarse and non-retentive, sandy or siltey, well drained.
18	Dry sal bearing forest - Dry Shiwalik sal forest	5B/C1/1a	Shiwalik hills	*Anogeissus latifolia, Buchanania lanzan*	Rock and conglomerates, shallow sandy and is completely drained
19	Dry sal bearing forest - Dry plains sal forest	5B/C1/1b	Flat areas in UP; Ramnagar, Haldwani and Bahraich	*Terminalia alata, Terminalia bellirica, Pterocarpus marsupium, Madhuca indica, Acacia catechu*,	Top soil clayey, surface drainage sluggish
20	Northern dry mixed deciduous forest	5B/C2	Shiwaliks, Bhabar plains	*Anogeissus latifolia, Boswellia serrata, Acacia catechu, Shorea robusta, Terminalia alata, Stereospermum suaveolens, Lannea coramandelica*	
21	Dry deciduous scrub	5/DS1	Dry Shiwalik hills	*Acacia catechu, Butea monosperma, Randia dumentorum, Carissa opaca*	
22	Dry savannah forest	5/DS2	Throughout dry deciduous forests, following severe anthropogenic pressures	Trees standing singly or in small groups with heavy undergrowth of fire and grazing resistant species.	
23	Aegle forest	5/E6	Drier regions of Gonda, Bahraich	*Aegle marmelos* forming nearly pure consociations,	
24	Dry tropical riverain forest	5/1S1	Narrow strips along hilly sections of larger streams	Trees larger than the surrounding dry deciduous forest, more or less evergreen.	Light sandy soil
25	Khair-sissoo forest	5/1S2	Along all larger rivers of N.India	*Acacia catechu, Dalbergia sissoo, Holopteliaintegrifolia, Cannabis sativa, Grewia oppositifolia*	Sandy or gravelly alluvium, devoid of humus
26	Inundation babul forest	5/1S3	Bahraich Division	*Acacia nilotica*, thick grass cover	Flooded for a few weeks.
27	Lower or Shiwalik chir pine forest	8B/C1/1a	Shiwalik hills	*Pinus roxburghii* singly or with *Shorea robusta, Terminalia alata, Anogeissus latifolia*	

Appendix VII: Habitat characteristics in Forest Divisions and Protected Areas within TAL (values are mean ± standard deviation)

Forest Divisions/PAs	Canopy cover (%)	Tree density	Tree richness	Shrub density	Shrub richness	Sapling density	Sapling richness	Lopping	Cattle dung density	Wild herbivore pellets	Dominant trees	Dominant shrubs
Kalesar WLS	23.6 ± 6.3	20 ± 7.3	3.1 ± 0.7	10.7 ± 7.4	1.4 ± 0.8	11.4 ± 7.7	2.1 ± 0.7	0.6 ± 1.0	1.9 ± 1.5	0 ± 0	*Tectona grandis, Mallotus philippinensis, Eucalyptus*	*Lantana camara, Aerva scandens, Dendrocalamus strictus*
Shivalik	20.4 ± 10.6	6.4 ± 4.1	2.3 ± 1.3	17.2 ± 11.2	2.2 ± 1.2	5.5 ± 7.5	1.2 ± 1.2	0.7 ± 1.4	1.3 ± 1.7	0.1 ± 0.3	*Acacia catechu, Tectona grandis, Diospyros melanoxylon*	*Lantana camara, Adhatoda vasica, Murraya paniculata*
Rajaji NP	23.4 ± 12.3	8 ± 4.4	3.3 ± 1.2	17.1 ± 12.1	2.2 ± 1.2	4.8 ± 5.3	1.3 ± 1.4	1.5 ± 2.4	1.3 ± 1.6	2.4 ± 3	*Mallotus philippinensis, Holarrhena antidysenlerica, Anogeissus latifolia*	*Lantana camara, Murraya paniculata, Helicteres isora*
Dehradun	21.6 ± 17.6	5.3 ± 3.6	2.3 ± 1.1	18.8 ± 6.8	2.1 ± 1	3.1 ± 4.8	0.8 ± 0.9	0.1 ± 0.3	2.7 ± 3.2	3.7 ± 2.1	*Tectona grandis, Trewia nudiflora, Eucalyptus*	*Adhatoda vasica, Murraya paniculata, Clerodendron viscosum,*
Narendranagar	13.8 ± 2.5	5 ± 0.8	2 ± 0	20.3 ± 7.1	2 ± 0.8	10.5 ± 13.4	1.3 ± 1.3	0.0 ± 0.0	2.5 ± 3.0	0.3 ± 0.5	*Holoptelia integrifolia, Tectona grandis, Aegle marmelos*	*Murraya paniculata, Adhatoda vasica,*
Haridwar	25.4 ± 15.1	4.8 ± 2.9	2.5 ± 1.4	11.8 ± 6.4	2.1 ± 0.8	1.4 ± 2.3	0.4 ± 0.5	1.8 ± 1.1	0.5 ± 0.7	1.2 ± 1.5	*Holoptelia integrifolia, Acacia catechu, Zizyphus mauritiana*	*Lantana camara, Adhatoda vasica, Helicteres isora*
Lansdowne	14.7 ± 9.0	6.5 ± 3.7	2.9 ± 1.4	15.2 ± 11.5	2 ± 0.8	4.9 ± 3.0	4.9 ± 3.0	0.8 ± 1.3	3.9 ± 3.0	2.5 ± 2.4	*Mallotus philippinensis, Shorea robusta, Acacia catechu,*	*Murraya paniculata, Lantana camara, Colebrookia oppositifolia*
Sonanadi WLS	19.1 ± 4.0	8.6 ± 2.2	5.4 ± 1.2	37.4 ± 14.4	3 ± 1.1	6.5 ± 5.3	1.8 ± 1.0	0.1 ± 0.5	0.2 ± 0.4	1.3 ± 1.2	*Aegle marmelos, Ehretia laevis, Mallotus philippinensis*	*Helicteres isora, Murraya paniculata, Desmodium spp.,*
Corbett TR	21.6 ± 12.3	7 ± 5.7	3 ± .3	23.6 ± 18.3	1.9 ± 1	5.2 ± 5.6	1.1 ± 0.9	0.0 ± 0.1	0.2 ± 0.6	1.3 ± 1.6	*Shorea robusta, Mallotus philippinensis, Syzygium cumini*	*Murraya paniculata, Clerodendron viscosum, Helicteres isora*
Ramnagar	24.5 ± 10.1	9.4 ± 4.2	2.9 ± 1.2	26.4 ± 21.4	2.3 ± 1.6	8.7 ± 8.4	1.5 ± 1.2	0.1 ± 0.4	1.0 ± 1.2	0.5 ± 0.8	*Shorea robusta, Mallotus philippinensis, Tectona grandis*	*Murraya paniculata, Lantana camara, Clerodendron viscosum*
Terai West	21.1 ± 5.6	13.8 ± 4.1	4.2 ± 1.5	37.3 ± 23.1	3.2 ± 1.3	8.3 ± 8.0	1.5 ± 1.1	0.1 ± 0.5	0.4 ± 0.8	0.3 ± 0.6	*Mallotus philippinensis, Eucalyptus, Acacia catechu,*	*Glycosmis pentaphylla, Murraya paniculata, Lantana camara*
Terai Central	30.8 ± 16.7	13.8 ± 6.2	3.9 ± 1.3	25.5 ± 20.1	2.2 ± 1.2	5.9 ± 5.8	1.5 ± 1.3	0.9 ± 1.8	1.2 ± 1.2	0.9 ± 1.2	*Mallotus philippinensis, Tectona grandis, Acacia catechu,*	*Murraya paniculata, Lantana camara, Clerodendron viscosum*
Terai East	20.8 ± 12.6	7.7 ± 5.9	3 ± 2	18.9 ± 19.4	2.1 ± 1.4	6.7 ± 7.7	1.8 ± 1.8	0.7 ± 1.2	1.9 ± 2.0	0.2 ± 0.5	*Shorea robusta, Acacia catechu, Trewia nudiflora*	*Lantana camara, Murraya paniculata, Clerodendron viscosum*

Haldwani	30.6 ± 12.6	11.2 ± 4.8	3.8 ± 1.8	16.9 ± 14.6	2 ± 1.3	15.0 ± 12.7	2.6 ± 1.8	0.7 ± 1.4	0.8 ± 1.2	0.3 ± 0.8	*Shorea robusta, Mallotus philippinensis, Tectona grandis*	*Clerodendron viscosum, Murraya paniculata, Millettia auriculata*
Champawat	21.1 ± 8.9	7.3 ± 3.3	2.8 ± 1.9	5.6 ± 7.5	1.2 ± 1.1	5.4 ± 4.6	1.7 ± 1.2	1.0 ± 1.2	0.1 ± 0.3	0.1 ± 0.3	*Shorea robusta, Mallotus philippinensis, Holoptelia integrifolia*	*Murraya paniculata, Lantana camara, Pogostemon parviflorus*
Pilibhit	21.7 ± 11.0	7.7 ± 4.1	2.4 ± 1.4	8.5 ± 8.5	1.1 ± 1	14.3 ± 10.6	2.3 ± 1.3	0.4 ± 0.9	1.0 ± 1.9	0.4 ± 0.9	*Shorea robusta, Mallotus philippinensis, Syzygium cumini*	*Millettia auriculata, Clerodendron viscosum, Helicteres isora*
Shahjahanpur	22.5 ± 4.6	7.3 ± 1.7	2.3 ± 0.7	-	-	3.6 ± 2.7	2.0 ± 1.1	0.3 ± 0.5	0.0 ± 0.0	0.1 ± 0.4	*Shorea robusta, Terminalia alata, Miliusa velutina*	No shrub in the sampled area
Kishanpur WLS	25.7 ± 13.9	9.2 ± 5.5	3.6 ± 1.8	7.9 ± 11.7	1 ± 1.1	9.7 ± 11.1	1.8 ± 1.4	0.6 ± 1.2	0.5 ± 1.2	0.9 ± 1.1	*Shorea robusta, Mallotus philippinensis, Syzygium cumini*	*Helicteres isora, Clerodendron viscosum, Glycosmis pentaphylla*
South Kheri	28.2 ± 9.9	10.8 ± 3.9	3.8 ± 1.5	5.2 ± 7	0.6 ± 0.7	14.1 ± 14.0	2.5 ± 1.5	0.5 ± 0.9	1.1 ± 1.7	0.4 ± 0.7	*Shorea robusta, Mallotus philippinensis, Syzygium cumini*	*Clerodendron viscosum, Glycosmis pentaphylla, Desmodium spp.*
Dudhwa NP	26.4 ± 10.8	8.1 ± 4.7	2.9 ± 1.3	7.3 ± 9.3	0.9 ± 0.8	8.6 ± 11.2	1.5 ± 1.3	0.3 ± 0.7	0.4 ± 1.0	0.6 ± 1	*Shorea robusta, Syzygium cumini, Mallotus philippinensis*	*Murraya paniculata, Clerodendron viscosum, Tiliacora acuminata*
North Kheri	14.6 ± 9.0	4.7 ± 3.2	2.1 ± 1.2	8 ± 8.4	1.3 ± 1.3	3.6 ± 4.1	0.9 ± 0.9	0.5 ± 1.1	3.1 ± 1.9	0.3 ± 0.7	*Acacia catechu, Dalbergia sissoo, Trewia nudiflora,*	*Murraya paniculata, Glycosmis pentaphylla, Solanum spp.*
Katerniaghat WLS	26.3 ± 10.9	8.8 ± 5.1	3.5 ± 1.4	11.8 ± 9.5	1.4 ± 0.9	9.2 ± 7.1	1.5 ± 0.9	1.0 ± 1.5	1.5 ± 2.0	0.7 ± 1.1	*Mallotus philippinensis, Shorea robusta, Acacia catechu*	*Glycosmis pentaphylla, Murraya paniculata, Clerodendron viscosum*
Shrawasti	20.7 ± 7.6	6.6 ± 3.1	2.9 ± 1.2	10.5 ± 8.5	1.2 ± 0.7	5.2 ± 4.5	1.1 ± 0.8	0.2 ± 1.0	1.1 ± 1.8	0.2 ± 0.6	*Tectona grandis, Mallotus philippinensis, Shorea robusta*	*Murraya paniculata, Glycosmis pentaphylla, Carissa opaca,*
Suhelwa WLS	24.6 ± 10.0	8.8 ± 3.7	3.8 ± 1.4	13.1 ± 10.1	1.5 ± 0.9	7.8 ± 6.6	1.8 ± 1.2	0.8 ± 1.3	7.0 ± 1.4	0.2 ± 0.5	*Mallotus philippinensis, Holoptelia integrifolia, Acacia catechu*	*Murraya paniculata, Clerodendron viscosum, Glycosmis pentaphylla*
Sohagibarwa WLS	28.8 ± 12.4	8.6 ± 5	2.7 ± 1.6	3.6 ± 5.5	0.6 ± 0.9	12.7 ± 12.0	2.3 ± 1.4	1.1 ± 1.6	1.6 ± 3.0	0.2 ± 1	*Shorea robusta, Syzygium cumini, Tectona grandis*	*Clerodendron viscosum, Carissa opaca, Millettia auriculata*
Valmiki TR	19.8 ± 8.3	5.2 ± 2.1	3.1 ± 1.3	8.8 ± 8.2	1.3 ± 0.9	5.1 ± 4.8	1.4 ± 1.2	0.2 ± 0.6	1.5 ± 1.9	0.5 ± 1.3	*Shorea robusta, Acacia catechu, Syzygium cumini*	*Clerodendron viscosum, Lantana camara, Pogostemon parviflorus*

