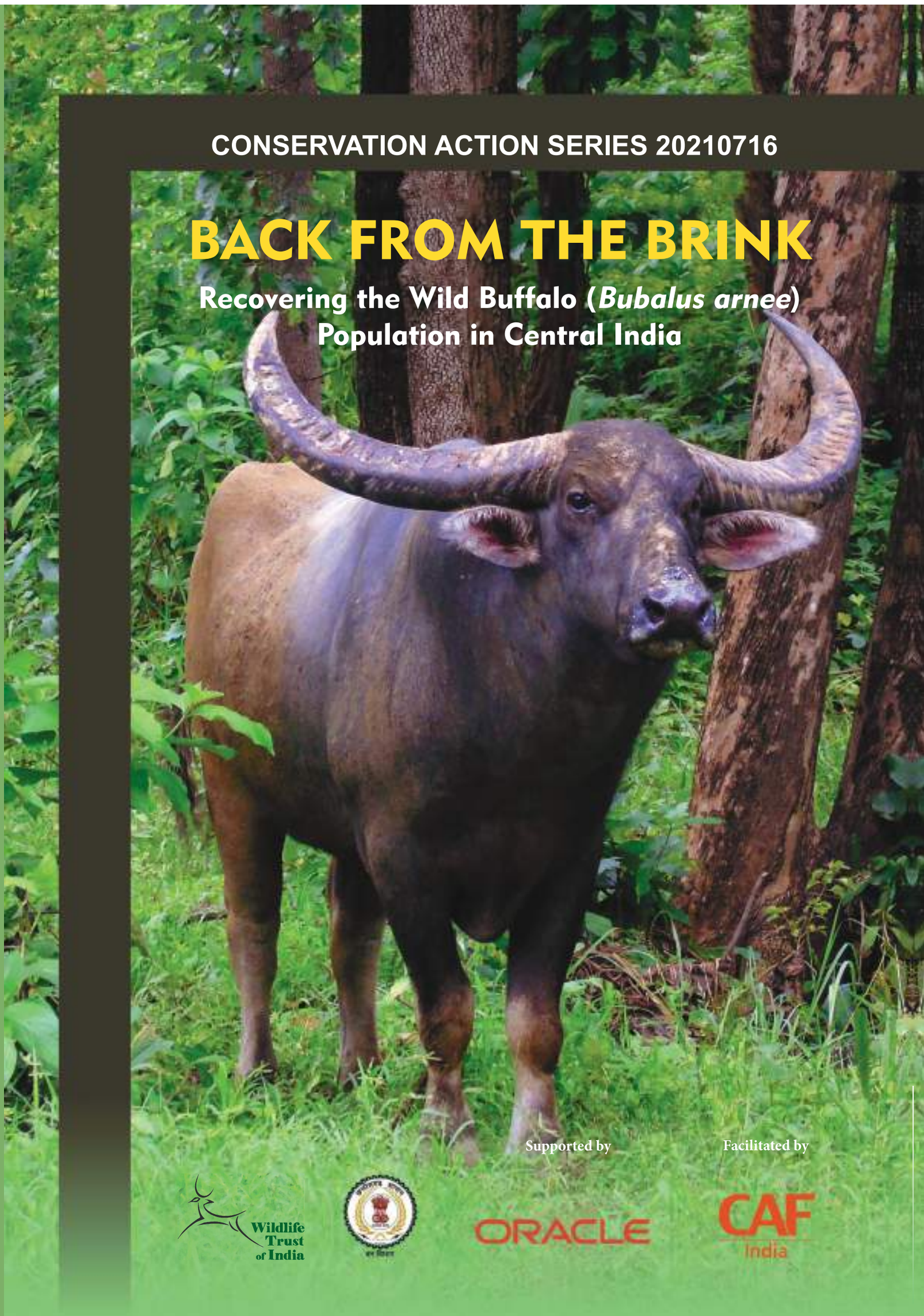

CONSERVATION ACTION SERIES 20210716

BACK FROM THE BRINK

Recovering the Wild Buffalo (*Bubalus arnee*) Population in Central India

Supported by

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Wildlife Trust of India

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Chhattisgarh Forest Department (www.cgforest.com) is one of the important departments under the government of Chhattisgarh. It is engaged in planning, implementation, monitoring and evaluation of forestry, and environmental programmes in the state.

Wildlife Trust of India (WTI) is a leading Indian nature conservation organisation committed to the service of nature. Its mission is to conserve wildlife and its habitat and to work for the welfare of individual wild animals, in partnership with communities and governments. WTI's team of 150 dedicated professionals work towards achieving its vision of a secure natural heritage of India, in six priority landscapes, knit holistically together by nine key strategies or Big Ideas.

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BACK FROM THE BRINK

Recovering the Wild Buffalo (*Bubalus arnee*) Population in Central India

Eds: Vivek Menon, Rahul Kaul , NVK Ashraf and Rupa Gandhi Chaudhary

Wildlife Trust of India

Supported by

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FOREWORD

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RAKESH CHATURVEDI IFS
Principal Chief Conservator of Forest
& Head of Forest Force

D.O./P.C.C.F./50/83
Dated 20/07/2021

I am pleased to see the Central India Wild Buffalo Recovery project, come to age. From its humble initiation way back in the year 2005, collectively led by Chhattisgarh Forest Department, Wildlife Trust of India and its partners, it is able to make significant contributions in the recovery of the State animal, the Wild Buffalo.

The publication, which is the first-ever comprehensive report on the species, clearly spells out the key results of collaboration in domains ranging from conservation research to conservation action, involving grassroots initiatives to international advocacy.

For over 15 years, WTI has worked with the Chhattisgarh Forest Department to save its state animal - the wild buffalo (*Babalus arnee*) in Central India. When a joint survey conducted by Chhattisgarh FD and WTI highlighted that only a handful of individuals remained in Udanti Wildlife Sanctuary, the Chhattisgarh FD and WTI have since then left no stone unturned for the recovery of the wild buffalo population in Udanti. Frome understanding the ecology of the species

in the Central India landscape, providing an amicable habitat for the species to thrive in, veterinary care of the free-ranging wild buffalo, conservation breeding, and translocation to increase the species number in the state, garnering rural and urban support in identifying the species as a state pride, building the capacity of frontline staff for more effective anti-poaching operations. This holistic treatment of a complex issue has shown hope for recovery of its population in the state. I congratulate WTI for this publication, as it clearly showcases the conservation action in its entirety and enables the reader to understand the complexities of recovering a species fromthe brink of local extinction. I am sure this will be widely referred by various agencies, including state forest department(s), international and local conservation organizations, researchers, development agencies, donors as well as other policymakers for long-term conservation of our state animal.

I express my deep appreciation for the strong and long-lasting partnership between the Chhattisgarh Forest Department and WTI. It is critical this partnership thrives so as to ensure Wild buffaloes always have a favorable abode in the forests of Chhattisgarh. I look forward to continued support in the future as well.

(Rakesh Chaturvedi, IFS)
PCCF & HoFF, Chhattisgarh

MESSAGE

P. V. Narsinga Rao, IFS
Principal Chief Conservator of Forests
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The conservation and management of the population of the Wild Buffalo which is the state animal is a big challenge. The joint report on "Central India Wild Buffalo Recovery" being nrought out jointy by WTI and the Forest Department of Chhattisgarh is the compendium of all the efforts taken during the last 15 yeras for the conservation and management of the Wild Buffao.

It clearly showcases the conservation initiatives in its entirety and enables the reader to understand the complexities of recovering a species from the brink of local extinction. I am sure the report will be widely reffered to by all the stakeholders viz Forest Deoartment(s), Conservation Organizations, Researchers as well as other policymakers for long-term conservation of the animal.

I extend my best wishes to Wildlife Trust of India and Forest Department for their timely endeavour.

Best Wishes

P. V. Narsinga Rao, IFS

PREFACE

Asiatic wild buffalo is the state animal of Chhattisgarh. It is also on the brink of extinction. Wildlife Trust of India (WTI) entered the state in 2005, when there were just 7 animals left in Udanti Wildlife Sanctuary with one of them being female. There were a few more individuals in Indravati National Park and adjoining Maharashtra but these were outside de-facto protection due to civil insurgency in those areas. This meant that the distinct population of Central India was in severe risk of being extirpated. Fifteen years of work in building political and public will, in building an in-situ facility inside Udanti WLS, programs on protection and habitat restoration has meant that the population of wild buffaloes increased to a maximum of 11 individuals within the project period.

However, as the report is going to print, both the female that was originally present and the only other female that was born during these period have died. There are thus only three ways for saving the central India wild buffalo.

1. Protection of the other remaining sub-population. It is heartening that Maharashtra state has declared Kolamarka WLS to protect this species.

2. Translocation of female buffalo from the related northeast Indian population. The state Government and Wildlife Trust of India have already initiated this and the two animals are now in an ex-situ enclosure in Barnawapara Wildlife Sanctuary. However, many more animals need to be brought as per the approved plan and financial resources provided by the State for this.

3. We have a last ditch option of a female clone of Asha, the lone wild female, which has been prepared by the National Dairy Research Institute, Karnal.

This report chronicles 15 years of saving this endangered population. But the work is yet far from over. Global attention as well as central and state government funding is required for conserving the state animal of Chhattisgarh.

Vivek Menon
Founder Trustee & Executive Director, Wildlife Trust of India
Councillor IUCN, Deputy Chair IUCN SSC & Chair AsESG
President, Society for Conservation Biology, Asia

ACKNOWLEDGEMENTS

This project is being carried out under a long term MoU with Forest Department, Government of Chhattisgarh who we are thankful to for providing excellent support to work on this project. Specifically, we are thankful to Shri Ram Prakash, former CWLW; Shri R.N. Mishra, former CWLW; Shri N.K. Bhagat, former CWLW; Shri Dhirendra Sharma, former CWLW; Shri R.K. Tamta, former PCCF; Dr R.K. Singh, former CWLW and Shri Kaushlendra Singh, former CWLW for providing all necessary support for the implementation of this project.

We are indebted to Shri Rakesh Chaturvedi, Principal Chief Conservator Forests (HoFF); Shri Atul Kumar Shukla, former PCCF (WL); Shri P.V. Narsingrao, PCCF (WL); Dr. S.K. Singh, former APCCF (Wildlife); Shri JACS Rao, former APCCF (WL); Shri Arun Kumar Pandey, APCCF (Wildlife); and Shri Kaushlendra Kumar, former APCCF (Eco-tourism) who supported and guided the course of the project.

In the field, Shri O.P. Yadav, former Field Director, USTR; Shri K.K. Bisen, former Field Director, USTR; Shri H.L. Ratre, former Field Director, Udanti- Sitanadi TR; Shri Anurag Shrivastava, Field Director, USTR; Shri Vishnuraj Nair, former Deputy Director, USTR and Shri Ayush Jain, Deputy Director, USTR have provided support and technical advice to the project team. Sincere gratitude to Shri M.S. Kesher, Shri K.L. Nirmalkar, Shri M.K. Shah R.K. Rayast, Shri P.R. Dhruwa, Shri M.S. Sirdar, Shri T.R. Nareti, Shri Punaram Sahu, Shri Lochn Ram Nirmalkar, Shri Anoop Jangde for their cooperation and assistance, during field work. We are deeply grateful to the frontline forest staff, forest daily wagers, field trackers and local villagers for providing help and support throughout the implementation of this project.

We are thankful to Manoj Kumar Pandey, former Deputy Director, Indravati TR; Shri M. Gurunathan, Former Deputy Director, Indravati TR Shri Vinay Chakraborty; Shri Umakant Pandey; Shri N. K. Sharma, Shri Chaudhary for their constant help and support while implementing this project in Chhattisgarh.

We are also thankful to Dr. Prakash Amte; DFO Allapalli; Shri Prafulla Bhamburkar; Late Shri M.S. Chauhan and field staff of Kamalapur & Dechli forest ranges, Maharashtra during the survey of Wild buffalo in Maharashtra and Indravati TR. We are indebted to Dr. Ajay Gaur, Scientist CCMB, Hyderabad for conducting a genetic study of wild buffalo. We also offer our sincere thanks to Mr. Sandeep Ghosh and his team for their contribution to planning the campaign element of the project. A special mention is in store for Mr. Rohan Chakravarty for his Wild Buffalo illustration of “Shyamu” which has struck a chord with everyone in the state and which has been accepted as the state mascot.

We are deeply grateful to our trackers Shri Daulat Ram, Shri Thakeshwar, Shri Dilip, Shri Khemraj, Shri Ramkumar, Shri Bal Singh and Keepers Shri Mohan, Shri Mehatar, Shri Moti, Shri Mansingh and local villagers for providing help and support for implementation of this project.

Our thanks also go out to our present and former colleagues from Wildlife Trust of India, Mr. Sahil Choksi, Ms. Shilpa Singh, Mr. Sathyan AV, Mr. Anson Philip, Mr. Yogesh Palawat, Mr. Jose Louies, Mr. Jeetendra Kumar, Dr. Krishnendu Mondol, Dr. Prabal Sarkar, Dr. Aeshita Mukherjee, Mr. Mukesh Pathania, Ms. Ragini Sinha, late Mr. Amlan Dutta, Ms. Rupa Gandhi Chaudhury and Mr. Vivek Menon for their contribution to the success of the project and preparation of this report.

We also would like to extend our sincere gratitude to Chester Zoo in supporting our project at the initial stage. We wish to thank Ministry of Environment, Forests and Climate Change (MoEFCC) for providing all the support in successfully running the project.

Last but not the least, we are grateful to our current donors of this project; Oracle, CAF India, Chhattisgarh Forest Department and the Government of Chhattisgarh, who provided generous financial support to enable us to run this project unhindered.

The authors seek sincere apologies if any individual or organisation has been inadvertently omitted from this list.

EXECUTIVE SUMMARY

India harbours more than 80% of the globally endangered wild Asiatic water buffalo (*Bubalus arnee*) population of the world in two disconnected clusters i.e. north-eastern India and Central India. Among all these clusters, Assam accounts for most of the wild buffalo population in India spread across several protected areas of the state, but in Central India its population has shown a massive decline. Conservation of the species thus warrants that the existing threats in the wild buffalo bearing protected areas (PA) in Chhattisgarh and a small pocket in Maharashtra (bordering Chhattisgarh) are ameliorated and the range and number of wild buffalo is recovered. The ground situation in some of the southern Chhattisgarh sites and adjoining Maharashtra sites were not conducive to implement conservation and management activities due to civil insurgencies.

In the year 2005, WTI partnered with the Chhattisgarh Forest Department to evaluate the number of wild buffaloes (being the state animal) in the state and work on its conservation. However, the results revealed that the population was precarious in Udanti Wildlife Sanctuary, hitherto believed to be a stronghold. Furthermore, its population had been rendered locally extinct in some areas where it was believed to occur. In view of the bad security situation in Indravati, all hopes of reviving the state animals lay on the few wild buffaloes in Udanti WLS. Following the stark revelations, WTI helped the Forest Department prepare a five-year Action Plan for the recovery of the wild buffalo population in Udanti. A multi-pronged need-based approach was adopted with a long- term conservation goal to ensure the survival of the last remaining population of wild buffalo in Udanti Wildlife Sanctuary, and recover it to a viable number in future; along with its sister PA, Sitanadi the Udanti-Sitanadi Tiger Reserve or (USTR) became a pivotal area to recover the Wild buffalo population in the landscape.

The "Central India Wild Buffalo Recovery Project", as it was christened, has undertaken a slew of measure over its course of time, which can be categorized under five major governing objectives.

A state wide survey to determine the presence and abundance at the beginning of the project revealed that Central India's wild buffalo population was largely concentrated in the state of Chhattisgarh i.e. 39-47 individuals, distributed in Indravati, Udanti and Pamed with the species having been extirpated in Bhairamgarh. Maharashtra's Sinroacha Forest Division had approximately 20 individuals. Unfortunately, the team was unable to find any credible evidence of the species surviving in Odisha's forests where it was distributed once. Therefore, the immediate problem at hand concerning the wild buffalo in Central India was demographic and various options to address this issue have been exercised.

From both manual tracking data and satellite telemetry, it appeared that the buffalo seemed to prefer Moderately Dense Forest at a landscape level, showing avoidance for Dense Forest and grasslands. At a micro level however, this changed to a preference for Agriculture and water bodies, characteristic of wild water buffalo. The free-ranging buffalo showed an overlapping ranging pattern, perhaps constrained by the limited availability of relatively flat forest and grass habitats and water. Connection with Sitanadi seems to be intact in parts but broken due to agriculture, roads etc., and some buffaloes have shown movement into Sitanadi occasionally.

Hybridization is a major threat afflicting the wild buffalo, and this introgression is affecting its genetic integrity. A small population also suffers from low heterozygosity, and as part of our recovery project, female buffaloes from other sources needed to be translocated. One such source was Assam, and it was important thus to discern the genetic compatibility between the two regions so as to not compromise its genetic integrity. Partnering with LaCONES (CCMB), WTI conducted genetic studies to ascertain the difference between Assam and Central Indian populations, study the level of inbreeding in Udanti and also study the relatedness of wild buffaloes in Udanti. The studies affirmed that the wild buffaloes of Assam share haplotypes with Central India and therefore are suitable for bringing to Chhattisgarh. It further revealed that the population was moderately heterozygous and therefore stable but recommended translocating buffaloes from Assam.

The buffalo is exposed to several threats in Udanti and unless these are mitigated, the future of buffalo, despite efforts to recover its populations are bound to fail. The threats are those posed to their habitats and to the animal numbers themselves. Together with the Chhattisgarh Forest Department, WTI was able to clear about 2000 hectares of buffalo habitat from invasive weed species and creating good conditions for growth of forage for buffaloes. The effort also involved ensuring regular supply of water through a network of natural and artificially made tanks and water holes to ensure one perennial water source in every 8km^2 of the sanctuary. Other forms of disturbance in the form of grazing and firewood collection were also checked. Hunting formed a tradition in these parts and although it is no longer practiced with that regularity and intensity, it still can take a toll of animals. A group of locals belonging to the hunting tribes from villages within and surrounding the sanctuary was made and they were trained in simple monitoring techniques to make a community based monitoring squad. Thus, hunters were turned into protectors and this squad monitored each free ranging wild buffalo, and reported the locations to the forest department. Additionally, the frontline staff were trained and equipped to improve the capacity for anti-poaching activities and enforcement.

Though the Chhattisgarh state adopted the wild buffalo was the "State Animal", it was necessary that the animal as also equally adopted by the public. WTI through concerted efforts targeted stakeholders to sensitize and instil a sense of pride about wild buffaloes. At first, a pre-campaign survey was conducted to explore the minds of the local population as well as the administration towards the issue at hand, their level of pride towards their state animal, their cognizance of the depleting population of the species and reasons therein. The result showed that the animal lacked popularity, and more importantly, the citizens were not aware of the crisis to the species. Using a variety of targeted and non-targeted campaigning interventions, ranging from introducing a "Shyamu", as a wild buffalo mascot, wall paintings across the capital city of Raipur, street plays/ skits and working

with policymakers of the state, the project aimed at making the wild buffalo synonymous to the wildlife of Chhattisgarh. The main target of the campaigns had always been the younger audience, aimed at fostering a generation that grows up to talk and care about the wild buffalo as their natural heritage. Customized programs like quiz, treasure hunts, drawing, painting, and photography competitions and rallies were conducted. Today, WTI has witnessed a positive change in attitude in the common populace towards the wild buffalo and the need for its conservation. The campaign has been able to associate the wild buffalo as the "pride" of the state and its targeted people.

Though this Conservation Action Report enlists the range of measures adopted to protect the species and the habitat, these are still initial (but critical) steps and much of the conservation action measures are to be persisted within the long run.

Male wild buffalo "Jugadu" in the Udanti Wildlife Sanctuary

Shri Bhupesh Baghel, Hon'ble Chief Minister of Chhattisgarh releasing the special postal cover and stamp on wild baffalo

Dr. Rahul Kaul, Chief of Conservation, WTI (left) gifted a wild buffalo sculpture to Shri RK Singh, PCCF (WL) Chhattisgarh Forest Department.

CHAPTER 1
INTRODUCTION

Rajendra Prasad Mishra, Debobroto Sircar, Adrish Poddar and Samir Kumar Sinha

The Asian wild buffalo or wild water buffalo (*Bubalus arnee*; Kerr, 1792), from which the present domestic water or river buffalo (*Bubalus bubalis*) is known to have originated, is a large and powerful bovid. It is globally 'Endangered' as per the Red List of the International Union for Conservation of Nature[1] (Kaul *et al.*, 2019) and its population is declining with less than 2500 mature individuals (4000 animals), across its current occupied range of about 20,000km^2 (Kaul *et al.*, 2019), restricted to a handful of sites

Presently, the last bastion of the wild population in India lies in its north-eastern and Central region.

Asian Wild Buffalo – Fact Sheet

Genus: Bubalus C. H. Smith, 1827

Species: *Bubalus arnee* (Kerr, 1792);

Names in other languages: French: *Buffled'eau*; German: *Arni*; Spanish: *Búfalo de agua*; Italian: *Bufalo indiano*; Adi-Mising: *Menjek*; Burmese/ Myanmarese: *Kywai*, *Taw jwai*; Lao: *Khoay Pa*; Assamese: *Bonoriamah*, *Pera*; Bengali: *Bano mosh, Jangli mohish*; Hindi: *Arna*; *Ban/ Van Bhainsa* or *Jungli Bhainsa.*

Other common names: Asiatic wild water buffalo, Asian wild buffalo, Indian buffalo, wild buffalo.

Longevity: In the wild, individuals usually live up to 25 years of age (Nowak 1999). In captivity, the maximum documented age is 29.

Morphological Attributes:

- The height, at shoulder, of males may be up to 1.8m or 5 ft. 9 inches
- Weight: from 600 –1000 kilos.
- Possesses massive crescent shape horns that averages over 1 m. in length. Largest horns in any surviving animal of the world today.
- Wide hooves with two joints (fetlock and pastron) makes them flexible for walking in mud.

[1] *Endangered A2de+3de; C1 (version 3.1); IUCN Red List*

in South Asia and Southeast Asia. Wild water buffalo (hereafter, wild buffalo) is listed in Schedule-I of the Indian Wildlife (Protection) Act, 1972[2], conferring the highest level of legal protection in India. The species is also listed in 'Appendix III' of the Convention of International Trade for Endangered Species of wild flora and fauna (CITES) to ensure the prevention of its unsustainable or illegal exploitation. It was also declared as the State Animal of Chhattisgarh (Central Indian state) in the year 2001.

1.1. Taxonomy

The wild buffalo is a member of the family *Bovidae*[3], the largest and most diverse family of ungulates, and the subfamily *Bovinae*[4]. This sub-family is further sub-divided into three tribes – *Bovini*[5] (Gray, 1821), *Boselaphini* (Knottnerus-Meyer, 1907) and *Tragelaphini* (Blyth, 1863). The tribe *Bovini* which contains the wild buffalo has five genera – *Bos* (Cattle), *Bubalus* (Water buffalo), *Syncerus* (African (cape) buffalo), *Pseudoryx* (Saola) and *Bison* (American and European aka wisent).

In 1758, Linnaeus described the species *Bos bubalis* from a domestic specimen from Rome, Italy. In 1792, Kerr described *Bos arnee* from a wild specimen from India. Later, both were assigned to the genus *Bubalus*. H. Smith, 1827; Kinloch, 1885 and Sanderson, 1896 provided valuable knowledge on this account.

The genus *Bubalus*, (the genus of the Asian wild buffalo), is known to contain at least four extant (distribution status depicted in Fig 1.2) and two extinct species (Groves and Grubb 2011) and these are:

1. ***Bubalus arnee:*** Distributed largely in the Indian sub-continent, this species is also believed to be found in Thailand and Cambodia. Groves (1996) on the basis of skull measurements split B. arnee into three sub-species – *B.a.arnee* found in Central India, Nepal, *B.a.fulvus*, found in the Cooch Behar (West Bengal), Brahamputra valley (Assam) and Bhutan and B.a.theerapati, found in Cambodia, Vietnam and Thailand. A recent study based on genetic profiles of samples from Central India and Northeast India however, suggested no major genetic differences between the two populations (Gaur & Mishra, 2019).

2. ***Bubalus mindorensis:*** Also known as the tamaraw or the Mindoran dwarf buffalo, this species is now confined to the island of Mindoro in Philippines. It is critically endangered with an estimated population of 30-200 individuals. This buffalo is much smaller than the arnee.

3. ***Bubalus depressicornis:*** Is also called the lowland Anoa and is distributed in lowland Sulawesi. The lowland Anoa is a relatively small animal, barely standing a meter at shoulder. It is endangered.

[2] *An Act to provide for the protection of [Wild animals, birds and plants] and for matters connected therewith or ancillary or incidental thereto.*

[3] *Bovidae comprise the biological family of cloven-hoofed, ruminant vertebrates.*

[4] *Bovinae includes a diverse group of genera of medium to large-sized ungulates. Their general characteristics include cloven hooves and at least one of the sexes of a species having true horns.*

[5] *The tribe Bovini, or wild cattle, are medium to massive bovines. Not only are they the largest members of the subfamily Bovinae, they are also the largest species of their family Bovidae.*

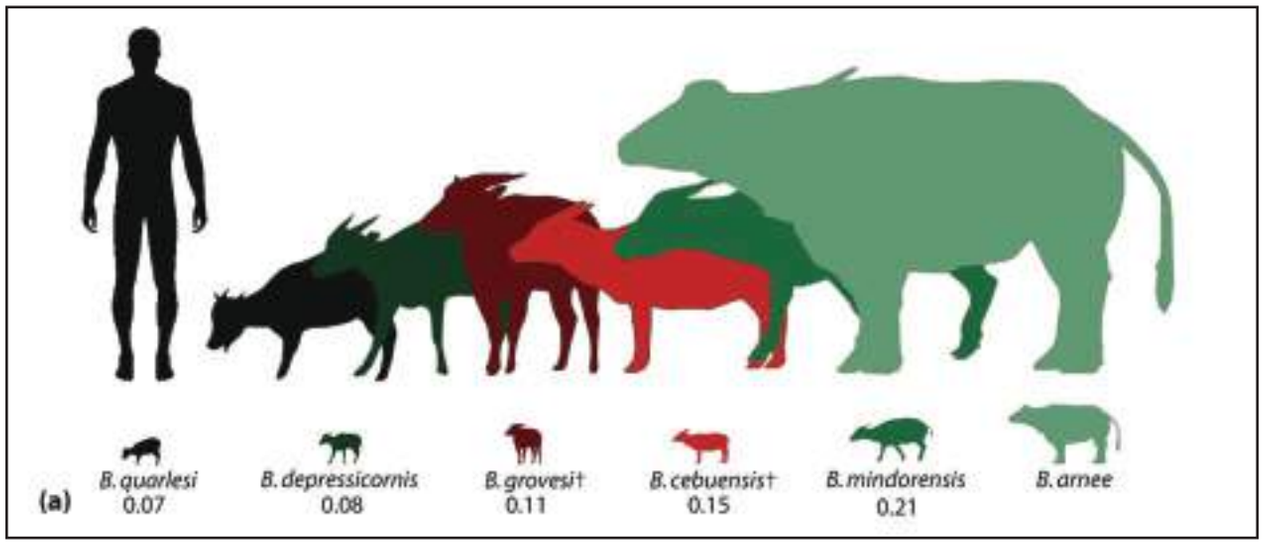


Figure 1.1: The scheme shows buffaloes species in proportion to a 1.8 m tall human. Modified from Roz-zi, 2017 (Source: BULLetin, December 2018 I Number 1)

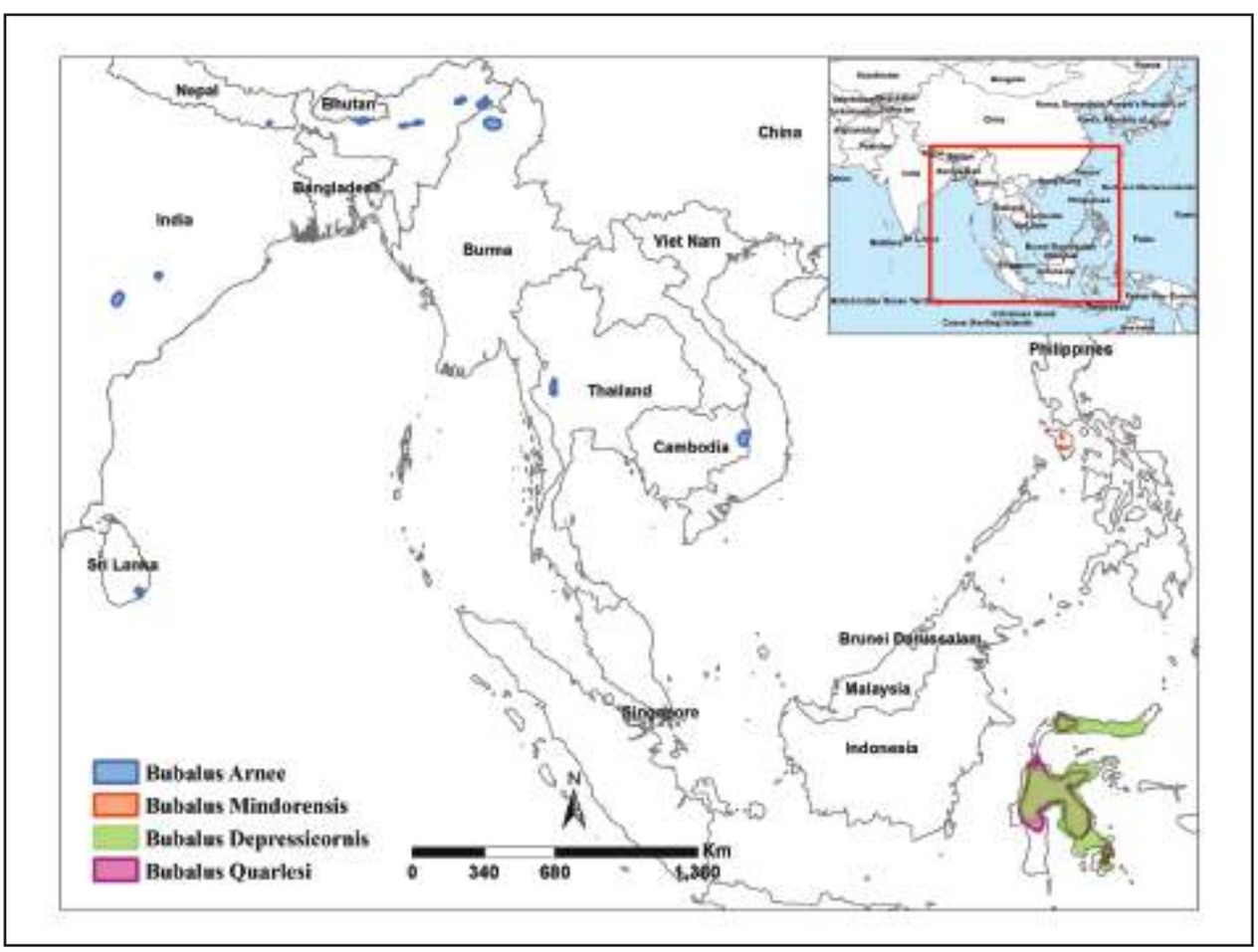


Fig 1.2: Global distribution range of all Bubalus spp.

4. ***Bubalus quarlesi:*** Called the mountain Anoa is found in the highlands of the Sulawesi islands of Indonesia between 500-1000 m altitude. The estimated population size is between 3000-5000 individuals and is listed as endangered (IUCN).

5. ***Bubalus cebuensis*** **(Extinct):** Known as the Cebu tamaraw is a fossil dwarf buffalo discovered in the Philippines, and first described in 2006.

6. ***Bubalus grovesi*** **(Extinct):** The species, from the Late Pleistocene/Holocene of South Sulawesi, differs from all previously described *Bubalus* in both the size and proportions of the skeleton and in possessing a unique combination of discrete character states, such as differences in their dental and postcranial features is included.

1.2. Population status of wild buffalo in the world

In historical context, there is paucity of published information on wild buffaloes. During the early Holocene, the distribution of the wild *Bubalus* arnee probably covered much of the tropical Asia from perhaps as far as east as the coast of southern China and throughout much of South and Southeast Asia. Evidence for the broad prehistoric distribution of water buffalo comes from archaeology and palaeontology with bone remains or representations identified from Mesopotamia and Northern Syria, China, Southeast Asia and South Asia.

The earliest graphical documentation on them was from third millennium BC Indus valley civilization (3300 BCE to 1300 BCE), sites of north-western South Asia (Fig 1.3). A terracotta

Fig. 1.3: Reverse of a terra-cotta moulded tablet from Harappa, Specimen no. H95-2486/4651-01 depicting a gharial (in the upper left) situated above the wild water buffalo being speared by a man while to the right is a horned human figure in a 'yogi' position.

Fig. 1.4: Wild buffalo by Sawana, Baburnama (1560-1600)

tablet depicts a human (probably a hunter) combatting and spearing a wild buffalo in the context of other typically Harappan iconographic elements including the gharial (*Gavialis gangeticus*). The man holds an upraised spear in one hand with one foot on the animals' head, while the other hand appears to be pushing on the right horn (Buitenhuis *et al.*, 1998). Perhaps the earliest written records of wild buffalo are from Mughal records especially Babur-nama, and the Tuzuk-I Jahangiri. Both the memoirs have described the wild buffalo from Suba of Awadh (Central and North-eastern Uttar Pradesh), Tirhut (Bihar), near Burdawan, and in the Sundarbans. According to Babur, the wild buffalo was "much larger than the (domestic) buffalo and its horns do not turn back in the same way. It is a mightily destructive and ferocious animal". The courts' artist Sarwan's representation of a wild buffalo in the Baburnama (C-1560-1600) may be taken as his best work preserved in British Museum (Fig 1.4).

Forsyth (1889) provided vital information on wild buffaloes in peninsular India. He described more numbers of wild buffaloes than the Gaur (*Bos gaurus*). The wild buffalo were found around Brahmaputra, along Narmada river of Nimar, Bilaspur, Khandwa, Kanha, and other parts of Central India. The classical Book "Natural history of Mammalia of the India and Ceylon" by Sterndale (1884) gave useful information on the habitat and distribution of the wild buffalo. Blanford (1891) in his book, The Fauna of British India, wrote about general account of the wild buffalo. The Maharaja of Cooch Behar (Northern West Bengal), documented the species in his long shikar career in Northern Bengal and Western Assam. Following this many scholars provided description of the species, with respect to its behaviour, morphology, numbers and distribution from not only in South Asia but South-east Asia also.