Appendix VIII: Transects details, evidence of tiger and other wildlife species in TAL

Division / PA	Range	Transect name	Transect ID	Transect start point		Transect end point		Distance (km)	Tiger PMER (no./km)	Leopard PMER (no./km)	Frequency of occurrence (%)										
				Latitude	Longitude	Latitude	Longitude				Tiger	Leopard	Sambar	Chital	Nilgai	Barking deer	Wild pig	Hog deer	Swamp deer	Elephant	Sloth bear
Bijnor-Plantation	Jaffarabhat	Malan river	1	29.70358	78.42087	29.7317	78.43719	3.5	0	0.86	0	36	0	71	100	0	36	0	0	71	0
Bijnor-Plantation	Jaffarabhat	Riwady rau	2	29.69972	78.43139	29.74333	78.41000	5	0	0.6	0	30	20	5	65	0	10	0	0	50	0
Bijnor-Plantation	Kodia	Railway Station sot	3	29.67694	78.44528	29.71583	78.47444	3.8	0	0.53	0	13	0	67	73	20	73	0	0	67	0
Bijnor	Amargarh	Kotri rau	4	29.38667	78.88750	29.40861	78.90028	3.5	0.86	0.29	29	14	79	100	50	0	64	0	0	7	0
Bijnor	Badhapur	Dholkhand rau	5	29.54444	78.61944	29.53750	78.59889	1.5	0.67	0	17	0	0	100	100	0	0	0	0	67	0
Champawat	Boom	Batnagad upstream	6	29.12361	80.16222	29.14417	80.14861	3	0.33	0.33	20	10	0	0	0	0	0	0	0	0	0
Champawat	Boom	Kaligad upstream	7	29.11028	80.13500	29.13583	80.11917	3.5	0	0.29	0	14	0	0	0	0	0	0	0	0	0
Champawat	Boom	Jhuligad upstream	8	29.14056	80.17833	29.14750	80.17889	1.5	0.67	0	17	0	50	0	0	17	0	0	0	0	0
Champawat	Boom	Babligad	9	29.13361	80.18639	29.10972	80.16111	1.5	0.67	0	17	0	67	0	0	17	0	0	0	0	0
Champawat	Boom	Bhawanigad	10	29.12528	80.21500	29.12750	80.21167	1.5	0	0	0	0	17	0	0	17	50	0	0	0	0
Champawat	Boom	Gojigad	11	29.12694	80.22139	29.13000	80.22361	1	0	0	0	0	0	0	0	25	0	0	0	0	0
Champawat	Dugari	Sajgad nala	12	29.08944	80.01750	29.11500	80.01278	2.9	1.03	0.34	17	25	83	67	0	0	8	0	0	8	0
Corbett TR	Paterpani	Paterpani sot	13	29.52250	78.77806	29.52333	78.80583	5	1.2	0	35	0	100	95	0	10	20	0	0	80	0
Corbett TR	Jhirna	Dhara sot	14	29.46448	78.84829	29.48527	78.87007	5	1	0	25	0	90	90	0	0	0	0	0	20	5
Corbett TR	Jhirna	Kotri rau	15	29.44361	78.91972	29.45556	78.92778	4	1.25	0	31	0	100	88	0	6	31	0	0	81	0
Corbett TR	Jhirna	Jirna sot	16	29.45306	78.89472	29.48194	78.89472	4.8	1.04	0.42	74	11	84	47	0	47	47	0	0	68	0
Dehradun	Azaroori	Suk rau	17	30.28250	77.92000	30.24806	77.93472	4.7	0	0	0	0	5	74	0	21	89	0	0	0	0
Dehradun	Bharkot	Lalpani rau	18	30.16639	78.24000	30.14889	78.23500	2	0	0	0	0	88	100	0	13	0	0	0	13	0
Dehradun	Bharkot	Soni sot	19	30.09611	78.21111	30.08194	78.21556	2	0	1	0	50	100	100	0	0	0	0	0	25	0
Dehradun	Bharkot	Sandrabhaga river	20	30.12111	78.28000	30.16417	78.25611	6.4	0	0.31	0	15	35	50	0	0	0	0	0	81	0
Dehradun	Ramghar	Azaroogi rau	21	30.24444	77.97472	30.23722	77.96278	1.9	0	0.53	0	25	88	75	0	50	88	0	0	0	0

Dudhwa NP	Satiyana /Dudhwa	Forest road	22	28.53694	80.58278	28.50667	80.62194	5	0.4	0	80	0	50	100	0	0	75	0	0	0	0
Dudhwa NP	Gouriphanta	Forest road	23	28.64722	80.54417	28.62944	80.58472	5	0.2	0	5	0	0	0	55	0	95	0	0	0	0
Dudhwa NP	Dudhwa /Bankatti	Forest road	24	28.57167	80.59778	28.5875	80.63111	3.5	0.29	0	14	0	0	86	0	36	93	0	0	0	7
Dudhwa NP	Sonaripur	Forest road	25	28.42111	80.70000	28.46861	80.70500	5.3	0.38	0	76	0	81	100	0	0	67	0	0	0	38
Dudhwa NP	South Sonaripur	Forest road	26	28.46278	80.74000	28.50694	80.72111	5	0.4	0	5	0	0	90	55	0	55	10	0	0	0
Dudhwa NP	Belrayan	Forest road	27	28.42722	80.91000	28.39861	80.91833	3.9	0.51	0	81	0	25	100	19	0	100	0	0	0	0
Dudhwa NP	Belrayan	Forest road	28	28.37111	80.78722	28.41333	80.77889	5	0.2	0.2	10	10	25	100	10	0	75	35	0	0	25
Dudhwa NP	Belrayan	Forest road	29	28.40889	80.86694	28.42611	80.82444	5.2	0.38	0	10	0	0	100	14	0	100	10	0	0	5
Haldwani	Nandaur	Nandaur river	30	29.15667	79.71389	29.11611	79.71556	5	0	0	0	0	65	80	0	0	40	0	0	20	5
Haldwani	Nandaur	Nandaur ghati	31	29.16000	79.71583	29.16333	79.74583	5	0	0.2	0	5	20	0	0	0	0	0	0	25	0
Haldwani	Nandaur	Asni nala	32	29.15889	79.66250	29.1375	79.64611	5	0.2	0.2	20	15	90	75	20	10	0	0	0	70	0
Haldwani	Jualasal	Bhargot rau	33	29.05694	79.88194	29.09278	79.89472	5	0.2	0.6	5	30	90	30	15	10	30	0	0	0	0
Haldwani	Jaulasal	Lebar nala	34	29.06000	79.92556	29.08056	79.91667	3	0.67	0.33	33	42	92	8	0	25	17	0	0	0	0
Haldwani	Jualasal	Kachham nala	35	29.09056	79.74722	29.12111	79.75000	4.5	0	0.67	0	17	50	83	0	0	0	0	0	0	0
Haldwani	Jualasal	Raila nala	36	29.07444	79.80306	29.10028	79.79611	4.3	0	0.47	0	29	82	41	0	0	24	0	0	0	12
Haldwani	Sarda	Kalonia rau	37	29.08583	80.08944	29.05500	80.04139	4.3	0.23	0.47	6	35	24	24	59	0	24	0	0	65	6
Haldwani	Sarda	Bhumiyagar nala	38	29.08694	80.05639	29.06167	80.07861	4	1	0.25	38	6	75	69	6	0	0	0	0	19	0
Haldwani	Sarda	Kirora rau	39	29.09444	80.11389	29.12111	80.08056	4.8	0	0.21	0	5	53	16	26	0	11	0	0	0	0
Haldwani	Sarda	Dulagarh nala	40	29.05056	79.97139	29.06417	79.99167	3	2	0.33	27	8	92	8	0	25	25	0	0	42	0
Haldwani	Chakata	Parla sot	41	29.19972	79.59528	29.18472	79.60111	3	0	0.33	0	42	50	67	0	50	33	0	0	17	0
Haldwani	Chakata	Porjia nala	42	29.16500	79.64528	29.18639	79.66111	5	0.4	0.4	15	15	90	75	0	20	0	0	0	25	10
Haldwani	Chakata	Seljam nala	43	29.17778	79.62806	29.21222	79.6525	5	0.2	0.4	5	10	100	45	0	5	5	0	0	60	50
Haldwani	Sarda	Jagpur-downstream	44	28.97667	80.05667	28.95139	80.08611	2	0	0.5	0	13	0	0	0	0	0	0	0	0	0
Haldwani	Sarda	Jagpur-upstream	45	28.97667	80.05667	29.00083	80.05806	3	0	0	0	0	0	0	25	0	83	0	0	0	0
Haldwani	Sarda	Sarda islands-downstream	46	29.03583	80.11972	28.99611	80.11361	4	0	0.25	0	6	0	6	0	6	25	0	0	0	0

Haldwani	Sarda	Sarda islands-upstream	47	29.03583	80.11972	29.08611	80.11944	4	0	0	0	0	0	0	0	6	19	0	0	0	0
Haridwar	Haripur	Rhaghati sot	48	30.08213	77.92384	30.04280	77.90758	5	0	0.4	0	15	35	40	95	15	95	0	0	35	0
Haridwar	Shampur	Mundal sot	49	29.88194	78.18778	29.87611	78.18056	1.6	0	1.25	0	29	29	71	71	0	100	0	0	86	0
Haridwar	Shampur	Simbal sot	50	29.86722	78.19000	29.88500	78.22167	4.4	0	0.68	0	67	50	61	22	0	44	0	0	50	0
Haridwar	Shampur	Paperi sot	51	29.85583	78.18750	29.87444	78.22472	5	0	0.8	0	25	25	85	30	0	0	0	0	80	0
Haridwar	Shampur	Sidh sot	52	29.90611	78.17750	29.91028	78.21306	5	0	0.4	0	20	80	90	10	5	40	0	0	30	0
Haridwar	Shampur	Ravasan sot	53	29.8104	78.24162	29.82974	78.22514	4	0	0.75	0	25	0	69	88	0	63	0	0	56	0
Haridwar	Shampur	Chandi nala	54	29.94611	78.17444	29.93250	78.20528	4	0	0.25	0	13	100	100	0	6	100	0	0	88	0
Kalagarh	Sonanadi	Dholkhand rau	55	29.56083	78.62056	29.5375	78.59889	3	1	0.67	25	33	83	100	100	0	67	0	0	92	8
Kalagarh	Sonanadi	Morgatti sot	56	29.55583	78.62917	29.54056	78.61278	2	0	1	0	63	75	100	38	0	0	0	0	63	0
Kalesar WLS	Kalesar	Barakhol rau	57	30.33583	77.57250	30.34639	77.55611	3	0	1	0	25	100	8	0	50	75	0	0	0	0
Kalesar WLS	Chhachrauli	Chikenkhol rau	58	30.38389	77.49500	30.39611	77.50944	2.9	0	0	0	0	83	83	8	75	0	0	0	0	0
Kalesar WLS	Kalesar	Sukh rau	59	30.37528	77.56556	30.38750	77.53889	3	0	0.67	0	17	100	100	92	0	50	0	0	0	0
Katerniaghat WLS	Katerniaghat	Forest road	60	28.28056	81.03833	28.27389	81.04444	1.4	0	0	0	0	0	0	67	0	83	0	0	0	0
Katerniaghat WLS	Murtiah	Forest road	61	28.11472	81.31250	28.15778	81.29194	5	0.2	0.2	5	5	0	65	10	0	50	0	0	0	0
Katerniaghat WLS	Kakraha	Forest road	62	28.09972	81.31944	28.11000	81.30000	2	0	0	0	0	0	88	88	0	88	13	0	0	0
Katerniaghat WLS	Motipur	Forest road	63	28.05556	81.34528	28.03889	81.32361	3	0.33	0	8	0	0	92	58	0	92	0	0	0	0
Katerniaghat WLS	Dharmapur	Forest road	64	28.21139	81.24500	28.22167	81.29417	5	0	0	0	0	0	60	30	0	50	0	0	0	0
Katerniaghat WLS	Katerniaghat	Forest road	65	28.34417	81.12083	28.35500	81.08472	4.5	0.22	0	6	0	0	0	0	0	0	89	0	89	0
Katerniaghat WLS	Nishangara	Forest road	66	28.26167	81.20972	28.26861	81.17639	5	0.2	0	50	0	0	90	0	0	100	0	0	0	0
Katerniaghat WLS	Nishangara	Forest road	67	28.26167	81.20972	28.28167	81.22972	3.5	0	0	0	0	0	36	14	0	21	0	0	0	0
Katerniaghat WLS	Katerniaghat	Gaura river	68	28.33972	81.19111	28.34944	81.18750	1.3	2.31	0	40	0	40	100	0	0	100	0	0	60	0
Kishanpur WLS	Mailani	Forest road	69	28.33361	80.36639	28.37861	80.35028	5	0.2	0	15	0	0	55	45	0	80	0	0	0	0
Kishanpur WLS	Kishanpur	Forest road	70	28.43861	80.34056	28.39444	80.38056	5	0.4	0	30	0	0	100	100	0	100	0	0	0	0
Kishanpur WLS	Kishanpur	Sarda river-downstream	71	28.40639	80.43861	28.37750	80.47250	5	0.8	0	70	0	0	75	0	0	85	0	0	0	0

Kishanpur WLS	Kishanpur	Sarda-upstream	72	28.43861	80.4075	28.45139	80.41667	5	0.8	0	70	0	0	100	0	0	100	95	100	0	0
Kishanpur WLS	Kishanpur	Forest road	73	28.33444	80.44861	28.36667	80.43972	3.6	0.28	0	7	0	0	100	100	0	93	0	0	0	0
Kishanpur WLS	Kishanpur	Forest road	74	28.36667	80.43972	28.37528	80.4275	1.5	0	0	0	0	0	50	67	0	50	0	0	0	0
Lansdowne	Kotri	Nimbu sot	75	29.70139	78.57083	29.69139	78.60389	5	0.8	0.2	65	5	100	75	0	0	90	0	0	100	0
Lansdowne	Kotri	Khewgard rau	76	29.71194	78.58556	29.72917	78.59056	2.2	0.91	0	22	0	100	100	0	0	0	0	0	89	0
Lansdowne	Kotri	Labbar sot	77	29.70139	78.57083	29.68222	78.56861	4.9	0.82	0.41	100	11	84	84	0	0	84	0	0	84	0
Lansdowne	Dugadda	Kho river	78	29.75639	78.54306	29.78361	78.57611	5	0	0.2	0	20	80	0	0	80	65	0	0	80	0
Lansdowne	Kotri	Sarkada sot	79	29.64250	78.53722	29.65111	78.54861	3.5	0	0.29	0	21	79	0	0	36	0	0	0	93	0
Lansdowne	Kotri	Saneh Nadi	80	29.69361	78.52861	29.71250	78.55361	5	0.2	0.2	5	5	100	5	0	85	40	0	0	100	0
Lansdowne	Kotdwar	Gujjar sot	81	29.61472	78.55889	29.62056	78.57194	4.5	0.22	0.22	17	6	89	72	0	33	0	0	0	89	0
Lansdowne	Kotri	Pakhrao	82	29.59500	78.57250	29.61694	78.59111	5	0.2	0.2	10	25	90	45	5	80	5	0	0	85	0
Lansdowne	Kotdwar	Giwain sot	83	29.75806	78.52750	29.78444	78.53444	4.8	0.21	0	5	0	42	0	0	5	11	0	0	21	0
Lansdowne	Kotdwar	Suka rau	84	29.76361	78.50139	29.77889	78.52583	5	0.2	0.2	15	10	50	0	0	25	5	0	0	40	0
Lansdowne	Laldhang	Ravasan river	85	29.85722	78.31861	29.85889	78.34583	4.3	0.23	0.23	6	12	12	18	0	0	0	0	0	24	0
Lansdowne	Laldhang	Maili sot	86	29.80417	78.35278	29.82361	78.36889	4	0.25	0.25	6	38	6	6	0	0	0	0	0	75	0
Lansdowne	Laldhang	Chawariya sot	87	29.81528	78.33083	29.83694	78.34361	4.3	0	0.23	0	35	0	0	18	0	47	0	0	12	0
Lansdowne	Kotdwar	Malan river	88	29.79389	78.45972	29.81056	78.46139	3.8	0	0	0	0	0	0	0	0	0	0	0	0	0
Lansdowne	Laldhang	Nalgaddi sot	89	29.80083	78.35389	29.80694	78.38611	4.5	0	0.22	0	28	0	17	0	11	0	0	0	50	0
North Kheri	Palyia	Sarda-upstream	90	28.43611	80.44972	28.46278	80.41000	5	0.8	0	15	0	0	0	15	0	60	0	0	0	0
North Kheri	Palyia	Sarda-downstream	91	28.43389	80.44917	28.39583	80.46528	5	1	0	60	0	75	85	20	0	50	0	0	0	0
North Kheri	Palyia	Sarda-upstream	92	28.46778	80.40528	28.48667	80.36333	5	0.4	0	10	0	40	45	75	0	30	0	0	0	0
North Kheri	Palyia	Paraspur-FR	93	28.47278	80.44806	28.48722	80.45111	4.3	0	0.23	0	11	0	39	44	0	72	0	0	0	0
North Kheri	Sampurnanagar	Sarda-downstream	94	28.76333	80.20694	28.76611	80.17167	2	1	0.5	38	13	0	63	88	0	100	0	0	0	0
North Kheri	Sampurnanagar	Sarda-downstream	95	28.74667	80.22194	28.70583	80.21917	7.5	0.53	0	37	0	0	87	13	0	87	0	0	0	0
North Kheri	Sampurnanagar	Sarda-downstream	96	28.70778	80.23833	28.69083	80.28028	5	0	0	0	0	0	40	80	0	95	0	0	0	0

North Kheri	North Nighasan	Forest road	97	28.36889	80.86972	28.36806	80.8225	5	0.4	0	5	0	0	70	65	0	90	0	0	0	5
North Kheri	North Nighasan	Batuwa-FR	98	28.29167	80.98833	28.28000	80.97667	1.8	0	0.56	0	14	0	71	71	0	29	0	0	0	0
North Kheri	North Nighasan	Latua-FR	99	28.30000	81.00722	28.29250	80.99167	2	0	0	0	0	0	38	100	0	13	0	0	0	0
North Kheri	North Nighasan	Majra-FR	100	28.28361	81.02583	28.28056	81.03833	1.6	0	0	0	0	0	0	14	0	86	0	0	0	0
North Kheri	North Nighasan	Bahira-FR	101	28.26278	80.99583	28.26056	81.02028	3.2	0	0	0	0	0	69	69	0	23	0	0	0	0
Narendra Nagar	Bhageerathi	Kara sot	102	30.14139	78.29694	30.14889	78.30000	2.7	0	0.37	0	9	9	27	0	0	0	0	0	0	0
Pilibhit	Barahi	Sarda river	103	28.81444	80.11472	28.84639	80.12194	4	0.25	0.25	13	31	75	63	81	0	88	0	0	56	0
Pilibhit	Barahi	Sarda river	104	28.81472	80.11417	28.77361	80.13889	5	0	0.2	0	30	0	5	0	0	25	0	0	20	0
Pilibhit	Mahof	Forest road	105	28.69028	80.06750	28.69444	80.02028	5	0.4	0	35	0	0	85	95	0	90	0	0	0	0
Pilibhit	Mahof	Forest road	106	28.70083	79.99500	28.70917	79.96500	3	0.33	0	8	0	8	100	67	0	100	0	0	0	0
Pilibhit	Mahof	Forest road	107	28.71389	79.95833	28.69444	79.94444	9.1	0.33	0	33	0	0	100	86	44	100	0	0	0	0
Pilibhit	Mala	Forest road	108	28.66250	79.94278	28.62306	79.93111	4.3	0.23	0	6	0	0	100	100	0	76	0	0	0	18
Pilibhit	Mala	Forest road	109	28.62500	79.93861	28.59917	79.92889	2.7	0	0	0	0	0	64	100	0	82	0	0	0	18
Pilibhit	Mala	Forest road	110	28.58806	79.93389	28.55500	79.97278	5	0.2	0	10	0	10	95	45	0	95	0	0	0	10
Pilibhit	Barahi	Forest road	111	28.68139	80.13444	28.64361	80.16722	5.7	0.35	0	26	0	0	100	100	0	100	0	0	0	0
Pilibhit	Mahof	Forest road	112	28.74833	80.08639	28.72917	80.07083	2.6	1.15	0	36	0	9	100	27	9	73	0	9	0	9
Pilibhit	Mahof	Forest road	113	28.72917	80.07083	28.77389	80.05917	5	0.4	0	20	0	0	95	35	0	90	5	0	0	0
Pilibhit	Barahi	Forest road	114	28.68306	80.13278	28.70583	80.15194	3	0.33	0	17	0	0	100	0	0	100	0	0	0	0
Pilibhit	Barahi	Forest road	115	28.64500	80.16861	28.66806	80.19139	3.1	0.65	0.32	15	8	0	85	8	0	92	0	0	0	0
Pilibhit	Deoria	Forest road	116	28.34889	79.97528	28.36556	79.94278	3.6	0	0	0	0	0	7	80	0	27	13	0	0	0
Pilibhit	Deoria	Forest road	117	28.33472	79.97167	28.30750	79.96111	3.3	0	0	0	0	0	85	85	8	62	0	0	0	0
Pilibhit	Deoria	Forest road	118	28.43528	79.99778	28.39000	79.97833	5	0	0	0	0	0	25	100	0	95	0	0	0	0
Pilibhit	Deoria	Forest road	119	28.48944	79.99806	28.49528	80.03556	4.3	0	0	0	0	0	71	100	0	100	0	0	0	0
Pilibhit	Haripur	Forest road	120	28.50806	80.29083	28.50500	80.2575	3.3	0.91	0	31	0	0	100	100	0	100	0	0	0	0
Pilibhit	Barahi	Forest road	121	28.57111	80.23278	28.57917	80.20722	5	0.2	0	5	0	0	80	95	0	100	0	0	0	0

Pilibhit	Haripur	Forest road	122	28.56722	80.25056	28.56694	80.29000	3.7	0	0	0	0	0	100	47	0	100	0	0	0	0
Pilibhit	Haripur	Forest road	123	28.46861	80.28667	28.46639	80.30778	2	0	0	0	0	0	50	75	0	63	0	0	0	0
Pilibhit	Haripur	Forest road	124	28.46639	80.30778	28.49611	80.3075	3.1	0.32	0	8	0	0	100	85	0	100	0	0	0	0
Ramnagar	Fatepur	Bhakra-upstream	125	29.26806	79.42222	29.23917	79.41722	3.7	0.27	0	7	0	13	40	67	0	0	0	0	7	0
Ramnagar	Fatepur	Bhakra-downstream	126	29.27306	79.42194	29.29667	79.42972	3.2	0	0.31	0	15	85	54	23	0	54	0	0	0	0
Ramnagar	Fatepur	Machhiyagat sot	127	29.26417	79.45778	29.27333	79.48194	3.5	0	0.29	0	7	93	0	0	50	7	0	0	0	0
Ramnagar	Fatepur	Nihal Nadi	128	29.27583	79.39944	29.30139	79.40333	3	1	0.33	42	8	83	100	67	17	17	0	0	0	0
Ramnagar	Kaladungi	Gumiyapani river	129	29.30222	79.37028	29.31833	79.36694	2.5	1.2	0	30	0	90	0	0	0	0	0	0	10	0
Ramnagar	Kaladungi /Dechurie	Baur river	130	29.24972	79.32083	29.22167	79.30194	4	0.5	0.25	38	19	50	50	44	13	25	0	0	0	0
Ramnagar	Kaladungi	Bour river	131	29.30694	79.33833	29.33500	79.33472	5	0.4	0.2	20	15	95	50	0	0	55	0	0	30	0
Ramnagar	Koshi	Koshi river	132	29.55361	79.14083	29.54389	79.11222	3	0.67	0	25	0	75	83	0	0	33	0	0	0	0
Ramnagar	Koshi	Koshi river	133	29.51444	79.11778	29.54444	79.11167	5	0.8	0	15	0	95	95	10	0	95	0	0	0	0
Ramnagar	Koshi	Koshi river	134	29.41722	79.13222	29.45389	79.14944	5	0.8	0	35	0	70	90	80	0	25	0	0	10	0
Ramnagar	Kota	Bangajala nala	135	29.4725	79.16389	29.46111	79.19972	5	0.6	0.2	45	5	95	95	20	30	20	0	0	10	0
Ramnagar	Kota	Kolygard sot	136	29.41611	79.21806	29.43028	79.24833	4	1	0.5	50	13	100	100	0	0	94	0	0	0	0
Ramnagar	Kota	Chahal sot	137	29.40833	79.22861	29.41722	79.26222	5	0.6	0.2	25	5	100	100	0	45	45	0	0	0	0
Ramnagar	Dechewrie	Dhapka river	138	29.37222	79.24806	29.40194	79.28028	5	0	0.8	0	40	85	35	0	0	40	0	0	0	0
Ramnagar	Dechewrie	Katcharpani sot	139	29.34278	79.23861	29.36444	79.26111	4.5	0	0.22	0	6	83	11	0	56	67	0	0	0	0
Ramnagar	Dechewrie	Timalia nala	140	29.36722	79.22111	29.37806	79.23167	2	0	0.5	0	13	75	38	0	0	0	0	0	0	0
Rajaji NP	Dholkhand	Sambawali sot	141	30.09866	77.98703	30.10856	78.02581	5	0.6	0.4	20	20	95	100	0	0	0	0	0	20	0
Rajaji NP	Dholkhand	Guleria sot	142	30.10417	77.99028	30.11750	78.02694	5	0.4	0.4	25	25	90	100	0	25	30	0	0	35	0
Rajaji NP	Dholkhand	Dholkhand sot	143	30.09878	77.98663	30.12642	78.02097	5	0.8	0.2	25	5	95	100	0	5	0	0	0	25	0
Rajaji NP	Motichur	Ganges-Motichur	144	30.00083	78.21306	30.03111	78.24750	2.6	0	0.38	0	20	60	60	0	0	60	0	0	0	0
Rajaji NP	Kansrau	Kansa rau	145	30.08833	78.14444	30.07250	78.16694	3.3	0	0.61	0	46	85	92	0	0	92	0	0	0	0
Rajaji NP	Chilla	Ganges-temple	146	29.98389	78.22111	30.02306	78.25167	5.9	0	0.85	0	50	79	92	0	0	21	0	0	13	0