The species witnessed a remarkable decrease in its numbers at the turn of the 20th century (Gee, 1959 and 1963; Spillet and Tamang, 1966), with instances of local extinction from its historical ranges. Being an animal of the grasslands, the degradation and fragmentation of grassland habitats in the Terai Belt (Indo-Nepal-Bhutan-China transboundary region) and the Central Indian highlands owing to the expansion of agricultural activities and growing human habitation seems to have drastically impacted the species. Except in some Protected Areas (PAs), buffalo numbers have continually declined due to above stated reasons as well as retaliatory killing in human wildlife conflict situations and poaching for its meat (Choudhury, 2019). In present day context, this globally threatened species is now confined to

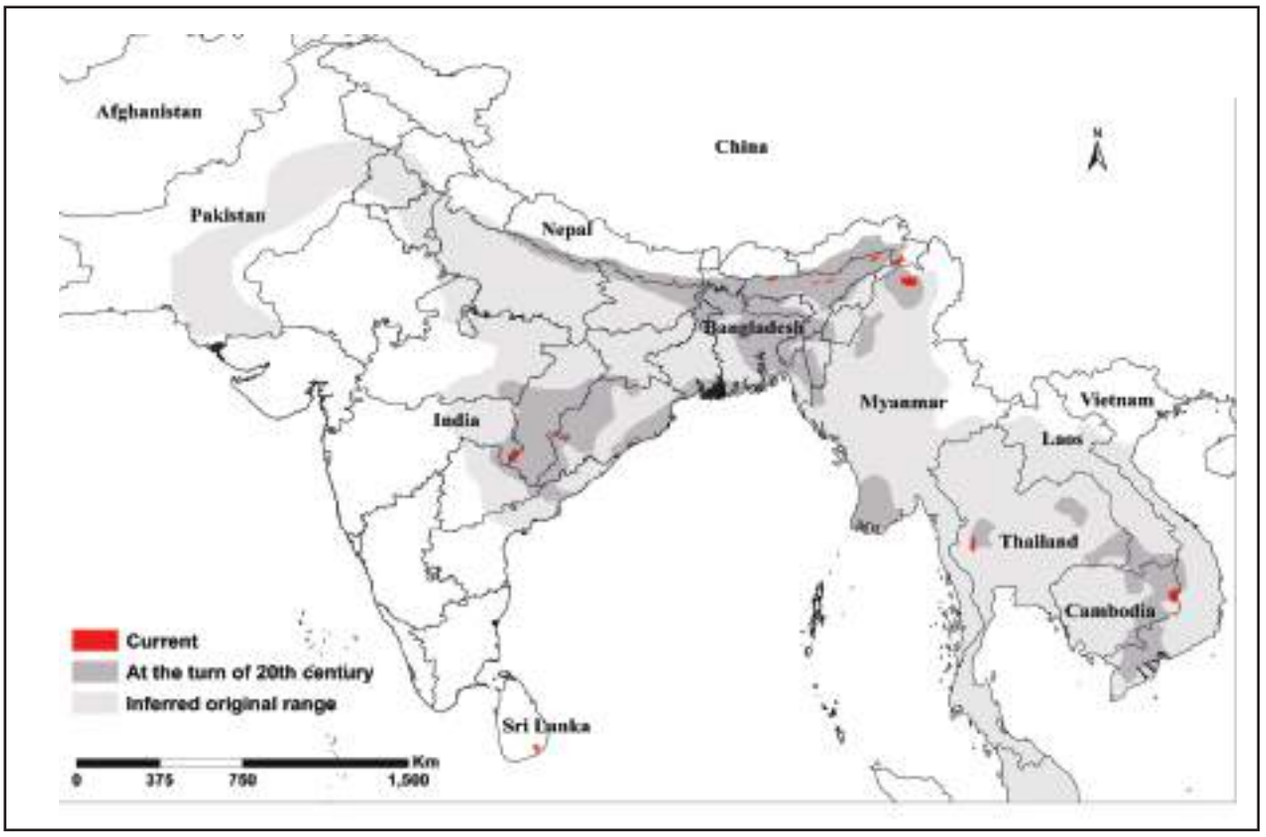


Fig 1.5: Current and historical distribution of wild buffalo (Source: Kaul et al., 2019, Choudhury, 2014)

single sites in each of southern Nepal, southern Bhutan, western Thailand, eastern Cambodia, and northern Myanmar, and at several sites in India: in Central India and the North-east, predominantly in Assam. Wild buffalo is believed to be extinct in Bangladesh, Peninsular Malaysia, and on the islands of Sumatra, Java, and Borneo (in Kaul *et al.*, 2019) (Fig. 1.5). Sri Lanka is included in the historic range of the species (Corbet and Hill, 1992) even though there is some disagreement on the origin of the population.

In India, the wild buffalo was once widely distributed in the riverine forests and plains of the northeast, extending west from the plains of the Ganges and Brahmaputra to Uttar Pradesh, and southwards, through eastern peninsular India to the Godavari river (Daniel and Grubh, 1966). Presently, the last bastion of the wild population in India lies in its north-eastern and Central region. In the northeast India, Daniel and Grubh (1966) considered Manas, Kaziranga, Pabha, Laokhowa, the Sankosh-Manas riverine tract and Lakhimpur in Assam as the range of this animal. In addition, there have been reports of its presence in Meghalaya (Rodgers and Panwar, 1988; Choudhury, 1994) and Arunachal Pradesh (Ranjitsinh, 1997, 1982; Choudhury, 1994). In Central India, there are two populations in Chhattisgarh, one in Indravati National Park and another in Udanti Wildlife Sanctuary. There is also a population that is found in the areas adjoining Indravati on the Maharashtra side in Kolamarka (Mayur, 2014). However, it is believed that a single large herd transcends the boundary across two states by crossing the Indravati river when it is dry (in summer).

Population estimates are not available for wild buffalo across its distribution range in India, barring some populations in north-east India (Choudhury, 2010) and now central India (Mishra *et al.*, 2001 and 2004), and this has led to wide discrepancy in local and global estimates. The IUCN/SSC Asian Wild Cattle Specialist Group (AWCSG)[6] projects a global population of 3500-4000 individuals (*Kaul et al.,* 2019).

Table 1.1: Global population status of Asian wild buffalo

Location	Number of buffaloes
Assam, India	2800
Arunachal Pradesh, India	200
Meghalaya, India	50
Other Indian States	>50
Nepal	200
Thailand	50
Cambodia	<20
Bhutan	<30

In the early 1960s, the estimated world population was presumed to be about 2000, although the IUCN Red data book suggested that 2000 occurred in India and Nepal alone (IUCN 1967). In 1980, the global number was estimated to be about 1000-1500 (Thornback, 1983). Humphrey and Bain (1990) estimated about 2000 in India and Nepal and 40 in Thailand. Choudhury (1994) suggested that there could be about 3300-3500 animals in northeast India alone. The latest estimate states the presence of >3500 individuals in the wild (Choudhury, 2010).

Table 1.1: Global population status of Asian wild buffalo. Source: Choudhury, A. U. (2010). The Vanishing herds: The Wild Water Buffalo. Guwahati: Gibbon Books & The Rhino Foundation for Nature in North-East India.

Although an estimated 3300-3500 wild buffalo exist in northeast India (Choudhury, 2010), an alarming decline in its population has been witnessed in and around Central India. In the late 1980's, estimated population of wild buffalo in Chhattisgarh was 104 (Divekar and Bhushan 1988), reporting about 26 wild buffalo restricted to Pillur meadow and Pengonda in Indravati Tiger Reserve, and 25 each in Pamed and Udanti Wildlife Sanctuaries. Earlier, the state forest department had estimated 240 individuals in 1986-87 for Chhattisgarh. Further, a small number was reported from the bordering areas of Andhra Pradesh and Chhattisgarh (Thornback, 1983; Ranjitsinh *et al.*, 2000). Daniel and Grubh (1966) reported about 100 animals in Kondakamberu Valley and Maheswarpur near Balimela in Odisha which later were believed to have gone extinct by 1980. In the state of Maharashtra, the population seems to have disappeared from Chandrapur district, after 1970 (Divekar *et al.*, 1979).

By the late 1980's, the wild buffalo was reported to be restricted to five populations in Central India with a total number of about 125 individuals (Mishra 2001). Ranjitsinh *et al.*, (2000) estimated 42-44 wild buffalo in Udanti Wildlife Sanctuary and about 25-30 in Indravati Tiger Reserve. Chhattisgarh Forest Department conducted annual population estimation in early 2000's and reported 109-124 individuals in Chhattisgarh; however, (Mishra, 2001), (Mishra and Kotwal 2003) and Mishra and Kotwal, 2004) put the estimates at about 70 in Central India.

[6] *The Asian Wild Cattle Specialist Group works to study and protect Asia's nine wild cattle species, all of which are threatened with extinction. https://www.asianwildcattle.org/*

In Chhattisgarh, presently, two confirmed wild buffalo populations exist - in Indravati Tiger Reserve, and Udanti Wildlife Sanctuary. The only other population of wild buffalo reported from central India is in the Gadchiroli district of Maharashtra, where a survey by Wildlife Trust of India (WTI) and other organizations estimated around 14-21 individuals (2-3 herds), mostly in Kopela-Kolamarka Conservation Reserve, the western contiguity of Indravati Tiger Reserve. The startling shrinkage in numbers has led to the local extinction of the species in Bhairamgarh WLS. Security reasons due to left-wing extremism curtailed opportunities for research and conservation work on wild buffalo in Indravati Tiger Reserve- an area that holds the only significant population (about 25 individuals) in Chhattisgarh (Mishra, 2001, unpublished report, WTI).

1.3. Habits and Habitats of Wild Buffalo

Wild buffalo is a social animal and follows fission-fusion dynamics in social arrangements. Females form loosely structured herds of 10–20, though occasional gatherings of more than 40 are also reported, often mixed with yearlings, contingent upon the population status. Newborn females typically remain within their maternal herd, while males disperse in their third year. A herd is typically led by the oldest member of the group. Herds of males are generally small, up to 10 individuals, comprising of adult and sub-adult individuals; older males generally remain solitary (Grzimek, 1990; Mishra, 2001).

Conflicting reports suggest that wild buffalo have either a distinct breeding season (October - November), an extended rut, up to five months long, or year-round reproduction; this may, in part, be attributed to regional differences. Mating system is generally polygynous; males may mate with multiple females. Gestation period varies by region, ranging from 300 to 340 days, and produces single offspring every two years (Sterndale, 1884; Brander, 1923; Gee, 1964; Scott, 1968; Prater, 1971; Krishnan, 1972). Female wild buffaloes may produce up to five calves in her lifetime. At birth, the calves are buff-brown in colour and it begins to darken around six months of age. Females reach their mature adult coloration at two or three years, while males do not become fully dark until four years of age. Sexual maturity is attained by males much earlier than females (18-month vs 36-month).

In a herd, wild buffaloes travel in single-file formation; an adult female in the lead, calves in the middle, and the remaining adults and sub-adults forming the rear. Buffaloes are extremely protective of their young and females fort the calves when threatened. If the threat persists, fleeing is their obvious choice but inside tall grass or forest and not into water (despite being strong swimmers).

Wild buffalo is known to coexist with several other ungulates and other wild species - rhinoceros, gaur, blue bull, swamp deer, hog deer, sambar, wild pig, elephants etc. They are usually seen sharing the same space and waterholes with sympatric species. In the wild, mature wild buffaloes have few predators, primarily being tiger, however adult bulls are rarely attacked. This is plausible given that there are many reports of tigers killed by adult buffaloes. In fact, the wild buffalo is well-known for its aggressive behaviour, more particularly with solitary bulls and cows (female wild buffaloes) with calves, although leopards are known to opportunistically hunt sub-adults and calves (Aflalo, 1904; Prater, 1971; Dougal, 1977).

1.4. Project Area

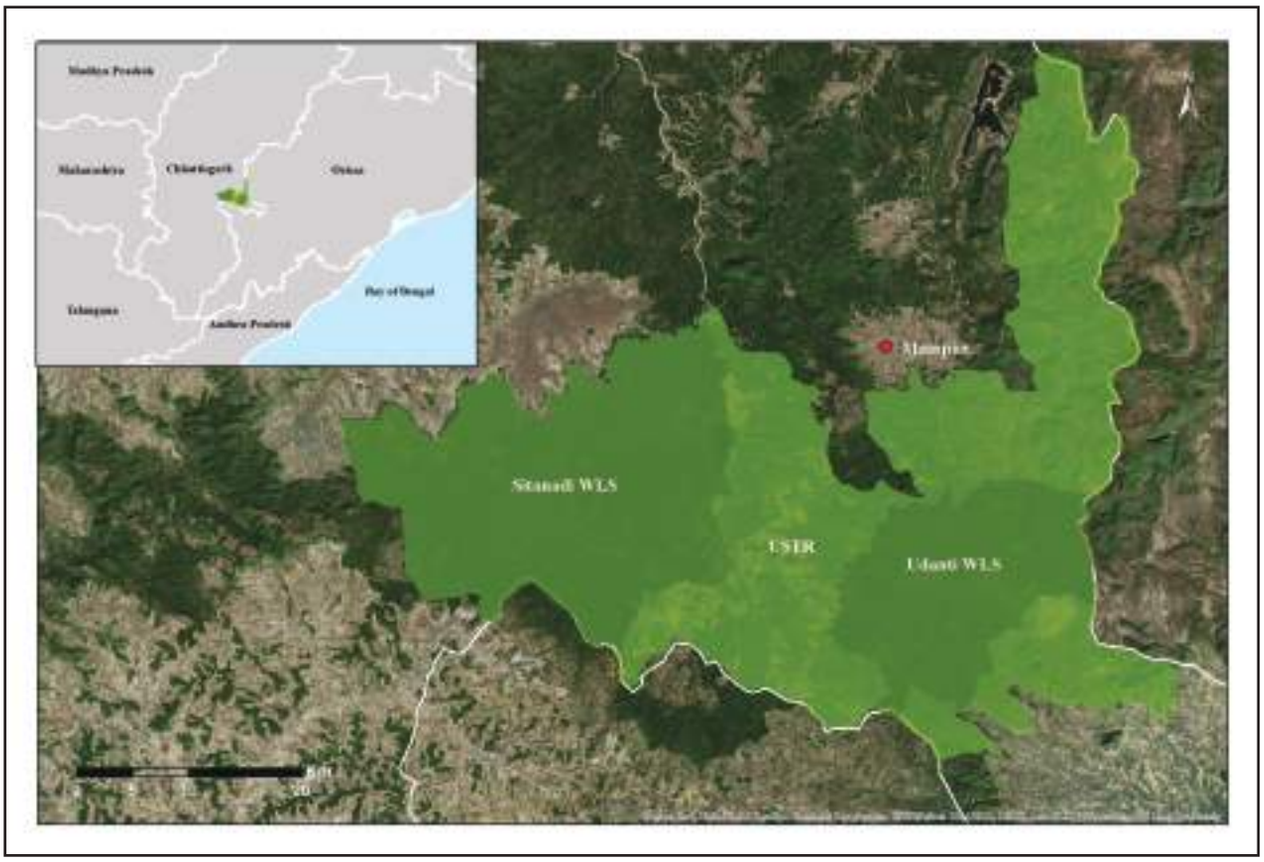


Fig. 1.6: Location map of Udanti WLS and Sitanadi WLS, which combines to form Udanti-Sitanadi Tiger Reserve, Chhattisgarh

The Central India Wild Buffalo Recovery Project (see section 1.5) has been largely implemented in Udanti Wildlife Sanctuary, which along with the Sitanadi Wildlife Sanctuary constitutes the Udanti-Sitandi Tiger Reserve (USTR) (Fig. 1.6). Situated in Gariaband and Dhamtari districts of Chhattisgarh, this area was declared a tiger reserve in the year 2008-09. The geographical area of USTR is 1842.54 km^2 of which, 851.09 km^2 is the core area and 991.45 km^2 forms the buffer area (Fig. 1.6). Though buffaloes are mainly found in Udanti, the adjacent Sitanadi is also known to harbour few individuals that move out from Udanti WLS periodically. Surveys were also conducted in promising wild buffalo areas in Chhattisgarh and adjoining states like Maharashtra and Odisha. Below, we provide a brief description of Udanti and Sitanadi Wildlife Sanctuaries (constituents of the USTR) and the areas where conservation work has been undertaken more intensively. We describe other areas where population surveys were conducted in Chapter 2 .

1.4.1. Udanti Wildlife Sanctuary

Udanti Wildlife Sanctuary is located in the Gariaband district of Chhattisgarh and covers an area of 237.27 km^2 (Fig. 1.6). It was formerly under the control of Bindranavagarh (Zamindari) estate before the forests were transferred to the government and forest rules were enforced to regulate hunting. Shooting of wild buffalo was then allowed, after obtaining a formal permission from the government as per the 1953 regulation. In 1984, the Government of

Madhya Pradesh (Chhattisgarh was part of the erstwhile Madhya Pradesh state then) notified it as a wildlife sanctuary as per the provisions of Wildlife (Protection) Act, 1972 before being notified as a tiger reserve along with Sitanadi Wildlife Sanctuary.

Forest cover in the sanctuary is mostly dense and *Shorea robusta, Terminalia tomentosa, Diospyros melanoxylon, Anogeissus latifolia, Bombax ceiba, Terminalia chebula, Tectona grandis, Boswellia serrata, Pterocarpus marsupium* are the common top storey species in the forest. The prominent middle storey tree species include *Emblica officinalis, Cleistanthes collinus, Grewia tiliifolia, Cassia fistula, and Soymida febrifuga.* The under storey species are dominated by *Indigofera cassioides, Chloroxylon swietenia, Randia dumetorum, Woodfordia fruticosa, Embelia ribes, Helicteres isora* etc. The common herbaceous species found in the sanctuary are *Grewia rothi, Sida acuta, Urena lobata, Chlorophytum arundinaceum, Curcuma aroginosa, Grewia hirsuta, Curcuma angustifolia, Curculigo orchioides, Andrographis paniculata* etc. Common grasses in the sanctuary are *Themeda quadrivalvis, Heteropogon contortus, Saccharum munja, Eragrostis tenella, Chrysopogon fulvus, Vetiveria zizanoides, Panicum sp. Panisetum sp, Apluda sp,*

Table 1.2: Topographical and climatic features of Udanti WLS

Topography	Hilly, Undulating terrain, moderate slope with flat plateau and valleys
Altitude	Between 320 to 370 m. above MSL
Drainage	Udanti and Indravan river basin besides seasonal nullahs
Geology	Archaean and Vindhyan sandstone
Soil	Laterite and sandy soil
Slope	Moderate, plateau, steep and plain
Climate	Monsoon with three distinct seasons - Rainy, Winter and Summer
Annual Rainfall	1200 – 1500 mm
Temperature	70- 41^0 C
Humidity	Rainy season: 70-90 %; Summer season: 20-30 %

The peripheral area of the sanctuary is mostly hilly while the central portion is generally plain or gently sloped. Detailed topographical and climatic features are given in Table 1.2.

The forests of Udanti WLS have been classified into five forest types i.e. 5A/C lb Southern Tropical Dry Deciduous Dry teak forest, 3C/C 2e (i) North Indian Tropical Moist Deciduous -Moist peninsular high level Sal, 3C/C 2e (ii) North Indian Tropical Moist Deciduous -Moist Peninsular low level Sal, 5B/C lc Northern Tropical Dry Deciduous – Dry peninsular Sal, 5A/C3 Southern Tropical Dry Deciduous – Southern dry mixed deciduous forest (Champion and Seth, 1968).

Bothriochloa sp., etc. These also constitute the main food species for wild buffalo. Orchids and epiphytes are also found in the sanctuary.

In addition to the wild buffalo, Udanti Wildlife Sanctuary also holds herbivores like chital (*Axis axis*), sambar (*Rusa unicolor*), barking deer (*Muntiacus muntjak*), four-horned antelope (*Tetracerus quadricornis*), nilgai (*Boselaphus tragocamelus*), gaur (*Bos gaurus*), wild pig (*Sus scrofa*), common langur (*Semnopithecus entellus*), and Indian hare (*Lepus nigricollis*), Tiger (*Panthera tigris*), leopard (*Panthera pardus*) and wild dog (*Cuon alpinus*) are the key predators. Sloth bear (*Melurnus ursinus*) is also found in parts of the sanctuary. Udanti WLS also reports a rich assemblage of reptiles, birds (more than 180 species), insects and butterflies. The state forest department conducts annual wildlife counts (of some major species) on regular basis. There are 17 small revenue villages inside the sanctuary occupied by about 5,800 people with over 4,154 head of livestock. Gond, Bhunjia, Kamar are the major tribes living in the area (WTI, 2009).

1.4.2. Sitanadi Wildlife Sanctuary

Sitanadi was declared as a Wildlife Sanctuary in 1974 and extends over 553.36 km^2. It is named after the Sitanadi River that originates from the sanctuary. The terrain is hilly and undulating.

The forests of Sitanadi WLS have been classified into five forest types i.e. 5 A/C 1 b (iii) Dry Teak Forest, 5 B/C 1 c (iv) Dry Peninsular Sal Forest, 5 B/C 2 (xi) Northern Dry Mixed Deciduous Forest, 5 /E/9 Dry Bamboo Forest (Champion and Seth, 1968).

Common trees of the deciduous forests of the sanctuary include *Shorea robusta, Terminalia tomentosa, Diospyros melanoxylon, Anogeissus latifolia, Bombax ceiba, Terminalia chebula, Tectona grandis, Boswellia serrata* and *Pterocarpus marsupium* among others. *Emblica officinalis, Cleistanthus collinus, Grewia tiliifolia, Cassia fistula, Soymida febrifuga* and other species form middle storey of the forest. Under growth is comprised mainly of *Indigofera cassioides, Chloroxylon swietenia, Randia*

Table 1.3 Topographical and climatic feastures of Sitanadi WLS

Topography	Hilly, Undulating terrain, moderate slope with flat plateau and valleys
Altitude	Between 327 to 737 m. above MSL
Drainage	Sitanadi river basin besides seasonal nullahs
Geology	Archaean and Vindhyan sand stone
Soil	Laterite and sandy soil
Slope	Moderate, plateau, steep and plain
Climate	Monsoon with three distinct seasons - Rainy, Winter and Summer
Annual Rainfall	1300 – 1600 mm
Temperature	8^0 - 42^0 C
Humidity	Rainy season: 70-90 %; Summer season: 20-30 %

dumetorum, Woodfordia fruticosa, Embelia ribes and *Helicteris isora*. Common herbs in the sanctuary are *Chlorophytum arundinaceum, Grewia hirsuta, Curcuma angustifolia, Sida acuta, Cassia tora, Urena lobata, Ageratum, Conyzoides, Lantana camara* and *Andrographis paniculata*. *Phoenix occaulis* and *Eupatorium, Odoratum* are major forest unwanted flora in the sanctuary.

Chital, sambar and barking deer are the deer species in the sanctuary besides two antelopes nilgai and the four-horned antelope. Other common mammals in Sitanadi are gaur, wild pig, common langur and Indian hare. Tiger, leopard and hyena (*Hyaena hyaena*) are important carnivores in the sanctuary.

There are 13 forest villages and five revenue villages inside the sanctuary. Gond, Marar, Bhunjia and Kamar tribes reside in these villages. Though paddy is the main crop in the area, forest resources are other major livelihood sources. Mahua (*Madhuca longifolia*) flowers and fruits, Aonla (*Emblica officinalis*) fruits and Achar (*Buchanania lanzan*) fruits, Siali (*Bauhinia vahlii*) leaves and Lac (extracted from *Schleichera oleosa* are major NTFPs of the sanctuary area.

1.5. Project Background, Goal and Objectives

It was way back in 2005, Wildlife Trust of India (WTI) partnered (through a bilateral MoU) with the Chhattisgarh Forest Department for conducting a joint survey to evaluate the number of wild buffaloes (being the state animal) in four wildlife sanctuaries namely Udanti, Pamed, Sitanadi and Bhairamgarh, and Indravati National Park in newly formed state of Chhattisgarh (erstwhile Madhya Pradesh). The survey revealed that no buffaloes remained in Sitanadi and Bhairamgarh WLS. Only the three remaining PAs, registered a small population of the species, i.e. Udanti with seven wild buffaloes (with one female), Pamed with five wild buffaloes and Indravati with a relatively large population of about 30 individuals. However, no conservation initiatives were possible in Pamed WLS and Indravati NP, owing to high left-wing extremism. These new figures indicated that the species' local extinction in the state of Chhattisgarh was imminent. All hopes of reviving the state animal's status, lay on the buffaloes in Udanti WLS.

Following the stark revelations, WTI helped the Forest Department prepare a five-year Action Plan for the recovery of the wild buffalo population in Udanti. A multi-pronged need based approach was adopted with a long term conservation goal to 'ensure the survival of the last remaining population of wild buffalo in Udanti Wildlife Sanctuary and recover it to a viable number in future'. Following are the key objectives, which were set at different timelines i.e. 2009-2020 under the overarching goal:

1. Gather and update scientific information on wild buffalo and their habitat in Central Indian landscape.

2. Improve habitat conditions for wild buffaloes in Udanti-Sitanadi Tiger Reserve (through community participation, protection, and habitat management).

3. Zero down unnatural mortality of wild buffaloes in Udanti WLS (using regular monitoring, frontline training and veterinary support).

4. Support augmentation of wild buffalo numbers (through assisted captive breeding and translocation).

5. Increase awareness about wild buffaloes amongst urban and rural stakeholders (through conservation incentives and targeted campaigning).

CHAPTER 2

WILD BUFFALO IN THE CENTRAL INDIA LANDSCAPE

Rajendra Prasad Mishra, Rahul Kaul, Samir Kumar Sinha, Adrish Poddar and Debobroto Sircar

2.1 Population assessment through surveys

Species-oriented conservation and management requires knowledge on population size and trends in abundance (Yoccoz *et al.,* 2001; Martin *et al*., 2007) which are a must to initiate a species recovery project. This is especially so, when existing records show discrepancies in the reported estimates of wild buffalo population in Central India, by different agencies and researchers. Therefore, a fresh look at the distribution and abundance of the species in the state and adjoining areas in other states was warranted. Thus, wild buffalo population surveys were undertaken at various times during the project. The next sections in the chapter provide detailed accounts of the surveys.

The population status of wild buffalo was assessed in Chhattisgarh and the adjoining states of Maharashtra and Odisha. Multiple surveys were undertaken after 2005 in many of the probable locations. The following areas were surveyed under the study (Fig. 2.1, Table 2.1);

A joint exercise of the Chhattisgarh Forest Department staff and field ecologists from WTI was conducted following the block count method to assess the wild buffalo number.

i. Chhattisgarh: Udanti Wildlife Sanctuary, Sitanadi Wildlife Sanctuary, Indravati National Park, Pamed Wildlife Sanctuary, Bhairamgarh Wildlife Sanctuary.

ii. Odisha: Sunabeda Wildlife Sanctuary and Sinapali Forest Range in Khariar Forest Division. These areas are adjacent to Udanti WLS with past records of wild buffalo presence.

iii. Maharashtra: Sironcha Forest Division (Gadchiroli district) adjoining Indravati National Park.

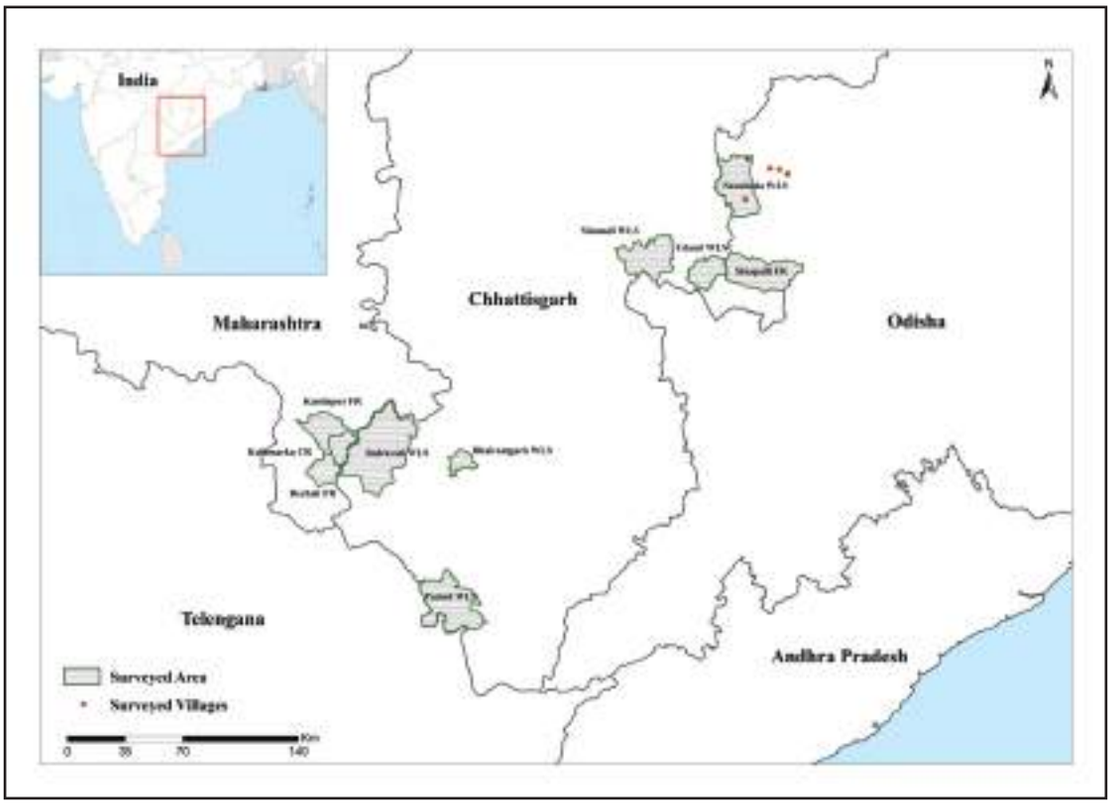


Fig. 2.1: Map showing wild buffalo survey locations in Central India

Details of the survey are as below:

Table 2.1 Wild buffalo survey details in central India

Sl. No.	State	Surveyed / visited areas	No. of visits / surveys	Survey Month(s) and Year(s)
1	Chhattisgarh	Udanti Wildlife Sanctuary	Multiple[7]	Regularly since 2006
		Sitanadi Wildlife Sanctuary	Multiple	
		Indravati National Park	05	April 2008, May 2010, April 2013, May and August 2016
		Pamed Wildlife Sanctuary	01	April 2008
		Bhairamgarh Wildlife Sanctuary	02	April 2008 and May 2010
2	Odisha	Sunabeda Wildlife Sanctuary	02	January and March, 2009
		Sinapali Forest Range (Khariar Forest Division)	02	January and March, 2009
3	Maharashtra	Sironcha Forest Division (Gadchiroli district)	02	June 2008 and July 2009

[7] *As WTI has a field station in Udanti WLS since 2006, the site is visited daily and data collected constantly for a period of 14 years*

Fig. 2.2: Wild buffalo named "Chhotu" (above) and "Jugadu" (below) in USTR, Chhattisgarh

Table 2.2: Salient information on the areas surveyed for wild buffalo population assessment

Sl. No.	Name of Protected Area	State	Area (km^2)	Forest Types	Anthropogenic attributes
1	Udanti Wildlife Sanctuary	Chhattisgarh	237.27	5A/C 1b Southern Tropical Dry Deciduous Dry teak forest; 3C/C 2 e (i) North Indian Tropical Moist Deciduous -Moist peninsular high level Sal; 3C/C 2e (ii) North Indian Tropical Moist Deciduous -Moist Peninsular low-level Sal; 5B/C 1c Northern Tropical Dry Deciduous – Dry peninsular Sal; 5A/C3 Southern Tropical Dry Deciduous – Southern dry mixed deciduous forest	17 small revenue villages inside the sanctuary; human population about 5,800; cattle population 4000
2	Sitanadi Wildlife Sanctuary	Chhattisgarh	553.36	5A/616 Dry teak forest; 5B/616 dry peninsular Sal forest; 5B/C2 north dry mixed deciduous forest; 5/E/9 drybamboo forest	34 revenue villages inside the Sanctuary
3	Indravati National Park	Chhattisgarh	1258.372	3B/C1Moist mixed deciduous forest with teak; 3B/C2 Moist Mixed Deciduous Forest without teak; and 3CA/c3 Southern dry mixed deciduous forest	56 small revenue villages in the vicinity; human population about 8000; cattle population: about 13000
4	Pamed Wildlife Sanctuary	Chhattisgarh	442.23	5A/3B/C1 southern semi-moist deciduous teak forest; 5A/3B/Cc2 southern semi moist deciduous without teak forest; 5A/C3 southern dry mixed deciduous forest	21 small revenue villages; human population about 4000; cattle population: over 6000
5	Bhairamgarh Wild Buffalo Sanctuary	Chhattisgarh	138.95	5A/3B/C1 southern semi-moist deciduous teak forest; 5A/3B/Cc2 southern semi moist deciduous without teak forest; 5A/C3 southern dry mixed deciduous forest	15 small revenue villages; human population about 5000; cattle population about 4500
6	Sunabeda Wildlife Sanctuary	Odisha	600	5B/C2 Northern dry mixed deciduous forest (5BC2)	52 villages (30 Revenue village + 22 other settlements)
7	Sinapali Forest Range (Khariar Forest Division)	Odisha	677.67	5B/C2 Northern dry mixed deciduous forest; 5B/C1b Dry Sal forest (dry peninsular types); 5AC1b/c Dry teak forest; 5A/E2 Boswellia forests; 5A/E9 Bamboo brakes	

2.2. Survey Method

Due to better access, survey efforts were concentrated in Udanti WLS. WTI and the state forest department jointly conducted the first estimation in 2006, followed by regular surveys thereafter. The methods followed in the wild buffalo population surveys in Udanti WLS are as below:

i. Obligatory design (Goodman, 1977; Melton, 1978) was employed in order to make use of the selected trails and paths within the study areas. The trails were visited periodically throughout the year, and tracks and direct sightings were recorded. This yielded information on individual animals, their presence, including habitats used.

ii. A joint exercise of the Chhattisgarh Forest Department staff and field ecologists from WTI was conducted following the block count method to assess the wild buffalo number. Each forest compartment of the sanctuary was treated as a block. All the compartments were surveyed simultaneously by the team of surveyors, and sightings of buffaloes were communicated to each survey party over wireless sets (walky-talky) to avert the possibility of double counts caused by the movement of buffaloes across compartments. With every sighting of wild buffalo, data on location, number of individuals, age-sex composition was recorded.

In Udanti and Sitanadi Wildlife Sanctuaries, extensive field surveys were conducted, whereas short visits - five to Indravati National Park, two to Bhairamgarh WLS and one to Pamed WLS were also undertaken. Short surveys were also conducted in the Gadchiroli district of Maharashtra; and Sunabeda Wildlife Sanctuary and Sinapali Forest Range under Khariar Forest Division in Odisha.

Direct sightings as well as indirect signs of the species were targeted during the field surveys. Local villagers and forest officials were also interviewed to find out about the population and distribution of wild buffalo in these PAs.

2.3. Survey Results

Findings on the distribution and population size of wild buffalo in the areas surveyed in different states are given in this section.

Chhattisgarh

On the basis of field surveys, discussion with villagers and forest field staff, details of wild buffalo population in Chhattisgarh are as follows. Although the first of these surveys was conductd in 2006, the situation has not changed very much. We undertook more surveys in subsequent years when claims of the presence of buffaloes were heard.

A. Indravati National Park

Several attempts were made to survey Indravati in 2008, 2010, 2013 and 2016, but only short visits were possible. This was largely related to security issues posed by the left-wing extremist movement. Indirect evidences of wild buffalo and interaction with local people in Farsegarh, Kutru villages and forest field staff of Indravati suggested the presence of about 25-30 wild buffaloes (Table 2.3). The interaction also indicated regular movement of wild buffaloes in the adjoining forests of Gadchiroli district (Maharashtra).

B. Pamed Wildlife Sanctuary

An attempt was made in April 2008 to survey Pamed WLS but due to prevalent security concerns, a detailed survey could not be conducted in the sanctuary. Based on discussions with field staff of the sanctuary and

locals, the presence of a herd comprising five to eight wild buffalo was suspected. The villagers and forest staff indicated the movement of wild buffaloes between Pamed and Indravati (being contiguous). No surveys could be carried out here due to difficulty in accessing the area on account of security issues.