Rajaji NP	Kotri	Binj rau	147	30.03250	78.27611	30.00528	78.29389	3.8	0.53	0.79	27	27	100	100	7	7	33	0	0	47	0
Rajaji NP	Chilla	Dhogudda sot	148	30.03750	78.13944	30.05278	78.28056	4.5	0.44	0.22	11	17	94	100	6	0	61	0	0	39	0
Rajaji NP	Mohand	Thanda sot	149	30.21444	77.93806	30.20639	77.90972	3	0	1	0	92	83	25	0	33	83	0	0	8	0
Rajaji NP	Haridwar	Ranipur-choki rau	150	29.97000	78.10806	29.98139	78.11667	3.3	0	0.61	0	38	100	100	0	0	38	0	0	0	0
Rajaji NP	Haridwar	Ranipur rau	151	29.96333	78.10528	29.96222	78.13639	5	0	0.4	0	25	95	85	15	15	25	0	0	55	0
Rajaji NP	Chilla	Ghara sot	152	29.9525	78.26556	29.66389	78.44389	3.5	0.57	1.14	14	57	93	93	0	0	86	0	0	93	0
Rajaji NP	Chilla	Amgadi sot	153	29.94194	78.27611	29.95528	78.31472	5	0.6	0.4	65	40	95	95	0	0	55	0	0	100	0
Rajaji NP	Chilla	Jabhar dhaba	154	29.96889	78.24611	29.96944	78.28194	3.9	0	0.26	0	6	100	100	0	0	38	0	0	19	0
Rajaji NP	Chilla	Mundal sot	155	29.9725	78.22278	29.95500	78.26000	5	0.2	0.6	20	45	85	100	45	0	50	0	0	90	0
Rajaji NP	Haridwar	Bhag rau	156	29.97278	78.16167	29.99639	78.13528	3.5	0	0.29	0	21	100	86	0	0	0	0	0	100	0
South Kheri	Mailani	Forest road	157	28.42472	80.41000	28.40278	80.42222	5.3	0.19	0	5	0	43	100	100	0	100	0	0	0	0
South Kheri	Mailani	Forest road	158	28.33833	80.32250	28.13056	80.30639	5	0.2	0	10	0	0	55	100	0	20	0	0	0	0
South Kheri	Mailani	Forest road	159	28.18722	80.33528	28.21667	80.36556	4.3	0	0	0	0	0	56	94	0	94	0	0	0	0
South Kheri	Bhira	Forest road	160	28.18722	80.33528	28.20778	80.51861	5	0.6	0	10	0	0	75	100	0	100	0	0	0	0
South Kheri	Bhira	Forest road	161	28.25778	80.47694	28.30056	80.45917	5	0.2	0	25	0	0	20	100	0	95	0	0	0	0
South Kheri	Gola	Forest road	162	28.32833	80.49417	28.32833	80.49278	3.3	0	0	0	0	0	0	100	0	0	0	0	0	0
South Kheri	Gola	Forest road	163	28.14083	80.50833	28.15167	80.52667	3	0	0.33	0	8	0	8	100	0	83	0	0	0	0
Shahjhanpur	Khuttar	Forest road	164	28.39083	80.33889	28.41	80.33444	5	0	0	0	0	0	25	100	0	30	0	0	0	0
Shahjhanpur	Khuttar	Forest road	165	28.37167	80.33278	28.33833	80.34694	4.2	0	0	0	0	0	59	100	0	65	0	0	0	0
Shivalik	Mohand	Lallukhoda nala	166	30.17667	77.88972	30.19556	77.89972	3.3	0	0.61	0	15	85	38	0	0	0	0	0	8	0
Shivalik	Mohand	Hathini sot	167	30.18889	77.84361	30.21083	77.85556	3.7	0.27	0.54	14	21	71	71	14	0	14	0	0	7	0
Shivalik	Barakala	Sanshara rau	168	30.23556	77.75361	30.26972	77.77111	3.5	0	0.86	0	29	86	79	0	0	29	0	0	0	0
Shivalik	Barakala	Khotri rau	169	30.22667	77.76861	30.24694	77.79889	5	0.2	0.4	15	35	90	70	0	30	45	0	0	0	0
Shivalik	Barakala	Barbla rau	170	30.26306	77.69694	30.28194	77.73222	5	0	0.6	0	60	55	40	5	5	10	0	0	40	0
Shivalik	Barakala	Chapri sot	171	30.30639	77.64861	30.31250	77.67639	5	0.6	0.4	15	30	65	60	0	5	30	0	0	65	0

Shivalik	Barakala	Karoandi rau	172	30.37361	77.60833	30.37583	77.64417	5	0.4	0.6	5	65	100	50	0	60	95	0	0	0	0
Shrawasti	Bhinga	Forest road	173	27.75825	81.99368	27.74211	81.98714	2	0	0	0	0	0	0	63	0	25	0	0	0	0
Shrawasti	Bhinga /Kakardhari	Forest road	174	27.77583	81.90292	27.77538	81.93882	2	0	0.5	0	13	0	0	0	0	38	0	0	0	0
Shrawasti	Bhinga	Forest road	175	27.72062	81.90891	27.72586	81.98065	2	0	0.5	0	13	0	0	25	0	38	0	0	0	0
Sohagibarwa WLS	North Chauk	Payas-downstream	176	27.34028	83.55306	27.32667	83.52889	5	0	0	0	0	15	65	70	0	100	0	0	0	0
Sohagibarwa WLS	Madhuvalia	Payas-upstream	177	27.33444	83.57694	27.36194	83.60000	5	0.4	0	20	0	25	85	80	0	0	50	0	0	0
Sohagibarwa WLS	North chauk	Forest road	178	27.36556	83.55389	27.37389	83.51611	4.2	0	0	0	0	0	53	59	0	82	0	0	0	0
Sohagibarwa WLS	Nicahlaul	Forest road	179	27.27278	83.79278	27.24889	83.7625	4.8	0	0	0	0	0	15	70	0	85	0	0	0	0
Sohagibarwa WLS	Nicahlaul	Little Gandek	180	27.31972	83.77417	27.28389	83.74639	5	0	0	0	0	0	55	95	0	0	0	0	0	0
Sohagibarwa WLS	Nicahlaul	Gandek-downstream	181	27.32139	83.84194	27.28444	83.82889	5	0.2	0.2	10	20	5	70	70	5	40	5	0	0	0
Sohagibarwa WLS	Pakri	Rihai nala-upstream	182	27.13639	83.45444	27.15806	83.46389	5	0	0.2	0	10	0	35	60	0	95	0	0	0	0
Sohagibarwa WLS	Pakri	Rihai nala-downstream	183	27.13528	83.45083	27.11944	83.42389	5	0	0	0	0	0	0	75	0	0	0	0	0	0
Sohagibarwa WLS	Lakshmipur	Rohini/Payas	184	27.25139	83.49056	27.23139	83.47306	4.5	0	0	0	0	17	39	28	0	0	0	0	0	0
Sohagibarwa WLS	Shivpur	FR/trail	185	27.30211	83.93102	27.27221	83.91628	4.2	0	0	0	0	0	6	0	0	0	0	0	0	0
Suhelwa WLS	Suhelwa-west	Bhavuva nala	186	27.87472	82.04722	27.90889	82.06306	5	0	0.2	0	20	15	65	15	0	100	0	0	0	0
Suhelwa WLS	Suhelwa-west/east	Baisahi nala	187	27.84944	82.08361	27.88250	82.11139	5.5	0	0.18	0	5	36	86	5	0	64	0	0	0	0
Suhelwa WLS	Suhelwa-west	Gongri nala	188	27.90722	81.96750	27.92222	81.97722	3.5	0	0.29	0	14	64	29	21	0	29	0	0	0	0
Suhelwa WLS	Suhelwa-east	Sonpathiri nala	189	27.8175	82.13083	27.84750	82.14500	5	0.2	0.2	10	5	45	65	40	0	80	0	0	0	0
Suhelwa WLS	Suhelwa-east	Hathikunda nala	190	27.78722	82.17972	27.80111	82.19972	5	0.8	0.2	25	5	20	95	20	0	95	0	0	0	0
Suhelwa WLS	Banketwa	Hingaha nala	191	27.76306	82.20833	27.79000	82.23500	5	0.2	0	5	0	5	10	25	5	90	0	0	0	0
Suhelwa WLS	Barahwa	Amha nala	192	27.71944	82.30917	27.75417	82.32222	5	0	0.2	0	20	85	60	60	0	25	0	0	0	0
Suhelwa WLS	Tulsipur	Gauraw nala	193	27.64722	82.43417	27.68528	82.44556	5	0.2	0.4	5	10	70	85	10	15	35	0	0	0	0
Suhelwa WLS	Tulsipur	Siriya nala	194	27.67000	82.39000	27.71250	82.39139	5.5	0	0.55	0	18	5	14	86	0	18	0	0	0	0
Suhelwa WLS	Banketwa	Jamdhara nala	195	27.72583	82.26667	27.75500	82.26833	5	0	0.2	0	10	15	25	5	0	90	0	0	0	0
Suhelwa WLS	Bhambhar	Barava nala	196	27.71000	82.67528	27.67417	82.69083	6	0.17	0	8	0	29	42	0	63	67	0	0	0	0

Suhelwa WLS	Rampur	Musi nala	197	27.65000	82.57306	27.67278	82.57778	4.2	0.48	0	12	0	47	18	18	0	35	0	0	0	0
Suhelwa WLS	Rampur	Dhara nala	198	27.68806	82.52722	27.64861	82.53417	5	0.2	0	5	0	10	35	85	15	70	0	0	0	0
Terai Central	Gadgadia	Nihal rau	199	29.21500	79.35222	29.17778	79.34056	4.5	0.89	0.44	44	11	100	78	22	6	50	0	0	0	0
Terai Central	Gadgadia	Bhakra rau	200	29.22722	79.40611	29.19250	79.38611	5	0	0.4	0	10	0	15	95	0	5	0	0	10	0
Terai Central	Bahrani	Baur river	201	29.21889	79.29833	29.18361	79.27028	5	0.2	0	5	0	5	40	70	0	0	0	0	0	0
Terai Central	Gadgadia	Bhakra rau	202	29.15528	79.37806	29.18861	79.38417	5	0.2	0.2	5	15	0	20	100	0	0	0	0	0	0
Terai Central	Bahrani	Baur river	203	29.24972	79.32083	29.22167	79.30194	4	0.5	0.25	38	19	38	56	50	19	25	0	0	0	0
Terai Central	Pipelparao	Bhakra rau	204	29.15417	79.36556	29.12083	79.35389	3.9	0	0.51	0	13	81	6	88	0	88	0	0	0	0
Terai Central	Pipelparao	10 no.nala	205	29.08778	79.39556	29.10222	79.41306	3.5	0	0	0	0	0	0	100	0	93	0	0	0	0
Terai Central	Thanda	Ganga patia	206	29.03472	79.50778	29.03028	79.50778	2.5	0	0.4	0	10	0	0	90	0	0	0	0	10	0
Terai Central	Haldwani	Fireline	207	29.11139	79.46694	29.08583	79.44361	4.9	0.2	0.2	5	5	0	75	85	0	0	0	0	0	0
Terai Central	Bahrani	Gadappu nala	208	29.24000	79.27500	29.22583	79.24333	5.1	0	0	0	0	0	0	100	0	75	0	0	0	0
Terai East	Surai	Forest road	209	28.79528	80.01278	28.83139	80.01139	5	0.2	0.2	30	10	0	60	0	30	60	0	0	0	0
Terai East	Surai	Fire line	210	28.80750	79.98056	28.80583	79.93722	5	0	0.2	0	5	0	75	45	0	75	0	0	0	0
Terai East	Surai	40-Choraha	211	28.79639	80.01083	28.74972	80.03028	4.1	0.49	0.24	29	6	24	24	76	0	94	0	0	0	0
Terai East	Kishanpur	Katna nala	212	29.07028	79.61778	29.05722	79.62861	2.2	0	0	0	0	100	0	0	0	89	0	0	0	0
Terai East	Doli	Forest road	213	29.07250	79.59028	29.07472	79.61083	5	0	0	0	0	0	40	15	0	0	0	0	0	0
Terai East	Ransali	Dedwa rau	214	29.06056	79.74556	29.04250	79.76278	3.5	0	0	0	0	29	100	100	0	100	0	0	0	0
Terai East	Kishanpur	Sukhi Nadi	215	29.06972	79.64889	29.10722	79.65139	5	0.6	0.2	25	15	10	100	95	25	40	0	0	0	0
Terai East	Katima	Jagpura rau	216	28.96556	80.06000	28.93167	80.06806	5	0	0.6	0	45	0	25	45	0	60	0	0	0	0
Terai East	Kilpura	Lohia nala	217	29.01417	79.99417	29.04083	80.00444	4.1	0.73	0.24	41	6	76	82	0	12	24	0	0	41	0
Terai East	Kilpura	East Kilpura	218	29.00806	80.01472	29.01806	80.05	4.3	0.23	0.47	6	24	76	82	29	0	6	0	0	41	0
Terai East	Jaulasal-south	Bhargath nala	219	29.07194	79.78444	29.03861	79.77667	5	0	0.2	0	0	0	0	0	0	0	0	0	0	0
Terai East	Ransali	Hatgad nala	220	29.06444	79.70361	29.04111	79.70472	5	0	0	0	0	20	45	5	205	0	0	0	20	0
Terai East	Ransali	Kailash river	221	29.05417	79.88056	29.03028	79.87	5	0	0	0	25	0	0	0	0	5	0	0	0	0