C. Bhairamgarh Wildlife Sanctuary

About 70% area of the sanctuary was surveyed during 2007-08, but no evidences of wild buffalo could be found. Based on interaction with villagers and forest department staff it was inferred that wild buffaloes have not been using the sanctuary since the year 2000. The local peoples also opined that the wild buffaloes might have moved to Indravati National Park due to biotic pressure and habitat degradation in Bhairamgarh Wildlife Sanctuary. Here, the last confirmed sighting of wild buffalo (one individual) was made in 1996. No buffalo sightings were reported in May 2010 visit. The situation remains unchanged even today.

D. Sitanadi Wildlife Sanctuary

Several field visits were made, but neither sighting nor evidence of wild buffalo was found in Sitanadi WLS during our initial surveys. Discussions with the local people revealed that the wild buffalo have been absent in the area for long. However, in December 1996, a wild buffalo herd moved from Udanti to Sitanadi and returned back to Udanti after some time. Further, movement of wild buffaloes from Udanti to Sitanadi has been recorded during 2006-2008 and as recent as 2015-17 a single buffalo moved into the area temporarily.

E. Udanti Wildlife Sanctuary

In Udanti WLS, 29 randomly identified trails were monitored to detect the presence of wild buffalo. Systematic observations made in Udanti WLS in 2006 suggested that there were seven buffaloes then – four adult males, one sub-adult male and one each adult female and sub adult female. The adult female was killed by a poisoned arrow in August 2006. Later, in December 2006, the other female (christened as *Asha*) was found pregnant, and was shifted to an *in-situ* enclosure in the sanctuary to avoid any unnatural casualty. The population abundance and structure of the species (in 2018-19) are shown in Table 2.3 and Fig.2.3.

The wild buffalo individuals (details in Table 2.4.) in Udanti WLS, because of very low numbers are being monitored regularly individually.

Table 2.3: Number of wild buffalo in various areas of Chhattisgarh (Recent estimates, in the year 2018-19)

Name of PA	Estimated Wild buffalo population in Chhattisgarh
Indravati NP	25-30
Pamed WLS	5-8*
Bhairamgarh WLS	Nil
Sitanadi WLS	Nil
Udanti WLS	9

*Estimated number in 2008

Table 2.4: Name and age/sex of wild buffalo in Udanti WLS (Year 2018-19)

Wild buffalo individuals (ID)	Age/Sex	Remarks
Jugadu	Male, about 22 years	Free ranging
Raja	Male, 10 years	
Prince	Male, 9 years	
Mohan	Male, 7 year	
Chhotu	Male, 15 years	
Aasha	Female, 13 years	In the in-situ enclosure created in Udanti WLS
Veera	Male, 6 years	
Somu	Male, 5 years	
Khushi/Kiran	Female, 4 years	

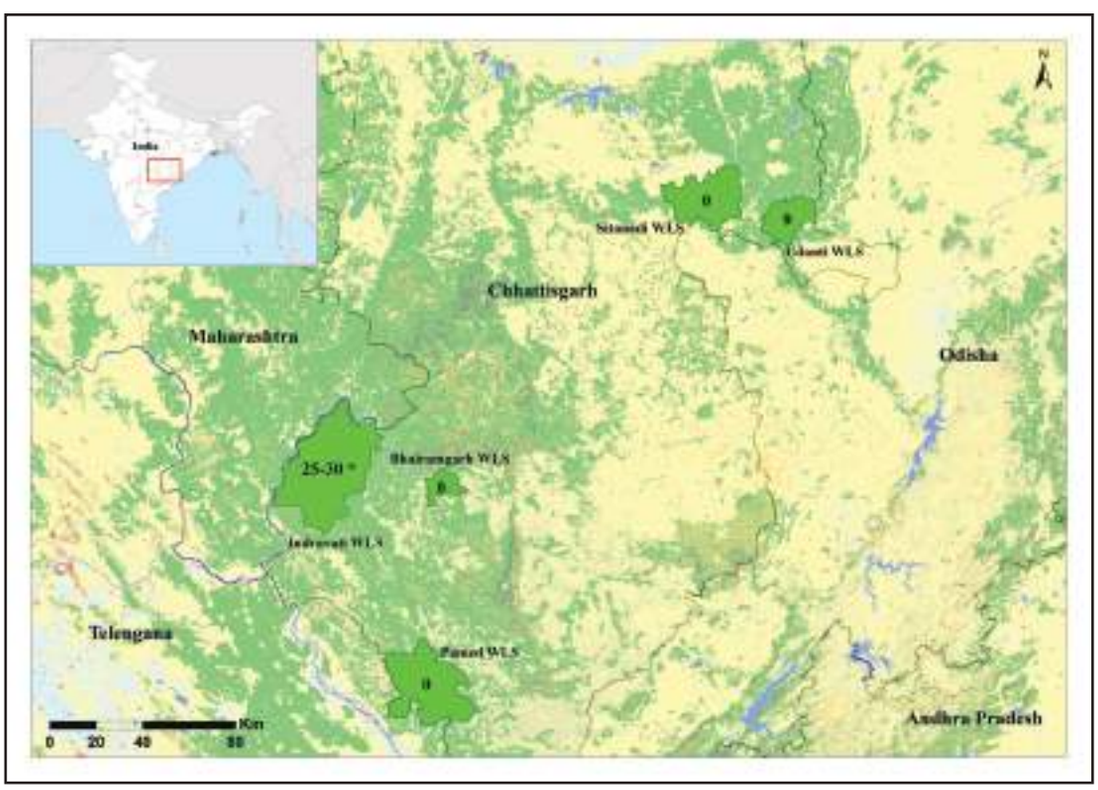


Fig 2.3: Population estimates for wild buffaloes in the surveyed areas in Chhattisgarh (Sitanadi WLS – Transient population found)

Odisha

Findings of the surveys conducted in Sunabeda Wildlife Sanctuary and Sinapali Forest Range in Nuapada district of Odisha, that adjoin Udanti WLS are given in Table 2.5.

A. Sunabeda Wildlife Sanctuary

Before the survey, the team had interactions with the residents of Datunama, Koked, Sunabeda, Jamgaon, Gadgada and Kholibhitar villages inside the sanctuary. The team also interacted with village elders and livestock herders, and used their traditional knowledge to understand the past and present distribution of the wild buffalo. No evidence could be gathered during the survey but our impressions are presented in Table 2.5.

Table: 2.5: Information on wild buffaloes collected in the villages in Sunabeda WLS

Village name and Location	No. of households	Community composition	Distance from the Sanctuary	Information about wild buffalo
Koked 20º 29.50'N 82º 29.66'E	10	Mainly Bhunjia tribe	8 km	• A villager had seen a wild buffalo trophy (Head) when hunting was allowed. But, majority of the villagers had never seen a live wild buffalo • Few villagers informed that wild buffalo were distributed in Chauradongar area long back, but none among them had seen any. • Nearby forest areas were surveyed by the team, no evidence of wild buffalo found.
Jamgaon 20º 32.451'N 82º 30.680'E	Unassessed	Unassessed	10 km	• Villagers informed that wild buffaloes were present in the area about 60 years back. No recent records. • No wild buffalo signs were recorded in the nearby forests by the survey team.
Gadgada 20º 28.894'N 82º 31.995'E	15	Mainly Paharia Kamar tribe	Inside the sanctuary	• No evidence of wild buffalo was seen by the villagers, some of them didn't even know about the species • No wild buffalo evidences were found in the nearby forests by the survey team.
Badkiaam 20º 28.715'N 82º 33.320'E	40	Unassessed	Inside the sanctuary	• No evidence of wild buffalo was found in the nearby forests by the survey team.
Kholibhitar 20º 25.785'N 82º 33.662'E	60	Mainly Chinda Bhunjia tribe	Inside the sanctuary	• Located in core area of the Sunabeda WLS and about 40 km from Udanti WLS • Villagers informed that wild buffalo was never seen by them in the area. • The survey team visited two trails along the banks of River Indravati, but no evidence of WB could be found.

B. Sinapali Forest Range
(Khariar Forest Division)

The Khariar Forest Division in Odisha was surveyed twice - in 2009. Poor availability of grasses and lack of perennial water sources was striking - even Udanti River flowing through this area dries up during summer. Villagers in five villages - Sindursil, Chitarama, Ludhwapara, Bhatapani and Nagalbond located adjacent to the Udanti WLS (In Chhattisgarh) were interviewed to know about the movement pattern of wild buffalo from Udanti to these areas. Details of the findings are given below:

Sindursil village (20°06'59.1" N / 82°25'48.6" E): This is the closest village to the boundary of Udanti WLS. A revenue village located on the bank of Udanti River, it has about 60 households (370 people), dominated by the Yadav community. The villagers informed that one male wild buffalo was seen in 1973 and 1974, but was not seen thereafter.

Chitarama village (20°06'40.1" N / 82°25'58.2" E): The village is also located on the banks of Udanti River. There are about 35 households (185 people) in this village mostly belonging to the Bhunjia tribe. They also referred to the wild buffalo sighting by the villagers in Sindursil village.

The team also visited Ladhwapara, Bhatapani and Ghatarnal villages to ascertain the presence of wild buffalo. However, the villagers informed that they had never sighted any wild buffalo. The team also discussed with the local frontline forest department staff posted at Ghatarnal and Chitarama beats, and they too were unaware of the presence of wild buffalo in these areas.

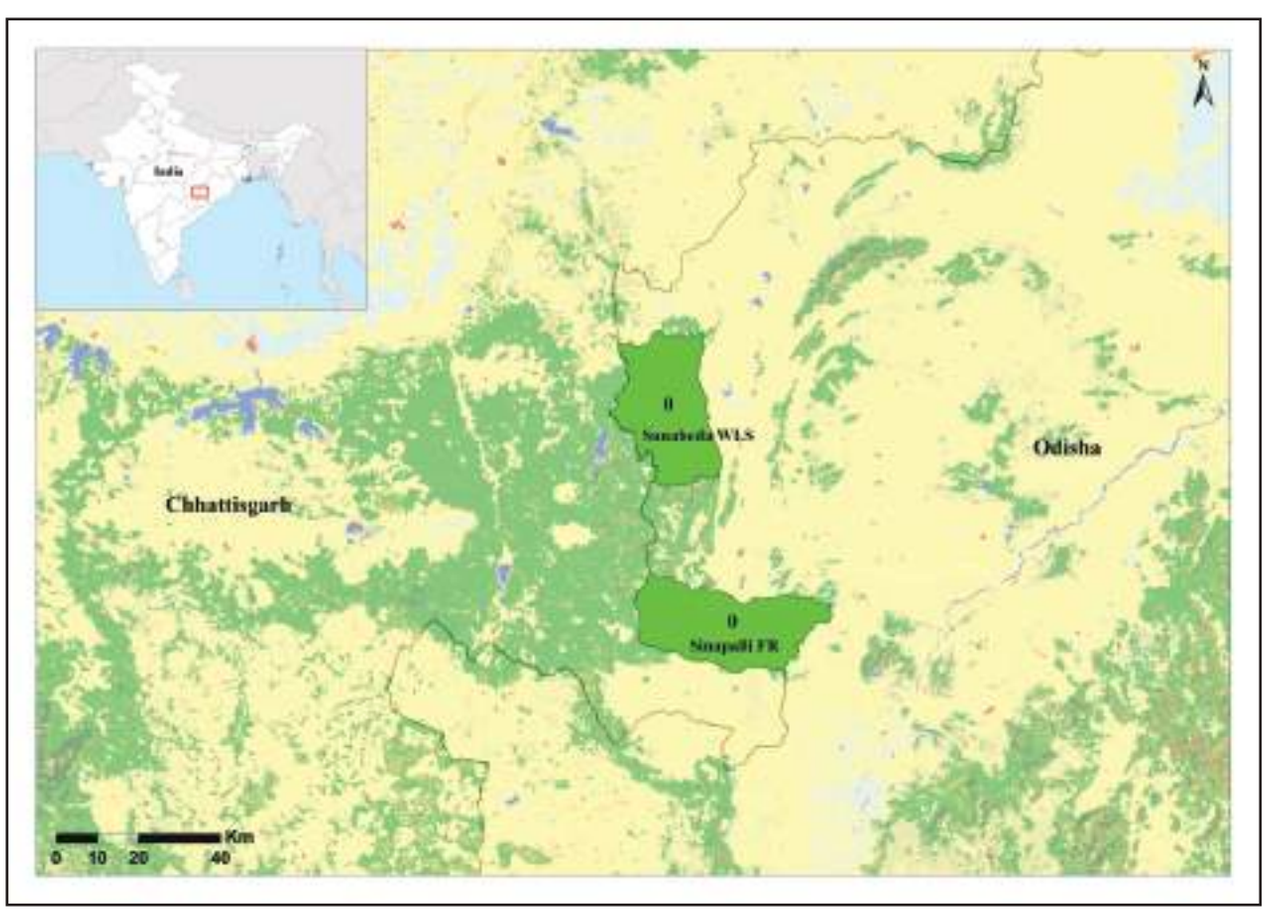


Fig 2.4: Population estimates for wild buffaloes in the surveyed areas in Odisha

Maharashtra

Being contiguous to the forests of Chhattisgarh, which are known to harbour existing population of wild buffaloes, Maharashtra was an integral part of the reconnaissance survey.

A. Sironcha Forest Division (Gadchiroli district)

The surveys covered Kolamarka, Garewada and Chitweli forest beats in Kamlapur Forest Range and Mukhanpalli Forest Beat in Dechli Forest Range in Sironcha Forest Division, adjoining the Indravati Tiger Reserve. Secondary information from villagers' interviews and evidences in the surveyed areas suggested the presence of wild buffalo in these ranges, especially in the areas along the Indravati river.

In Dechli and Todka villages adjoining Indravati River in Dechli Forest Range, villagers informed about the presence of 10 to 15 wild buffaloes along the riverbank (Fig.2.5), between Kamlapur and Dechli Forest Ranges (Fig.2.6).

The villagers of Chitweli in the Kamalpur Forest Range informed about the presence of about 15 wild buffaloes in three herds present in the year 2007, but only one pair of wild buffalo was seen subsequently in 2008. The villagers also informed that the wild buffalo often migrated from Indravati Tiger Reserve, Chhattisgarh to the adjoining areas in Gadchiroli areas in summer and returned in the monsoon. During the survey in Chitweli and Garewada Forest Beats on the bank of Indravati River wild buffalo signs were recorded in the following areas:

- Compartment nos. 80 and 82 - few old hoof marks
- Compartment nos. 52 and 79 - fresh hoof marks of three wild buffaloes (2 adults and 1 calf) on the bank of river Indravati on the Maharashtra side.

In the Dechli Forest Range, two wild buffaloes were sighted in the forest compartment number 15 in Mukhanpalli beat during the year 2009. Both the animals were resting under the shade of a Mahua tree (*Madhuca longifolia*) and disappeared fast into dense forest after detecting the presence of our survey team and hence sex of wild buffalo individuals could not be ascertained. Presence of fresh dung of wild buffalo was recorded in Rewancha area in Mukhanpalli beat in the range. Wallowing signs were also observed on the bank of river Indravati.

In a survey conducted between February and May 2016 by the Maharashtra Forest Department, 20 wild buffaloes were recorded in Kolamarka (180.72 km^2), which was declared as a Conservation Reserve (under WPA,1972) in 2013, especially to protect wild buffaloes.

Fig 2.5: Herd of Wild buffalo in Kopela-Kolamarka Conservation Reserve (Maharashtra FD)

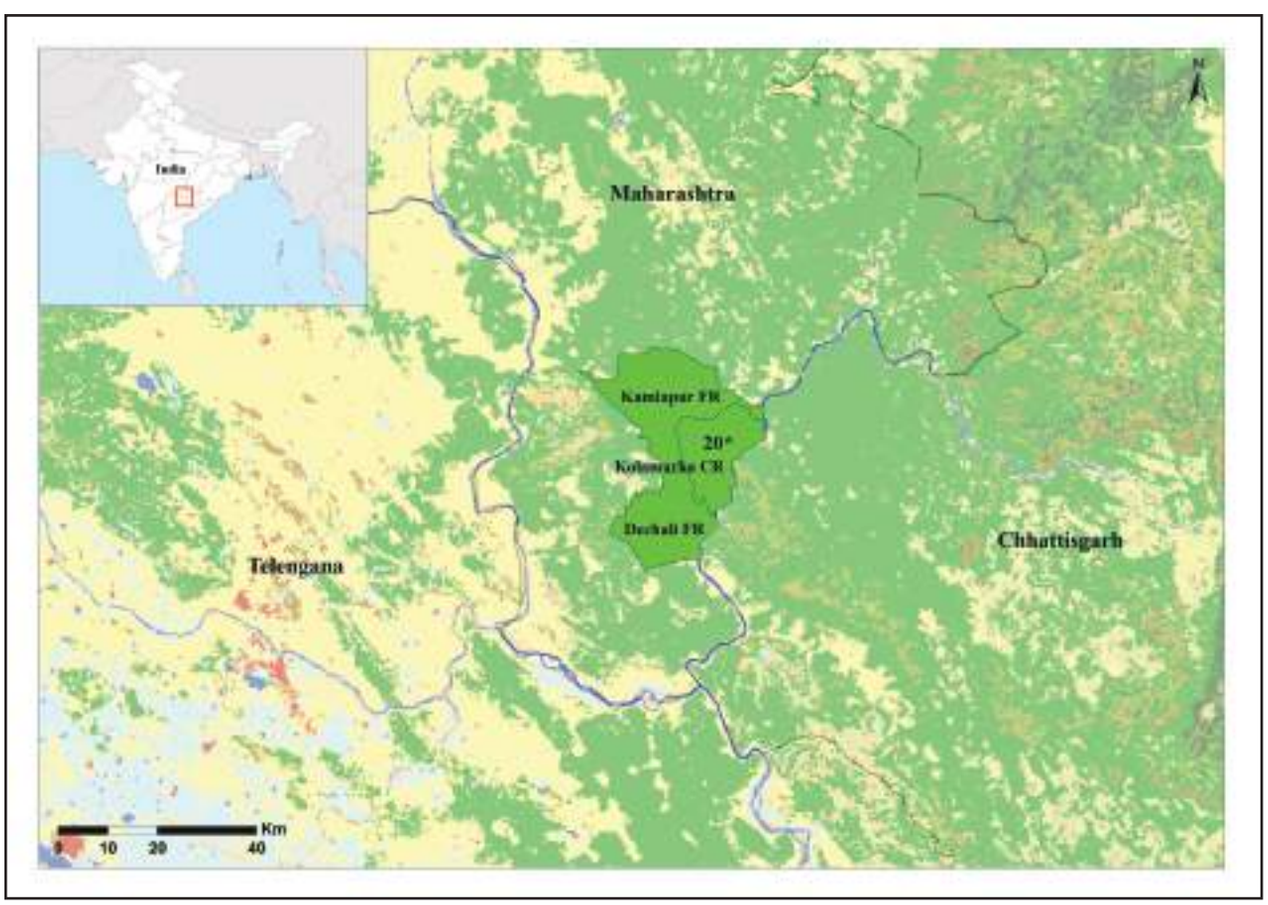


Fig 2.6: Population estimates for wild buffaloes in the surveyed areas in Maharashtra

2.3. Discussion: Estimate of population reduction and shrinkage of range

As per historical accounts, peninsular India (administratively known as Central Provinces, before Independence) had an abundant wild buffalo population, inhabiting areas alongside large rivers and their tributaries in the Gangetic plains and Sal forests (Fig. 2.7) of eastern–peninsular India i.e. South-eastern Madhya Pradesh in the district of Mandla, Raipur, Bastar (Now Chhattisgarh), Balasore and Sambalpur (Odisha). Two herds were recorded in the Patna state[8] on the borders of the Raipur district of Central Provinces (CP), where 40 to 50 animals used to frequent a locality within 10 miles (approx. 16 kms) of the state border and a small herd of about fifteen individuals 40 miles (approx. 64 km) further east. Occasionally a few wandering individuals used to cross into the west of Sambalpur as well (H.F. Mooney *et al.*, 1929). Another expedition in the year 1965 in and around Bastar estimated about 100 wild buffalo individuals in West Bastar (86 sighted), 50 in South Bastar (11 sighted) and 100 individuals in Odisha (suggested by Conservator of Forests, Jeypore circle). It goes on to estimate the total population of wild buffaloes in peninsular India to be less than 500 individuals (Daniel and Grubh, 1966). In Maharashtra, reports indicated two small herds of wild buffalo in the Allapalli division of South Chanda (now in Telangana) and few herds in the Aheri block in North Chanda (Gadchiroli) (Dunbar brander, 1923, as mentioned in Divekar *et al.*, 1983). However, over the course of time, the population has declined to around 50 – mainly distributed in Chhattisgarh and Maharashtra states. It has been observed, herds of wild buffaloes use the banks of the Indravati river[9] to move back and forth between the two neighbouring states, i.e. Chhattisgarh's

Fig. 2.7: A hand-drawn sketch by Alexander Inglis Robertson Glasfurd of wild buffaloes in Sal forests (Source: Leaves from an Indian jungle: gathered during thirteen years of jungle life in the Central Province, the Deccan and Berar, 1903)

Indravati Tiger Reserve and Maharashtra's Sironcha Forests Division. Thus, the wild buffalo population recorded in Kolamarka Conservation Reserve (latest minimum number of 20 wild buffaloes) could be the population common to Chhattisgarh (Indravati National Park) and Maharashtra states.

Though, the survey was conducted about a decade ago (during 2006-09), the scenario has not changed much except the recent reports from Kolamarka Conservation Reserve (Gadchiroli district, Maharashtra). The distribution of the species in central India was limited only to three protected areas of Chhattisgarh (Udanti and Pamed WLS and Indravati National Park) and Sironcha Forest Division in Gadchiroli district of Maharashtra. Owning to difficulty in conducting a proper survey in Indravati and Pamed, the population status of wild buffaloes here could only be an educated guess. Recent records of wild buffalo in Indravati NP are confirmed through the WTI project staff and staff of the Chhattisgarh Forest Department and local peoples; however, presence of the species in Pamed WLS in recent years could not be confirmed.

[8] *Patna, or Patnagarh, was a princely state in the Central Provinces of India during the British Raj. It had its capital at Balangir (Bolangir). Its area was 6,503 km2 (2,511 sq mi).*

[9] *Indravati river makes the natural boundary between two neighboring states, i.e. Chhattisgarh and Maharashtra*

Daniel and Grubh (1966) conducted surveys in 1965 in the erstwhile princely State of Bastar in eastern peninsular India (now in Chhattisgarh state) and the adjoining areas of Odisha and Maharashtra, which they referred to as the 'last stronghold of the Indian Wild Buffalo in peninsular India'. They recorded the presence of the species in Toinar (currently in Dantewada Territorial Forest Division) and Bhairamgarh Forest Ranges (currently in Bhairamgarh WLS) of the then West Bastar Forest Division. In South Bastar Division, wild buffaloes were present in Awapalli and Kistaram Ranges of the Bijapur division. During summer, wild buffalo also frequented the Pamed Reserve (currently Pamed WLS) and north Kistaram. In Orissa (now Odisha), they found the species restricted to pockets of Koraput District in the upper reaches of Sileru River. Additionally, wild buffalo presence was reported in the Maheswarpur area near Balimela at the foothills adjoining the Kondakamberu valley; near Orkel on the Potteru River west of the Sileru. Based on track counts and sightings, they could ascertain the direct presence of about 105 wild buffaloes in the surveyed area.

Divekar (1977) conducted surveys in Bhairamgarh and Toinar Forest Ranges in the west Bastar region in 1975 and estimated the presence of 23 wild buffaloes based on direct sightings and track signs. Thus, a decline of about 70% in the wild buffalo population was recorded in just a decade. For the region the population decline appears to be to the tune of over 80% in the last 50 years.

As per the Chhattisgarh Forest Department's assessment, there were 61-80 wild buffaloes in Udanti WLS during the period 1996-2005, which according to WTI estimates, appears to be a gross overestimate. There were only two females in the Udanti population in 2005, of which one adult female died in 2006. Thereafter, the only surviving female – named 'Aasha' was moved into an enclosure to avert any un-natural mortality. On November 17, 2006, Asha gave birth of the first male calf (Raja) in the captivity. Subsequently, she gave birth of four more males (2009, 2011, 2012 and 2013) and a female calf – christened as Kiran, in 2015. The population of wild buffalo in Udanti is thus small, and is certainly not viable in the long run, also given the fact that the off springs have been produced by a single female. More females must therefore be introduced into the population, either as hard released animals or through a systematic conservation breeding programme.

Along with the numbers, the distribution range of the wild buffalo in Central India has shrunk considerably and this is a major cause of worry not only for Chhattisgarh and Maharashtra where the distribution was more widespread than it is now, but also for states like Madhya Pradesh, Odisha and Andhra Pradesh where from it has been completely extirpated.

In Central India, the area over which the buffalo was distributed exceeded 300,000 Km^2. This had shrunk to about 2,28,000 Km^2 by the beginning of the 1900s. However, the maximum decline in its range was observed between 1900 and now. The present range of wild buffalo in central India is about 2,653 km^2, which is only 1.1% of the area that its distribution extended over in 1900 - a dramatic reduction indeed (as shown in Fig. 2.8).

Therefore, any recovery and consolidation of the species must take into account the recovery of its past distribution range., The species stands a better chance in the long term, if as many areas and as many populations are re-established.

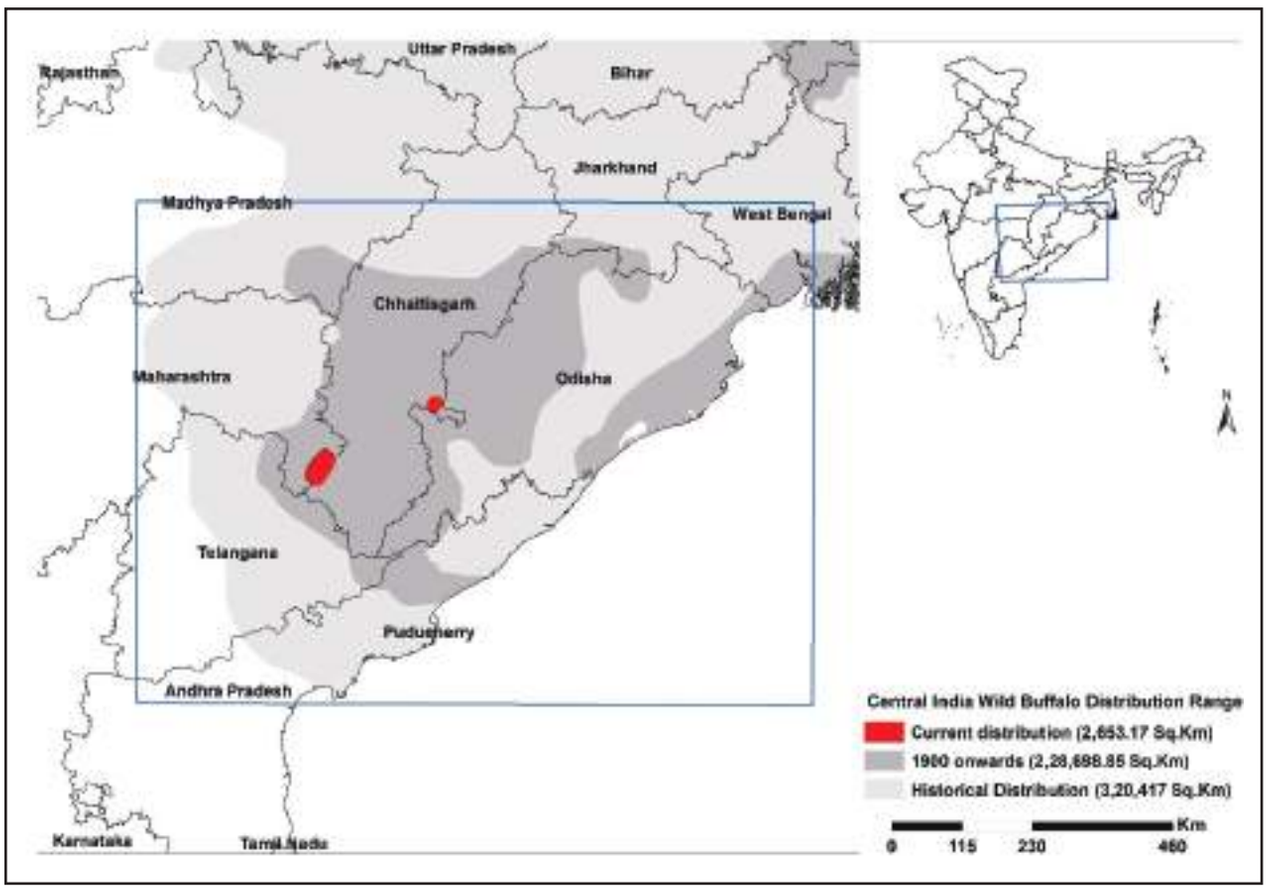


Fig 2.8: Range contraction of wild buffaloes in Central Indian landscape

Fig 2.9: Wild buffalo habitat in Udanti

CHAPTER 3

RANGING AND HABITAT USE OF WILD BUFFALO IN UDANTI-SITANADI LANDSCAPE

Rahul Kaul, Rajendra Prasad Mishra, Adrish Poddar and Poonam Chandel

Understanding and predicting relationships between wildlife and the ecosystem is fundamental to understanding wildlife and managing it (Hizrel *et al.*, 2006; Pearce and Boyce, 2006). With increasing human pressure on ecosystems and resultant depletion of animal populations, it is not surprising that extinctions occur with increasing regularity. The challenge is, therefore, to conserve the existing populations and assist in their expansion into contiguous suitable habitats for long term persistence. The recent decline in wild buffalo population in the central Indian landscape has garnered attention to the need of understanding the ranging and habitat preference of wild buffalo, which still remains understudied.

Wild water buffalo, as its name suggests, shows high affinity towards wetter and greener terrestrial forest areas. Areas featuring low-lying waterbodies with alluvial grasslands, including ox-bow lakes and other depressed derelict water bodies along rivers and sandy islets situated between branches of a river in a braided river system are particularly preferred (Lydekker, 1924; Prater, 1971; Choudhury, 1994). Salt licks, shallow waterbodies for wallowing and bathing are essential habitat requirements of wild buffalo (Panwar, 1982).

The challenge is to conserve the existing populations and assist in their expansion into contiguous suitable habitats for long term persistence.

In the Indo-China area, wild buffalo frequent lowlands, dominated by deciduous forest and use small pools and marshes (Wharton, 1957). Seasonally flooded grasslands and mixed forests are the key habitat features in the Sapt Kosi region in Nepal (Dahmer, 1978), whereas, in Thailand's Huai Kha Khaeng Sanctuary, wild buffalo occupies grasslands, mixed deciduous forests and dry evergreen forests along the rivers (Nakhasathien and Cox, 1990; Uicharoensak, 1992). In the Brahmaputra floodplain in Assam,

buffalo tends to prefer the alluvial grasslands (Spillet, 1966; Parihar *et al.*, 1986). In contrast, the animal inhabits tropical dry deciduous forests with grass-dominated under-storey and sal forests in Chhattisgarh (Daniel and Grubh, 1966; Mishra, 2003).

The following section is a result of the observations made during long-term ecological monitoring on wild buffalo. This monitoring includes information on the activity patterns, ranging and migration, dietary preferences and habitat use in the Udanti-Sitanadi Tiger Reserve (USTR) (Fig. 3.1).

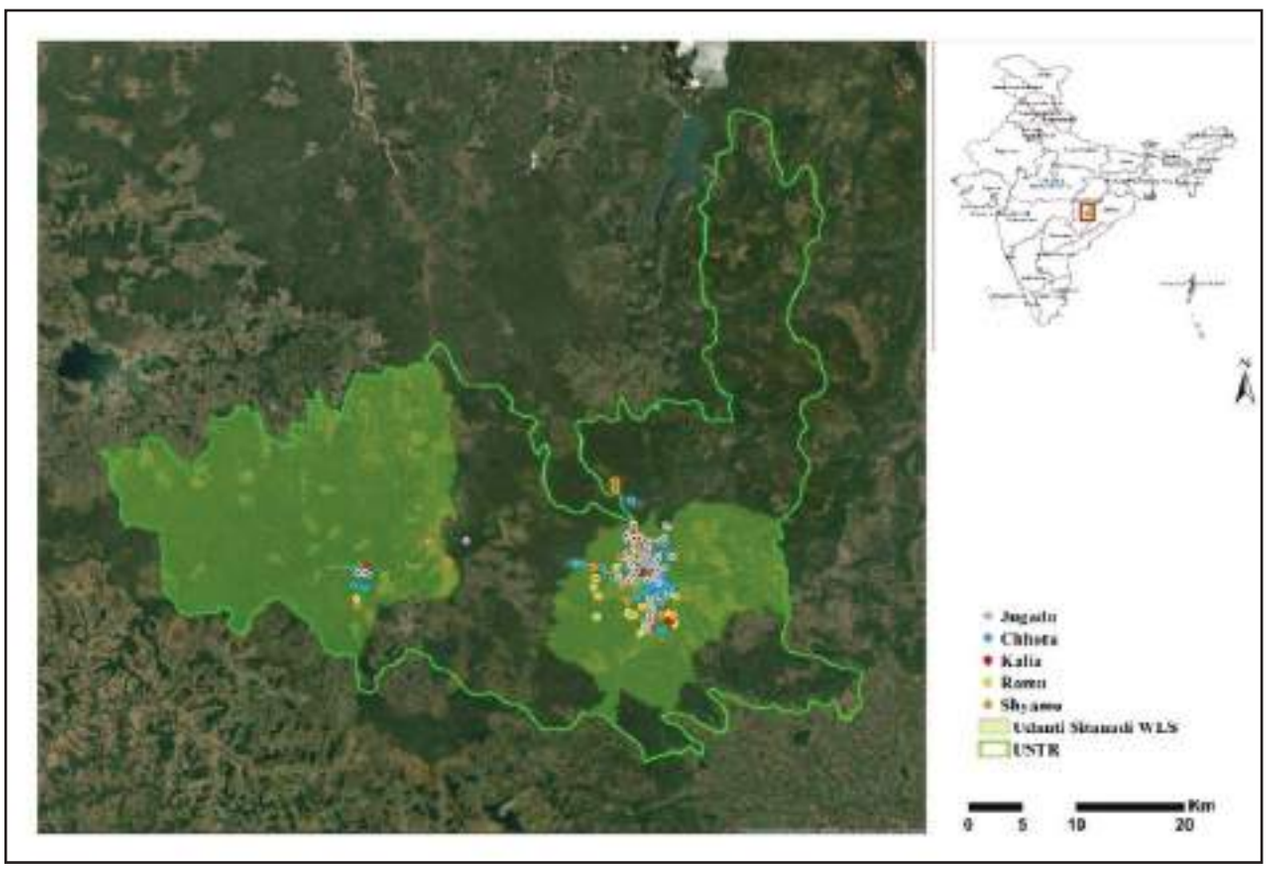


Fig.3.1. Presence of free ranging (five) wild buffaloes in USTR between 2006-08

3.1. Habitat Utilization and Availability in USTR

Methods

Compositional analysis (Aebischer *et al.,* 1993) has been followed to assess the habitat preferences of wild buffalo in USTR. An advantage of this technique is that it uses individual wild buffalo as the sample unit (N) and analyses the variance amongst the use of habitats between buffaloes as opposed to pooling data across buffaloes and avoiding the problem of unit-sum constraint as observed in other conventional techniques of assessing habitat preferences.

We conducted this analysis at two scales:

1. Larger landscape level analysis to evaluate second-order habitat selection (i.e., factors responsible for determining the individuals' home range). The available habitat was the proportion of different habitat types available within the delineated project area, in this case USTR, and habitat used was the habitat composition of the same constituents of habitat within each individuals' home range.

2. Smaller-scale analysis to evaluate third-order habitat selection (i.e., habitats used within a home range). Availability was measured as the proportion of each habitat type within a Minimum Convex Polygon (MCP)[10] home range of an individual and use as the percentage of tracker locations within each habitat type.

Creating land cover layer

Satellite imageries were used of Sentinel 2 Multi-Spectral Instrument (MSI) scene taken over the area on 15 February 2020 to classify the entire USTR, with a ground resolution of 10 meters[11]. Object-oriented classification was performed to classify the imagery (Burnett and Blaschke, 2003). For simplification, it was opted to keep broad nine land use classes– Dense Forest (DF), Moderate Forest (MDF), Open Forest (OF), Grassland (G), Water body (W), Sedimentation (SED), Canal (C), Agriculture (AGRI) and Settlements (SET).

For compositional analysis, some of the land use classes were clubbed - OF was clubbed with MDF, C and SED with W and SET with AGRI.

Tracker's locations

The analysis was performed using the wild buffalo presence location collected over the period of 2006 – 2008, since the number of buffaloes being tracked was maximum (N=5) during this period. There were in total 330 location points of all the buffaloes Chhotu (74), Jugadu (82), Kalia (80), Ramu (45) and Shyamu (49).

Compositional Analysis

Compositional analysis (Aebischer *et al.*, 1993) was used to determine the habitat types that govern the habitat preferences at the USTR level and at the range level. This was done using Adehabitat HS package (Calenge, 2006) in R version 3.5.3.

Results

Habitat availability in USTR

In USTR, forest is the most dominant habitat category accounting for over 79% of the total area. Of this the Moderately Dense Forest (MDF category) comprised of about 52% and the rest (27%) was Dense Forest (DF) (Table 3.1 and Fig.3.2). The other significant categories of habitat were Agriculture and Settlements which comprised a large 18%. Waterbodies, that the wild buffaloes are generally associated with formed a negligible 0.017% while grasslands, another habitat feature the buffaloes are associated with formed an even smaller 0.007% proportion of the total habitat.

Table 3.1 Area under each land use class in USTR

Land use classes	Area (in hectares)	Proportion
Dense Forest (DF)	48059.03	0.267
Moderate Forest (MDF)	93972.091	0.523
Grassland (G)	1386.61	0.007
Water body (W)	3106.19	0.017
Agriculture (AGRI)	32883.28	0.183
Total	**179,407.2**	

[10] *Method to draw the smallest possible convex polygon around location data, representing the home range of an animal*
[11] *B2 (490 nm), B3 (560 nm), B4 (665 nm) and B8 (842 nm)*

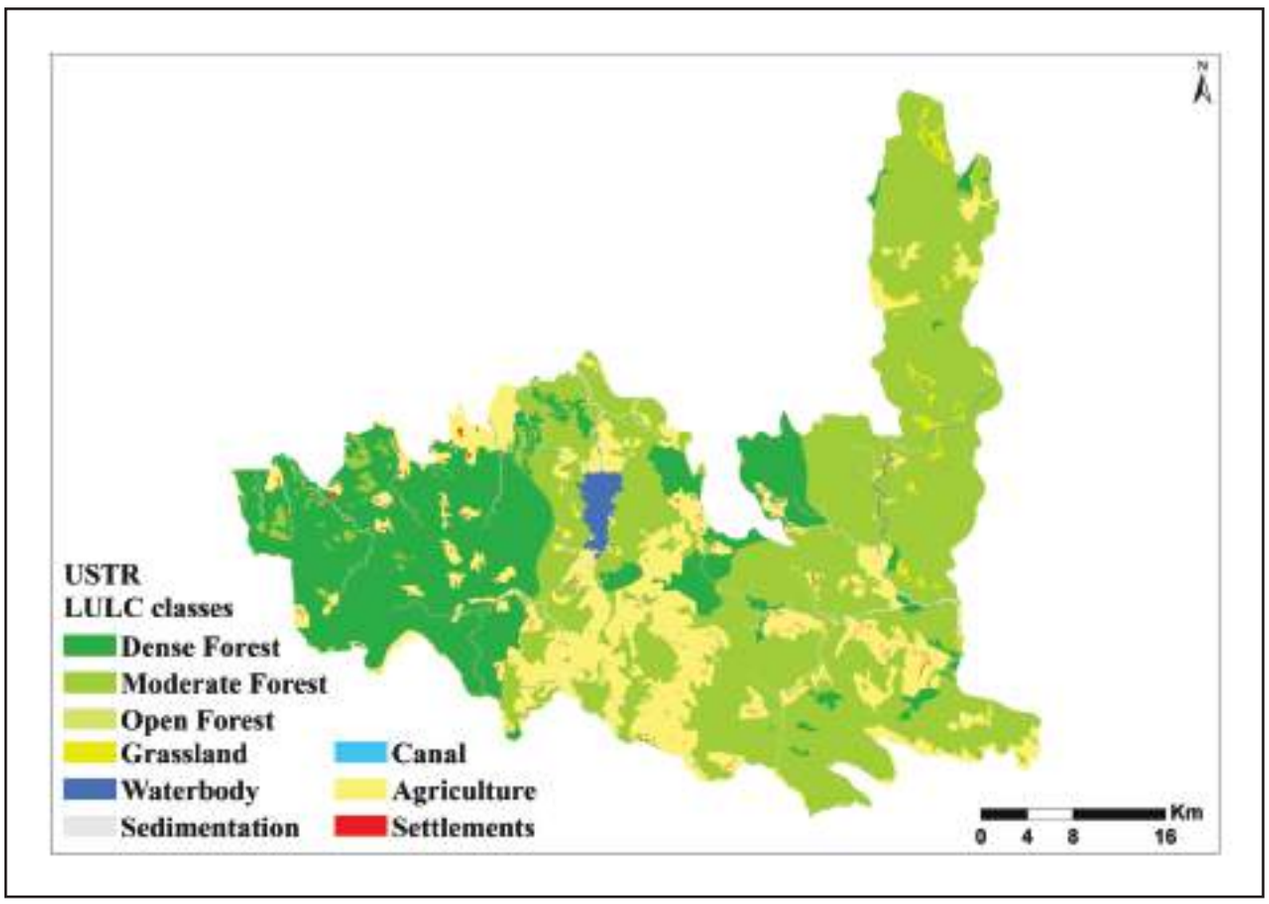


Fig 3.2 Map showing USTR Land Use Land Cover (LULC)

The utilization of these habitats (Fig. 3.3) was determined by the proportions of the five habitats present in the five ranges of the five buffaloes as determined by creating a home range for each buffalo using the MCP method. The proportion of used habitat by tracked individual wild buffaloes (n=5) within their home range (MCP) during 2006 - 2008 is shown in Table 3.1. The ranges of the five wild buffaloes tended to overlap with each other and ranged from 233 km^2 to 174 km^2 (Fig.3.4). Although we have tracked buffaloes regularly over the years, the data set between 2006 – 2008 proved to be the best in terms of the number of individual free-ranging buffaloes to satisfy the statistical requirements of the test. More recent datasets have been used to determine other aspects of range use which is discussed in the chapter separately.

The juxtaposition of the individual ranges seemed to follow a pattern of largely occupying the low land portions of Udanti WLS seemingly avoiding the hilly eastern and southern parts (Fig. 3.5). All five buffaloes made occasional forays into the south eastern part of Sitanadi WLS across the gap which is dominated by human settlements.

Habitat availability within the home range of all the buffaloes showed that MDF category constituted the main habitat type followed by AGRI, DF, W and G, in that order (Table 3.2). The proportion of individual buffalo locations overlaying each habitat type (used habitat) within their home range (MCP) during 2006-2008) is shown in Table 3.3.

Table 3.2 Proportion of used habitat by all the tracked wild buffalo within their home range (MCP) during 2006-2008

Individual Buffalo	DF	MDF	G	W	AGRI
Chhotu	16.26	51.91	0.25	1.24	30.34
Jugadu	14.48	53.47	0.26	1.19	30.60
Kalia	16.38	51.83	0.25	1.23	30.31
Ramu	10.17	54.08	0.24	1.34	34.18
Shyamu	12.81	34.89	0.17	26.51	25.61

Fig 3.4. A wild buffalo named 'Jugadu' tracked near a water body in Udanti WLS

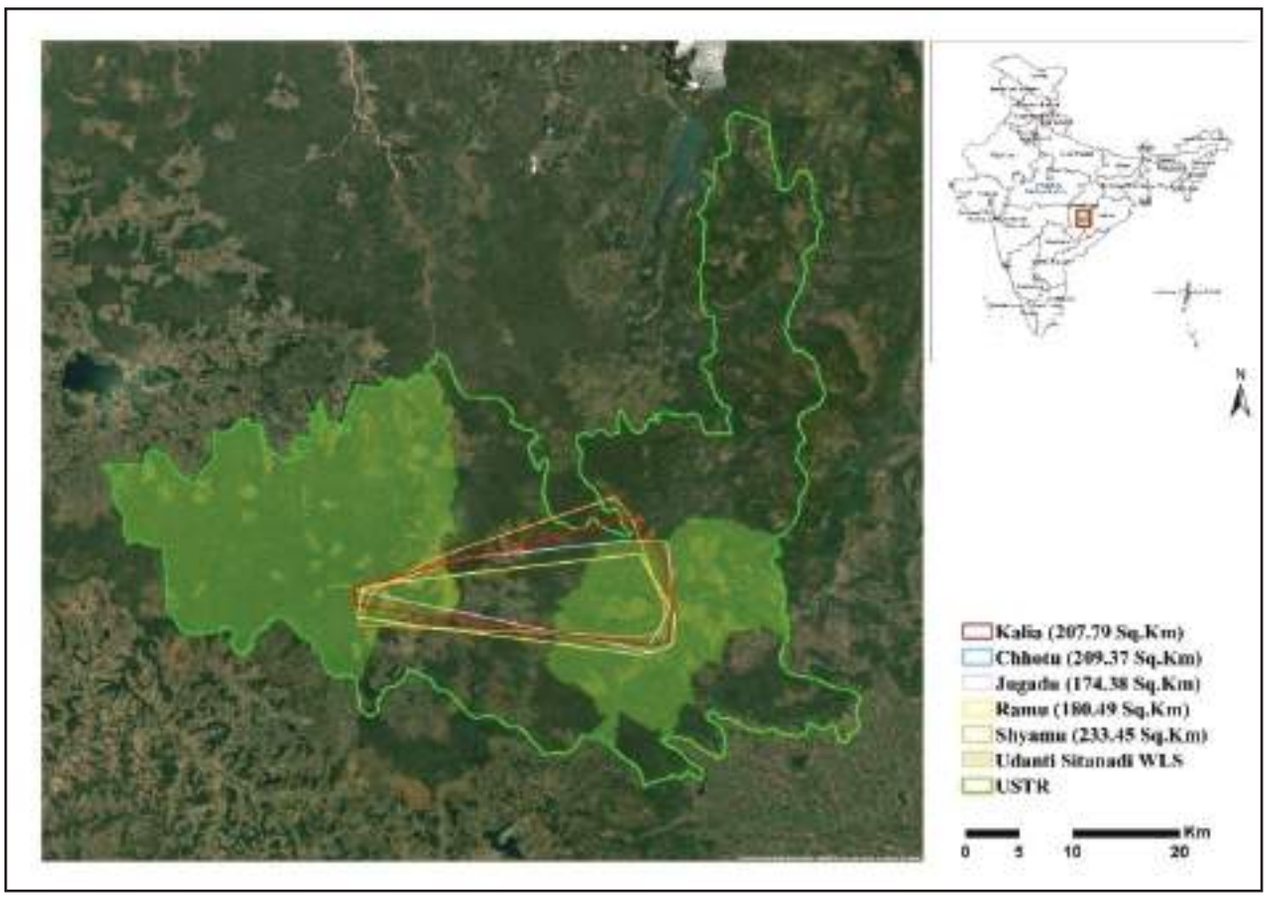


Fig 3.4 Habitat availability and usage within individual buffalo home range

Table 3. 3. The proportion of individual buffalo locations overlaying each habitat type (used habitat) within their home range (MCP) during 2006-2008

Individual Buffalo	DF	MDF	G	W	AGRI
Chhotu	8.11	72.97	1.35	8.11	9.46
Jugadu	2.50	82.50	1.25	1.25	12.50
Kalia	8.64	75.31	0.00	7.41	8.64
Ramu	6.67	66.67	6.67	11.11	8.89
Shyamu	16.33	53.06	4.08	8.16	18.37

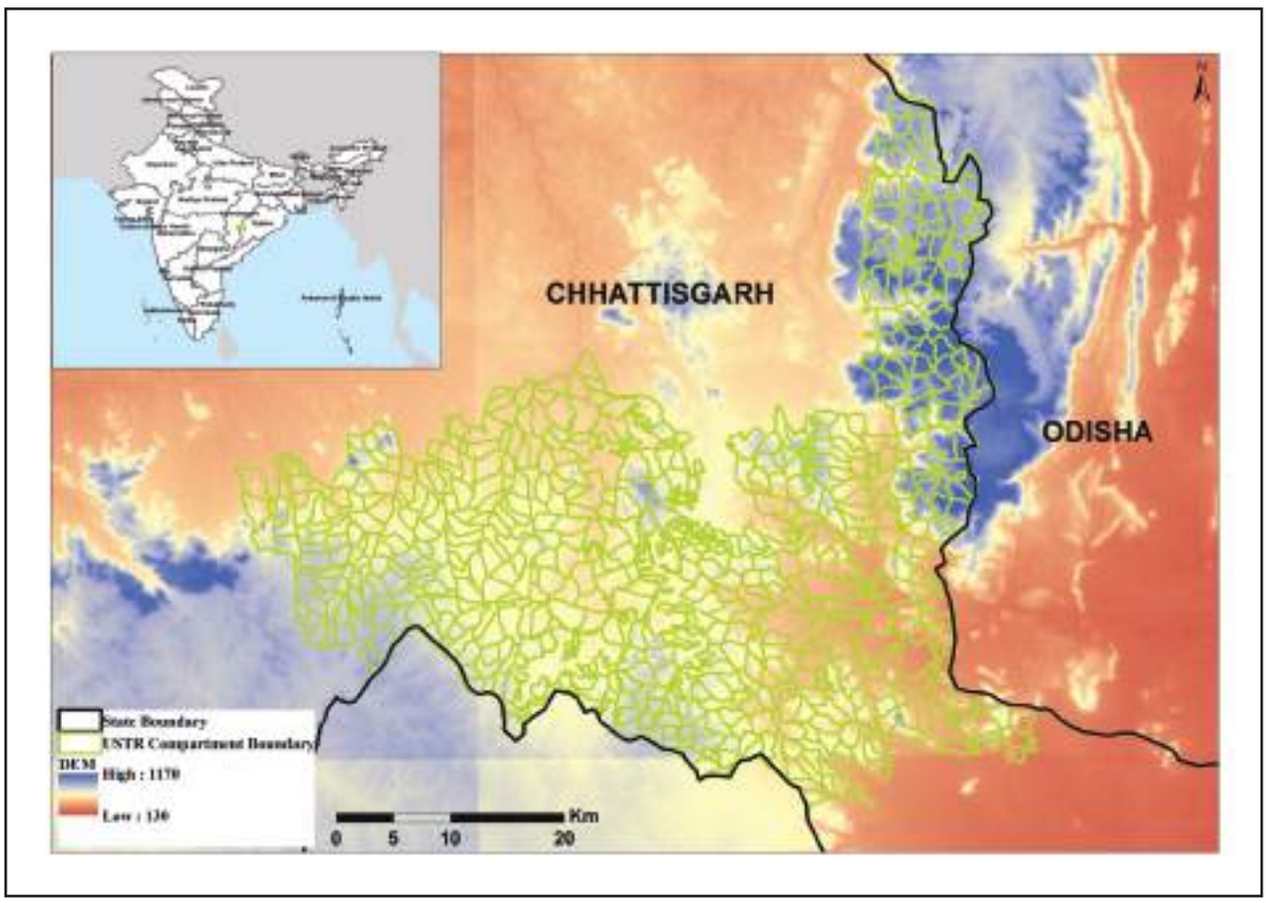


Fig. 3.5: Digital Elevation Model map of USTR

Compositional Analysis

USTR level selection

Before running the compositional analysis, a *Chi-square*[12] test was run using the available as 'expected' and used as 'observed'. The results showed that there was an overall habitat preference, i.e. the buffaloes were not using the habitats as expected by the proportions available to them and therefore were selected certain types (p value = 2.442491e-15). Therefore, preference and avoidance were established.

Ranking of habitats

A residual relationship matrix was generated to rank the habitats used by wild buffaloes. A (+) sign is given when the habitat shown in the row is used more than the habitat in column, and a (-) sign in case of underuse (Table 3.4). When the difference is significant, the sign is tripled. For example, as seen in second row, Moderately Dense Forest (MDF) is highly preferred over Dense Forest (DF), Grasslands (G) and Water Bodies (W) and least preferred over Agriculture (AGRI).

[12] *A chi-square test for independence compares two variables in a contingency table to see if they are related.*

Table: 3.4. Relationship matrix showing rankings of habitat selection at landscape level

	Dense Forest	Moderate Forest	Grassland	Waterbody	Agriculture
Dense Forest	0	- - -	+++	- - -	- - -
Moderate Dense Forest	+++	0	+++	+++	- - -
Grassland	- - -	- - -	0	- - -	- - -
Waterbody	+++	- - -	+++	0	- - -
Agriculture	+++	+++	+++	+++	0

(+) sign denotes preference, and (-) sign denotes less use than expected. Three signs denote the use as statistically significant (P<0.05)

Based on the above relationship matrix, it is evident that MDF, W and AGRI were used more when compared to DF type in determining the habitat selection. Surprisingly though, G was underused against all other habitat types. The reason could be that buffaloes use the small openings within the forested areas for grazing rather than open degraded grasslands that the satellite image perhaps picked up and classed as grassland. The order of ranks in decreasing order of selection of habitats at landscape level thus was Agriculture (AGRI) > Moderate Dense Forest (MDF) > Water Body (W) > Dense Forest (DF) > Grassland (G). Therefore, at the Reserve level, a combination of agricultural fields and forests seemed to be the determining factors driving habitat use.

Habitat use at the home range level

After determining the main habitat types responsible for the selection of habitats at the landscape level, we examined the factors driving their use at the micro-habitat level. For this, we compared the proportion of habitats available within each buffalo's home range and the buffalo locations recorded in each of these habitat types within each home range. For the habitat use assessment at the landscape level, Chi-square tests were run on the observed use against the expected use. The test once again indicated that the different habitat types were not being used by the wild buffalo in proportion to the habitat types available, showing preference for certain habitat types. Probability values at which the null hypothesis was rejected were Chhotu (p = 3.866263e-05), Jugadu (p value = 2.446313e-04), Kalia (p value = 5.193947e-05), Ramu (p value = 4.350231e-09), Shyamu (p value = 2.737358e-04).

Test of overall habitat selection

Null hypothesis (Ho) of this test is that there is no overall habitat selection and the alternate hypothesis (H_1) is that there is an overall habitat selection. The result shows that there is overall habitat selection (p value = 0.05) and the null hypothesis is thus rejected.

Ranking of habitats

It is interesting to observe that the habitat use determinants changed at the home range level when compared to the landscape level selection. At the home range level, availability of W and G seemed to be used more than expected from the proportions available. Surprisingly, AGRI and SET were avoided. The decreasing order of selection was Water Body (W) >Grassland (G) > Moderate Dense Forest (MDF) >Dense Forest (DF) >Agriculture (AGRI) (Table 3.5).

While these analyses were useful to understand the habitat use of wild buffalo, the data collection occurred only during the daylight hours and therefore this habitat use analysis pertains to diurnal use. However, later in 2017, satellite transmitters were attached to two wild buffalo (details in box) and some information on nocturnal use and activity pattern could also be generated from the location data (Fig 3.6).

Table 3.5: Relationship matrix showing rankings of habitat selection at the home range level

	Dense Forest	Moderate Dense Forest	Grassland	Waterbody	Agriculture
Dense Forest	0	- - -	-	- - -	+
Moderate Dense Forest	+++	0	-	- - -	+++
Grassland	- - -	- - -	0	- - -	- - -
Waterbody	+	+	0	-	+
Agriculture	-	- - -	-	- - -	0

Fig.3.6. Satellite tracking of wild buffaloes in Udanti WLS

Chemical capture and satellite tagging of wild buffaloes

WTI, in collaboration with the Chhattisgarh Forest Department, under Central India Wild Buffalo Recovery Project in the year 2017 (18th and 19th March), deployed satellite collars on two wild buffaloes, i.e. Jugadu and Shyamu. The need to deploy satellite collars was considered necessary as the free-ranging wild buffaloes had proven difficult to monitor, especially during the monsoons.

A core team comprising Mr SK Singh, IFS, APCCF (WL), Government of Chhattisgarh; Mr OP Yadav, IFS, Field Director, Udanti-Sitanadi Tiger Reserve; Mr V Vivekanand Reddy, IFS, Deputy Director, Udanti-Sitanadi Tiger Reserve; Dr NVK Ashraf, Senior Director & Chief Veterinarian, WTI; Dr Rajendra Mishra, Project Head, WTI; Dr JK Jadia, Veterinarian, Nandanvan Zoo, Chhattisgarh; and Dr PK Chandan, Veterinarian, Kanan Pendari Zoo, Chhattisgarh, planned and conducted the operation with the additional expertise of Dr Markus Hofmeyr, Head Veterinarian, South Africa National Parks (SANParks), who had previously assisted WTI in its pioneering eastern swamp deer translocation in Assam.

In addition to two wild buffaloes, a gaur (*Bos gaurus*) was also satellite tagged. For chemical immobilization, Etorphine hydrochloride and Azaperone were used for all the three bulls (two wild buffaloes and one gaur) that were satellite collared. Dan-Inject syringe projectors with a wooden frame were used for darting. As soon as the darted animals came down to sternal/lateral recumbency, Midazolam hydrochloride was given intravenously in the leg or ear veins to calm down the animal during induction and recovery. For reviving, Naltrexone was administered intravenously, as shown in the table below. The entire operation could be completed in three days (17th-19th of March 2017).

Drugs/Stats	Buffalo-1	Buffalo-2	Gaur
Age and Sex	Adult male	Adult male	Subadult male
Estimated weight	900 kg	1000 kg	600 kg
Etorphine	10 mg	13 mg	5 mg
Azaperone	60 mg	60 mg	60 mg
Midazolam (after recumbency)	50 mg IM & 50 mg IV	25 mg IV	25 mg IV
Darting distance	35 meters	35 meters	40 meters
Darted from	On foot	Vehicle	On foot
Darting location	Tracked and darted	Near waterhole	Near the same water hole
Visual contact	Lost and regained	Always in sight	Lost and regained
Distance travelled	1.5 km	40 meters	Less than a km
Down time	About 15 mts	Under 10 mts	10-12 mts
Naltrexone (for reviving)	125 mg	125 mg	100 mg

Activity Pattern

Wild buffalo may be found active during both day and night, but peak in feeding activity usually occurs in the late afternoon and evenings. Activity peaks shift to nocturnal in areas with substantial human interference. The buffaloes prefer to spend the day in forested areas or near shallow water bodies which provide relief from the mid-day heat and human disturbance. Wallowing in mud is a frequent activity, especially in summer, as it provides protection from biting insects (Laurie, 1978).

During wallowing in shallow water bodies, they may sweep their horns as shovel to increase mud coverage. When mud is not available for wallowing, wet sand bank of rivers is opted for. Fig. 3.7 presents a breakup of times of the day spent by wild buffalo in different habitats, based on our radio-telemetry and satellite tagging exercise on free-ranging individuals (three and two buffaloes respectively in Udanti. The data corroborates with other observational records with a general exception that the buffaloes also used moderately dense forest and agriculture to meet their requirements.

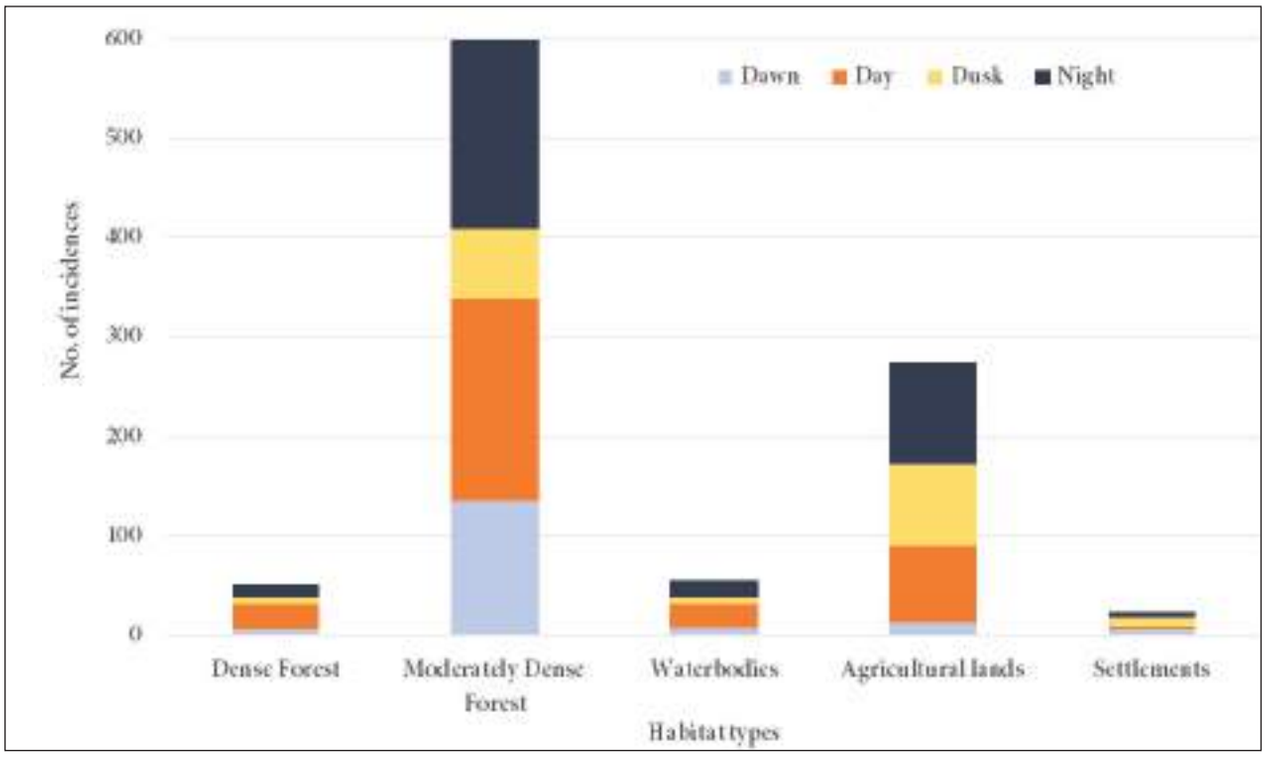


Fig. 3.7: Use of habitats by wild buffalo during different phases of the day

Movements

Historical records indicate that buffalo did move over long distances seasonally, sometimes covering distances of over 200 km (Hasan, 1980; Singh, 1980), although none of the surviving individuals now seem to undertake such long-distance movements. Evidences of some relatively long- distance movement were observed in Udanti in 2006-2008 (also see habitat use section above), but these appeared to be temporary movements into Sitanadi WLS for short durations. Observations in Indravati too indicate local movements during summer when buffaloes cross the Indravati river in the Indravati Tiger Reserve and seek refuge in the Kolamarka Conservation Reserve in Gadchiroli district of Maharashtra, only to return at the onset of rains (pers. obs. R.P Mishra). Studies in Nepal, however, suggest that herds occupy stable home ranges (Heinen, 1993). In Udanti-Sitanadi Tiger Reserve (USTR) now, free-ranging buffalo do not form herds and generally remain solitary, perhaps a result of very low population size.

The use, reliability, logical assessments and their interpretation in predicting likely events, has implications on policy and conservation of a species (Schadt *et al.*, 2002). As mentioned earlier, movements between Udanti Wildlife Sanctuary and Sitanadi Wildlife Sanctuary, reported in the past, have not been observed recently, which is perhaps a reflection of the low number of buffaloes in Udanti. However, movements could also be constrained by either lack of suitable movement area or connectivity.

Using buffalo presence location data, wild buffalo movement pathways across USTR were identified using grid-based occupancy surveys and using common analytical approaches based on landscape pattern, animal-based movement simulations and habitat suitability (McRae *et al.*, 2008; Phillips *et al.*, 2017). The habitat suitability model (Fig. 3.8) predicted about 100 km^2 of highly suitable area for buffaloes (AUC> 0.5) between Udanti and Sitanadi WLS.

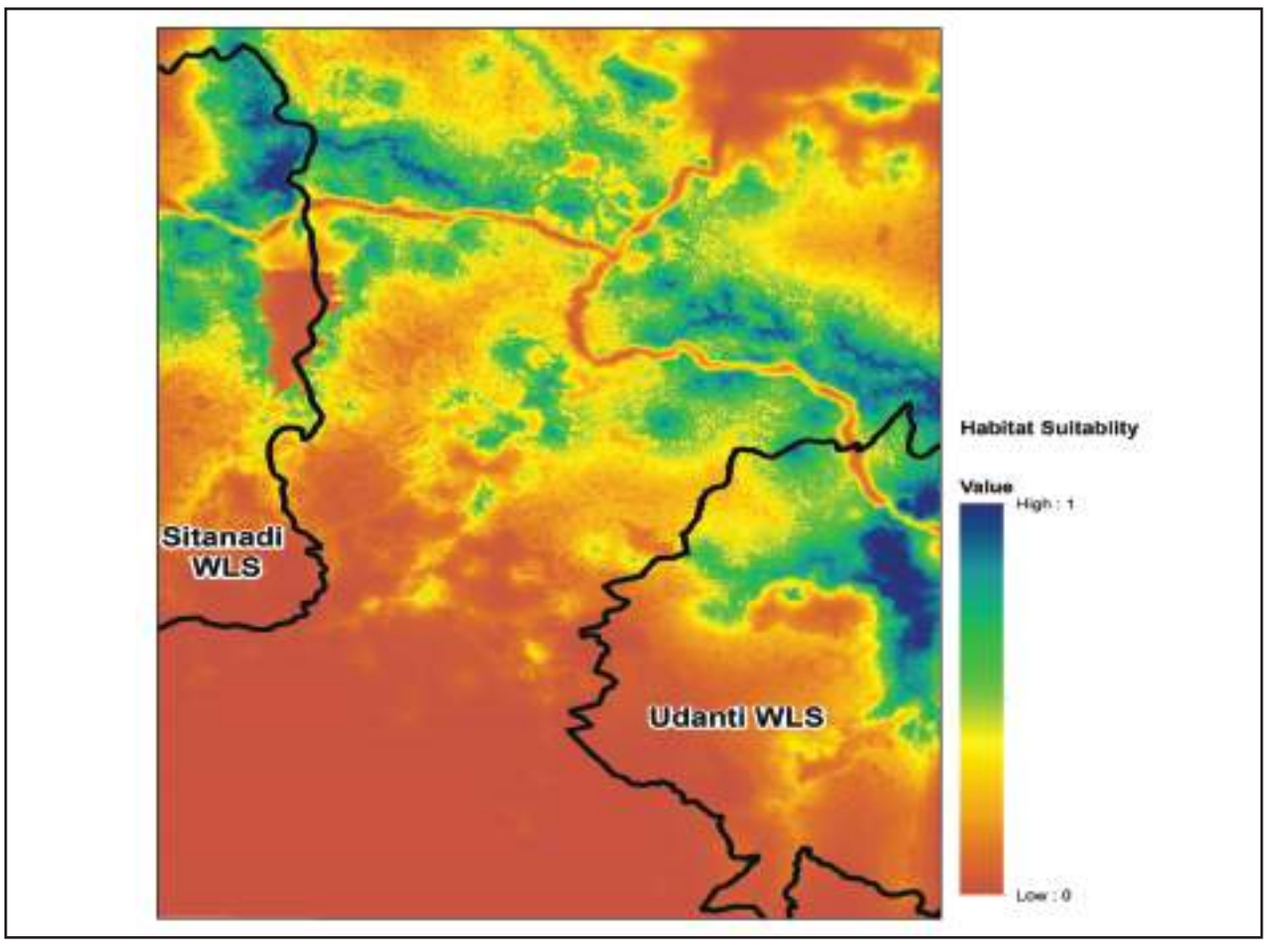


Fig 3.8: Habitat available for wild buffalo in the Udanti-Sitanadi landscape. Cooler color (dark blue) indicates high suitability and warmer color (red) shows less suitability

However, there occurred some discreet and isolated patches which are less likely to be populated by wild buffaloes, unless the extant population spreads. Interestingly, the modelled movement pathway (shown in Fig 3.9) agreed with the observational records of Mishra (2001). The model demonstrated complete avoidance of roads and settlements, preferring moderately dense forest and river banks. Elevation and slope had no effect on their movement.

Areas with little or no current flow of buffaloes have actually been interpreted as less important areas for connectivity. Current flow is directed from the assumed breeding patch, i.e. Udanti WLS to a population patch across the habitat area between Udanti and Sitanadi. The simulated MaxEnt[13]-Circuitscape[14] map predicts movement paths which totally leave out the road network as the least preferred pathway. This is due to the fact that the current map is based on the habitat suitability model which actually indicates relative suitability (not probability of occurrence).

[13] *MaxEnt software is based on the maximum-entropy approach for modelling species niches and distributions.*

[14] *Circuitscape is a connectivity analysis software package which borrows algorithms from electronic circuit theory to predict patterns of movement, gene flow, and genetic differentiation among plant and animal populations in heterogeneous landscapes.*

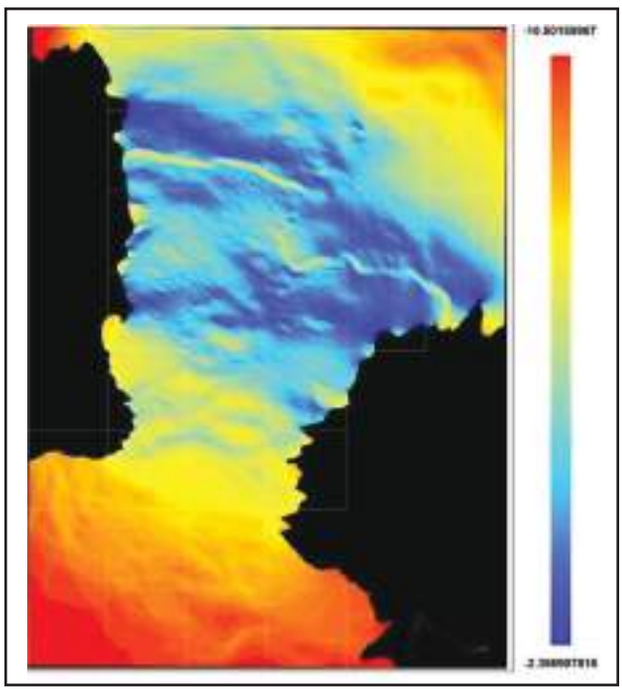


Fig 3.9. Cooler colours (blue) represent area of high conductivity and warmer colours (red) represent high resistance.

Dietary preferences

Primarily a grazer, the wild buffalo feeds more often on grasses and leafy aquatic vegetation unlike other alikes[15]. However, eating forbs, fruits and barks, browsing on trees and shrubs is also reported (Ashby and Santiapillai, 1986). On the basis of size and weight, the wild buffalo require roughly on a daily basis, about 15,000-20,000 calories for growth and development (Mishra, 2001). *Cynodon dactylon*, *Themeda quadrivalvis* and *Coix* sp. are grasses preferred by wild buffaloes in India (Daniel & Grubh, 1966). In the Udanti-Sitanadi landscape wild buffaloes have a wide range of diet and switch to browsing during summers (Mishra, 2001). The species also feeds opportunistically on agricultural crops, causing considerable damage (Lekagul and McNeely, 1977; Kushwaha, 1986; Bauer, 1987).