Terai West	Belparao	Karkat nala	222	29.33694	79.23111	29.31083	79.21361	4	0.75	0.25	25	25	63	75	0	69	75	0	0	0	6
Terai West	Belparao	Dhapka river	223	29.35139	79.16333	29.35833	79.19556	3	0.33	1	8	25	58	100	75	0	92	0	0	0	0
Terai West	Belparao	Chumakhan nala	224	29.29528	79.25472	29.31306	79.27972	5	0.4	0	15	0	85	90	40	0	25	0	0	0	0
Terai West	Bannabhera	Gadappu nala	225	29.24111	79.27583	29.27250	79.30111	5	0	0.2	0	5	0	5	100	0	75	0	0	0	0
Terai West	Ampokra	Dhela rau	226	29.34750	79.00750	29.39667	79.01528	5	0.4	0.2	15	5	65	75	55	0	65	0	0	0	0
Terai West	North Jaspur	Pikha pathi	227	29.38917	78.90306	29.39361	78.90583	1	1	1	25	25	0	100	100	0	75	0	0	0	0
Terai West	Ampokra	Patharuva nala	228	29.36139	78.97556	29.39417	78.97556	4.7	0.21	0.43	11	32	42	84	74	0	53	0	0	37	0
Valmiki TR	Manguraha	FR/trails	229	27.31526	84.5426	27.33837	84.55674	4.5	0.22	0.44	6	17	56	67	0	0	0	0	0	0	0
Valmiki TR	Manguraha	Pandai river	230	27.33431	84.60908	27.32863	84.57514	5	0	0.2	0	5	10	0	15	0	45	0	0	0	0
Valmiki TR	Manguraha	FR/trails	231	27.27017	84.62654	27.26311	84.64967	5	0	0	0	0	0	0	10	0	50	0	0	0	0
Valmiki TR	Manguraha	FR/trails	232	27.26295	84.66951	27.25034	84.65525	2	0	0.5	0	13	0	100	13	0	0	0	0	0	13
Valmiki TR	Manguraha /Govardhana	Gidahi	233	27.32090	84.47874	27.34138	84.46012	5	0	0.2	0	5	65	35	10	15	0	0	0	0	10
Valmiki TR	Govardhana	Pathygar rau	234	27.31141	84.41609	27.32554	84.4165	3	0	0.33	0	8	83	83	25	0	25	0	0	0	0
Valmiki TR	Manguraha	Ammoha Nadi	235	27.30835	84.51558	27.31961	84.4958	4	0	0	0	0	25	0	19	75	0	0	0	0	56
Valmiki TR	Govardhana	Sukada nala	236	27.3184	84.34507	27.32912	84.34602	1.5	0.67	0	17	0	67	67	17	0	0	0	0	0	17
Valmiki TR	Raghia	Bhakna Nadi	237	27.32969	84.27427	27.3545	84.27562	3.6	0.28	0	57	0	86	7	0	50	0	0	0	0	57
Valmiki TR	Raghia	Bichuri river	238	27.38956	84.19798	27.40806	84.20172	3	0	0.33	0	8	17	0	0	67	42	0	0	0	0
Valmiki TR	Govardhana	Balooha rau	239	27.45370	84.16180	27.44012	84.16163	4	0	0.25	0	6	81	56	0	0	38	0	0	0	0
Valmiki TR	Govardhana /Raghia	Singaha nala	240	27.33154	84.30538	27.34813	84.31204	2	0.5	0	25	0	13	0	13	0	100	0	0	0	0
Valmiki TR	Chutaha	Bhapsa Nadi	241	27.36266	84.06990	27.34042	84.04522	5	0	0	0	0	0	0	0	5	25	0	0	0	0
Valmiki TR	Chutaha	Kirwania sot	242	27.27813	84.18684	27.30339	84.1863	4	0	0	0	0	0	0	0	63	0	0	0	0	6
Valmiki TR	Hanatarn	Kosil rau	243	27.29502	84.10886	27.32164	84.12123	4.3	0	0.7	0	11	50	67	39	0	100	0	0	0	0
Valmiki TR	Ganoli	Pachmol rau	244	27.44248	83.95484	27.44404	83.99904	5	0.4	0.4	10	10	70	40	0	0	55	0	0	0	0
Kalsi	Timili	Mundiawala rau	245	30.24209	77.60540	30.40528	77.61168	3.1	0	0.32	0	15	46	23	8	0	31	0	0	0	0
Kalsi	Timili	Binol rau	246	30.40304	77.58527	30.39956	77.60259	3	0	0	0	0	83	25	0	0	25	0	0	0	0

Appendix IX: Status of corridors identified in TAL

1. Yamuna river corridor

The tiger habitats on the banks of Yamuna river vary in size and conservation status. The forests on the left bank of the river are in Shivalik FD (332km^2), Uttar Pradesh and Kalsi FD (293km^2), Uttaranchal. These forests are contiguous with Dehradun FD (510km^2), Narendranagar FD (part, 150km^2) and the western portion of Rajaji NP (west of Ganga river), which together constitute a single block of ca. 1800km^2. The tiger habitat on the right bank of Yamuna river is limited to the Kalesar forests (ca. 150km^2, Kalesar WLS, Haryana) and Simbalbara forests (ca. 50 km^2, Simbalbara WLS, Himachal Pradesh). Surveys in December 2002 and January 2003 indicated that one or two tigers range from Badshahibagh Range of Shivalik FD to Kalesar and Simbalbara WLSs.

There are five *rau*s in Badshahibagh Range that flow into the Yamuna river (left bank) through aqueducts built under the Yamuna canal (Ghara canal). Of these, the Karaundi and Bari Lui *rau*s are 10-30m wide, while the rest are about 5m wide. There is a *gujjar* camp near the aqueduct of Binaul *rau*, and a grass-cutters' camp near the exit of the Karaundi *rau* aqueduct. Other *rau*s or *nallah*s are free from human settlements. Tigers can move along any of the *rau*s, come to the Yamuna riverbed via the aqueducts, walk west diagonally across the riverbed into Kalesar WLS between Bohra village (Majra Range, Paonta FD, Himachal Pradesh) and Mamduwas village of Kalesar WLS, from where they can move into Simbalbara WLS. Earlier observations by staff of the Himachal Pradesh Forest Department indicate that the tigers move back to Shivalik FD at the end of winter. Unfortunately, the entire riverbed along the Bohra–Mamduwas–Hathnikund stretch, a distance of 9km, is highly disturbed by boulder collection in the riverbed. The following need to be done immediately if the tigers are to continue to range between Shivalik FD and forests, west of Yamuna river:

The *gujjar* camp near the Binaul *rau* aqueduct should be shifted, at least a kilometer inside the forest.

The grass-cutters' camp near the exit of Karaundi *rau* aqueduct should be shifted away.

The other smaller *rau*s and their aqueducts need to be kept free from human disturbance.

Boulder collection between Bohra and Mamduwas village (this stretch belongs to Himachal Pradesh) and between Mamduwas and Hathnikund (this stretch belongs to Haryana) should be banned.

Anthropogenic pressures from the villages on the eastern and southern boundaries of Kalesar WLS should be contained, so that at least 50km^2 of Kalesar WLS will remain a disturbance-free core area.

The stretch of ca. 7km between Kaludeo *rau* and Barudev *nalla* of Simbalbara WLS should be kept free from human disturbance, as a mini-core. Presently, *gujjar*s and villagers move with their livestock from Sudanwala to Haryana via Simbalbara, disturbing this proposed mini-core.

It is important to provide a special status to these forests (like establishing Rajaji-Shivalik Tiger Reserve), with satellite cores in Kalesar WLS and Simbalbara WLS (Johnsingh *et al* in press). This conservation programme would require commitment and coordination between the State Governments of Uttaranchal, Uttar Pradesh, Haryana and Himachal Pradesh, and the Government of India. This initiative along wth *gujjar* relocation, control of boulder collection and other anthropogenic pressures would enable revival of the tiger population in its northwestern range on both the banks of Yamuna river.

2. Kansrau–Barkote corridor

A 2km stretch of forests between Lal Thapar and Chiddarwala village on the Dehra Dun–Haridwar Highway connects Kansrau Range of Rajaji NP and Barkote Range of Dehra Dun FD. This corridor stretch and Barkote Range itself are subjected to high disturbance arising from wood cutting and grazing. At present, prey availability in the Barkote Range is extremely poor, and therefore tiger use of this Range and corridor is low. The proposed 4-lane (Delhi-Haridwar-Dehra Dun) highway further threatens the viability of this corridor. Regulation of vehicular speed and minimization of hazards to wild animals attempting to cross the highway are required to be put in place. Eventually, it may be desirable to use the portions of Barkote Range closer to Rishikesh for resettling villages such as Gangabhogpur Talla and Malla and Kunaun *goth*, which can cause enormous problems to the tiger habitat on the east bank of Ganges. Tigers and other wildlife may increasingly use this corridor if anthropogenic disturbances to Dehra Dun FD, Rajaji NP and the corridor stretch are brought under control.

3. Chilla–Motichur corridor

As late as the 1950s, the summer concentration of elephants as presently seen on the banks of Ramganga river in Dhikala in Corbett TR was an annual wildlife spectacle even on the banks of Ganga river (Singh 1978, 1989). This assembly does not occur any more, and the forest connectivity between Chilla and Motichur portions of Rajaji National Park has been severely hampered, ever since the land between Rishikesh and Haridwar was subjected to enormous changes over the last 40 years. Specifically, (i) expansion of Haridwar and Rishikesh townships and Raiwala village, (ii) establishment of Raiwala Army Camp with the ammunition dump, and the Hindustan Antibiotic Factory, (iii) establishment of Khand *Gaon* settlements (I, II and III) on the west bank, for the Tehri dam evacuees and (iv) construction of the 14km long Rishikesh-Chilla power channel on the east bank have contributed to disruption in the habitat connectivity.

At present, movement of elephant bulls and other wildlife such as sambar, chital, wild pig and nilgai, is restricted to the forests along Motichur (between Motichur *rau* and Raiwala village) on the west bank and Chilla/Gauri Range (between Suni *sot* and Dogudda *rau*) on the east bank. Wildlife Institute of

India identified this crucial stretch as the Chilla–Motichur Corridor, way back in 1980s. The islands on the Ganga river in this corridor are critical for safe passage of large mammals. Also, it is pertinent to note that the Binj *rau* corridor identified by Uttar Pradesh Forest Department is no longer viable, as the west bank of Ganga river, opposite Binj *rau*, is under human occupation and agriculture. Even in 1988, when WII studied this corridor, there were very few elephant signs in the Binj *rau* area (Johnsingh *et al.* 1990). This brings forth the criticality of the Chilla–Motichur corridor in enabling movement of large mammals between the forests on the west and east bank of Ganges. This corridor is extremely crucial for charismatic species like elephant and tiger, as their population to the west of the Ganga river represents the northwestern limit of their distribution range. When we strive to envisage and implement a concept like Terai Arc Tiger Conservation Landscape, extending from Yamuna river to Bhagmati river in Nepal, this corridor is of great consequence. The elephant and tiger habitat west of Ganga river (ca. 1800 $km^{2)}$ will become isolated from the adjoining habitats east of Ganga river if a permanent breakage is allowed to develop along this corridor. Establishment and reinforcement of this corridor require immediate action on the following:

- **Relocation of Khand Gaon (settlement):** The 30 or so households of the Khand *Gaon* III should be shifted to the relocation site already identified by the Uttaranchal Forest Department near Rishikesh in the Dehra Dun FD. This will create a 600m wide corridor between the Motichur forests and the Army Camp. The relocation site is not of great consequence for wildlife values as it is situated at the extreme western end of the highly disturbed elephant range, and elephant use of this area is negligible. However, its proximity to the Haridwar–Rishikesh road and a perennial spring should make the relocation site attractive to the Khand Gaon III villagers. The present location of the village is away from the road with inadequate water provision and educational facilities for children. Once the village is relocated, the wall built to prevent crop depredation between Motichur *rau* and Khand Gaon III village, should be pulled down.
- **Shifting the army ammunition dump:** The army ammunition dump should be shifted out of the corridor area. There is sufficient land near the Army Camp to build this dump and the Army could take a lead in this conservation programme by vacating the area at the earliest. This request is being made since 1990 (Johnsingh *et al.* 1990).
- Disturbances originating from Raiwala (including Khand Gaon II village and the Army Camp) and Haridwar township into the corridor area should be contained. This could be achieved by (i) building a wall south of Khand Gaon II, from Haridwar-Raiwala road to the west bank of Ganga river (given the Army ammunition dump is shifted), (ii) placing two 'Corridor Guards' to prevent woodcutting by people of Haridwar township and (iii) planting a belt of trees such as *Polyalthia longifolia* along the right bank of Motichur *rau* (so that the *rau* remains dark at night). This 60-80m broad *rau* is very

important for large mammal movement, including elephants, between Motichur forests and Ganga river. The road and rail bridge over this *rau* is high enough to permit even large elephant bulls to pass under.