Table 3.6: List of plant species preferred as food by wild buffaloes excerpted from Mishra (2001)

Grasses	Forbs	Trees
Apluda mutica	*Phoenix acaulis* (young shoot & fruit)	*Grewia tiliefolia*
Bothriocholoa spp.	*Justicia spp.*	*Shorea robusta*
Cyperus spp.	*Achyranthes aspera*	*Pterocarpus marsupium*
Imperata cylindrca	*Alysicarpus spp*	*Dalbergia paniculata*
Saccharum munja	*Indigofera spp*	*Bridelia retusa*
Saccharum spontaneum	**Crops**	*Cassia fistula*
Thameda quadrivalbis	*Dolichos biflorus*	*Terminalia elliptica*
Cynodon dactylon	*Brassica campestris*	*Ougeinia oojeinensis*
Eragrostis tenella	*Phaseolus radiates*	*Emblica officinalis*
Panicum sp.		*Indigofera cassioides*
Digitaria granularis		*Anogeissus latifolia*
Heteropogon contortus		*Schleichera oleosa*
Cenchrus sp.		
Themda laxa		

[15] *Feral buffaloes in Australia are also selective grazers while the Sri Lankan buffaloes are known to feed on anything in their path*

3.2. Conclusion

Data acquisition biases

Our whole analysis relies heavily on animal presence data—either collected using radio-telemetry or on-ground physical detection. Both had equal pros and cons, which influenced our analysis variously. The ground-based monitoring involving local trackers is a more convenient, cost-effective and non-invasive approach than remote monitoring which requires capturing and collaring (satellite-tagging) of the animal and other problems innate to the technique. However, tracker-based method works best when animal ranging areas are easily accessible and the to-be-monitored population is small in comparison to the manpower available. The cons that tracker-based monitoring brings are biases related to detection, positive identification and the effort put by trackers. Buffaloes are generally shy and prefer to move using moderately dense forests and river-banks, rather than paths. To obviate such biases, indigenous trackers who had knowledge about the movement of the buffaloes, were handpicked and further trained. Bias, rather, occurred in our study due to the low number of free-ranging buffaloes providing low number of animal presence points (or sample size). Another downside of using tracker-based data is that the presence points are based on detections during the day without any data for the night.

Gains and shortcomings of our models

Niche modelling with MaxEnt has been proven to perform better than 15 other algorithms used to model species distribution (Elith *et al.*, 2006; Elith and Graham, 2009). However, performance of any modelling approach relies heavily on the set of predictors used—influencers, inhibitors and regulators. Omission of key variables or use of auto-correlated variables could potentially dilute the model's performance. For instance, bioclimatic variables (http://www.worldclim.org/bioclim) were not used for the analysis. The modelling was done with the assumption that variation in temperature and precipitation are least likely to affect the vegetation pattern in a small landscape. Also, instead of using human census data to estimate disturbance, we used cattle population as a proxy. This was done with the knowledge that the male wild buffaloes are used to human presence as they wander in search of potential mates (domestic buffaloes). Because they are bold of to co-inhabit near human settlement areas, their movement is less likely to be affected by human presence. Wild buffalo habitats modelled in this study were crosschecked using known distribution range of the wild buffalo from the Udanti-Sitanadi landscape. Our model correctly aligned with the available resource (Hedges *et al.*, 2008), and overlap was above 90%.

To predict the expanse of the habitat available for the wild buffalo, the low population size affected the quality of data collected. Ideally, animal-location data from a population which is saturated and uses the land extent optimally would best predict a scenario. The absence of such a scenario may have led to model under fitting, and area highlighted by the model should be rather seen as the wild buffalo's 'favourable' areas. As our models are built using presence-only data, limiting factors of distribution could not be estimated. On a different perspective, threatened species which are rare in the landscape seldom occupy the whole range available. However, we feel that the general use of habitats will remain unaffected and the range may increase till availability of water resources becomes the limiting factor.

Patterns of habitat selection and distribution

We are confronted with a conflicting theory evidencing a shift in ranging patterns, at particular times of the year and somewhat contradicting the hypotheses that buffaloes prefer greener and wetter portions of the area available (Daniel and Grubh, 1966). Our results demonstrated the buffalo's fidelity towards moderate dense forests and agriculture, none with slopes or altitude, and avoidance of human settlements except for crop raiding or mating instances during October – December (Lekagul & McNeely, 1977; Kushwaha, 1986; Bauer, 1987). The season also coincides with the harvest season of agricultural crops like kulthi (*Macrotyloma uniflorum*), wheat (*Triticum aestivum*) etc. It is likely that the grassy glades within MDF provided forage and canopy, the necessary cover. The only peculiarity is the lack of selection of water body at the landscape level. This peculiarity may have arisen perhaps due to the limitation of remotely sensed imagery; sensitivity of satellite imageries, like any digital image, is contingent on its native ground resolution defined by pixel counts. Logically, a satellite image would fail to capture land features which are sized less than the native resolution (pixel value). Another possible explanation could be that the central Indian (hard ground) wild buffaloes have adapted to the water-scarce landscape (Brander, 1923; Martin, 1977, and Mishra et.al 2002) of Udanti as compared to their eastern counterparts in North-east India (Assam's Kaziranga and Manas). A manor adaptation being hard ground species possessing closed hooves compared to splayed hooves (Pocock, 1923). In USTR, buffaloes are known to use small non-perennial waterbodies (for instance, village ponds) of size lesser than 10x10m. The native spatial resolution of the satellite imagery used in this study was 30x30m.

On careful observation of spatial arrangement of ranging data, it can be noticed that buffaloes tend to prefer certain areas over others; for instance, northern boundary of the Udanti WLS. The relatively large home ranges of wild buffalo in Udanti is perhaps not a reflection of unsuitable habitats, although, movements might be triggered by the scarcity of water during summers, but perhaps also due to males wandering to far off places in search of mates.

Habitat Fragmentation

Fragmentation of wild buffalo habitat could be seen in the southern part of the map (Fig.3.10; Table 3.7 below). Changes inside

Table 3.7: Land use change area in km^2

Categories	Inside Corridor	Outside corridor	Inside PA	Entire Study area
Habitat loss	8.742	52.544	39.562	61.286
Habitat gain	10.66	42.268	181.845	52.928
No change in non-habitat area	171.143	38.599	12.155	209.742
No change in habitat area	34.907	524.033	28.200	568.94

Udanti WLS could be linked to the expansion of two villages—Amad; whereas in Sitanadi, the Sondur reservoir and its flood plain have reduced available habitat for the wild buffaloes. Three distinct zones (marked in yellow) could be identified inside the corridor showing high degree of loss. Regeneration has occurred in two zones—the central part of Udanti and the northern part of Sitanadi.

Implication for conservations

The known decline of wild buffaloes in the past few years shows that the species is losing ground very fast and the factors affecting the decline are hunting, habitat loss/degradation and interspecific competition and hybridization (Kaul *et al.*, 2019). Urgent measures are required to stall this decline. Based on our understanding, conservation of the species now requires active interventions, in the form of reintroduction, habitat improvement, and possible village relocation. Along with habitat improvement plans, population viability analysis (Boyce, 1992; Paul and Reed *et al.*, 1998) should now be the next step to assess the capacity of USTR, before restocking is effected. The present study takes an important step towards the conservation of this large bovid, providing the first-hand information on ranging patterns and their habitat preference across different seasons. The information furnished could be used by park managers to conserve the critically endangered wild buffalo and would also further assist in planning studies on mega-herbivores.

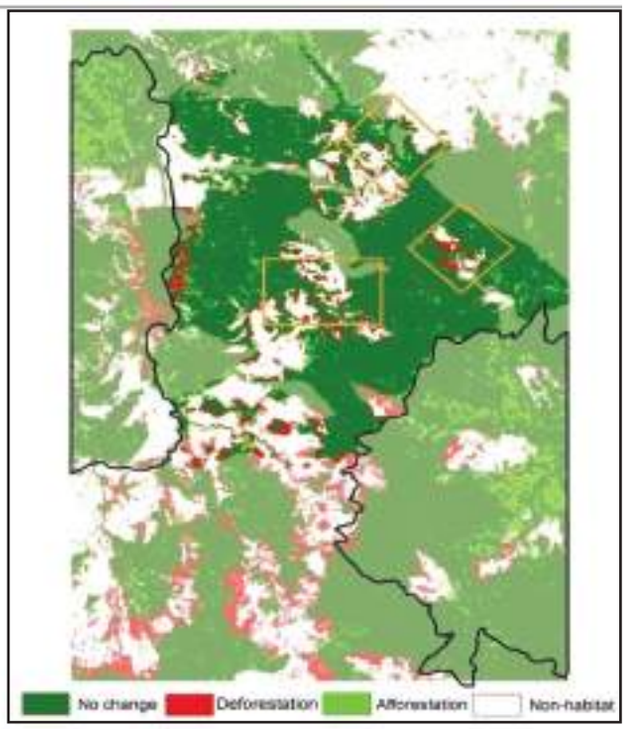


Fig. 3.10: Change in forest cover in the buffalo ranging areas of Udanti-Sitanadi Tiger Reserve. Change was computed by comparing themed imageries from 2016 and 2006, where Dense Forests, Medium Dense Forests and Water Bodies was clubbed into one

Fig. 3.11: Wild buffalo monitoring

Fig. 3.12: Wild buffalo with calf in enclosure

Fig. 3.13: A female wild buffalo "Asha" in Udanti

CHAPTER 4

GENETIC STATUS OF WILD BUFFALOES OF INDIA

Ajay Gaur and Rajendra Prasad Mishra

Wild buffalo can occupy and disperse through a wide range of habitat types, being physically capable of moving over large distances. Wild buffalo males are reported to kill domestic buffalo males to mate with domestic females. There are reports from Assam as well as Chhattisgarh to suggest that domestic females may have calves sired by wild males. Hybrid males that remain in the wild are likely to be subordinate to wild males, and hence may not breed, but hybrid females would be expected to breed with wild males. The extent of this genetic introgression[16] may depend on the hybrid progeny of wild males actually returning to the villages. Such events indicate the genetic proximity of wild and domesticated buffalo and subsequently, mixing of their germplasm.

With such a small population it is imperative to boost the numbers by introducing individuals into the population either through wild to wild translocations or through a carefully run conservation breeding project.

While some morphological attribution has been suggested by Ranjitsinh (per comms in Menon, 2014) to differentiate wild and domestic buffaloes, it is difficult to distinguish the degree of domestication and hybridization, the actual conservation status is uncertain and the possibility of extinction of wild populations is quite real. Therefore, an urgent need was felt to review the genetic status of this endangered species for ascertaining its genetic purity and to assess the level of genetic diversity in the existing populations using tools of molecular genetics. This is especially important from the point of a suggested augmentation of the central Indian population using individuals translocated from the north-eastern population.

[16] *The transfer of genetic information from one species to another as a result of hybridization between them and repeated backcrossing.*

In the absence of pedigree information, the availability of highly polymorphic genetic markers, microsatellite markers in particular, has made it possible to test the impact of inbreeding on fitness in the field. These can provide information on a number of questions ranging from distinctiveness of species, their ranking according to the number of close relatives and phylogenetic position, how populations of a given species are distributed, how different populations are genetically distinct, how much genetic variation is present within and between populations and whether there is a gene flow or migration between them. The acquired information holds promise to predict future population dynamics and extinction risks, resulting from demographic or genetic processes.

Faeces/ Scat/ Dung has been found to be an ideal source for obtaining DNA non-invasively. Collecting faecal samples in the wild is much less laborious and less disruptive than capturing and anaesthetizing the animal.

4.1. Methods

- **Sampling**

  Dung samples of wild buffalo were collected from wild buffalo bearing PAs in India (Fig. 4.1). Locations of each dung sample was geo-referenced using a Global Positioning System (GPS) device unit. Dung from an individual was stored in plastic bags / zip-lock bags containing silica gel for desiccation and to prevent growth of microbes. Samples were collected randomly from different locations and at different times. The samples were stored at 4°C until DNA extraction.

Fig 4.1: Collection of wild buffalo dung for genetic analysis in USTR

A total of 68 samples were collected and sent to the Laboratory of Conservation of Endangered Species (LaCONES)[17], Hyderabad. These included samples from Udanti Wildlife Sanctuary, Chhattisgarh (n=10), CWRC Rescue Centre and Dibru-Saikhowa, Assam (n=3), Kaziranga National Park, Assam (n=45); Sironcha Forest Division, Maharashtra (n=1), Skin sample (n=1) from Ambikapur Palace, Chhattisgarh; skin sample (n=1) from Dharamjaygarh Palace, Chhattisgarh; skin sample (n=1) from Udanti WLS, Chhattisgarh and control samples in the form of tissue biopsy and blood samples (Fig.4.2) of known wild and domestic buffalo (n=6) collected from Udanti Wildlife Sanctuary, Chhattisgarh.

[17] *Laboratory for the Conservation of Endangered Species (LaCONES), Centre for Cellular and Molecular Biology (CCMB), Sai Hills Colony, Rambagh Colony, Hyderabad, Telangana 500030*

Fig 4.2: Genetic sample collected through a Bio-dart in USTR

The first part of sample analysis involved the extraction of high molecular weight DNA. Centre for Cellular and Molecular Biology (CCMB) has successfully standardised a modified phenol-chloroform (Sambrook *et al.*, 1989) method for DNA isolation from non-invasively collected dung samples. This method was found to be the most effective in isolating high quality, high molecular weight DNA. The DNA was quantified both by spectroscopy and in-gel analysis and diluted accordingly for the Polymerase Chain Reaction (PCR) amplification (Fig. 4.3). The three skin samples received were highly degraded and failed to give any DNA.

- **Mitochondrial DNA sequencing**

  Primers for PCR amplification of the following markers were designed from sequences available in the GenBank database[18]. Amplification conditions for each marker (Table 4.1) were optimized by variation of annealing temperature, Magnesium concentration, number of cycles, concentration of primers, and DNA in the reaction mixture.

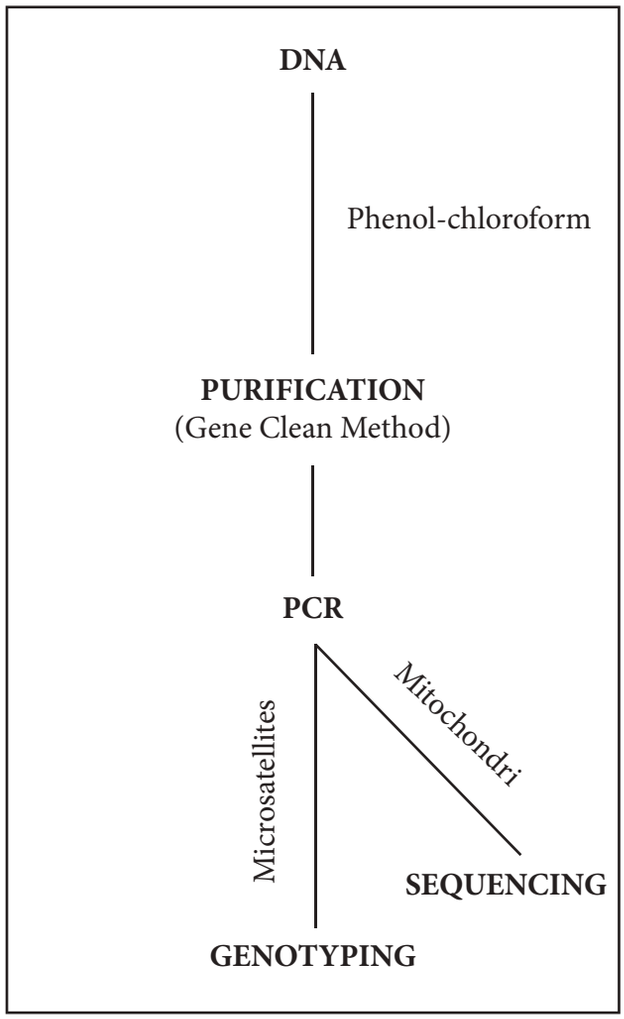


Fig 4.3. Flow diagram of protocol employed for DNA analysis of wild buffalo samples

[18] *The GenBank sequence database is an open access, annotated collection of all publicly available nucleotide sequences and their protein translations. It is produced and maintained by the National Center for Biotechnology Information as part of the International Nucleotide Sequence Database Collaboration.*

Table 4.1. Details of mitochondrial DNA markers used in this study

Sl. No	Region of mtDNA	Size of amplicon (bp)	Reference
1	Cytochrome b	489	Kumar *et. al.*, 2007
2	Hypervariable region I	468	Vila *et. al.*, 1999
3	Hypervariable region II	380	Kumar *et. al.*, 2007
4	16s Rrna	581	Palumbi *et. al.*, 1991

MtDNA sequences were initially edited and aligned using AUTOASSEMBLER software (Applied Biosystems)[19]. Initial sequence comparison, measures of variability and phylogenetic relationships among the haplotypes from different regions were examined using neighbour-joining analysis based on Kimura two-parameter (Kimura, 1980) distance with gamma correction, as implemented in MEGA version X (Kumar *et al.*, 2018). *Bos taurus* was used as the outgroup. The robustness of the neighbour-joining tree was assessed by 500 bootstrap replications (Felenstein, 1985).

- **Microsatellite genotyping**

  Twelve microsatellite loci, moderately to highly polymorphic, distributed across 17 cattle chromosomes were used for the genotyping of the faecal samples. All these markers have been selected from the BOVMAP database (available at www.marc.usda.gov). One of the primers for a given locus was labelled with fluorescent dye (FAM or HEX). Fluorescent tagged amplification products were size fractionated and visualized on ABI 377 DNA sequencer (Applied Biosystems Inc, USA), and allele size was determined using HD400 [ROX-0350] or [Tamara-350] size standard and the GENESCAN 3.1 software[20] [Applied Biosystems Inc, USA].

4.2. Results and Discussions

Median Joining (MJ) Network[21] of wild and domestic buffalo haplotypes based on variation in Cytochrome B sequences showed that the wild buffalo from Central-India and North-east had a common genetic ancestor (Fig. 4.4).

[19] *Is a Macintosh software package from PE-Applied Bio-systems (Foster City, CA) designed for assembly of DNA sequences.*
[20] *GENSCAN is a program to identify complete gene structures in genomic DNA.*
[21] *A statistical procedure for reconstructing phylogenies from intra-specific data.*

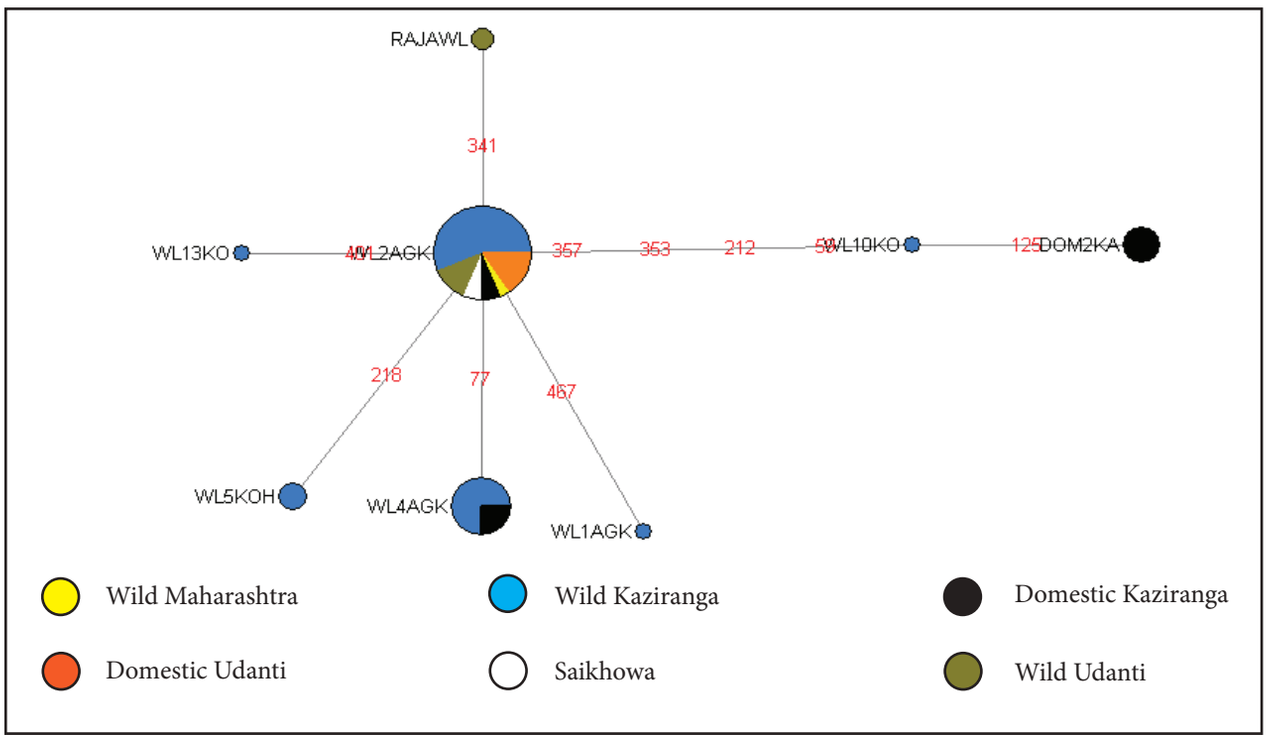


Fig 4.4. Median Joining Network of wild and domestic buffalo haplotypes based on variation in Cytochrome B Sequences

Most of the domestic buffalo samples from Kaziranga showed distinct variations as compared to their wild counterparts. Still some of the domestic samples were found to be sharing haplotypes with wild samples. The samples from the Udanti WLS also showed clear cut distinction between wild and domestic samples. The samples from the Udanti WLS (Chhattisgarh) were found to be closer to the wl-ag/bg kaz series of wild samples from Kaziranga (Assam). But these samples showed overall distinct variations from Kaziranga samples, may be because of the geographical distance. There were three distinct haplotypes among the wild animals of Udanti based on 18 polymorphic and variable sites with a nucleotide diversity of 0.667. Asha, Raja and recently born Prince shared same haplotype, but are clearly different from other animals. The partial sequences of cytochrome b (489bp, n=64), Hypervariable region I of d-loop (468bp, n=64), 16S (581 bp, n=64) and hypervariable region II of d-loop (380 bp, n=64) were generated from the DNA obtained from the faecal samples. The neighbour-joining (Fig. 4.5) and UPGMA phylogenetic trees were constructed based on the 1917 bp of combined sequences of the four markers.

Proper amplification and genotypes could be obtained at 9 loci. Allele frequency, number of alleles, observed and expected heterozygosities[22] were calculated using GenAlEx software. The comparative alleles for different genotypes of Udanti wild buffaloes at these nine loci is presented in Table 4.2. The pattern of sharing of alleles of Asha, Raja, and Prince with Shyamu at six out of nine loci also hint that Shyamu might have fathered Raja and Prince. The observed heterozygosity among the wild animals was found to be about 45% (Table 4.3). The domestic animals showed a lower level of heterozygosity, i.e. 22% only. Several alleles were found in the wild animals only and not in the domestic ones and vice versa, which shows the genetic distinctiveness of both which was not observed clearly with the mitochondrial markers (Uni-parental inheritance).

[22] *the condition of having two different alleles at a locus—is fundamental to the study of genetic variation in populations.*

Table 4.2: Genotypes of the wild buffalo individuals of Udanti WLS at the nine selected microsatellite loci.

MARKER / WILD SAMPLES	L1	L1	L2	L2	L3	L3	L4	L4	L5	L5	L6	L6	L7	L7	L8	L8	L9	L9
ASHA/WB FEM	151	151	118	120	106	106	111	113	115	115	157	163	153	153	139	139	105	105
WL RAJA	149	151	118	120	106	108	113	113	115	117	157	163	153	159	139	153	105	107
WL CALF PRINCE	149	151	118	120	106	108	113	113	115	117	157	163	153	159	139	153	105	107
WL SHYAMU	147	149	118	120	106	108	113	113	117	117	157	163	159	159	153	153	103	107
WL CHHOTU	151	153	126	126	106	106	105	107	115	117	163	163	171	171	119	121	105	109
WL RAMU	141	143	126	126	110	110	127	127	113	113	157	157	147	147	151	151	103	103
WL KALIA	149	151	114	116	106	106	115	115	115	115	157	163	147	149	151	151	105	105
WL JUGADU	151	153	122	124	106	106	111	111	115	119	157	163	139	153	151	151	105	109

Table 4.3: Comparative Observed (Ho) and Expected He) levels of heterozygosity in the wild and domestic buffalos from Kaziranga National Park (Pop 1 and Pop 2) and Udanti WLS (Pop 3 and Pop 4), respectively. N: Number of individuals; NA: Average number of alleles; Ne: Effective number of alleles

Mean and SE over Loci for each Population						
Population		**N**	**Na**	**Ne**	**Ho**	**He**
Pop 1	Mean	36	15.667	9.279	0.396	0.863
	SE		1.994	1.356	0.038	0.029
Pop 2	Mean	10	7.000	4.993	0.367	0.766
	SE		0.782	0.596	0.076	0.037
Pop 3	Mean	08	5.556	3.971	0.456	0.691
	SE		0.503	0.503	0.084	0.059
Pop 4	Mean	09	5.667	3.914	0.246	0.673
	SE		0.799	0.692	0.068	0.055
Grand Mean and SE over Loci and Populations						
Total			**8.472**	**5.539**	**0.366**	**0.748**
			0.903	0.553	0.037	0.026

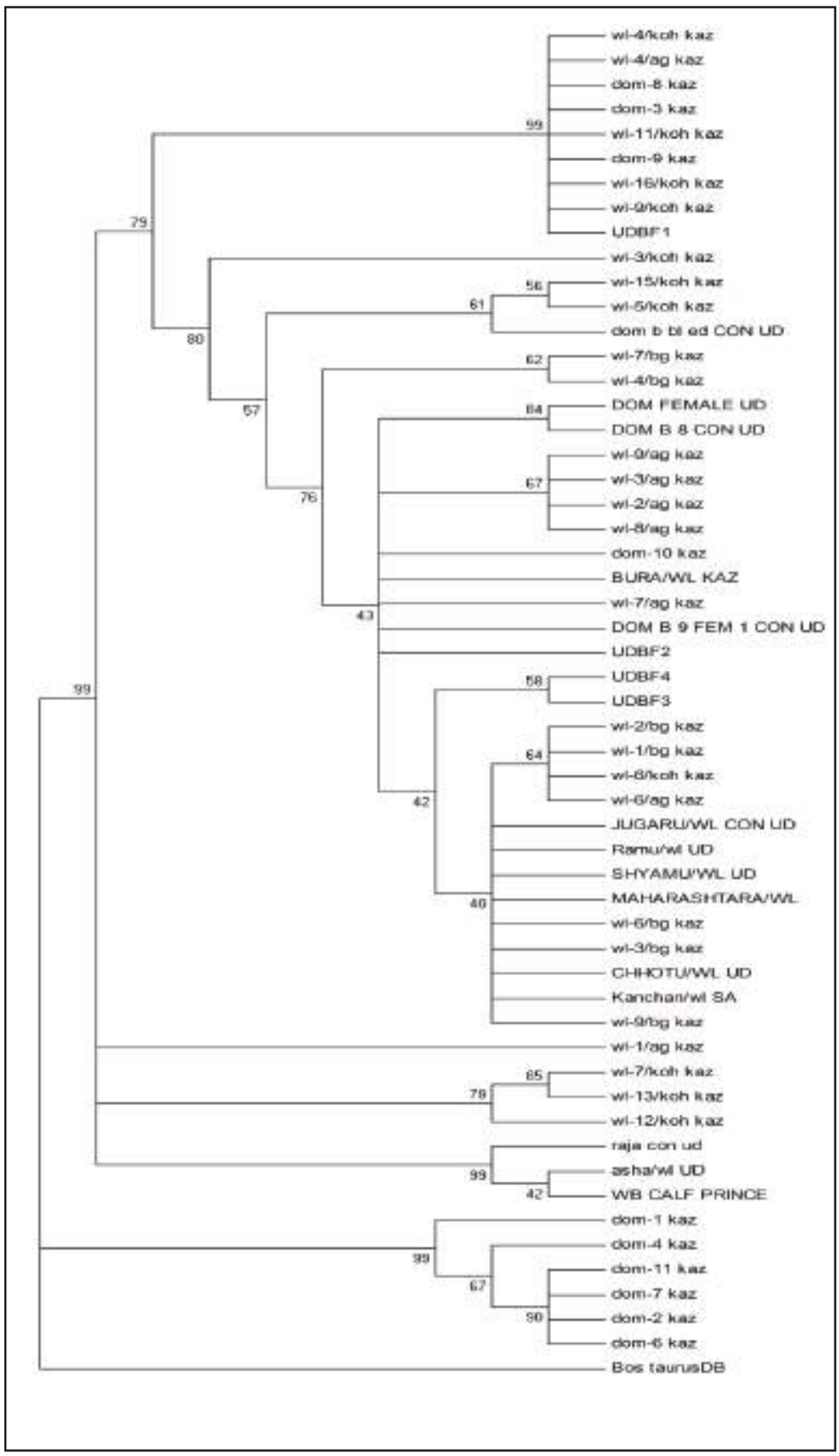


Fig 4.5: Neighbor-joining tree of combined mitochondrial markers sequence (UD = Udanti Wild Life Sanctuary, Chhattisgarh; KAZ = Kaziranga National Park, Assam; SA = Dibru-Saikhowa, Assam; WL =Wild Buffalo; DOM = Domestic Buffalo; DOM B BL ED = Domestic Buffalo (Stored Blood)

4.3. Conclusions

This investigation was undertaken with the purpose of answering two important questions: a) With such low numbers, is the wild Udanti population inbred and b) if the numbers are to be augmented, which are the genetically most suitable populations from where the animals should be brought.

The genetic variation estimated with microsatellite size and mtDNA nucleotide variation, the significantly moderate level of heterozygosity as well as nucleotide diversity is indicative of a genetically stable population in Udanti. It also indicates that the population decline is recent in nature. With such a small population, it is imperative to boost the numbers by introducing individuals into the population either through wild to wild translocations or through a carefully run conservation breeding project. The buffalos in Udanti share haplotypes with wild buffaloes from Assam and even Maharashtra and, therefore could be used to augment the wild buffalo population in Udanti.

The results of the present study would also facilitate the identification of animals with unique genotype, which can be used in controlled breeding programs to ensure propagation and genetic variability.

Fig 4.6: Dung collection of wild buffalo for DNA test

CHAPTER 5

SOCIO-ECONOMIC ATTRIBUTES OF HUMAN POPULATION AROUND THE WILD BUFFALO HABITAT

Rajendra Prasad Mishra, Indu Kumari, Kaushik Deb, Adrish Poddar and Madhumay Mallik

A high proportion of forest fringe communities are dependent on the proximate forests and therefore makes conservation of forest and wildlife resources more challenging. The traditional exclusionary approach to wildlife conservation is perhaps one of the main reasons for local peoples' antipathy towards wildlife conservation.

Udanti Wildlife Sanctuary has 17 villages (Fig 5.1) dotted in and around the sanctuary. With over 6000 people living in and dependent on the resources of the sanctuary, one can assume that the pressure on the animals and their habitats must be immense. At the onset of the project, there was no information available on the magnitude of such anthropogenic pressures, and therefore an effort was made to quantify these through a comprehensive survey conducted in the year 2007. A repeat survey was conducted in the year 2017 to find out if the pressures persisted or had they increased with the increase in the human population, after a decade. The survey focused on collecting information about the demand for:

When asked about the reasons for the depletion of forest cover, 94% of the community mentioned it is due to NTFP extraction, cattle grazing and timber extraction.

a. Cultivated land holdings and cropping type (demand for forest area dependency)

b. Livestock assets (demand for fodder and cut grass)

c. Sustenance of people in the community (demand for fuel wood and NTFPs) and

d. Other support from ecological services (for water, fresh air, weather etc.)

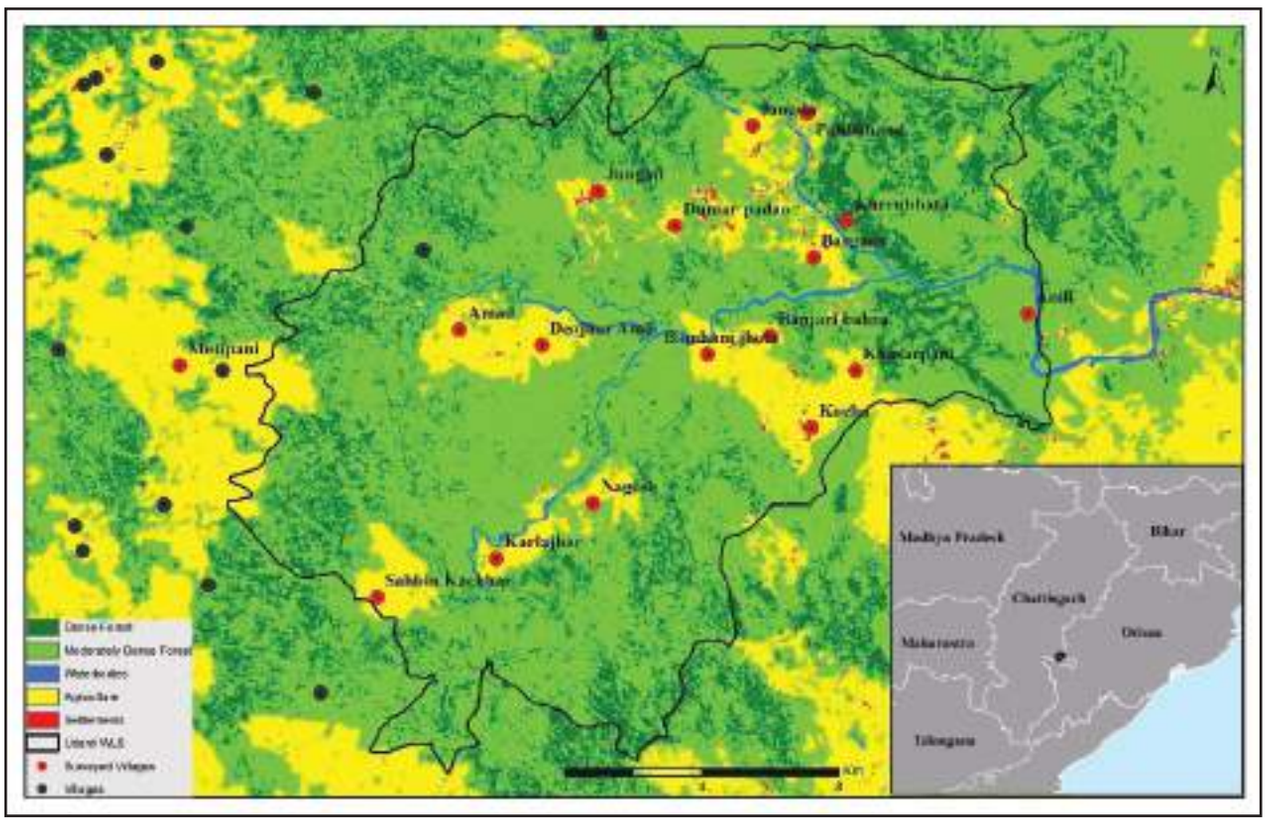


Fig. 5.1: Location of villages (red dots) in and around Udanti WLS, Chhattisgarh

5.1. Survey Area

There are 17 small revenue villages, under five village panchayats, inside the WLS (Fig. 5.1). These villages were surveyed to understand the dependence of people on the forests. Some of these villages are quite old (about 300 years), while others are relatively recent settlements (35 years).

5.2. Sampling

An interview-based survey was conducted, and a pre-structured questionnaire was used to survey the population of the 17 villages located in the sanctuary. In 2007, 173 households (16%) were randomly selected for the survey, while in 2017, the survey was more intensive with about 30% of all households in the 17 villages surveyed by systematic random sampling, i.e. surveying every third household in a village.

5.3. Results

- **Number of households**

  The total number of households saw a 34% increase from 1477 in the year 2007 to 1984 in the year 2017. The average village size also increased, with 82 households in a village increasing to 110 per village in 2017. It is, of course, understood that this increase was not even, but varied, across the villages (Fig 5.2).

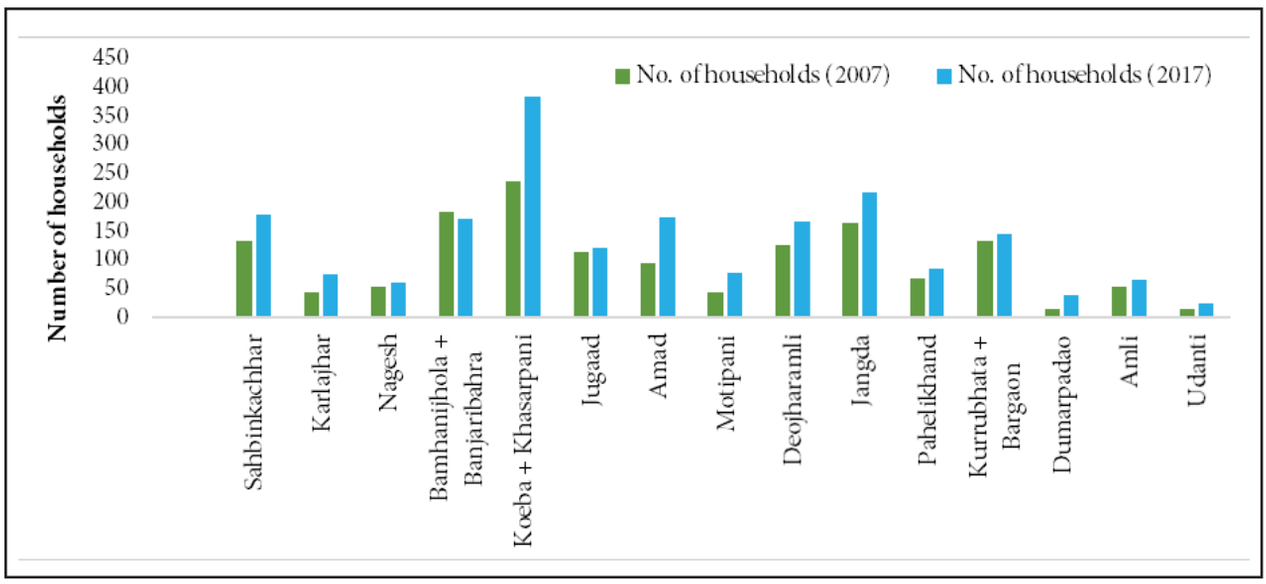


Fig. 5.2. Comparison of household numbers between 2007 and 2017 in Udanti WLS

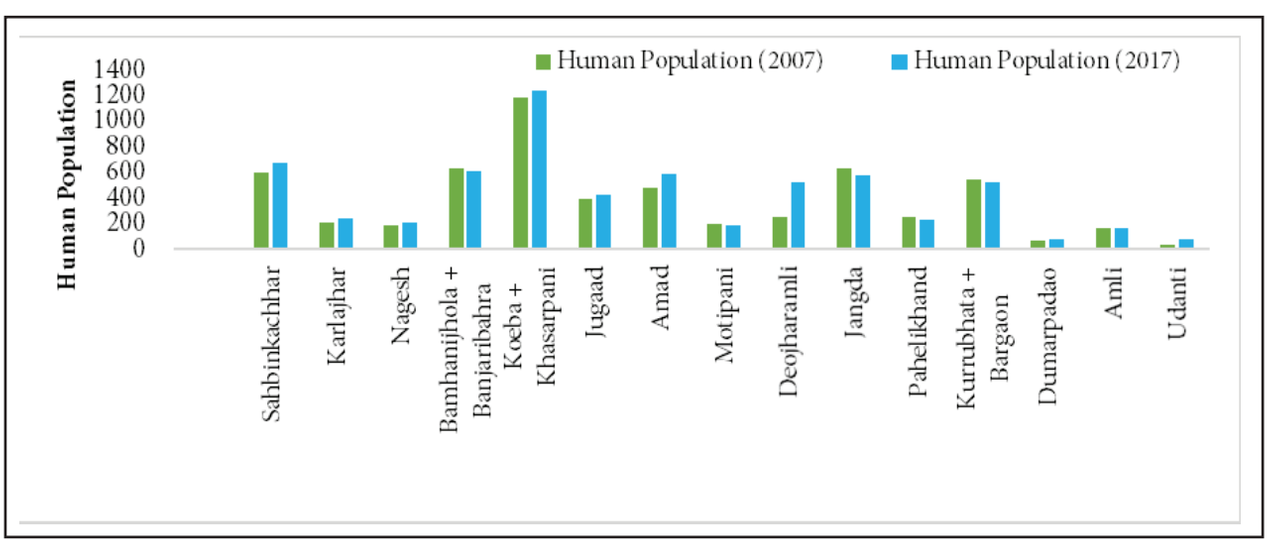


Fig. 5.3. Changes in human population in Udanti Landscape (2007 & 2017) in Udanti WLS

- **Human Population**

  The human population registered a growth of about 9% from 5866 in the 17 villages in 2007 to 6392 in 2017 (Fig 5.3 & Table 5.1). In 2007 each household comprised of an average of 3.97 persons, which decreased to 3.22 in 2017. This decline is perhaps due to the disproportionate increase in the number of households compared to the increase in population, youngsters opting for separate ration cards (which determines a household) perhaps to secure the governmental benefits.

Table 5.1: Demographic profile of the 17 surveyed villages

Sl. No	Name of village	No. of households (2007	Human Population (2007)	No. of households (2017)	Human Population (2017)
1	Sahbinkachhar	133	600	179	678
2	Karlajhar	44	206	75	249
3	Nagesh	53	194	61	209
4	Bamhanijhola (Udanti is part of Bamhanijhola)	184	637	144	506
5	Banjaribahra	15	41	52	193
6	Koeba	236	1184	294	954
7	Khasarpani			89	293
8	Jugaad	113	391	120	431
9	Amad	95	482	173	589
10	Motipani	45	202	77	186
11	Deojharamli	126	254	167	522
12	Jangda	164	637	218	585
13	Pahelikhand	69	258	86	229
14	Kurrubhata	132	544	93	341
15	Bargaon			52	182
16	Dumarpadao	14	73	38	80
17	Amli	54	163	66	165
TOTAL		**1477**	**5866**	**1984**	**6392**

- **Gender Ratio**

  The male-female ratio of the surveyed villages was 956 females to 1000 males in the year 2017, which matches the national ratio for the country, i.e. 940 females to 1000 males (Census of India 2011).

- **Caste wise population**

  Gond and Bhunjia were the major tribes (over 72% of the surveyed households) in the villages with a small population of Kamar tribe (7%) also being recorded. Apart from these, tribes like Raut/Yadav (12%), Kashyap (2%) and others (Gada, Luhar, Kumhar, Sahu, Nai, Mali, Sinha) were also found (Fig.5.4).

The above figure clearly shows that there was an increase in the Gond population from 38 % to 44 %, Yadav's from 10 % to 12% at the cost of Bhunjia's and Kashyap's declining from 36% to 27% and from 3% to 2%, respectively.

- **Civil Society Integration**

  Over 98% of the surveyed adults possessed voter identity cards. The eligible families also had ration cards. 57% surveyed families were Below Poverty Line (BPL)[23] in 2017. The percentage of BPL families across the villages varied extensively. (see Table 5.2 for details).

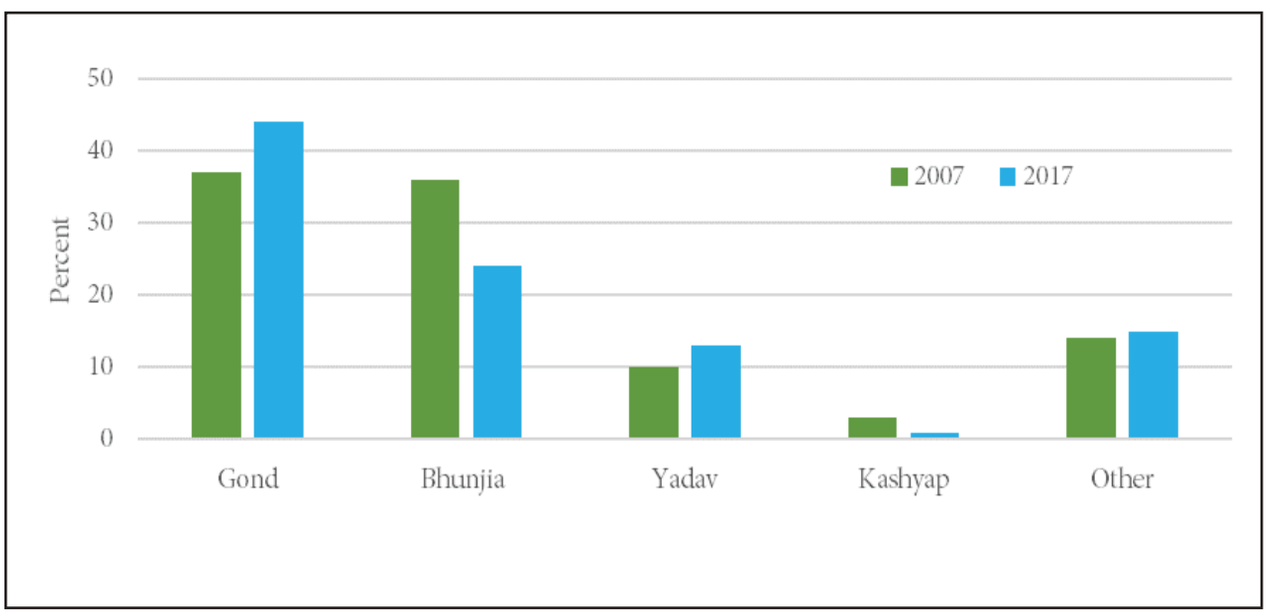


Fig 5.4: Change in caste composition from 2007 to 2017 in Udanti WLS

- **Household Infrastructure**

  Only 7% of the surveyed households had pucca or cemented houses in the landscape, 60% of households were kuccha (mud) houses, and 32% households had been built under the Indira Awas Yojna (IAY) Scheme.

[23] The income limit for households for qualifying as a beneficiary under the BPL (below poverty line) list has been pegged at about ₹ 27,000 per annum, according to the methodology approved by the Union Cabinet

Approximately 70% of the surveyed village households did not have toilets. The households in Kasarpani, Banjari, Bahara, Bargaon, Khurrubhata, Jangda, Pailikhand, Amli and Kalajhar villages did not have any toilets. Therefore, these should be linked and the government's Swachh Bharat Abhiyan (Total Sanitation Campaign) scheme to make them open defecation free. This would also reduce people's movement in the forests and also perhaps reducing the risks of conflict with wild animals.

- **Land holdings**

  In 2007, among the landowners, 49% had land titles while the remaining were encroachments, 11% were landless. The total landholding of the *patta* land[24] of 17 villages was 2493.72 acre in 2007 which increased marginally to 2498.36 acre in 2017 (data unavailable for Khasarpani village). Similarly, the total landholding of non-patta land increased marginally from 3568.99 acre in 2007 to 3572.42 acre in 2017. The average household landholding of the community decreased from 4.23 acres in 2007 to 2.70 acres in 2017 (Table 5.3) which can be attributed to the increase in population and the division of landholdings.

- **Livestock dependency**

  81% of the households possessed livestock for

Fig 5.5: Consultative meetings with forest guards and villagers

[24] A type of land (legal) deed issued by the government to an individual or organization. The term is used in India and certain other parts of South Asia for a small piece of land granted by the government to an approved cultivator with a land revenue exemption.

Table 5.2: BPL Families, Household Type and Toilets in Udanti WLS in 2017

Villages	BPL Families	Kaccha	Indira Awas Yojana	Pakka	No Toilet
Dumarpadao	14.29%	42.86%	42.86%	14.29%	100.00%
Amad	78.95%	31.58%	65.79%	2.63%	18.42%
DeojharAmli	58.06%	51.61%	45.16%	3.23%	16.13%
Koyba	37.50%	78.00%	20.00%	2.00%	72.00%
Khasarpani	26.09%	78.26%	21.74%	0.00%	100.00%
Banjaribahara	61.54%	38.46%	61.54%	0.00%	100.00%
Bamhanijhola	62.96%	55.56%	40.74%	3.70%	85.19%
Bargaon	50.00%	75.00%	25.00%	0.00%	100.00%
Kurrubhata	63.16%	84.21%	10.53%	5.26%	100.00%
Jangda	38.71%	54.84%	12.90%	32.26%	100.00%
Pailikhand	93.75%	56.25%	31.25%	12.50%	100.00%
Matipani	38.89%	88.89%	11.11%	0.00%	22.22%
Udanti (Extension of Bamhanijhola village)	70.00%	60.00%	40.00%	0.00%	100.00%
Amali	100.00%	20.00%	80.00%	0.00%	100.00%
Karlajhar	80.00%	66.67%	26.67%	6.67%	100.00%
Nagesh	81.82%	66.67%	26.67%	6.67%	73.33%
Sahbinkachhar	32.61%	65.22%	19.57%	15.22%	65.22%
Jugad	64.00%	72.00%	16.00%	12.00%	24.00%
Average	**57.11%**	**60.63%**	**32.37%**	**7.00%**	**69.08%**

milk, meat and agricultural toil. They were grazed/ browsed in the sanctuary throughout the year (Fig 5.7). Stall-feeding of livestock had never been practiced in the villages.

In 2007, cow (74%) was the most favoured livestock (mean of 4.58 individuals/ household), followed by goat (18 %) (3.8 / household) and domestic buffalo (8%) (2.6/ household) among the villages (Fig.5.8). In 2017, the households possessing buffaloes reduced to 2% following the forest department's efforts to reduce buffaloes in the area by encouraging people to exchange

Table-5.3: Landholding in villages near and within Udanti WLS

Village Name	2007			2017		
	Avg. Landholding (acres)	Avg. Patta land (acres)	Avg. Non Patta land (acre)	Avg. Landholding (acres)	Avg. Patta land (acres)	Avg. Non Patta land (acre)
Amad	5.27	1.32	3.95	4.00	1.00	3.00
DeojharAmli	3.14	0.93	2.21	2.37	0.70	1.67
Koyba	5.07	1.92	3.15	3.48	1.32	2.16
Khasarpani	NA	NA	NA	NA	NA	NA
Banjari Bahara	3.81	1.85	1.96	2.76	1.34	1.42
Bamhanijhola	3.2	1.07	2.13	2.50	0.84	1.66
Dumarpadao	9.98	6.22	3.77	3.42	2.13	1.29
Bargaon	4.57	1.37	3.2	2.58	0.77	1.81
Kurrubhata	3.54	1.48	2.06	1.90	0.79	1.10
Jangda	4.03	1.92	2.11	3.03	1.44	1.59
Pailikhand	3.86	2.72	1.13	3.09	2.19	0.91
Motipani	7.18	0.22	6.96	4.04	0.13	3.91
Udanti	0.23	0.23	0	0.12	0.12	0.00
Amali	2.49	0	2.49	1.95	0.00	1.95
Karlajhar	5.02	3.22	1.81	2.76	1.77	0.99
Nagesh	5.67	2.25	3.42	3.80	1.51	2.29
Sahbin Kachhar	3.3	2.69	0.61	2.01	1.63	0.37
Jugaad	2.29	1.26	1.02	2.14	1.18	0.95
Average	4.23	1.78	2.45	2.70	1.11	1.59

or sell them off for cows[25]; while the number of households having cows increased to 81%. The households having goats remained almost stable at 17% (Fig 5.6).

Overall the livestock population decreased from 4154 in the year 2007 to 3898 in 2017, in the Udanti landscape (Fig 5.7 & Table 5.4).

- **Overall Income**

  The survey in 2007 showed that 48% of the annual income of the local people came from forests while 41% of income was from agriculture-based activities. In 2017, the percentage of income from agriculture significantly increased to 48%, while the income from Non-Timber Forest Products (NTFPs) reduced to 7% (Fig.5.9). This was perhaps due to the implementation of various government schemes in the area and an increase in the minimum wages, which

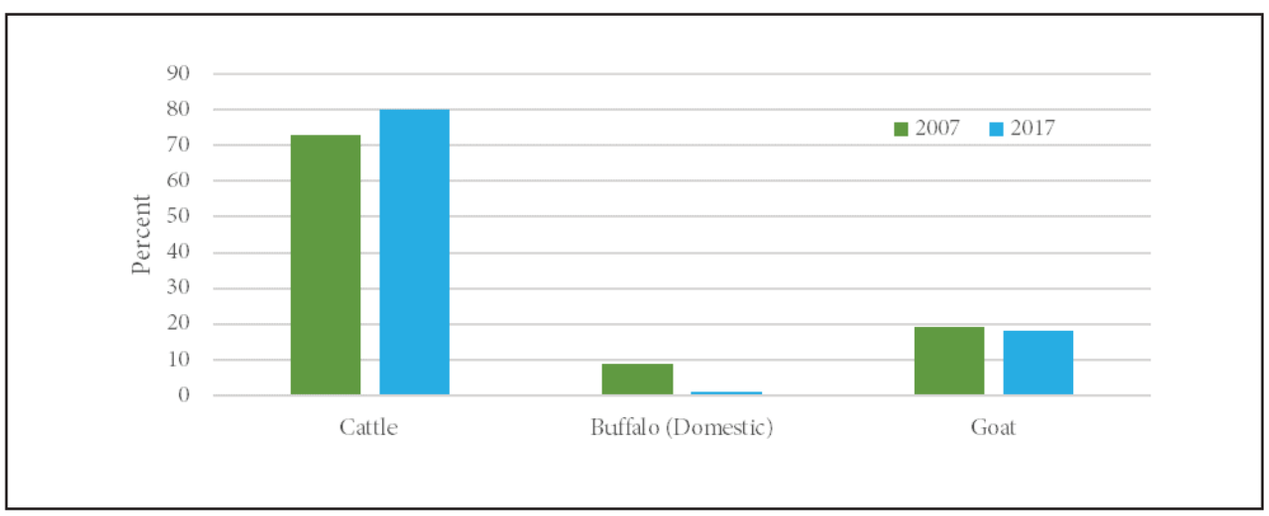


Fig 5.6: Change in Livestock Dependency of Community in Udanti WLS

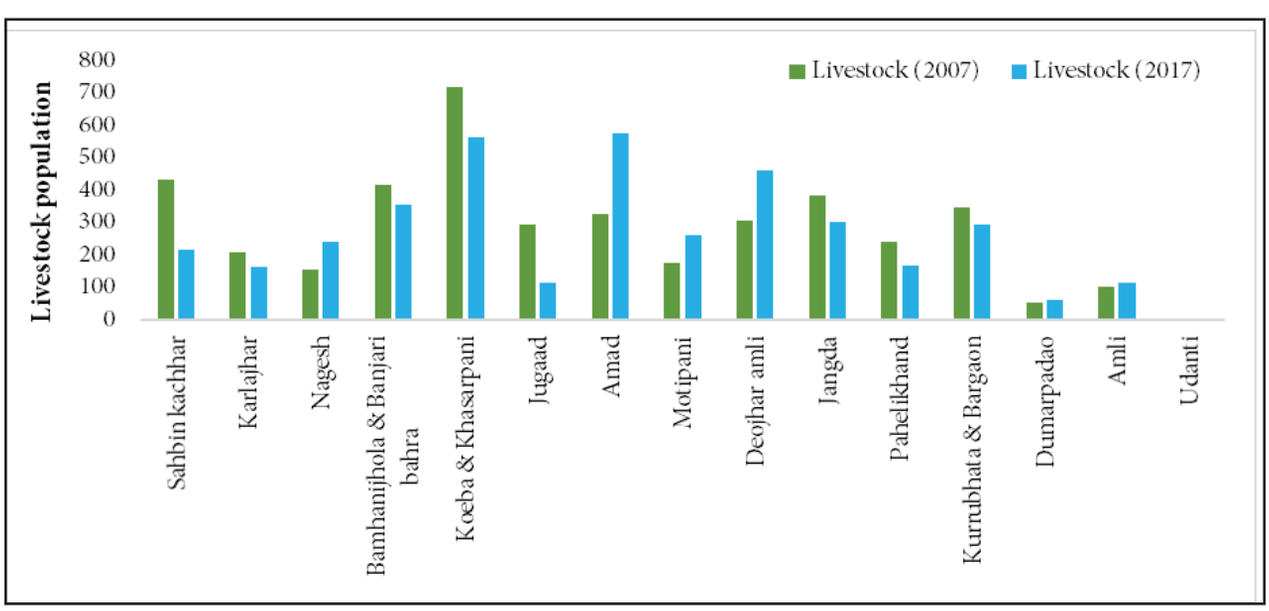


Fig 5.7: Change in Livestock Population (2007-2017) in Udanti WLS

[25] In order to ensure the genetic purity of wild buffalos, the Wild Buffalo Task Force recommended to remove domestic buffalos from the villages in Udanti WLS. In 2007-08,>150 domestic buffalos were sold off, where the difference was compensated by Chhattisgarh FD

Table 5.4: Village and livestock profile in and around Udanti WLS

Sl. No	Name of village	Livestock (2007)	Livestock (2017)
1	Sahbinkachhar	431	218
2	Karlajhar	207	165
3	Nagesh	154	239
4	Bamhanijhola	418	182
5	Banjaribahra		171
6	Koeba	718	374
7	Khasarpani		189
8	Jugad	292	116
9	Amad	325	575
10	Motipani	177	262
11	Deojharamli	308	460
12	Jangda	382	304
13	Pahelikhand	240	167
14	Kurrubhata	345	177
15	Bargaon		117
16	Dumarpadao	53	63
17	Amli	104	114
18	Udanti	16	25
	TOTAL	**4160**	**3898**

Fig. 5.8: A herd of domestic buffalo inside Udanti WLS

increased crop production and attracted the villagers towards daily wage labour. Collection of Tendu leaves, one of the major sources of income of villagers in Udanti WLS, was strictly prohibited for collection after the declaration of the tiger reserve in 2008-09.

a. Agriculture based income

i. Income from agriculture crops: Agriculture was the main occupation of the villagers. Most farmers practiced single crop cultivation while some practised multiple cropping also. Paddy was the major crop (83%) grown in the area. On average, each household earned about ₹10,278 from agriculture (both in-kind and through sale) in 2007, which increased to ₹24,601 in 2017, perhaps due to availability of High Yielding Variety (HYV) seeds and fertilizers by the government, and through better availability of irrigation systems, solar pumps and efficient modern techniques of farming.

ii. Income from agriculture-based labour and daily wage labour: Mostly, landless and marginal land farmers worked as agriculture labour in 2007 but in 2017, labour work contributed greatly to the livelihood of many more villagers. In 2007, on average, about two persons per household were employed as agriculture labourers for an average of 31.34 days/year. This contributed to an income of ₹1367 per household. In 2017, the income from daily wage labour witnessed a tremendous hike to ₹10,987/- due to an increase in

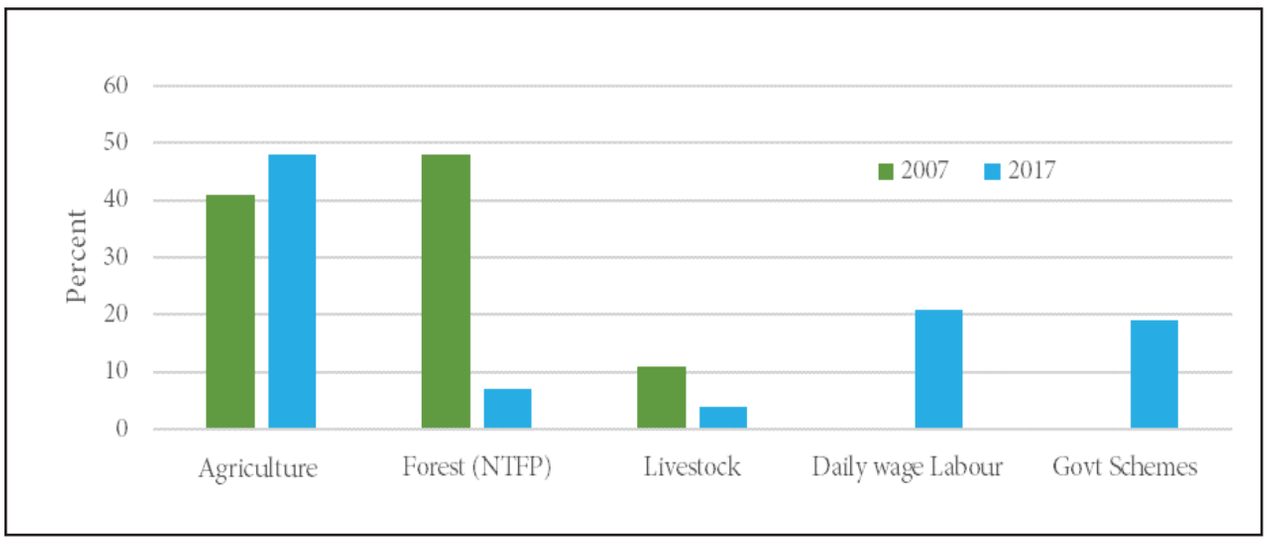


Fig. 5.9: Overall household income from various sources in 2007 and 2017 in Udanti WLS

construction and infrastructure work, availability of work through the Mahatma Gandhi National Rural Employment Guarantee Act (MNREGA, 2005) scheme and also due to increase in per day minimum wage.

b. *Forest-based income*

Income from forests came down from 48% to 7% in a span of 10 years (2007-2017)[26]. In 2007, the overall forest-based income came from three main activities, non-timber forest produce (NTFP) (48%), forest-based labour (37%) and timber and fuelwood (15%). NTFPs collected were used for domestic consumption as well as for sale. Honey, medicinal plants, seasonal roots and tubers were used for domestic consumption. The flowers and fruits of Char (*Buchanania lanzan*), Aonla (*Emblica officinalis*), Baibiring (*Embelia ribes*), leaves of Tendu (*Diospyros melanoxylon*) and Siali (*Bauhinia vahlii*) and lac from Kusum (*Schleichera oleosa*) tree were collected for sale.

i. *Income from NTFPs*

- Mahua flower and fruit: Generally, Mahua (*Madhuca longifolia*) trees were found in revenue land in addition to the forests. Most landless families collected mahua flowers and fruits from forests and also from some revenue lands during summer (Table 5.5). On average, 325 kg of mahua/household/season was collected. Most

[26] *In 2007, the villagers were largely dependent on NTFPs and forest-based work, however with the state government's push towards agriculture in the following years i.e. providing subsidies on installing solar power irrigation pumps, villagers made a strategic shift towards agriculture and started growing cash crops like Maize.*

people sold mahua flowers and fruits within 15 days of collection in weekly markets, but some saved them for up to two months before the sale to get better returns. Mahua flowers were sold at around ₹500 to ₹700 per 100kg.

- Income from other NTFPs: The fruit of Baibirang (*Embelia ribes*) and Sal (*Shorea robusta*), rhizome of Tikhur (*Curcuma angustifolia*) and lac (produced on Ceylon Oak - Kusum "*Schleicheria oleosa*" trees) were also extracted. There were a number of Kusum trees in and around the villages and few in the forests. The people collected lac in the month of June, July, November and December. The villagers also collected fruits of Sal and rhizome of Tikhur from forests during summer while fruits of Baibirang were collected during November-December (Table 5.5). The rate of the NTFPs traded were: lac between ₹5000 to ₹11000/quintal, Baibirang from ₹1500-₹2000/quintal, Sal seed ₹350/ quintal and Tikhur rhizome after the processing between ₹8000 to ₹15000/ quintal. The average annual income from this activity was about ₹3,500/ household/year.

ii. Forest-based labour

Forest-based labour also contributed to the livelihood of local villagers. The local villagers were engaged as daily wagers in many forest-related works like construction of new ponds or deepening of old ponds, dry relief works, habitat improvement work, road maintenance, fire protection, and barrier guarding in the sanctuary.

Fig.5.10: Tendu leaves (Diospyros melanoxylon) and its collection by locals in Udanti WLS

Table 5.5: Name of NTFPs and their collection method, local & middlemen rate in Udanti WLS

Sl	Name of NTFPs	Collection month	Collection method	Local rate per kg (in ₹)	Middlemen rate per kg (in ₹)
1	Sal dry gum (*Shorea robusta*)	January to April	Collected from tree bark	200	500
2	Chaar fruit (*Buchanania lanzan*)	Febuary to March	Collected by tree branch cutting	50	200
3	Lac (*Schleichera oleosa*)	November to December & June to July	Collected by tree branch cutting	100 - 150	300 - 400
4	Honey	February to April	Collected from direct remove honey comb	100	300
5	Imli fruits *(Tamarindus indica)*	February to April	Plucked from the branches & collect by lopping of branches	20	40 - 50
6	Mahua flower *(Madhuca longifolia)*	February to April	Collected fallen flower from ground	20	50
7	Sal seed *(Shorea robusta)*	March to April	Collected fallen fruits from ground	10	20 - 30
8	Tendu leaves *(Diospyros melanoxylon)*	May	Directly plucked from small trees but some time lopping braches	Every year changing	
9	Mahua fruit *(Madhuca longifolia)*	May to June	Collected from the branches	10	40
10	Wild mashroom *(Phuto)*	July to August	Plucked directly from ground	200	600
11	Kushum seed *(Schleichera oleosa)*	July to August	Collected by lopping the branches	15	
12	Boda (Wild mushroom)	July to August	Collected from ground	100	300
13	Bhui bhilma *(Premna/ Pygmae herbacea)*	August to September	Digged out from the ground	10	50
14	Baibirang fruits *(Embelia ribes)*	September to October	Fruit collected directly from branches	35	500 - 700
15	Tikhur rhizome *(Curcuma angustifolia)*	November to February	Digged out from the ground	250	500 - 700
16	Aonla fruits *(Emblica officinalis)*	November to January	Collected by lopping the branches of tree	25	100
17	Charota seed *(Cassia tora)*	December To January	Fruits collected through cutting the plants	30	80 - 100
18	Grass broom *(Aristida seonoides)*	December To January	Cutting the mature grass and making bundle	05 per broom	15


Fig 5.11: Roots of Bhuibhilma (Premna pygmae /herbacea) & Kusum (Schleichera oleosa) seed


Fig 5.12: Flower of Madhuca longifolia and Lac extracted from Schleichera oleosa

Fig 5.13: Broom grass collected by locals in Udanti WLS

In 2007, on average, about 71 wage days/year were availed by each household that generated an income of about ₹4438/household/year for the villagers. In 2017, the income from daily wage increased to ₹10,987/ household/year.

c. Other sources of income

These included income from animal husbandry, daily wage labour (non-forestry), business enterprises like shops, government and non-government services etc. The average income was about ₹3003 per household per year in 2007 which significantly saw a 7.7-fold increase to ₹23,118 in the year 2017.

- **Use of Fuel wood**

The 2007 survey showed that fuel wood was a basic requirement of villagers and most of it came from the surrounding forests or village lands. Majority of the people were totally dependent on fuel wood for heating and cooking, more so during winter. The average consumption of fuel wood was about 54.31quintals/household/ year. Villagers collected fuel wood from the nearest forest around the villages. The most preferred tree species for fuel included Saj (*Terminalia elliptica*), Dhawa (*Anogeissus latifolia*), Sal (*Shorea robusta*) and Karra (*Cleistanthus collinus*) as they emitted less smoke. Value of fuel wood/household/year @ ₹100/quintal was ₹5,431.

In 2017 over 95% of the families were still dependent on Traditional Cook Stoves (TCS) for cooking. 3.83% of households also had Liquefied Petroleum Gas (LPG) connections, 4.17% of households had solar energy, and 4.17% households had electricity connections.

- **People's Perception of the status of forest and its conservation**

While discussing with the local community about the state of forests now and a decade ago, 14.5% of people felt that the forests around were in better shape a decade back. When asked about the reasons for the depletion of forest cover, 94% of the community mentioned it is due to NTFP extraction, cattle grazing and timber extraction. About 8% also mentioned hunting and population growth as major contributors. The people also felt that despite the loss, forests should be conserved for future generations.

While agreeing that forests were important, the local people wanted the conservation agencies to take up the activities largely to develop their village infrastructure ranging from river bridge constructions; road construction; better electricity and communication facilities. Interestingly, none of their suggestions included conservation of forests, water and natural resources, which emphasizes the need for sensitization of the community on ecosystem services.

5.4. Discussion

Forest conservation interventions include the declaration of conservation zones, forest reserves, national parks etc., which are exclusively aimed at preserving the forests and their wildlife. The resultant impacts due to the restrictions on socio-economic aspects of the peripheral households are often disregarded. Based on pieces of evidence gathered from

different parts of the world, it is now recognized that the use of strict protection and tight regulations in managing natural forests is largely unsuccessful, especially in the areas with highly forest-dependent populations, with high poverty and few alternative livelihood options (Harvest, *et al*, 2003). Long-term conservation of the forest is therefore greatly impacted by the socio-economic condition and locals' dependency on forest resources. A few important points that would affect conservation surfaced from the survey. These included an increasing number of households, demand for land, fuel wood and the resultant grazing pressure.

The community of Udanti landscape has an agriculture-based economy wherein the land holding of the farmer determines the economic status. The 2007 survey showed that the villagers had small land holding, which was decreasing significantly due to population growth. They mostly practiced single cropping (rain fed), hence had very low income resulting in 48% dependence of the community on the forest for livelihood. The efforts by the forest department and other government interventions in the last decade included: Diversification of income source by the introduction of livelihood schemes like SGSY[27], MANREGA , etc.; increase in minimum wage by three folds (from less than ₹100/- in 2007 to ₹305/- per day in 2017); distribution of subsidized HYV seeds and fertilizers; Introduction of cash crops; increase in availability of labour work due to infrastructure development in the area.

This resulted in an increase in their income from ₹10,278/- per household/year in 2007 to ₹51,454/- in 2017, and the dependence of the community on the forest for livelihood decreased from 48% of their income to 7% of their income. However, the dependence on fuelwood and grazing was still over 95% in 2017. The quantity of earnings through timber was insignificant but led to significant forest loss.