- No further development should be allowed around the place of worship, on the west bank between the Army Camp and the river. There is an unpaved road from Haridwar to the place of worship, which needs to be blocked to prevent vehicular traffic. On no account should this road be upgraded to an all weather road.
- The islands on the Ganga river need total protection from any form of human use such as cattle grazing, camping and wood cutting.
- Daytime traffic on the power channel road on the east bank between Chilla and Rishikesh is largely between the *ashrams* on the left bank of Ganges. Such traffic can be and should be considerably reduced if a bridge is built across the river near Lakshman *jhula* at Rishikesh. Night traffic on the existing road should be stopped.
- **Relocation of Gangabhogpur villages and Kunaun goth:** Gangabhogpur, a village of about 30 households on the east bank of Ganga river between the river and the channel, should eventually be resettled. This village was settled at its present location in the early 1960's when the original village in the nearby Outer Himalayan range began to sink as a result of the unsettled nature of the fragile Himalaya. Unfortunately, this village is situated close to ca. 2km riverine forest, the only patch of forest that is still being used by tiger and elephant along the entire length of the Ganges (ca. 2500km) and if this village is not shifted, the resource demands arising from this village will eventually destroy this unique riverine forest. After the translocation of this village, a few rhino, barasingha and hog deer, which must have ranged here in the past, can be released into the marshy area between the canal and the river within an enclosure protected by electric fence. This will add to the wildlife values of this area.

  Translocation of Gangabhagpur Malla village with about 150 households and Kunaun *goth* with about 70 households is also desirable. Sufficient land for the relocation of these villages could be found in Barkote Range, Dehra Dun FD that is increasingly losing values for large mammal conservation as a result of pressures arising from firewood collection and sale into Rishikesh town. The narrow bridge across the Chilla power channel in front of Kunaun *goth* should be either closed or dismantled so as to protect the Bidasani forest block of ca.15-20km^2, an excellent tiger breeding site given its hilly terrain and dense vegetation.
- **Flyover between Haridwar and Raiwala:** Heavy vehicular traffic along the Haridwar–Raiwala road and rail traffic between Dehradun and Haridwar are preventing the daytime crossing over of

large mammals across Chilla-Motichur corridor. The proposed plans to widen the road will only exacerbate the situation and should be dropped. Instead, the Uttaranchal Forest Department, Ministry of Environment and Forests, Government of India, and conservationists need to take a firm and unanimous stand on the construction of a flyover between Haridwar and Raiwala, which allows large mammals to move unhindered below the flyover. However, impacts associated with the construction phase of a flyover are expected to be significant. These would largely result from clearing of the area, man and material movement, disposal of debris and the ensuing physical disturbance during the construction phase. Some of these impacts can be minimized by careful planning of the construction operations, ensuring use of pre-fabricated structural elements and completion in the shortest possible time. Further, habitat restoration may be required to compensate for the likely habitat degradation during construction (Rajvanshi *et al.* 2001). The underpass that would be created by the construction of the flyover will have to be kept free from human use through access control. Till such time that the flyover is built, there should be adequate regulation of the traffic along the Haridwar–Raiwala highway at night (between 2200 and 0400 hours) from February to June (dry season), when more animals move to the Ganga river. The traffic should either be allowed to move only at intervals of 60 minutes or speed breakers should be put in place, to allow animals more time to cross and avoid road kills. Earlier recommendation of Johnsingh (2002) to have a tunnel between Haridwar and Raiwala should be discarded.

- Relocation of *gujjars* from the entire Rajaji NP should be completed at the earliest, which will lead to significant decline in disturbance levels, the consequent recovery of prey populations and enhanced breeding of tigers on both the banks of river Ganges. With an increase in the population, tigers will start using the corridor once it is established.

Establishing the Chilla–Motichur corridor, which we have been demanding for the last two decades, is an acid test for Indian conservation efforts.

4. Rajaji–Corbett corridor

The forest ranges in Lansdowne FD, Laldhang Range (94km^2) to the west and Kotdwar Range (92km^2) to the east form the corridor between Rajaji NP and Corbett TR. In the past, there was a continuous stretch of forests south of the hilly tract between the eastern end of Rajaji NP (Rawason river, west of Laldhang village) and Khoh river (northeast of Kotdwar town). Over the years, these foothill forests in Kotdwar Range and the eastern part of Laldhang Range were lost to human settlements and agricultural frontier expansion, confining habitat connectivity to the hills. This narrow hilly corridor and the adjacent forests have come under immense anthropogenic pressures from *gujjar* and *bhotia dera*s (settlements) and villages situated on the northern and southern boundary. In 2002, Laldhang Range had

34 *gujjar dera*s with 203 *gujjar*s and 330 buffaloes, and 4 *bhotia dera*s with 17 persons, 800 sheep and 250 goats. There were 50 villages within a 5km belt along the southern boundary of this corridor. These villages had about 4000 households with a human population ranging between 20,000 and 30,000. There were 40 trails leading into the 27km long boundary of this corridor between Laldhang and Kotdwar. These trails were being used for fodder and fuel wood collection and livestock grazing. *Gujjar*s from this area should be resettled on a priority basis, and *bhotia*s should not be given permission to use this area. Similarly, along the hilly northern boundary of the corridor, 36 villages were enumerated with about 3,000 families consisting of 15,000-20,000 people in a 3km wide stretch.

The corridor patches between Rajaji NP and Khoh river (west of Corbett TR) need immediate attention, and the anthropogenic disturbances emanating from the villages and Kotdwar township need to be controlled. As of now, tiger use of this corridor is extremely low (Johnsingh and Negi 2003). Appropriate ecodevelopment measures for the villages along the northern boundary should address fodder and fuel requirements, to minimize impact on the corridor forests. There are five streams in this corridor: Rawasan, Malan and Khoh (perennial), and Maili and Sigaddi (these two have water up to the boundary of the forest till the end of March). Rawasan supplies water to Laldhang village and Khoh to Kotdwar town. The crucial role of this forest patch in regulating water availability could form the cornerstone in developing a conservation ethic amongst people of the villages benefiting from these streams. Measures including conservation education, ecodevelopment and anti-poaching programmes would go a long way in making this corridor suitable for tiger and other large mammals.

5 Kalagarh corridor

The construction of a reservoir across the Ramganga river, and Kalagarh township on the southwestern boundary of Corbett TR in the early 1970s, have curtailed the movement of tigers across the Ramganga river, south of the reservoir, from Corbett NP to Sonanadi WLS. Occasionally, tigers come down from the Reserve along the *Sukha sot,* east of Kalagarh–Saddle Dam road, to the Ramganga river and cross over into Sonanadi WLS. The *Sukha sot* area needs total protection from disturbances such as wood cutting arising from Bikkhawala village with about 1200 people.

The Kalagarh project and township was built on 90km^2 of forest land, and according to an agreement between the Irrigation and Forest Departments, 3.5km^2 of this area should have been vacated and returned to the Forest Department soon after the completion of the construction of the reservoir. After much persuasion, 3.1km^2 were returned by the Irrigation Department. The remaining area has colonies with about 4000-5000 encroachers. Subsequently, the Forest Department, supported by NGOs, has filed cases in the court of the Sub-Divisional Magistrate, Kotdwar for eviction against 724 individuals and their families. The encroachers in the Kalagarh colony should be evicted, which will be

possible only when the Government of India, the Government of Uttaranchal and NGOs interested in the conservation of Corbett TR, work together.

6 Kosi river corridor

The Kosi river flows between Corbett TR and Ramnagar FD, and although there are human habitations along the river, forest connectivity is available in four places: for a stretch of 5km between Mohan and Kumaria; 1.5km between Dhangari gate and Sunder Khal; 100m between the two blocks of Sunder Khal; and 6km between Infinity Resorts and Bijrani. In 1974, about 400 people, prompted by *Parvati Shilpkar Samiti – Sunder khal* (beautiful home), encroached into the western Kunkhet Beat, Dhulwa Block 5, 9 and 11, an area of 73.84 ha. This area was once famous for abundant wild pig and was hence called *Suer khal*, and is located in the Kosi Range of Ramnagar FD. The encroachment destroyed a teak plantation, which was raised by the Forest Department in 1971. The Forest Department filed cases in the Kashipur Court to evict these encroachers: 24 cases in 1974-75, 114 in 1989 and 131 in 1990, a total of 269. The Kashipur Court in 1992 gave a verdict that 172 families should leave, but no directives were given for the other 97 families. The 172 families refused to leave as they were not given resettlement sites at a single place. As per the 1999 census, 300 families with 1500 individuals lived there, most with voting rights. There were ca. 100 houses and 200 temporary huts. The growing problems of Sunder Khal, an encroachment since 1974, now 3.5 km long, along the right bank of Kosi river, is the major threat to this corridor. The people depend on the adjacent areas of Corbett TR for fuel, fodder and small timber. This dependency, which will only grow in the years to come, will be severely detrimental to the Reserve. The 3.5km long encroachment is also an impediment to animals moving from the Reserve to Kosi river for water.

The forests between Mohan and Kumaria villages should be made disturbance-free, by shifting the Indian Medicines Pharmaceutical Corporation Limited to a location closer to Ramnagar town. Most of this company's 200 or so employees come from this town, which is ca. 15km away from the present location of the factory. Another commercial unit Gargia Chemicals, where less than 10 people are employed, should be immediately closed. There is a colony of 15-20 huts, ca. 75m north of Mohan, on the way to Kumaria. The people in this colony earn their livelihood by cutting firewood and selling it in Ramnagar. Immediate attention is needed to address this problem. The encroachers at Sunder Khal could be resettled in Gabua forest patch (13km^2), between Ramnagar and Kaladhungi, in Terai West Forest Division. Gabua is surrounded by human habitation, and may eventually be encroached by the people or alternatively be used by the Government for some other purpose. The connectivity between Infinity Resorts and Bijrani can be improved if the two small villages, Ringora and Amdanda, are resettled. Similarly, shifting of Tedha forest village on the left bank of Kosi river (Ramnagar FD) would go a long

way in strengthening this corridor. All these three villages originated as cattle camps, and together have about 80 families.

Habitat restoration measures are immediately needed in the corridor patches identified between Kumaria–Mohan, Dhangari and the western block of Sunder Khal, and between Infinity Resorts and Bijrani. Planting of teak and other plants that provide cover (e.g. bamboo *Bambusa arundinacea* and *Dendrocalamus strictus* and browse (e.g. *Zizyphus mauritiana*) would be useful. The survival of the planted species could be improved by planting saplings (of 3-4 years) in the beginning of rainy season. Provision of cover in these teak plantations would facilitate large mammal use of this area.

7 Boar river corridor

This forest patch provides connectivity around Kaladhungi, the winter home of Jim Corbett, in Ramnagar FD. Boar river corridor needs total protection from infrastructure development and excess tourism. The buildings of Sterling Resorts, the construction of which was stopped by the Supreme Court, should be dismantled and taken away from the forest area. The Uttaranchal Government should acquire other private holdings in this corridor area in order to keep the area relatively disturbance free.

8 Nihal–Bhakhra corridor

The 4km wide Nihal–Bhakhra corridor is between Boar river and Gola river, and connects Ramnagar FD with Terai Central FD. Within the corridor area, there are seven villages – Bedrampur, Pratappur, Kharakpur, Lachchampur, Rampur, Sakatpur and Sherpur with a human and cattle population of 4000 and 3000, respectively. However, the major threat to this corridor is from clear felling for agriculture, besides legal and illegal commercial felling. The Nihal–Bhakhra corridor area needs intense management input in the form of ecodevelopment measures in the surrounding villages to arrest disturbances to the corridor area. The connectivity between Ramnagar FD and Central Terai FD if lost will in turn jeopardize any opportunity to revive the Gola river corridor.

9 Gola river corridor

Growth of Haldwani town and Lal Kuan industrial complex, on the southern periphery Haldwani has caused a major break in the tiger range. Heavy day and night time traffic along Haldwani–Lal Kuan road, and large-scale boulder mining involving hundreds of labourers along the Gola river from October to June, have also contributed to this fragmentation. The firewood demands of these labourers, camping in the riverbed, are decimating the Doli Range of Terai East FD and Tanda Range of Terai Central FD. There is a possibility of restoring the continuity between Terai East and Terai Central FDs by translocating the timber depot of the Uttaranchal Government north of Lal Kuan to a location east of the

Haldwani–Lal Kuan road and west of Gola river. This area is sparsely populated by illegal settlers of boulder collectors in Gola river. It will be crucial to ban sand and boulder mining in the entire stretch of Gola river and declare this stretch as an '**ecologically sensitive zone**'. Intensive regeneration of forests on either side of this corridor, particularly of Doli Range, by planting of suitable fodder tree species and bamboo, and protection from grazing and cutting should also be carried out.