To summarize, the government's welfare and support programmes have resulted in an increase in income which has offset the reduction in forest-based livelihood opportunities. This augurs well for the conservation of wild buffalo and its habitat. However, increasing human population and high level of dependence of communities on the forest for fuel wood is still a major challenge for wild buffalo conservation. Despite the reduction in the number of livestock in the area over the last 10 years, continued livestock grazing in the forest poses threats of habitat degradation. Therefore, containing anthropogenic pressure on wild buffalo habitat, as outlined above, should be one of the key initiatives to recover wild buffalo population in Udanti-Sitanadi landscape. The population recovery plan for Udanti-Sitanadi wild buffalo population entails the restocking of buffaloes raised through conservation breeding initiatives. As a preparatory measure for restocking resource extraction and disturbance in the habitat must be significantly reduced. While provisions of alternate fuel like cooking gas would minimize the demand for fuel wood rather than reducing it to zero. For this, buffer plantation of firewood species outside the sanctuary and regulation on firewood collection from forest

[27] Swarnajayanti Gram Swarojgar Yojana (SGSY) is an employment generation programme that provides income-generating assets through a mix of bank credit and government subsidy.
Mahatma Gandhi National Rural Employment Guarantee Act" or MGNREGA, is an Indian labour law and social security measure that aims to guarantee the 'right to work'.

areas under eco-development scheme might help in meeting the needs of communities and reducing pressure on wild buffalo habitat as well. The prime habitat for wild buffalo, being a Tiger Reserve, needs to be made inviolate. Effecting voluntary relocation of villages from inside the core area would also benefit the buffalo recovery plan. It is important to prepare a robust and attractive relocation and rehabilitation plan in consultation with villagers to make the relocation package acceptable to villagers. Similarly, for the movement of buffaloes and other wildlife between Udanti and Sitanadi WLS, it would be important to reduce biotic disturbance in the buffer forest between these two protected areas.

All the points discussed above thus stresses the fact that engaging communities to support wildlife conservation activities is often challenging and, in most cases, takes a long time. WTI, through its community mobilization work over the course of 15 years, was able to find a balance between maintaining wildlife habitat for the wild buffalos and maintain livelihoods and will continue to create stronger incentives for local communities to engage in wildlife conservation in the landscape.

Fig 5.14 Improved Cook Stove installed in USTR villages to reduce fuelwood usage and improve health of women folks.

CHAPTER 6

ADDRESSING THREATS IN USTR

Rajendra Prasad Mishra, Rahul Kaul, NVK Ashraf, Samir Kumar Sinha, Adrish Poddar, Jose Louies, Bhaskar Choudhury, Samshul Ali and Krishnendu Mondol

Small populations are prone to demographic; environmental and genetic stochasticity (Lande *et al*., 2003; Stacey and Taper, 1992; Newman *et al;* 1997; Lloyd & Powlesland, 1994; Charlesworth & Charlesworth, 1987). Wild Buffalo populations may therefore be exposed to a host of threats ranging from poaching, habitat loss and a highly skewed small pool of individuals.

In anticipation of an increase in the wild buffalo population in the wild, it was imperative to maximize the available potential habitat (through restoration and other means) to accommodate an enhanced population post conservation breeding and release. The wild buffalo in Udanti faces the following threats a) Habitat degradation, b) Hunting (for meat or retaliatory killing) c) Low sensitization and awareness levels among various stakeholders and d) Low population size.

Over the last decade, several actions were undertaken at various times to address these threats to make conditions conducive for the wild buffalo. Below is a summary of the actions taken jointly by the Chhattisgarh Forest Department and WTI to reduce these threats.

Human-induced threats are so disruptive and persistent, and the degree of damage is so high and often irreversible that it has adverse consequences for the entire ecosystem.

6.1. Addressing threats to habitats

Forests have long been threatened by a variety of destructive agents that includes both, natural and man-made. Natural processes such as fire, pests and diseases are regulatory in nature and are integral to forest dynamics. But in the case of human-induced threats that are so disruptive and persistent, and the degree of damage is so high and often irreversible that it has adverse consequences for the entire ecosystem. A great threat the

world is facing today is the loss of forest cover and, consequently, biodiversity (Estavillo *et al.*, 2013). Encroachment and conversion of forest cover into human-dominated landscape have been identified as the major drivers of biodiversity loss (Hansen *et al.*, 2005) throughout the world. As the demand for forest resources increases, the pressure on the forest also amplifies.

Other threats like selective logging, planting monoculture and plantation of commercially important species also result in a decline of wildlife habitat (Dahaban *et al.*, 1996). A gradual succession of grassland habitat into woodlands has also wiped out several grassland dependent species throughout the world (Sauer *et al.*, 2004; Jones-Farrand *et al.*, 2007). Additionally, cattle grazing in such areas results in competition for food and space, which in turn displaces major wild animals from their habitat. Alien invasive species have been identified as one of the major biological threats that can transform the structure and species composition of ecosystems by repressing or excluding native species, either directly by out-competing them for resources or indirectly by changing the way nutrients are cycled through the system (Mc Neely, 2001).

Spatio-temporal variations are observed in the intensity of such human-induced threats across locations. An attempt was made, very early on, in the Central India Wild Buffalo Recovery project to understand the threats operational in Udanti WLS and to then find ways of ameliorating these. In addition to threats of spreading invasive species, Udanti WLS is also a relatively dry area, and therefore, hot summers and water-deficient conditions posed great challenges to the wild buffalos' survival. The dry heat before the monsoons set in also brings in forest fires which affect a significant proportion of the sanctuary. The local human population bring in their own anthropogenic pressures in the form of firewood collection, grazing by domestic livestock and collection of other NTFPs.

The following section describes the conditions which do not make habitats conducive to buffalo survival. Pilot projects carried out by WTI and the Chhattisgarh Forest Department is being presented here.

Measurement of threats to habitat

A total of 29 transects, each one-kilometre-long were randomly selected/laid covering 32 forest compartments representing all major vegetation types found within the sanctuary. Each transect was monitored on a monthly basis to record threats such as water scarcity, human interference and man-made fires. On these 29 transect, plots were laid to record vegetation and also weed infestation, logging and grazing pressure. Details of the sampling on threats are given below:

a. **Weed infestation:** A total of 162 random plots of 20x20 m size were laid for quantifying vegetation attributes in Udanti WLS. Random plots laid on transects were analysed to find out the frequency/density of weeds. The number of weed species found in 162 quadrats before uprooting was calculated to find out the degree of weed infestation. After uprooting of weeds by the forest department, 44 quadrats (4 in each of the cleared compartments), each of 20 x 20 m size were laid in cleared areas to collect information on their regeneration (new growth and un-plucked) and animal use (wild and domestic) of such cleared areas.

b. **Forest fire:** Evidences of fire were recorded in each of the plots where vegetation was sampled. However, the total area burnt was measured through visual estimation supported by remote sensed mapping during each fire incident.

c. **Logging pressures:** During the sampling of vegetation in plots, the number of stumps found in 162 quadrats was calculated to measure the degree of logging pressure.

d. **Grazing pressure:** Information about the number of livestock was recorded from the state veterinary department. But the degree of the grazing pressure was calculated during the regular monthly surveys by recording the number of cattle found along each transect.

e. **Crop depredation:** Whenever there was information on crop depredation by the wild buffalo, data on the extent of damage with respect to the name of the village, name of the farmer, geo-location of the incident and the type of crop depredated were recorded.

f. **Water scarcity:** Each and every water body was visited on a regular basis, at least twice a month. The presence or absence of water in the water bodies was recorded, and remedial measures were suggested to the forest department, if needed.

Results

a. **Weed infestation:** Of the 32 forest compartments surveyed, weed infestation was recorded from 28 compartments (Fig 6.1). The mean density of weed infestation was 542.5 ± 52.25 plants per hectare. Among the affected compartments, numbers 34 and 38 were the worst infested with over 1000 weed plants/ ha compared to other forest compartments (Table 6.1).

Table 6.1: Weed (*Phoenix acaulis*) infestation in various compartments of Udanti WLS

Number of weeds /ha	Weed infested area in forest compartments
01-100	1 and 3
101-500	6, 26, 39,45, 46, 61, 68, 71, 81, 84, 85 and 86
501- 1000	13, 33, 41, 43, 65, 72, 73, 77, 82, 83, 89 and 80
> 1000	34 and 38

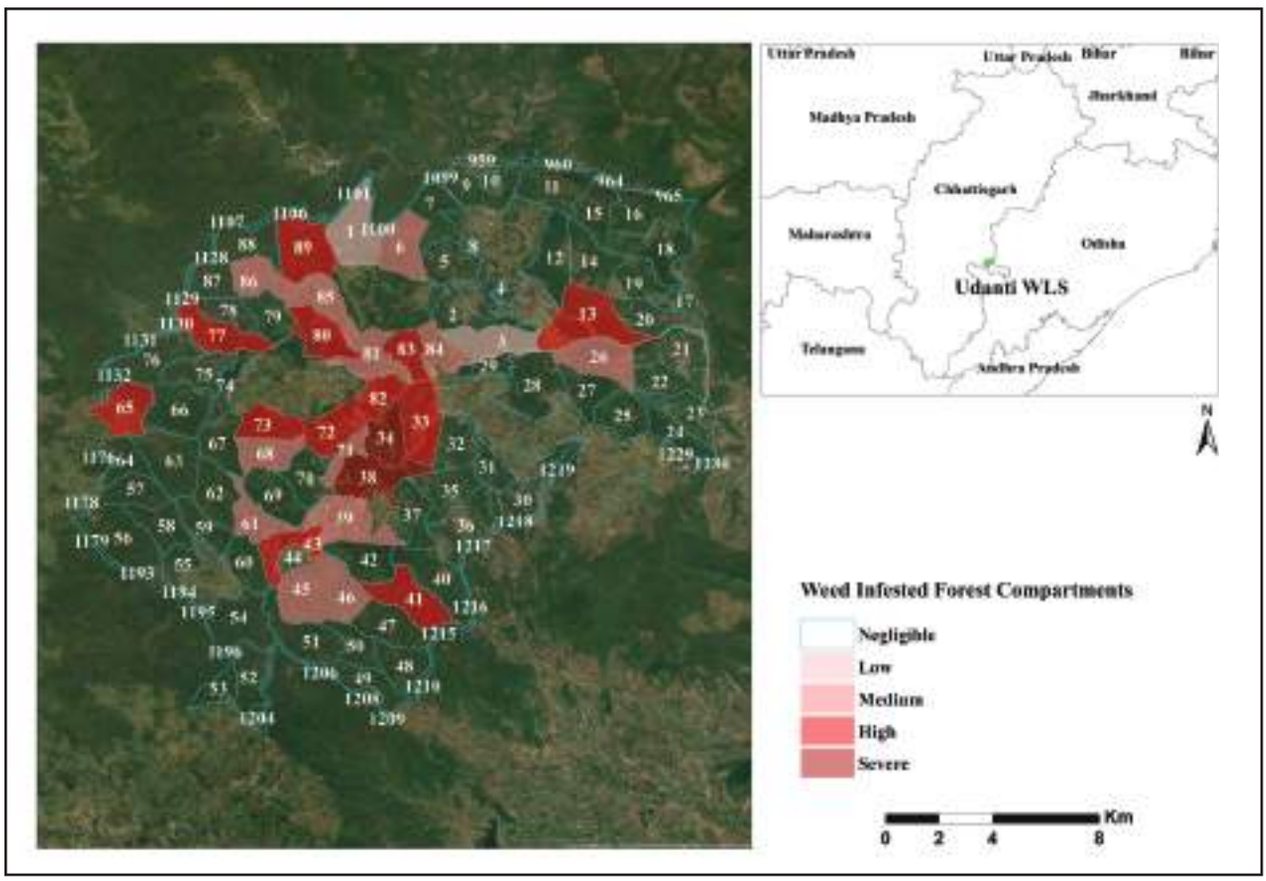


Fig. 6.1. Location of the forest compartments in Udanti WLS affected by weeds

The sanctuary is widely infested with *Phoenix acaulis* and *Chromolaena odorata*. *Lantana camara* was recorded on the banks of Udanti River in Karlajhar, Nagesh and Sahbin forest beats, while *Hyptis suaveolens* was found in Amli, Jangda and Kurrubhata forest beats. *Parthenium* sp. and *Cassia tora* were also found near the human habitations.

Chhattisgarh Forest Department undertook weed clearing operations in the 11 most infested compartments. In order to understand the success of this activity, 44 quadrats were laid in the 11 cleared compartments (4 plots in each compartment). The observed mean of 712.69 ± 77.36 weed plants per hectare were recorded in the sanctuary prior to their clearance. After removal, the density of weeds was reduced to a mean value of 12.45 ± 1.88 weeds per hectare. The success rate of de-weeding was very high, ranging from 97.2-99.3%.

After weed uprooting, evidence of the use of these cleared areas by wild buffaloes and other domestic animals were recorded. (Table 6.2). Most pieces of evidence (75%) of wild buffalo were recorded from forest compartment numbers 86 and 89 (North-west of Udanti WLS). Interestingly, evidence of use by domestic animals was recorded from all compartments.

Over the years, the Chhattisgarh Forest department has cleared weeds from over 2137 hectares of the wild buffalo habitat, as shown in the decadal trend below in Fig 6.2.

Table 6.2: Presence of weeds before and after uprooting them in the wild buffalo bearing habitat in Udanti WLS

Sl. No.	Compartment no.	Avg. number of weed plants/ ha before weeding	Avg. number of weed plants/ha after weeding	Evidences of wild buffalo within the quadrats (%)	Evidences of domestic animal within the quadrats (%)
1	33	818.75	8.5	0	100
2	34	1075	12.375	25	100
3	38	1025	16	25	75
4	72	725	16.125	25	75
5	73	639.58	17.625	25	100
6	77	641.66	8.25	25	50
7	80	555.76	17.375	50	50
8	81	302.77	5.125	50	50
9	82	842.85	23.125	25	100
10	86	366	6.25	75	25
11	89	847.22	6.25	75	25

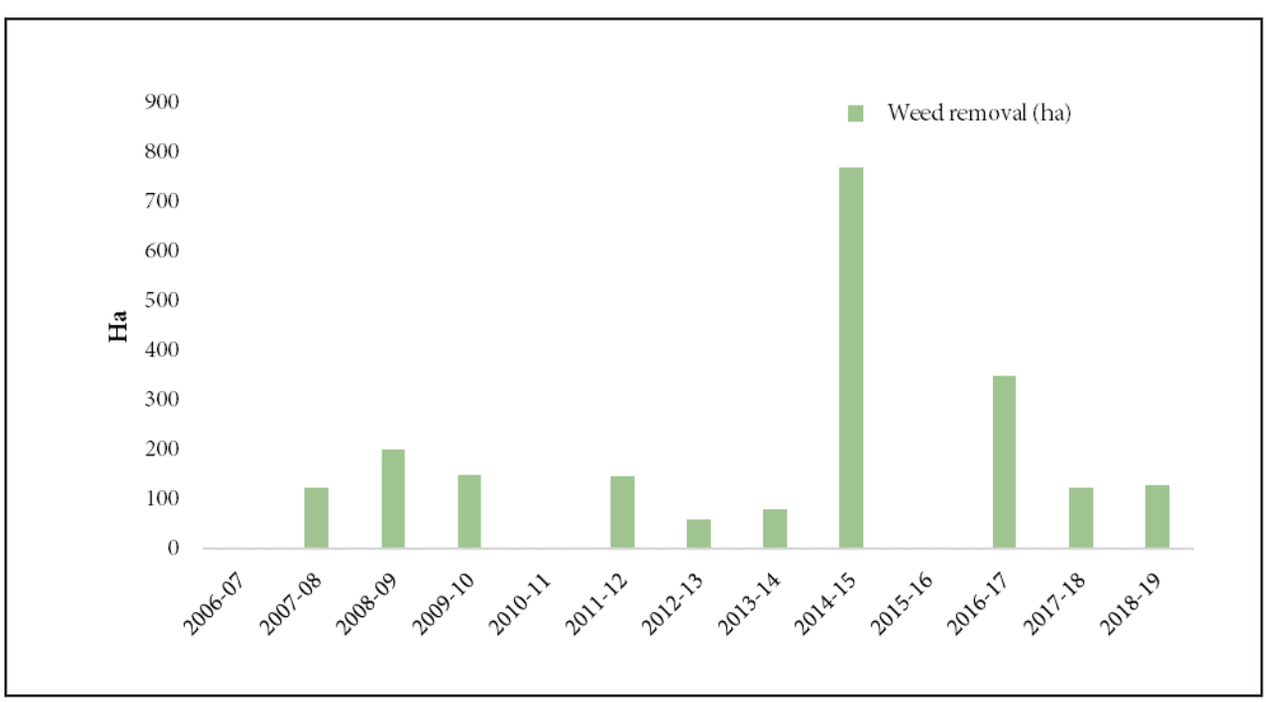


Fig. 6.2. The extent of weed-infested areas subjected to the removal of weeds by the Chhattisgarh Forest Department in Udanti WLS (Source: Chhattisgarh Forest Department).

b. Forest Fire: Forest fires[28] appear to be one of the major decimating factors affecting forests and other habitats in Udanti WLS, and it directly affects the use of habitats by the wild buffalo. The forest fires in Udanti are largely human-induced. A high incidence of forest fires was reported up to the year 2011, after which it was better controlled by the Chhattisgarh Forest Department (Fig 6.3).

In the last two decades, the year of 2008, has been the worst year in terms of forest fires in Udanti WLS. Fires in that year spread over 1211 ha (about 5 %) of the total sanctuary covering 53 forest compartments. The following year was better, with the recorded incidents of fire marginally coming 959 hectares, covering 48 compartments. Since the year 2012, fires have by and large been controlled, with only sporadic events being reported in 2017, 18 and 19 and also spreading over a significantly smaller area than earlier (Fig 6.3). Since the year 2006, fire has affected an extent of 7 hectares in 2012 to 1211 hectares in 2008, affecting 5 to 53 compartments in all these years.

Information collected showed that while several forest beats are prone to forest fire, Jangda, Kurrubhata, Amli, Raxapathera, Udanti, Chauksil, Karlajahar, and Sahbin forest beats were more affected than others.

The most common reason for fires is the practice of setting the ground under the Mahua tree alight to clear the litter for easy collection of fallen Mahua (*Madhuca longifolia*) flowers. Another reason for setting fire is to get a good new flush of "Bidi" leaves (*Diospyros melanoxylon*) which is obtained if the bushy growth is subjected

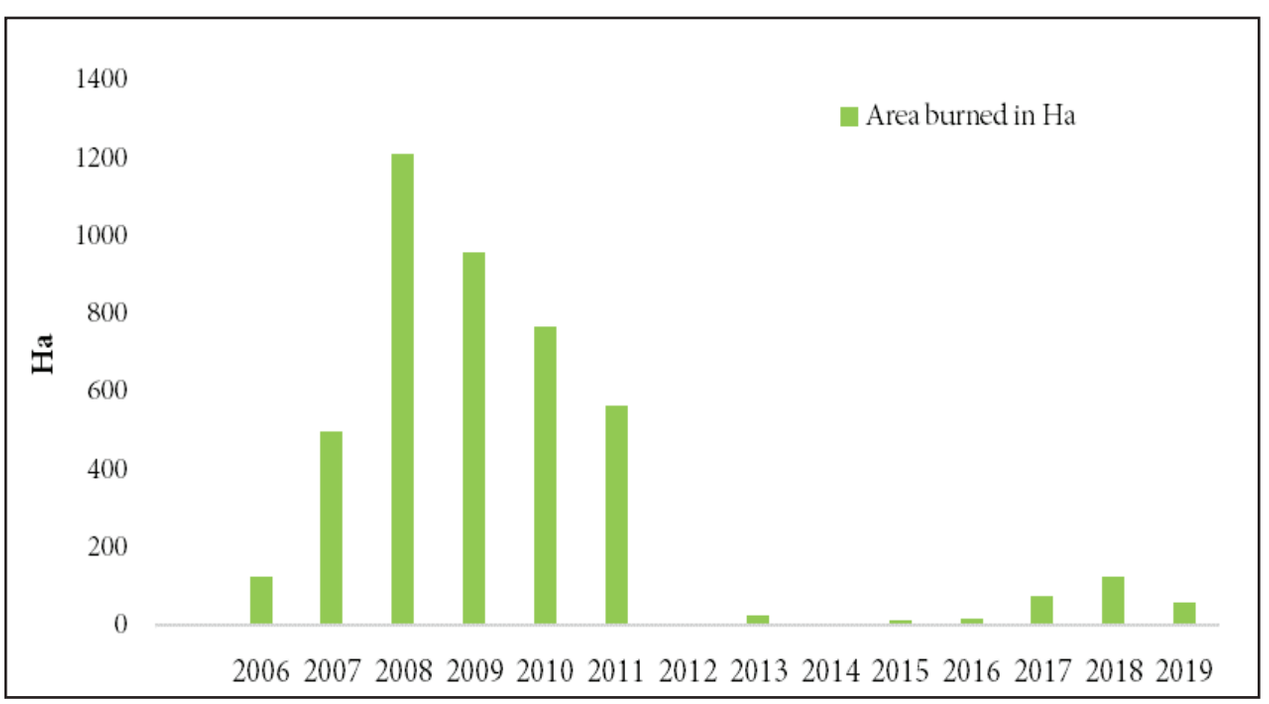


Fig 6.3. Extent of forest area burned due to forest fire from the year of 2006 to 2019 in Udanti WLS

[28]Forest fires are uncontrolled and non-prescribed burning of vegetation. Not to be associated with controlled burning used by forest authorities as an ungulate conservation management. Controlled fire assist in the growth of new grasses, beneficial for species like wild buffalo.

to pruning and fire. As a tradition, locals also set fire to appease gods. For instance, if a sick member of a family gets cured, then the family members light a number of fires in the forest as thanksgiving, and these may spread uncontrolled.

c. **Logging pressures:** Out of 32 forest compartments where all the quadrats were plotted, evidence of illegal logging was recorded from 17 compartments. A mean of 17.28 tree stumps per hectare were recorded from the affected compartments in the sanctuary.

With an aim of reducing forest dependency for fuelwood among locals, a comprehensive socio-economic survey of the forest community at Udanti WLS was conducted in 2007 and later in 2017 (refer Chapter 5). This revealed that the villagers used fuel wood from the sanctuary. The average consumption was estimated at 5431 kgs/household/year. In 2016-2017, a pilot study was initiated to understand how useful 'improvised cook-stoves' in Udanti WLS are. The installation was undertaken by personnel from the Appropriate Rural Technology Institute (ARTI)[29] as part of the WTI project, and the installation was preceded by a survey to assess the consumption patterns of fire-wood, using the regular cook-stoves.

The pre-installation baseline survey for fuel wood utilization was carried out by WTI and ARTI in two villages of Udanti WLS. details of the sample villages surveys are given in Table 6.3.

Table 6.3: Sample size for accessing fuelwood efficiency in the villages of Udanti WLS

Sl.	Name of the Village	Total Households in the village	No. of households surveyed		Kitchen Performance Test (KPT) conducted
			Single Pot	Two Pot	
1	Nagesh	40	07	13	1 (Two pot)
2	Karlajhar	50	09	18	1 (Single Pot)

The survey showed that people were using both the traditional one pot and two pot stoves for cooking inside the house while one pot stoves were being used outside the house for heating water, especially in winter season. The quantity of fuelwood utilized depended on the number of family members in the household. The tree species preferred for fuelwood included Dhawda (*Anogeissus latifolia*), Sal (*Shorea robusta*), Saja (*Terminalia tomentosa*) and teak (*Tectona grandis*).

[29] *Appropriate Rural Technology Institute (ARTI) is an Indian non-governmental organization specializes in developing innovative and environmentally friendly rural technologies, based on modern scientific knowledge*

ARTI also conducted tests on the heat efficiency of traditional cook stove with test parameters confirmed with the Bureau of Indian Standards (BIS) (1991). The test results are given below in Table 6.4.

Therefore, Improved Cook Stove (ICS), which reduce the consumption of fuel wood and is relatively smokeless, was suggested for the area. WTI piloted the installation of Improved Cook Stove (ICS) in two villages - Karlajhar and Nagesh and the post monitoring survey conducted indicated that ICS was a feasible option for the area.

All the beneficiaries of two villages where cook-stoves had been installed were surveyed (48 families from Karlajhar and 34 families from Nagesh Village). The results showed that 69.5% of households (73% of Karlajhar village and 52% of Nagesh village) frequently used ICS, whereas the rest were largely using their traditional stoves. Of the ICS installed, 22% were found damaged or not in working condition. However, the frequency of visits to the forest had reduced by about 30% (161 times in a year to 113 times in a year post-installation).

The consumption of firewood declined by about 35% after the installation of ICS in the households where the stoves were installed (Table 6.5).

Table 6.4: Thermal efficiency of the species used as fuelwood and cook stoves in Udanti WLS

Fuelwood requirement & Efficiency of Traditional Cook Stoves		
Fuelwood species	**Burning Rate**	**Efficiency**
Sal (*Shorea robusta*)	1.2 kg per hour	17.48%
Dhawda (*Anegeissus latifolia*)	1.56 kg per hour	18.5%.

d. Grazing pressures: Livestock grazing is identified as one of the major threats to wild buffalo in Udanti WLS. There were over 5000 livestock in the villages located inside and on the fringes of the sanctuary. There is no system or tradition of stall feeding in these villages and the cattle are left inside the sanctuary for grazing.

Table 6.5: Consumption of firewood in the two targeted villages of Udanti WLS, pre and post-intervention

Sl.	Name of Village	Net quantity of fuel-wood used before ICS installed (Kg) per month/family	Net quantity of fuel-wood used after ICS installed (Kg) per month/family	Percentage reduction
1	Karlajhar	434.0	288.5	33.52
2	Nagesh	257.0	157.0	38.91

Evidence of livestock was widespread and was recorded from 82% of the compartments that were surveyed. Evidences of livestock were also recorded on transects (29) that were monitored in each season. Livestock was sighted on 69% of the transects. Cows and bulls were recorded from 78% of the transects, followed by domestic buffalo 12.3% and goat/sheep 10% (Fig.6.4). The Chhattisgarh Forest Department, through an innovative exchange scheme (in the year 2007-2008), replaced more than 150 domestic buffaloes with cows to reduce competition of wild buffaloes with the buffaloes owned by the people. Now only a handful of domestic buffaloes are present.

It was also recorded that domestic animals often use the water bodies during the day. To avoid competition with these domestic buffaloes, the wild counterparts avoid the water holes at these hours especially, during the summer.

e. Crop depredation: Damage to crop, although not much, is sufficient to have led to retaliatory killing of a female wild buffalo in the year 2006. The results are discussed in the next section, i.e. "Addressing threats of low population".

f. Water scarcity: Water is one of the foremost factors that governs the distribution as well as habitat use of wild buffalo and other wild animals, especially during summers, when

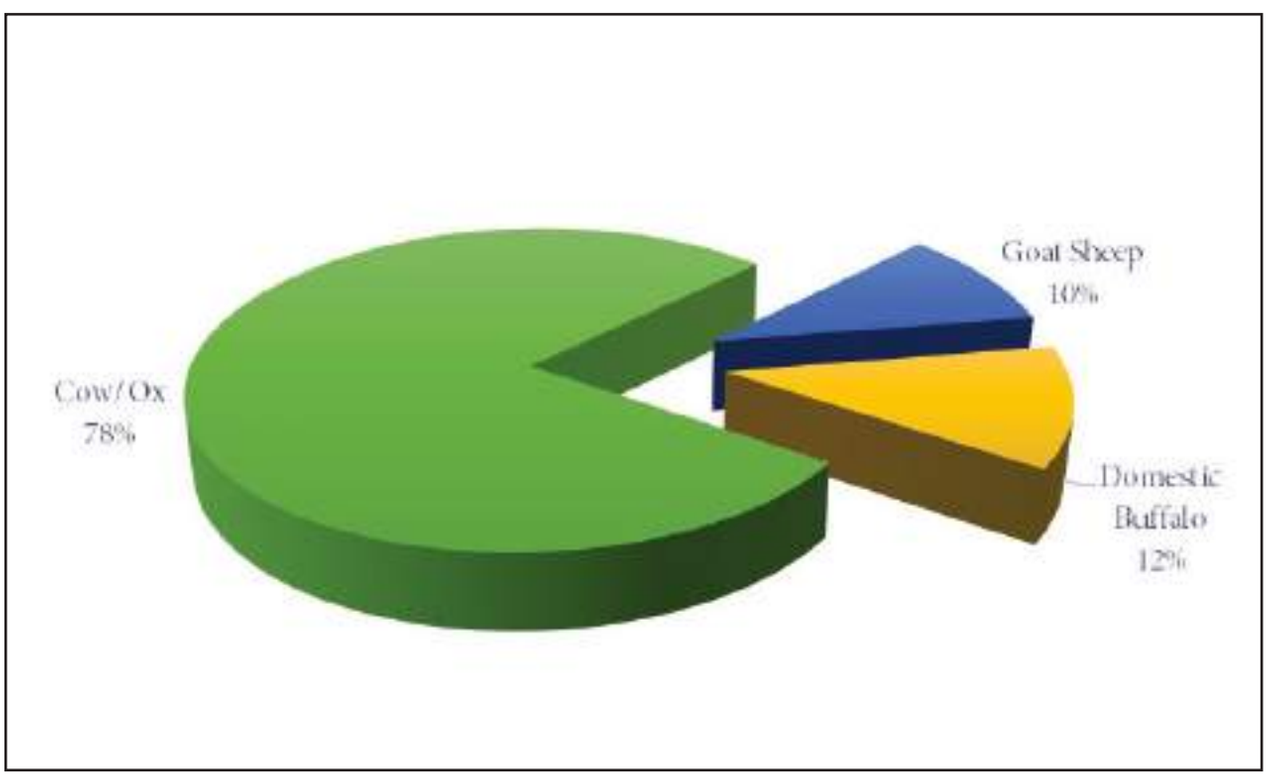


Fig. 6.4. Sighting of domestic animals in transects

it is scarce. Wild buffaloes need water not only for drinking but also for wallowing to regulate body temperature and to protect themselves from ecto-parasites.

When the project was initiated, water availability for wild buffaloes in Udanti Sanctuary was found to be inadequate, especially during summers. The forest department took cognizance of this fact and identified 30 water holes, which were necessary. An additional 16 water hole sites were identified (Table 6.6), restored or constructed to provide water throughout the year, with an aim that there should be at least one water body in every 8 km2 of the sanctuary. However, along the periphery of the sanctuary, it was witnessed that the water holes were infiltrated by domestic livestock, which in turn restricted the usage by wild buffaloes, especially during the day. Excessive usage of these 'shared' water holes additionally posed an increased threat of transmission of infectious diseases from livestock to the wild, which could potentially wipe out the already small population size of the wild buffalo in Udanti. To counter this, efforts were made by the department to cordon off these water holes and free them of these pressures. Apart from the water holes, the wild buffaloes were reported to also use perennial rivers, i.e. Udanti; Indravan and streams (nullahs) like Dasin, Patabahal and Loharin (which had smaller pockets filled with water till April) (Fig 6.5).

Discussions

Most of the PAs of Chhattisgarh are facing problems of weed invasion. Among them, *Phoenix acaulis* and *Chromolaena odorata* seems to be the most widespread species. Since the prime wild buffalo habitat is being infested with *Phoenix* and other species of weeds, the authorities at Udanti WLS have undertaken a massive exercise to clear weeds from crucial

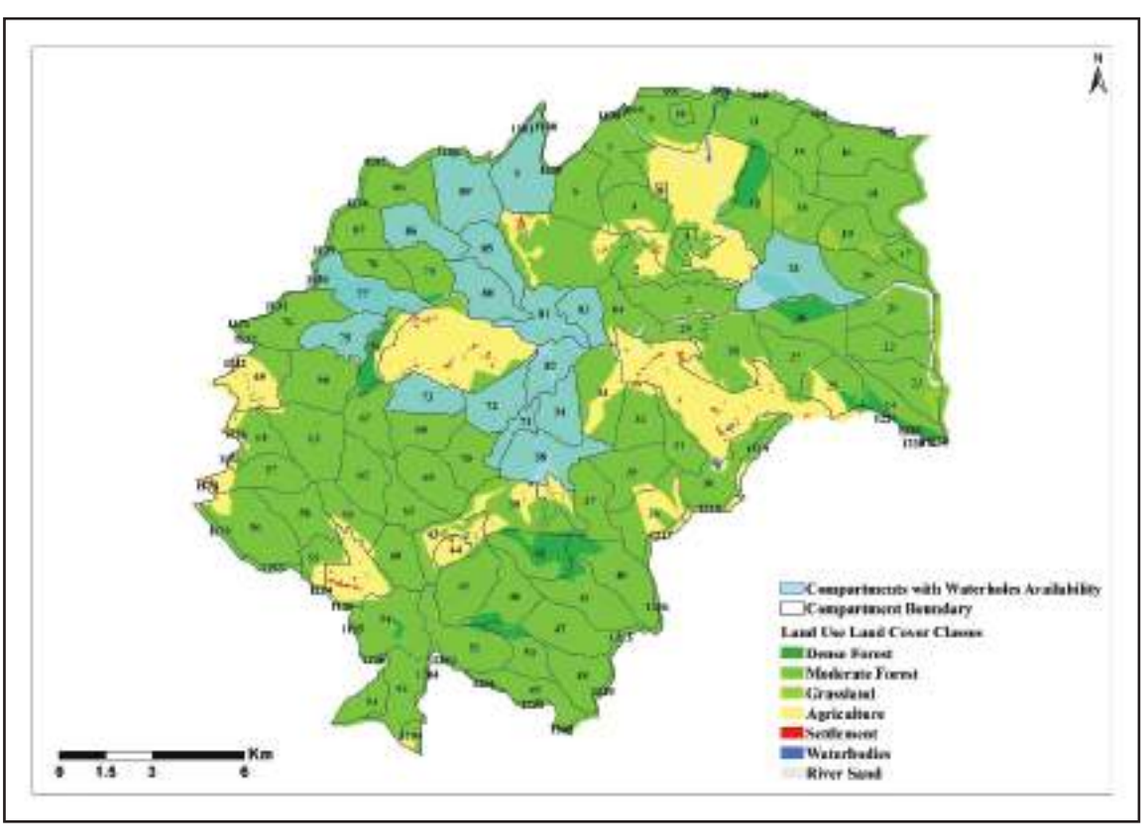


Fig. 6.5: Location of the forest compartments in Udanti WLS with water holes

Table 6.6: Use of water holes by Wild buffalo in Udanti WLS

Sl. No	Types of water holes	Water availability	Compartment no.
1	Artificial pond	Up to April, Now perennial	01
2	Artificial pond	Perennial	R. land Jugad
3	Artificial pond	Perennial	75
4	Artificial pond	Perennial	77
5	Artificial pond	Perennial	72
6	Artificial pond	Perennial	73
7	Artificial pond	Perennial	34
8	Artificial pond	Perennial	38
9	Artificial pond	Perennial	82
10	Artificial pond	Perennial	83
11	Artificial pond	Perennial after deepening	89
12	Artificial pond	Up to Feb.	86
13	Artificial pond	Perennial	85
14	Artificial pond	Up to May Now perennial	80
15	Artificial pond	Perennial	81
16	Artificial pond	Perennial	71
17	Udanti river	Perennial in places	Many compartments
18	Indravan river	Perennial in places	Jangda, 13

compartments. To date, over 2000 hectares of habitats have been cleared, and the benefits of this are there to see with the areas showing an increase in their use of wild animals. However, the weeding should be done on a regular basis and more area should be covered to improve the habitat quality for wild buffalo and other species of wildlife.

Human-induced forest fire is common in most of the PAs of Chhattisgarh and is associated with the collection of Mahua flower, Tendu leaves, and other economic reasons and social beliefs, as explained earlier. In doing so, large chunks of the forest are burnt every year. Though the impact of the forest fire was not studied, its adverse impacts have been well studied and known (Cooper *et al.*, 1960; Converse *et al.*, 2006; Collins *et al.*, 2007) and can benefit some species or be disastrous for others. Fire-charged weed species like Phoenix benefit from perpetual fires, and therefore, to stop it spread, fires need to be controlled in the sanctuary. The frontline forest staff need to be alert to fires and have to be supported by remote sensed fire detection systems. Community-based groups may be used to fight fires in the fire season, and it could generate goodwill amongst the local communities by engaging them for a wage. It has been shown in some parts of Maharashtra that it is possible to harvest Mahua better without having to set the forest floor alight and such techniques should be made available to the people, which will help reduce instances of fire linked to the harvesting of Mahua flowers (*Madhuca longifolia*).