10 Kilpura–Khatima–Surai corridor

Encroachments and infrastructure development have caused a distinct break in the tiger habitat in the Khatima Forest Range, between Kilpura and Surai Ranges of Terai East FD. Khatima Range (Terai East FD) is surrounded by Nepal to the northeast (Kanchanpur tehsil and Mahendra Nagar district), Sharda Range of Haldwani FD to the north, Kilpura Range to the northwest, Khatima township to the southwest, Surai Range to the south, and by cultivation to the southeast. Major landmarks in this corridor are Jagbora river (28º 58′ 31.6N, 80º 03′ 24.4E), Sannia *nallah* (28º 58′ 09.2N, 80º 01′ 52.2E) and Lal Kothi (28º 56′ 30.5N, 80º 01′ 10.9E). The forests of Khatima Range are a vital link in the chain of connectivity between Haldwani FD, Pilibhit FD and the forests in Nepal, and can serve as a corridor for several large mammal species, including tigers and a population of ca. 30-40 elephants that are currently confined to Haldwani FD and part of Terai East FD. Terai East FD faces severe encroachment problems as exemplified by Khatima Range (92km^2), of which, at least 6km^2 is under encroachment by about 800 families. The forests of Khatima are highly disturbed from settlements (Pachoria, Ghosi Kuan, Amanwa, Burahi) along the right bank of the Sharda Canal. As a result, the movement of large mammals between Kilpura and Surai ranges has almost come to an end. A few elephants occasionally cross the Sharda Canal and move into the Nepal forests across the Jagbora river, but this movement is limited by settlements (e.g. Banbasa and Devipura Majgain) along the left bank of the canal. There is a need to establish a 7km long and 3-4km wide corridor between Kilpura Range and Surai Range to maintain connectivity in this part of TAL.

Another problem to this corridor emanates from five *goth*s or settlements at Panthagoth, Jhamnabari, Rajana, Jungla and Berigot, with a total of 50 households, along the west (right) bank of Jagbora river, in Kilpura Range. The Colonial Administration encouraged these settlements, to maintain labour for forestry operations. Any effort to establish the Kilpura–Khatima–Surai corridor should include the resettlement of these *goth*s. Encroachments in this area, as a result of settlements such as Pachoria, Ghosi Kuan, Amanwa, Bhurai and Devipura Majgain need to be evicted on a priority basis. Lal Kothi bridge should be closed to woodcutters, so that Khatima forests between Sharda Canal and Jagbora river (Chhini Compartment 13 & 14) can be protected and revived. The Government of Nepal should be requested to initiate special ecodevelopment measures for the villagers on the banks of Jhagbora river on the Nepal side, in order to reduce their dependency on Khatima forests. Besides encroachment, Khatima

Range has suffered due to establishment of NAPIERS, an Army camp, in the year 1966-67 which led to the loss of 3.39km^2 forest areas. Further, Banbasa Hydel Project in 1952-54 and, Sharada Sagar and Sharda Main Canal in 1955-56 to 1959-60 have led to a loss of 0.25km^2 and 1.30km^2 forest areas respectively. Encroachment related habitat loss has been exacerbated by the linear breakages in the forests resulting from the alignments of the canal and road (Tanakpur-Khatima Highway).

11 Lagga Bagga–Sukhlaphanta–Tatarganj corridor

Lagga Bagga (5.9km^2) is part of Barahi Range of Pilibhit FD and is situated on the northern (left) bank of Sharda river. It is contiguous with Shuklaphanta Wildlife Reserve (WLR, 305km^2) to the north and northeast. Tatarganj forest block represents the northernmost forest patch of Sampurna Nagar Range of North Kheri FD. This narrow stretch of forest, along the north (left) bank of Sharda, provides connectivity between Shuklaphanta WLR and Haripur Range of Philibhit FD across Sharda river. There are large settlements (Gorakh Dipi) of over 100 households between Lagga Bagga and Tatarganj, which has led to habitat loss between Lagga Bagga and Tatarganj. Habitat connectivity is available only along Lagga Bagga, Sukhlaphanta WLR, Tatarganj and Haripur Range, which in turn is connected to Kishanpur WLS. Lagga Bagga is dominated by tall grasslands, which are interspersed with *Acacia catechu*, *Dalbergia sissoo* and *Bombax ceiba* trees. This grassland habitat supports several large mammal species including swamp deer, chital, hog deer, barking deer and nilgai. Tiger, elephant and a few rhinos frequent Lagga Bagga from Sukhlaphanta WLR, and some of them are reported to cross the Sharda occasionally. Encroachment by nearly 2000 *Bengali* settlers began in August-September 1996, was subsequently removed from the core area of Lagga Bagga. However, in spite of relocating these villagers across Sharda river in Ramnagar and Maharajpur villages, they continue to extensively use the forests of Lagga Bagga, for collecting firewood and cattle grazing.

The Tatarganj corridor (28º 44′ 42.9N, 80º 14′ 23.1E) is a narrow stretch of forest (1-3km wide and 20km long) along the north bank of Sharda, and consists of four major forest blocks; (from southeast to northwest) these are Hazara, Behla, Tila No.4 and Tatarganj. The vegetation here largely resembles that of Lagga Bagga, but supports a high density of *Acacia catechu*. However, the connectivities between these blocks are weak and are subjected to anthropogenic pressures from the villages to the north: Tatarganj, an Indian village with 60-70 households and Bewa, Jilmila and Goudi–Jilmila (villages in Nepal) with about 350 households adjacent to Sukhlaphanta WLR. Other than these villages, there is no major human habitation in this area. If these villages are translocated, large mammal movement between Sukhlaphanta WLR and Pilibhit FD along Tatarganj corridor would be facilitated. The villagers, ca. 420 households, may be willing to move out as their habitations are cut off during the rainy season. Resettling of Gorakh–Dipi on the south bank of Sharda would strengthen the connectivity between Lagga Bagga and Tatarganj. Periodically, the floodwaters of Sharda, flowing south of these blocks, alter

their shape and size. The Hazara forest (28º 34′ 33.1N, 80º 17′ 59.0E), for example, became an island in the year 1994, but it provides connectivity to Haripur Range of Pilibhit FD. Tatarganj forest block is connected to Sukhlaphanta WLR through patches of grasslands. Tiger, elephant, chital and wild pig use these forest patches. It is also possible for elephant and tiger to move between Sukhlaphanta WLR and Haripur Range along the Tatarganj corridor. Poaching and agricultural expansion are other problems.

12 Kishanpur-Dudhwa corridor

Increasing human habitations and vehicular traffic, particularly along the Paliya-Sampurnanagar road, have decisively disrupted the connectivity between Kishanpur WLS and Dudhwa NP. Local people report that tigers seldom move between the WLS and the NP through the sugarcane fields. This, however, needs to be confirmed. Establishing corridor here would be critical for two reasons: one is to enable gene flow between the populations and the other would be to avoid tiger-human conflict that is likely to occur here. Because, both Kishanpur WLS and Dudhwa NP function as source populations, and since there is no adjacent natural habitat for emigration, there is a likelihood of tigers getting into conflict with people while moving through sugarcane fields. In the current scenario, the area between Kishanpur WLS and Dudhwa NP can only be deemed as a potential corridor. Additional information and enormous efforts will be required to establish this corridor, which will be extremely expensive.

13 Dudhwa–Katerniaghat corridor

Dudhwa NP (Kheri District) and Katerniaghat WLD (Bahraich District) are in the western part of Uttar Pradesh. Isolated forest patches of varying sizes in North Nighasan Range (North Kheri FD), though in the midst of human habitations and agriculture, provide potential connectivity between Belrayan Range of Dudhwa NP and Katerniaghat Range of Katerniaghat WLD, along two corridors (northern and southern). Twenty-one villages in this corridor belt have encroached nearly 16km^2 of forest. The northern corridor includes six forest patches, west to east, these patches are (i) Belaparsua (1.37km^2), (ii) Ragunagar (2.45km^2), (iii) Kishannagar (2.09km^2), (iv) Deepnagar (1.88km^2), (v) Ganganagar (0.28km^2) and (vi) Khairatya (4.57km^2). Khairatya, being in the drawdown area of Ghagra reservoir, is largely swampy and under encroachment. It, however, provides connectivity with the southern corridor along Majra forest patch (8.23km^2). Large mammals such as tiger, elephant, chital, nilgai, hog deer and wild pig use the first four of the six patches. Recently elephants coming from Nepal were reported to use Khairatya patch before moving to Dudhwa. The southern corridor includes forest patches of Ramnagarh (9.25km^2), Batuwa (8.89km^2), Latuwa–Mortia (4.78km^2), Behria (4.80km^2) and Majra (ca. 8km^2). Ramnagarh forest patch, contiguous with Dudhwa NP, has miscellaneous forests, and had signs of tiger and sloth bear use. There is a gap of 6-7km between Ramnagarh and the other forest patches close to Katerniaghat. The gap is dominated by agricultural areas, largely sugarcane and wheat,

and habitations belonging to indigenous people including *tharu*s and punjabi settlers. Batuwa, Latuwa–Mortia and Behria form two isolated clusters northwest of Majra village; Batuwa and Latuwa–Mortia being in one unit and Behria being the other. *Acacia catechu* and *Dalbergia sissoo*, interspersed with small patches of short grasslands dominate the forests here. Prey species are scarce, and tigers stray here only occasionally. All these patches, however, are close to Majra patch, which is contiguous with Katerniaghat Range. As a result, evidence of tiger use of the Majra patch was relatively higher. According to Sinha (2003), the possibility of strengthening the northern corridor is greater than the southern corridor, but the cost involved in removing encroachments and restoring the area is going to be substantial. During the last eight years (1996-2003), only 1.71km^2 encroached area has been evicted and afforested at a cost of Rs.34,00,000 (US$ 69,800). According to Sinha (2003), the total estimated cost for the removal of encroachments and restoration of the area is ca. Rs.1,50,00,000 (US$ 3,07,945). There is also a very narrow stretch of forest patches, primarily dominated by *Acacia catechu*, along the Suheli river southwest of the southern corridor. This stretch has a tenuous link with Sonaripur Range of Dudhwa NP in the west, but does not provide connectivity to Katerniaghat WLD. Recently, a male rhino that escaped from the enclosure in Sonaripur used this stretch of forest, and from Ramnagarh patch, moved through sugarcane fields and reached Latuwa, injuring a few and reportedly killing two people on the way. It is reported to have reached Katerniaghat WLS. The southern ranges of Dudhwa NP (Sonaripur and Belrayan) are richer in large mammal abundance, and consequently straying of animals from these ranges along the Suheli river is possible. The forests along the Suheli river therefore need continued protection.

Katerniaghat WLD extends east of Geruwa branch of Ghagra/Karnali river but also to the west of Geruwa, up to the Kaudiala branch of Ghagra/Karnali. The northern boundary of these forests between Geruwa and Kaudiala is at the Indo-Nepal border, in an east-west orientation. The area north of this, is the Nepalese part between the Kaudiala and Geruwa, and is devoid of forests except for some small, degraded patches, with much of the area being essentially under agriculture. Bardia NP lies east of Geruwa on the Nepalese side. The southern boundary of Bardia NP, along the Geruwa river, is about 12km from the northern boundary of Katerniaghat WLD. Geruwa is a large river and its riverine forests may enable movement of rhinos between these two protected areas. In addition to this riverine forest, elephants moving between these two PAs may also use patches of degraded forests interspersed within the larger agricultural matrix. Possibility of some connectivity between Dudhwa NP and Katerniaghat WLD on the north, in the form of an arc from Belrayan Range through Basantha forests, Churia hills, Bardia NP and the northeastern part of Katerniaghat Range may exist. The gap between Belrayan Range and Basantha forests is less than a kilometer. Establishing a functional corridor here is relatively easier, and is also crucial as Dudhwa NP is otherwise an isolated habitat.

Appendix X: Poaching in TAL

The magnitude of the threat posed by illegal removal of wild species from Protected Areas and Reserve Forests is demonstrated by the fact that even relatively well-protected areas, such as Corbett TR and Rajaji NP, have reported instances of poaching (Wildlife Protection Society of India 2003). Perhaps the most highlighted instances of poaching come from the organized operators feeding the international demand for animal parts and products. Poaching for meat, plants and plant parts, animal parts and products derived thereof are responsible for jeopardizing the future of many wildlife species. The demand for trophies, animal parts such as tiger bones and ivory, along with the urge for the thrill and adventure associated with s*hikar* (hunting) continues to pose severe challenges for PA managers. In the long run, all these types of poaching can seriously deplete the abundance of large mammals, which has already happened in most parts of TAL.

People of the TAL, regardless of their social status, are fond of eating meat and naturally, poaching is widely prevalent in the entire Landscape. This is likely to be a major reason for low abundance of large mammals in most of the forests, particularly the ungulates. Three instances typify the general trend. (i) On 15th November 2002, acting on a tip off from a local, a team of forest staff guided by Mr. Ramakant Tiwari (Range Officer, Belparo Range of Terai West FD) apprehended poachers from Rudrapur and confiscated their car, rifle and a double-barrel shotgun. The poachers were caught in the act of cooking a chital that was shot in the nearby forest. This instance of poaching is typical of the intent of the poachers seeking adventure, the thrill of *shikar* and wild meat. (ii) Another group of people who poach for meat are the daily wage labourers engaged in sand and boulder mining, road repair and other works related to Forest Department. Snare-lines kept by daily wage labourers for junglefowl (*Gallus gallus*), kalij (*Lophura leucomelanos*) and peafowl (*Pavo cristatus*) were found barely 50m from Dholkhand Range office in Rajaji NP. Also local craftsmen like the *kanjars*, who are blacksmiths by tradition, provide the expertise for making traps; their poverty has driven them to poach and assist in poaching. (iii) During the survey, the project team encountered a poaching party of *rai sikhs* (Jaulasal Range of Haldwani FD) with hunting dogs, returning from the jungle carrying a sambar cut into large pieces. It is pertinent to note that such violation of laws is possible largely due to insufficient personnel for protecting the forests and wildlife. It could also be attributed to the lack of motivation, training and awareness among the people. In Nandaur Valley (Haldwani FD), the *chowkidar* of the Durgapeepal Forest Rest House, who has been serving there for the last 25 years, stated that the major reason for the depleted status of large mammals in the Valley is due to regular poaching by *rai sikhs*. The poachers usually camp in the Valley, after the monsoon (July – August) rains have damaged the only road into the Valley, and continue their illegal activities without any fear till December-January, when the roads are

repaired, leading to frequent visits by the staff. Poaching is done with dogs, snares, spears and guns. This practice by people is difficult to control, as the local people know the terrain and behaviour of animals very well.

PA management has to regard poaching as a serious problem, and demonstrate their will power to control poaching (Kumar and Wright 1999). Johnsingh and Negi (2003) suggested measures, such as replacing the guns around the tiger habitat with specially made guns that cannot be used for poaching, giving substantial rewards to persons who apprehend poachers and recruiting and training staff for protection. The involvement of local people, through conservation education and conservation programmes, is critical in bringing about their transformation, from providers of expertise and logistical assistance to poachers, to protectors of wildlife. Special programmes are needed to provide employment opportunities to *kanjars*, and persuade *rai sikhs* to give up poaching.

Appendix XI: Encroachments in TAL

Over the decades the forests in the Terai Arc Landscape have suffered as a result of encroachment. This has lead to loss of habitat, encroachers and their livestock place continuous and increasing pressures on the resources, which are important for the survival of wildlife. Further, encroachments gradually grow in size over years, often leading to habitat fragmentation. Parts of the Landscape falling in the State of Uttaranchal have suffered the most as a result of large scale State encouraged encroachment. Government encouraged the locals since there was large scale aggressive encroachment by the Punjabis and resettling of Bengalis displaced from erstwhile East Pakistan by Government of India. Two examples of State sponsored encroachment are Sunder Khal in the Kosi river corridor area and the other is in the Terai East FD. In 1974, about 400 people, prompted by *Parvati Shilpkar Samiti – Sunderkhal* (beautiful home), encroached western Kunkhet Beat, Dhulwa Block 5, 9 and 11, an area of 73.84ha. This encroached area within Kosi Range of Ramnagar FD was previously known for abundant wild pig and was hence called *Suerkhal*. The encroachment destroyed a teak plantation, which was raised by the Forest Department in 1971. The Forest Department filed cases in the Kashipur Court to evict these encroachers: 24 cases in 1974-75, 114 in 1989 and 131 in 1990, a total of 269. The Kashipur Court gave a verdict in 1992 that 172 families should leave, but no decision was made on the other 97 families. The 172 families refused to leave, as they were not given resettlement sites at a single place. In 1999, 300 families with 1500 individuals were reported from here, most with voting rights. There are 100 houses and 200 temporary huts. The population gets its fuel, fodder and small timber from the Corbett TR. This impact, which will only grow in the years to come, will be disastrous for the Reserve. The 3.5km long encroachment is also an impediment to animals moving from the Reserve to the Kosi river for water. Resettlement of these people enmass should be a priority to secure the future of this premier Tiger Reserve of the country. Parts of Gabua forest patch (13 km^2), between Ramnagar and Kaladhungi, in Terai West FD may have to be traded-off for resettling these people. Gabua is surrounded by human habitations, and may eventually be encroached or used by Government for some other purpose. Before this happens, the encroachers could be resettled here, eradicating this growing scourge from the environs of Corbett TR.

The Terai East FD has an area of 820km^2, of which nearly 60km^2 is encroached. The ranges affected are: Barkoli (encroached area 22.40ha), Doli (138.44), Gaula (4312.63), Khatima (ca. 600), Kishanpur (84.10), Ranshali (250.71), South Jaulasal (159.570 and Surai (497). Hundreds of families live in these encroached areas. The worst affected Range in Terai East FD is Khatima Range (92km^2), with nearly 6km^2 under encroachment, supporting ca. 800 families. Besides encroachment, Khatima Range has suffered from establishment of NAPIERS (Army camp), Banbasa Hydel Project, Sharada

Sagar reservoir and Sharda Main Canal, leading to the loss of 4.94 km^2 forest area since 1952. As a result the habitat connectivity between the forests west of Tanakpur-Khatima Highway (e.g. Kilpura and South Jaulasal ranges of Terai East FD and Jaulasal Range of Haldwani FD) and Surai Range (Terai East FD) and Pilibhit FD is lost. Regretfully, the Forest Department does not have the requisite mechanisms in place to monitor the growth of encroachment. Similar information on encroachments in the entire TAL should be collected, as the information is not readily available with the Forest Department. There is a dire need to remove encroachments at least from some crucial areas to arrest the growing threat to wildlife habitats and to establish corridors. The study on encroachments should be taken up on a priority basis and the help of Central Empowered Committee should be sought to evict encroachers.

Appendix XII: Sand and boulder mining in TAL

Bhabar tract, characterized by boulders and a low water table, has numerous rivers and streams, locally called *raus* and remain dry in summer. These *raus* are the source for sand and boulders and have considerable commercial value as construction material. Extensive commercial mining for sand and boulders in these *raus* in many parts of this *bhabar* tract is underway, with the exclusion of PAs (Kalesar WLS, Simbalwara WLS, Rajaji NP and Corbett TR). Mining activities disturb wildlife habitats, further posing the danger of disrupting forest connectivities. In Uttaranchal alone, nearly 25,000 labourers from Bihar and eastern UP are employed for mining near the Reserve Forests. They mostly live in flimsy huts on the riverbeds, and their firewood needs, particularly in winter, are enormous. While one or two family members may be engaged in the mining related activities, others cut and sell firewood. Already, a large population of the resident population of Uttaranchal depends on the forests for their firewood needs, and the additional removal by these labourers only adds to the pressures. The hundreds of labourers staying in the Ganga riverbed, near Haridwar, for example, cut wood from Chandi Range of Haridwar FD and Chilla Range of Rajaji NP. Miners camping in the Rawason riverbed near Haridwar-Chidiapur Highway put enormous pressure on the 4km wide forest connectivity between Rajaji NP and Corbett TR, along Haridwar and Bijnor Plantation FD.

As late as the year 2000, tigers inhabited the islands on Sharda river between Tanakpur and Banbasa barrage, but boulder mining has driven them out now. Among the worst affected areas is Doli Range of Terai East FD, where hundreds of labourers camp in the Gola riverbed between Haldwani and Lalkuan. If such large-scale mining is allowed to continue, the foothill forests, tiger and elephant habitats, will degrade and disappear from most places within years, and the existing forest connectivities will be broken. For example, there is a possibility to create a corridor for tiger and elephant between Terai Central FD and Terai East FD across Gola river near Lalkuan timber depot, but the continued mining will preclude this opportunity forever. Another area where mining leads to habitat fragmentation in the western part of TAL, is the Yamuna river, which in winter is still being used by one or two tigers moving between the forests on the left bank (Shivalik FD) and right bank (Kalesar-Simbalwara WLSs). The area crucial for tiger and other large mammal crossing the Yamuna is along the 9km stretch between Bohra (Himachal Pradesh) – Mamduwas – Hathnikund (Haryana). This area is highly disturbed by the plying of numerous trucks and tractors in and out of the riverbed for boulder collection.

To control the ill effects of mining, the following measures need to be undertaken:

Gola river area should be declared an **ecologically sensitive zone**. Mining should be stopped between Haldwani and Lalkuan, and efforts should be made to establish the Gola river corridor

between Terai Central and Terai East FDs. If the Chilla-Motichur corridor (across the Ganga river) and Gola river corridor are established, and anthropogenic disturbances to Rajaji-Corbett corridor minimized, then these areas together will form a contiguous wildlife habitat of ca. 8,000km^2 for tiger and elephant populations between Yamuna river and Sharda river.

No labour camps should be allowed on the Ganga riverbed between Haridwar and Chandi Range. This is vital to curb the growing anthropogenic disturbances to Chilla and Chandi Ranges from the environs of Haridwar.

Mining should not be permitted in Rawason riverbed, so as to reduce disturbances to Rajaji-Corbett corridor along Haridwar and Bijnor Plantation Division.

No mining should be permitted on the islands of Sharda river, falling under Sharda Range of Haldwani FD.

In the Yamuna river, boulder collection between Bohra and Mamduwas village (this stretch belongs to Himachal Pradesh) should be totally banned. This two-kilometer stretch is extremely crucial for the movement of tigers. Efforts should also be made to ban boulder collection between Mamduwas and Hathnikund (this seven kilometer stretch belongs to Haryana), which will significantly strengthen the connectivity between the forests on both the banks of the Yamuna (Johnsingh *et al*. in press). Help of Uttar Pradesh Government will also be needed in this venture, as there is boulder mining adjacent to Shivalik FD.

Reports of illegal mining in the *bhabar* tract should be investigated and all unlicensed boulder-crushing factories should be closed down.

Ideally boulder mining should be banned in the western part of the TAL, between Sharda and Yamuna rivers, in 5km buffer areas adjacent to and between tiger habitats. Alternately, river stretches like Song river, north of Doiwala, can be identified for boulder mining. Help of Central Empowered Committee should be sought in this regard. The Uttaranchal Government faces the choice between either mining, which may fetch annual revenue of Rs. 30-50 crores, but will eventually destroy the tiger and elephant habitat, or a forested landscape with these charismatic species and other associated fauna. The latter option, in the long run, will be beneficial for Uttaranchal, which plans to steer a sustainable future based on ecotourism.

Appendix XIII: List of TAL Workshop (6-7 November, 2003) participants

1. Mr. S.S. Rasaily, DFO Terai West
2. Mr. G.S. Pande, DFO Terai East
3. Dr. P.S. Easa WTI
4. Mr. Vivek Menon, WTI
5. Dr. Sarla Khaling, WWF Nepal
6. Mr. G.D. Sarin, The Corbett Foundation
7. Mr. Ashok Kumar, WTI
8. Mr. Ramesh Chandra, DFO Lansdowne
9. Mr. Ashok K. Mohan, DFO Nainital
10. Dr. Eric Wikramanayake, WWF-US
11. Dr. David Ferguson, USFWS
12. Mr. Jai Raj, CF, Dehradun
13. Mr. A.S. Negi, Ex-CWLW, Uttaranchal
14. Dr. M.C. Porwal, IIRS, Dehradun
15. Dr. Nita Shah, Biologist
16. Mr. M.K.S. Pasha, WPSI
17. Mr. P.K. Sen, WWF-India
18. Mr. A.K. Gulati, CWLW HP
19. Mr. Deepak Kumar, DFO Shivalik
20. Mr. P.K. Singh, Deputy Director, DTR
21. Mr. Tariq Aziz, WWF-India
22. Dr. Harish Guleria, WWF-India
23. Mr. Manoj Kumar, DCF, Karnataka
24. Mr. H.K. Singh, DFO Haridwar
25. Mr. Dhananjai Mohan, IGNFA
26. Mr. Ramesh Pandey, DFO, Pilibhit
27. Mr. Rupak De, CF, Mirzapur, UP
28. Mr. Sunil Pandey, CF, Moradabad
29. Mr. Nav Prabhat, Minister of Forests and Environment, Uttaranchal
30. Mr. Samir Sinha, Director, Rajai NP
31. Mr. P. K. Ghosh, Friends of the Doon
32. Mr. N. S. Negi, Eye of The Tiger
33. Mr. Harshwardhan Varma, Film Maker
34. Dr. Barry Noon
35. Mr. S. Singsit, IFS, Director, WII
36. Dr. Atul K. Gupta, WII
37. Dr. Gopal S. Rawat, WII
38. Dr. S. P. Goyal, WII
39. Dr. Sanjay K. Shrivastwa, WII
40. Dr. Mehar Singh, WII
41. Dr. B.K. Mishra, WII
42. Dr. P.K. Mathur, WII
43. Dr. Asha Rajvanshi, WII
44. Dr. K. Sankar, WII
45. Dr. Vinod B. Mathur, WII
46. Dr. S.A. Hussain, WII
47. Dr. Ruchi Badola, WII
48. Ms. Bitapi Sinha, WII
49. Dr. B.S. Adhikari, WII
50. Dr. Parag Nigam, WII
51. Dr. Karthik Vasudevan, WII
52. Dr. S. P. Sinha, SOS Rhino
53. Mr. Anil K. Singh, WTI
54. Mr. A. K. Pathe, WII
55. Ms. K.V.R. Priyadarsini, WII
56. Mr. K. Yoganand, WII
57. Mr. Ashutosh Sharma, WII
58. Dr. Manoj Aggrawal, WII
59. Mr. Panna Lal, WII
60. Mr. Rajesh Thapa, WII
61. Mr. V. Sukumar, WII
62. Mr. Lekh Nath Sharma, WII
63. Mr. Pranab Pal, WII
64. Dr. A.J.T. Johnsingh, WII
65. Mr. Qamar Qureshi, WII
66. Dr. K. Ramesh, WII
67. Mr. K. Rajapandian, WII
68. Ms. Soumya Prasad, WII
69. Dr. Ashish David, WII
70. Mr. M.S. Chaitra, WII
71. Mr. Advait Edgaonkar, WII
72. Mr. Rashid Raza, WII
73. Ms. Bindu Raghavan, WII
74. Dr. N. M. Ishwar, WII
75. Mr. Gopi G.V., WII
76. Ms. Reeta Sharma, WII
77. Ms. Rina Singh, WII
78. Mr. Vivek Sehjpal, WII
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