According to the post-implementation survey, almost 67% of respondents thought that the ICS was beneficial over the traditional cook-stove, in terms of lower fuel consumption, faster cooking and healthier environs. In addition to reduced fuelwood requirement, the beneficiaries saved time from having to go to collect firewood on lesser occasions and used the time elsewhere (agriculture or household work). The local women also expressed that being smokeless, they felt a lot more comfortable cooking food on the modified stoves. But as is apparent from the post-installation survey in 2019, there is still some resistance to its use, and spreading awareness about the benefits of its use may help in more people opting for it.

Grazing by cattle, especially, domestic buffalo not only displaces wild buffalo, but also threatens the spread of communicable diseases. During day hours, most of the low lying grassland habitat and water bodies are occupied by domestic buffalo, the wild buffalo withdrawing into the deeper forest and higher ground. There was thus an urgent need to check such grazing inside the sanctuary. The forest department initiated a unique scheme to replace domestic buffaloes with cows in some peripheral villages. As a result, more than 150 domestic buffaloes were replaced. Such initiatives have the potential to bring in long term dividends in the form of reduced competition for wild buffalo.

The unavailability of water not only acts as a limiting factor for the population growth but also affects the distribution of wildlife across the habitat (Dunbar, 1923). Wild buffalo, being a grassland dependent species, prefer moister habitats for feeding and wallowing (Choudhury 2010). However, in the absence of such wet habitats available in the northeast, it has been observed that the wild buffalo in Chhattisgarh are used to drier water regimes. The wild buffaloes, therefore, use the natural and artificial ponds and tanks spread across the sanctuary. However, the water holes and artificial water tanks, especially on the periphery of the sanctuary, are largely occupied by domestic buffalo during the daytime. It is only when the domestic buffaloes abandon these tanks at dusk do the wild buffaloes use them through the

night. Taking the paucity and the water scarcity in Udanti WLS into account, the Chhattisgarh Forest Department has undertaken several activities in consultation with WTI. Initiatives have been taken for the deepening of existing ponds and construction of new ones within the home ranges of the wild buffaloes. The Forest Department has also installed solar pumps in tube wells in compartment numbers 85 and 89 for ensuring water supply to the water holes throughout the year. The ponds located in compartment number 38, 80, 81, 82, 85, 86 and 89 are very important as they are exclusively used by wild buffaloes in all seasons.

Habitats such as in Udanti WLS, where 17 villages are lodged inside or on its periphery, will always be under human pressure. Patrolling can stop people from going inside the boundary of the sanctuary, but with people living inside, such controls become difficult to exercise. In such situations, it becomes imperative that the local communities who impinge on the resources in the forests are sensitized appropriately on the finite nature of the resources and the harmful impacts of over-extraction. At the same time, the communities should be made partners in the conservation efforts, clearly providing them with the objectives of the exercise and the desired outcomes with clear indications of their roles and responsibilities. For instance, if the benefits of smokeless cook stoves are communicated to the communities and their voluntary discontinuation of the use of traditional stoves (*chulhas*) is seen as their commitment to conservation with due credit, conservation may become more sustainable. Very often, it has been seen that the sense of participation by local people and their voluntary contribution to the cause of conservation is seen as a bigger reward than cash. Therefore, information sharing is the key which if the forest department is deficient, then NGOs may be able to bridge this gap.

6.2. Addressing threats of low population

In addition to habitat loss, animal populations are impacted directly by hunting as it causes their removal from an area. Humans have caused the extinction of several species of animals directly by hunting and also several indirectly (Holdaway *et al.*, 2000; Roberts, 2013 and Winters *et al.*, 2017). Extinctions were largely caused by demands for meat and also due to the clearance of habitats for settlements and plantations. Hunting for trade is another dimension that is causing a huge damage to populations of several species worldwide. Hunting for trade, valued globally between USD 8 billion to USD 21 billion (Scheffers *et al.*, 2019), is regarded as a global threat to biodiversity. Species are hunted globally to feed largely the oriental traditional medicine market that ensures sufficient demand and remuneration despite the risks. In India, several species are targeted for animal trade, and these include most species of large cats, bears, pangolins, musk deer, tortoises and others. Unorganised hunting also occurs locally, and this form is largely for subsistence although there is evidence to suggest that this wild meat may also be supplied to urban centres for sale (Kaul *et al*; 2004, Hilaluddin *et al.*, 2005). Therefore, the protection machinery of the forest department must be enabled to deal with reducing or stopping altogether such illegal acts.

Udanti WLS, the home to wild buffalo, is also a tiger reserve (Udanti-Sitanadi TR)[30] albeit with a low tiger population[31]. However, the area has a tradition of local subsistence hunting in the

[30] *The notification of Udanti Sitanadi Tiger Reserve of Chhattisgarh Government Raipur came into existence letter No./F-8-43/2007/10-2 dated 20/02/2009.*

[31] *Only 1 tiger is reported from USTR (within the reserve, i.e. 1842 km^2) and 3 tigers in Udanti-Sitanadi-Sunabeda complex (764 km^2), State of Tigers Co-predators and Prey in India, 2018, NTCA*

form of community hunting called "*Parad*". Much of this type of hunting is now under control, but sporadic hunting events do persist, which threatens largely, the ungulates including the buffalo. Another source of threat to wild buffalo in Udanti is the retaliatory killing by farmers to crop-raiding.

The animals, therefore, need to be guarded against such attempts. Five actions were taken in Udanti WLS in a bid to secure largely the wild buffalo in the sanctuary. These are a) constant monitoring of the wild buffalo population and reducing the threat from local hunters; b) resolution of crop depredation conflict; c) raise a trained and equipped frontline forest staff to patrol more meaningfully; d) veterinary interventions and, e) augmenting population through conservation breeding.

a. Monitoring

Hunting of wildlife inside and around Udanti Wildlife Sanctuary used to be rampant prior to it being taken over by the forest department and then later upgraded to the status of a wildlife sanctuary. This hunting was largely carried out by the hunting tribes, which forms a significant population of the people living around the sanctuary. These are Kamars, the Bhunjia etc., who continued this practice of hunting even after the notification of the sanctuary. It was a part of the strategy to engage these hunting tribes to monitor and secure the wild buffaloes by constituting community-based monitoring squads. The idea behind the activity was to seek the help of a community that might have otherwise been the biggest reason for the decline in wild buffalo numbers.

Monitoring of wildlife provides crucial information about the animal and its responses to management interventions being undertaken, and this, in turn, helps in course corrections, if required. Monitoring is thus an intrinsic component in the bid to recover the wild buffalo in the Central India landscape, not only to understand the animals' movement to newer habitats but also to provide veterinary assistance and prevent imminent conflicts.

Field-based monitoring involving local trackers was found to be more convenient, cost-effective and non-invasive than remote monitoring, which requires animal handling

Fig 6.6. Tracks and pugmarks of animal (a) wild buffalo (b) common leopard (c) sloth bear documented by trackers, while monitoring forests of Udanti WLS

and capture. This method was found to be suitable to monitor small populations since it additionally provided information about the health of the animal as well (body status, movements etc.). A pool of 15 local tribesmen was formed and trained as core 'wild buffalo watchers'. The team of trackers used indigenous knowledge and skills of animal tracking, natural distinguishing features (body size, stature, horns and hoofmarks) and secondary knowledge about their ranging areas to distinguish and positively identify the individual buffalo (Fig. 6.6 and 6.7). The monitoring was done mostly on-foot and occasionally on motorbikes or bicycles. The entire reserve and buffalo ranging areas are equally accessible through a network of roads, access paths and clearings.

In the effort, individual buffaloes were tracked at least twice a month. Each location, as a point file, was rendered in ArcGIS 10.5 with other information, such as individual's name and the date of recording, into the attribute table. This yielded a dataset of about 89 points per year (range: 35-156) in 763 days of monitoring (Table 6.7). Details of the analysis and the inferences of both the monitoring programmes was presented earlier in Chapter 3.

Fig 6.7. Trackers collecting the presence data of wild buffaloes in Udanti WLS

b. Resolution for Crop depredation

As mentioned earlier, the wild buffalo in Udanti WLS preferred agriculture fields (see Chapter 3) inflicting crop damage, which ranged from a low loss of around 50 kgs of crop in the year 2017-18 to a high of over 5600 kgs of crop biomass in the year 2013-14 (Fig 6.8). Among the villages most affected by crop raiding in the last 15

Table 6.7: Wild buffaloes, free ranging in Udanti – Sitanadi TR

ID	Names	No of data points gathered	Years monitored	Current status
$Buffalo_1$	Chhotu	74 points	2006- 2008	In captivity
$Buffalo_2$	Jugadu	228 points	2006-2019	Died
$Buffalo_3$	Kalia	135 points	2006-2012	Died
$Buffalo_4$	Prince	58 points	2014-2019	Currently free-ranging
$Buffalo_5$	Raja	89 points	2012-2019	Currently free-ranging
$Buffalo_6$	Ramu	55 points	2006-2010	Died
$Buffalo_7$	Shyamu	246 points	2006-2018	Died

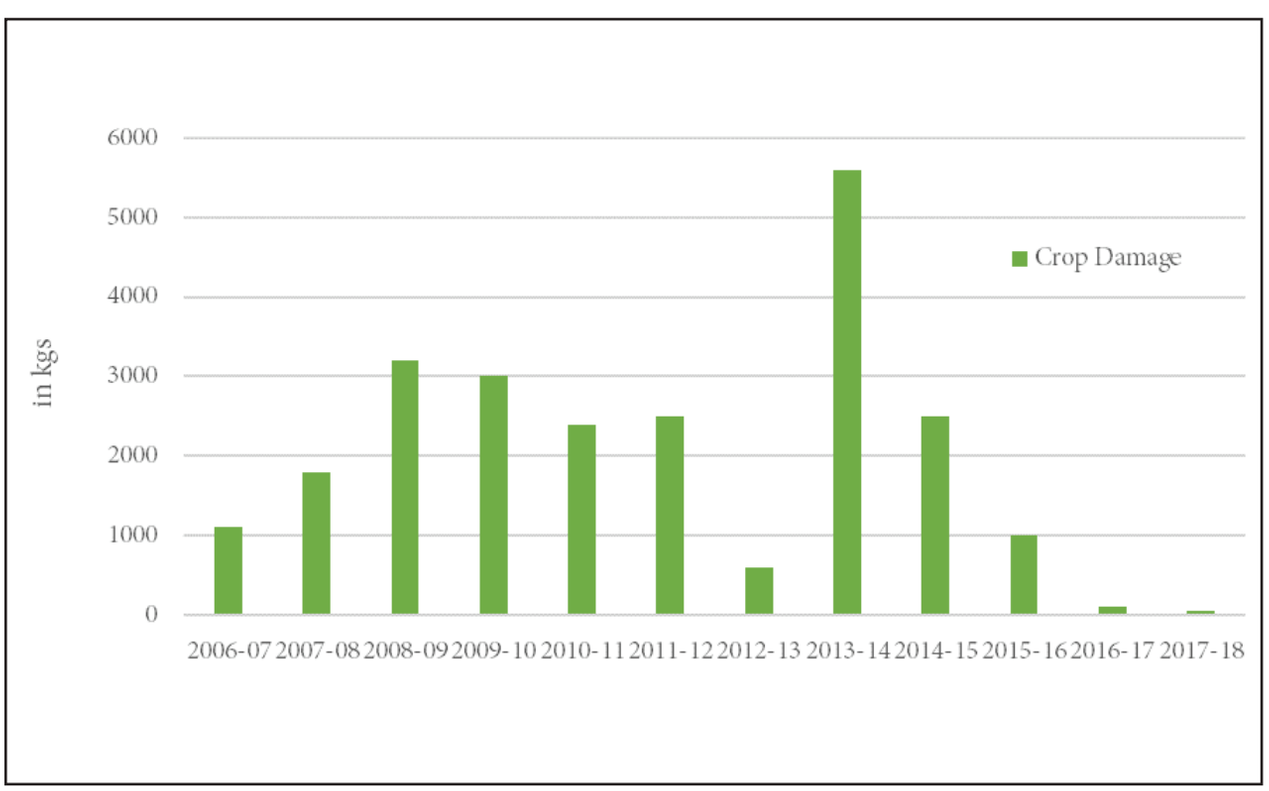


Fig 6.8: Details of crops damaged (in kg) due depredation by the Wild buffaloes

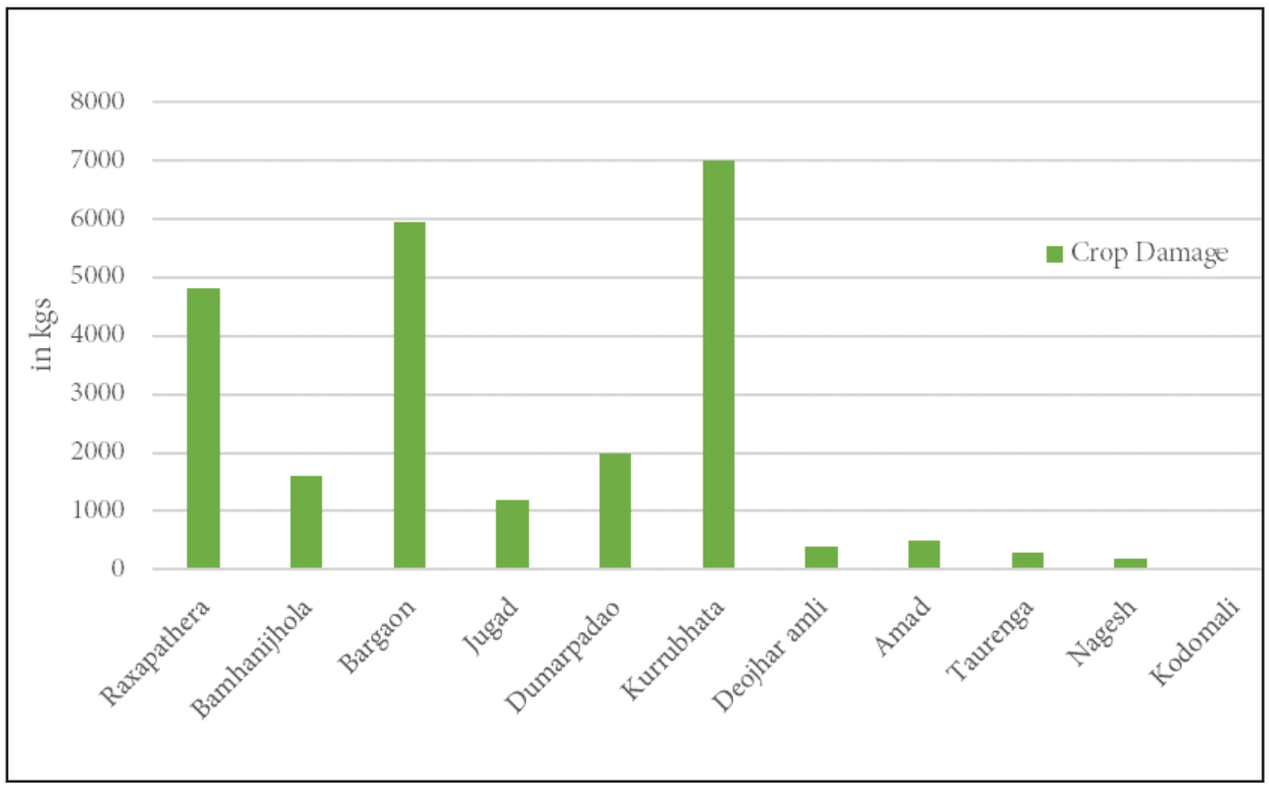


Fig 6.9. Crop damaged (in kg) by the wild buffalo in different villages of Udanti WLS

years, Kurubhata saw the maximum damage followed by Bargaon and Raxapathera. The farmers of Bargaon were the most affected (115) followed by Raxapathera (78) and then Kurrubhata (61) shown in Fig 6.9. In Udanti WLS, though the degree of crop damage by wild buffalo was less compared to other parts of the country[32], incidents of retaliation causing injuries and even death to wild buffalo occurred. Considering the low population status of wild buffalo, it was suggested that ex-gratia be provided to the owner of the crop in lieu of crop damage. The matter was discussed at the first Governing Council Meeting of the wild buffalo project, following which the Chhattisgarh Forest Department initiated the scheme to provide this ex-gratia support for loss of crop to wild buffalo every year. Between the year this scheme was instituted and now, over 300 farmers have been provided relief as per the assessed damage. This has reduced significantly any attempts to retaliate over a crop attack by the wild buffalo.

c. Training and equipping frontline forest staff

Wildlife (Protection) Act, 1972 is a powerful legislation for the protection of wildlife in India. However, direct and indirect threats, such as wildlife poaching and habitat destruction, continue all across the country including the PAs (Menon and Kumar, 1999). The onus of enforcement of the provisions of the act lies on the union and state governments, and the frontline staff of the state forest department is empowered to register a case, conduct search and seizures, make arrests, investigate the case and file complaints in the court of law. However, lack

[32] *As the population is comparatively low as compared to other wild buffalo ranging states*

of skills is one of the key reasons why the legal provisions are not enforced strongly for abatement of wildlife crime.

The situation is not much different in Udanti WLS, where poaching was one of the reasons for the decline in the wild buffalo population. Conservation measures implemented in Udanti WLS resulted in some improvement in habitat quality and wildlife abundance, which sadly increases the probability of incidents of wildlife crime in the absence of adequate anti-poaching mechanisms. Incidentally, Udanti had a history of retaliatory hunting of wild buffalo by locals. Hence, as a preventive measure, WTI implemented capacity building and morale boosting measures to increase the operational efficiency of the frontline staff serving in the area, thus curbing the threats of hunting and forest degradation. Training of frontline forest staff and equipping them with proper field gears for protection duty has been one of the recommendations given by governmental committees appointed to look into wildlife protection issues (Narain *et al.*, 2005; CAG Report, 2006; Kirpal *et al.*, 2006 as mentioned in Menon *et. al*., 2008).

Two capacity building training programs in the year 2013-14 and 2015-16 were organized for the frontline staff of Udanti WLS by WTI's Van Rakshak Programme (Guardians of the Wild)[33] through a multi-pronged strategy. The four focus areas of training were Training, Equipping, Awareness and Morale boosting (TEAM) of frontline staff of the protected area network in the country. The elements for enhancing field skills include a clear assessment of the training needs, competent instruction, using effective training materials, and the selection and motivation of participants. Topics covered in the training focus on the different aspects of threats, including wildlife consumption, preventing wildlife trade, collaborative planning and tactical response – all delivered from a practical and localized perspective. Related subjects were grouped into sessions, with each being taught by a professional with noted expertise in the area.

The goal of the training was to increase the operational efficiency of the frontline forest staff serving in USTR, Chhattisgarh, with the following broad objectives:

- Create a strong, motivated and well-equipped frontline field staff
- Boost field staff morale for effective anti-poaching operations
- Curb poaching and tree felling

Methodology

A need assessment for the training was first made to identify the shortcomings in the existing training program if any, and develop a customized module for the training of frontline staff (ranked Range Officer and below) of Udanti WLS and Sitanadi WLS – together constituting USTR. The training programmes were organized on 16-25th August, 2013 and 10-12th August, 2016. The team of trainers included biologists, lawyers, enforcement experts and activity coordinators. After the training, feedback of participants was also sought in a structured manner to help the team

[33] *Guardians of Wild or the Van Rakshak Project was initiated by WTI in 2001 with the goal of assisting the government in creating a strong, well-equipped and motivated force of frontline field staff, to curb poaching and habitat degradation across the Protected Area network.*

members in improving their training skills in future.

a. Training module

Two modules – **MODULE A** and **MODULE B** (Annexure II (i and ii)) were developed for the training in Udanti and Sitanadi Wildlife Sanctuary. Module A comprised of a three-day training, while Module B was of two days' duration. Following broad topics were covered in the modules:

- An overview of wildlife crime trends in India and globally
- The Wildlife (Protection) Act, 1972 of India and its various sections
- Anti-poaching techniques
- Crime Scene Investigation
- Intelligence gathering
- Procedures for the collection and preservation of evidences
- Interrogation techniques
- Preparation of Preliminary Offence Report (POR).

During the training, audio and visual aids were used along with a field demonstration. In the demonstrations, mock crime scenes were constructed, and teams were formed for conducting the investigation. The mistakes committed by the investigation teams were pointed out, and they were briefed about procedures of collecting and preserving evidences, including sealing and collection of materials/evidences for forensic examination. Afterwards, the trainees were asked to write a POR and Panchnama for the crime they had investigated. The lacunae in the POR were discussed with them by a professional lawyer, and they were taught how to correlate sections with the various evidences collected from the crime scene.

The participants were also trained in the identification of signs of important wild animals present in the area.

b. Course Material

Course material exclusively developed by the Bharati Vidyapeeth Institute of Environment Education and Research (BVIEER), Pune were provided to each trainee.

c. Pre and Post-training evaluation

Before the start of the training, a questionnaire was given to the participants to evaluate their knowledge about the area, the Wildlife (Protection) Act, 1972 (WPA,1972) and the management problems that the frontline staff often face. A post-training evaluation was again conducted to evaluate the gain/ increment in their knowledge levels. The questionnaire was divided into four sections - a) Schedules of WPA, 1972, b) Different sections of WPA, 1972, c) Patrolling and crime prevention and d) General ecology. The changes in the levels of knowledge of frontline staff were evaluated according to the above-mentioned sections.

d. Patrolling kit distribution

Based on a detailed field need assessment, the team shortlisted a range of field equipment that

would help the frontline forest staff monitor and patrol the forest efficiently, which will, in turn, increase the protection status of the PA.

Results

e. Staff Profile

WTI maintains a Protected Area Staff Status (PASS) database[34] of staff of protected areas in the country. The database was used to analyse the age structure and educational qualification of staff (n=50) posted in Udanti WLS. Most (over 50%) of the staff members were old (i.e. over 45 years of age), 35% were between 30 and 45 years, and only 15% are between 25-30 years (Fig 6.10).

As far as the educational status of the staff in USTR was concerned, more than 46% of staff possessed an educational qualification up to secondary or middle school standard. Only 14.6% of staff were graduates while 30.8% of staff had studied up to Higher Secondary level and around 8.5% of staff were illiterate (Fig 6.11).

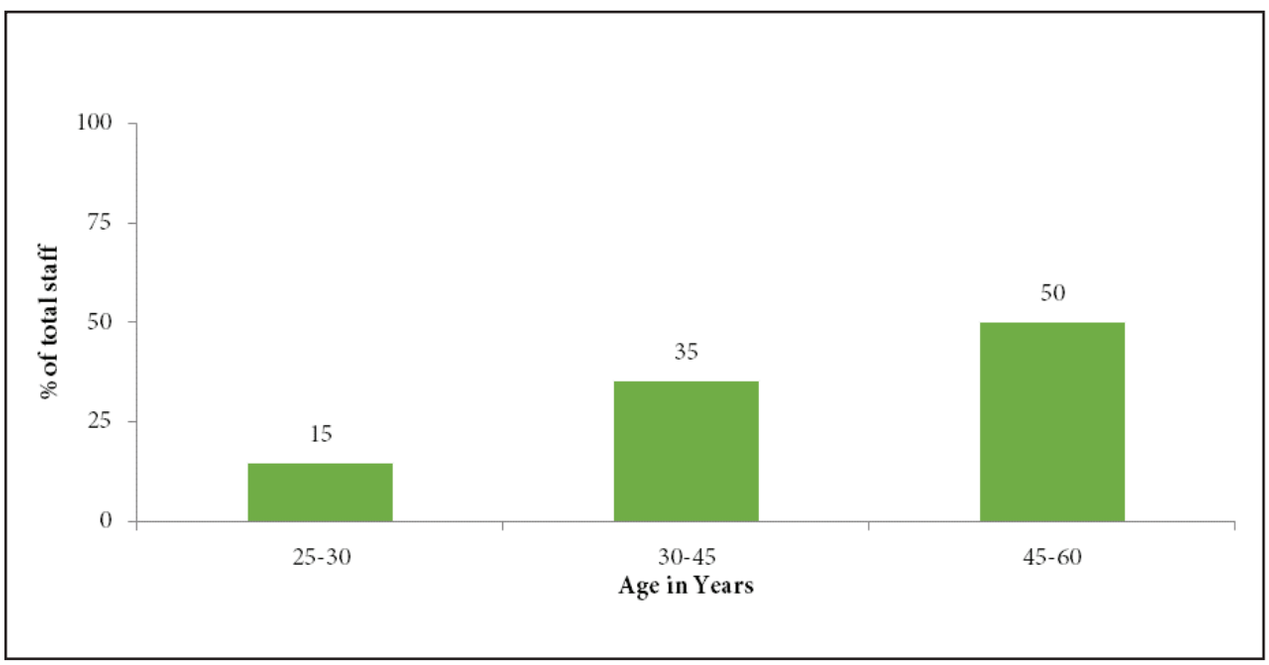


Fig. 6.10: Age-structure of frontline staff in Udanti WLS and Sitanadi WLS

A. Training (Year 2013-2014)

The **MODULE-A** of Wildlife Crime Prevention Training was followed in the program organized in three batches from August 16-25, 2013.

I. Training Participants

The training was imparted in Udanti WLS and Sitanadi WLS, where

[34] *WTI maintains a countrywide Protected Area Staff Status (PASS) database and runs an accident ex-gratia scheme for the frontline staff to benefit their families in case of accidents while on duty.*

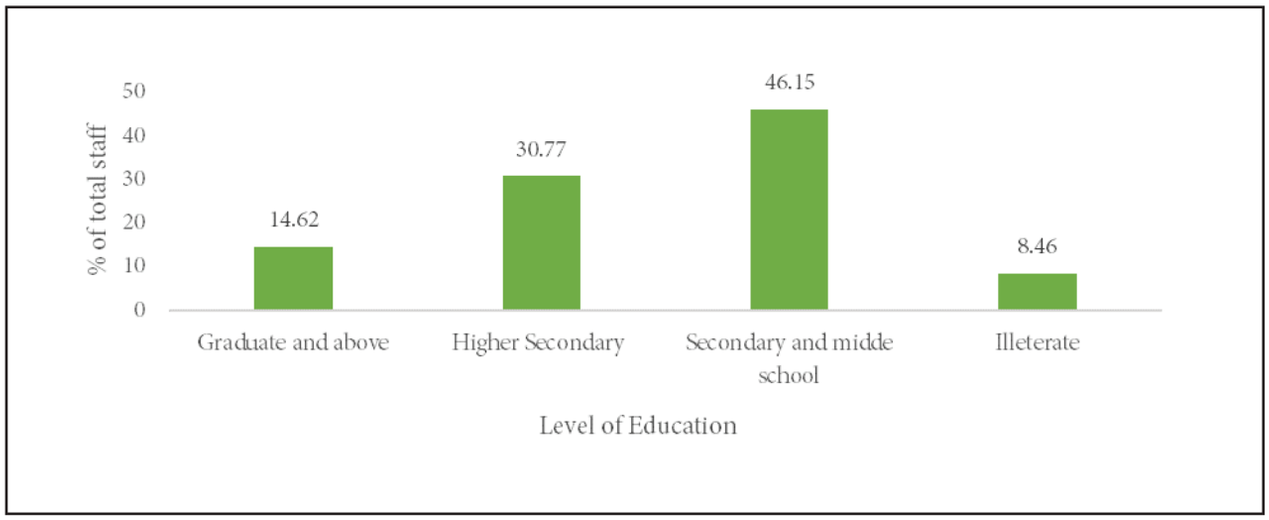


Fig. 6.11. Education level of frontline staff posted in Udanti WLS and Sitanadi WLS

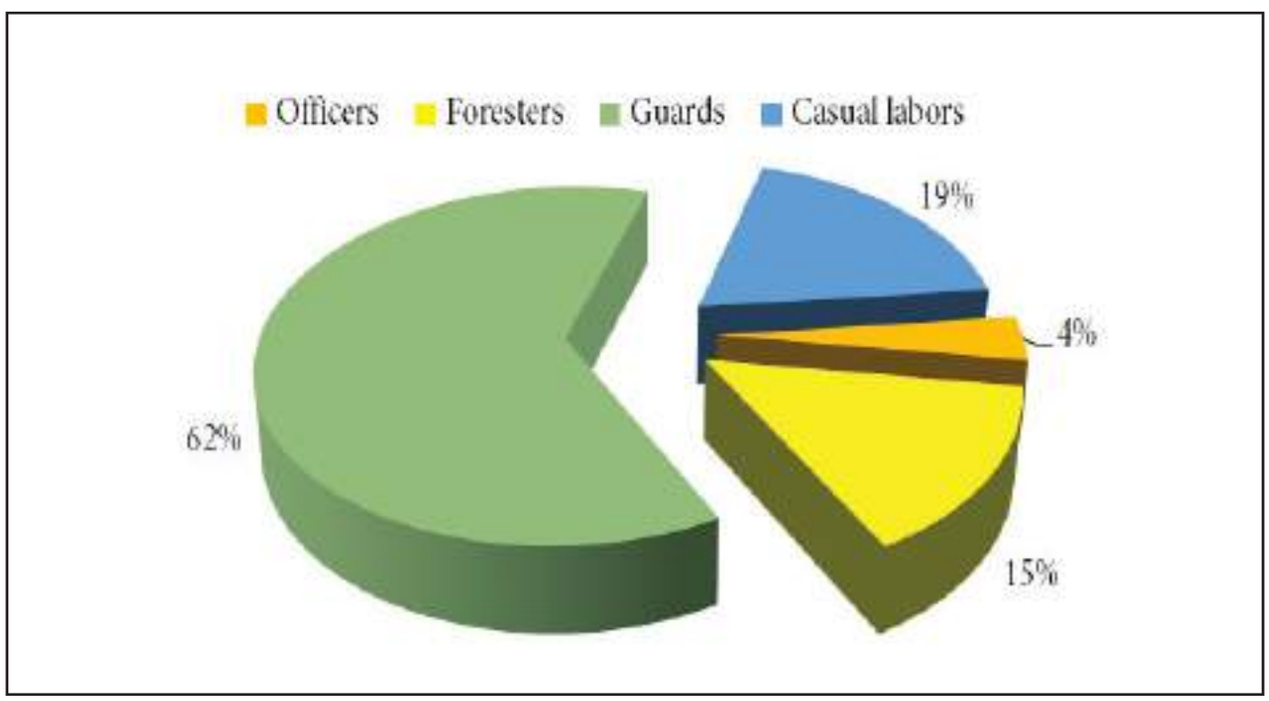


Fig 6.12: Rank-wise number of training participants in Udanti WLS and Sitandi WLS

altogether 127 staff participated (Range Officers and Assistant Conservator of Forests-5, Foresters - 19, Forest Guards-79 and Casual Labours - 24 (Fig. 6.12). The list of names and designation of the participants attending the training program is listed in Annexure III(i).

II. *Key threats and management issues in the Udanti-Sitanadi WLS*

Key threats operational in the project area, according to the training participants in 2013, were enlisted before the training through questionnaire-based survey. Villages located both on the fringe as well as inside the sanctuary were identified as major threats[35] to the park. Illicit felling of trees, poaching, encroachment, fire, the boundary of the PA and mining

[35] *The forest officials perceived that villages inside the PA as an impediment to conservation*

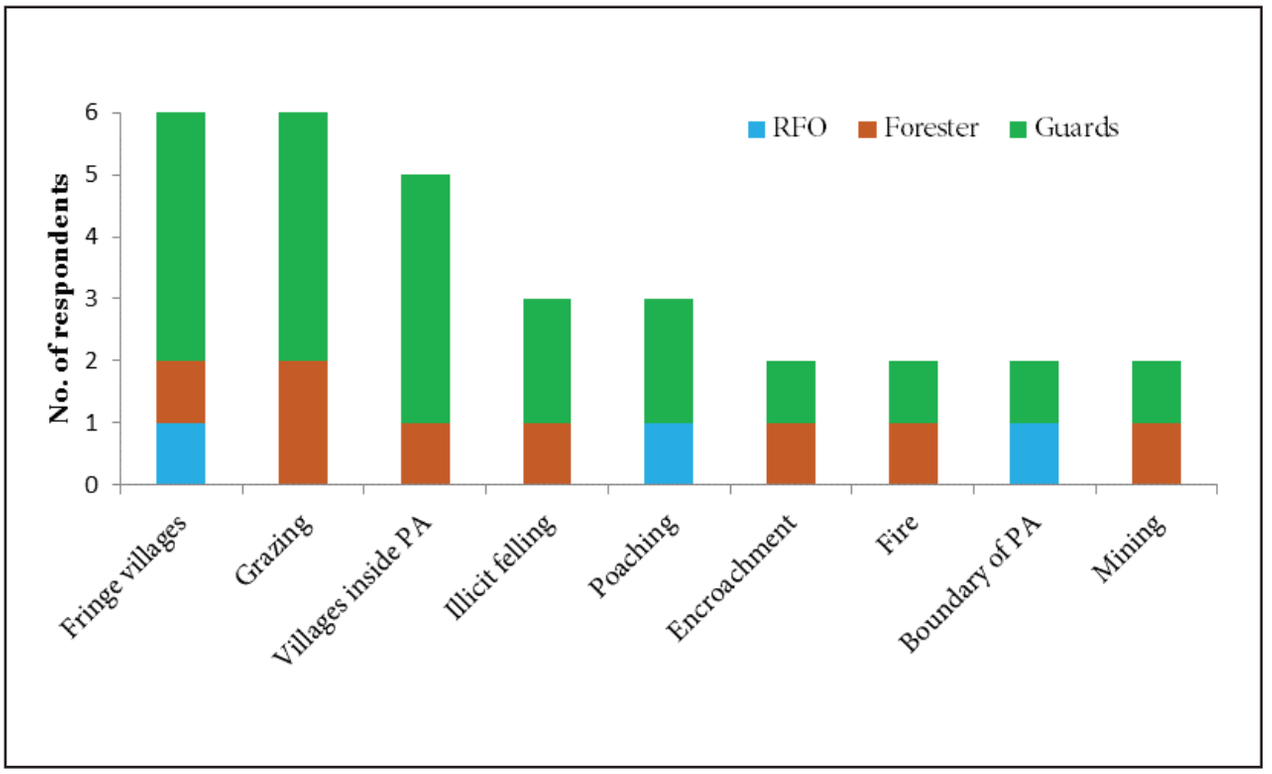


Fig 6.13: Different threats in Udanti WLS perceived by the forest department staff

(artisanal and small scale) are the other threats that were reported; all are anthropogenic in nature (Fig 6.13).

Trainees cited lack of vehicles for patrolling, untrained staff and lack of weapons as key issues that create impediments in the management and protection of the protected area. Lack of medical facilities, poor communication network and inadequate staff were other management and protection issues (Fig.6.14).

Livestock grazing, uncontrolled fire and illicit felling of trees were the three major threats faced by the Sitanadi sanctuary management. Location of 34 villages on the fringes of the sanctuary, poaching and encroachment, left-wing extremist (Naxal) activities and roads/ highways passing through the sanctuary were also perceived as threats to the sanctuary (Fig 6.15). Threats of submergence of more PA land due to a dam on the Sondhur River was also flagged by the participants as a key threat to the PA, besides the potential transmission of infectious diseases from livestock to wild animals and infestation of *Lantana camara* and *Chromolaena odorata* in the forest area.

The staff of Sitanadi WLS felt that lack of vehicles, inadequate staff and poor road network were the key issues in Sitanadi. Water scarcity, poor awareness among locals, poor communication network, political interference, increased traffic through the sanctuary and

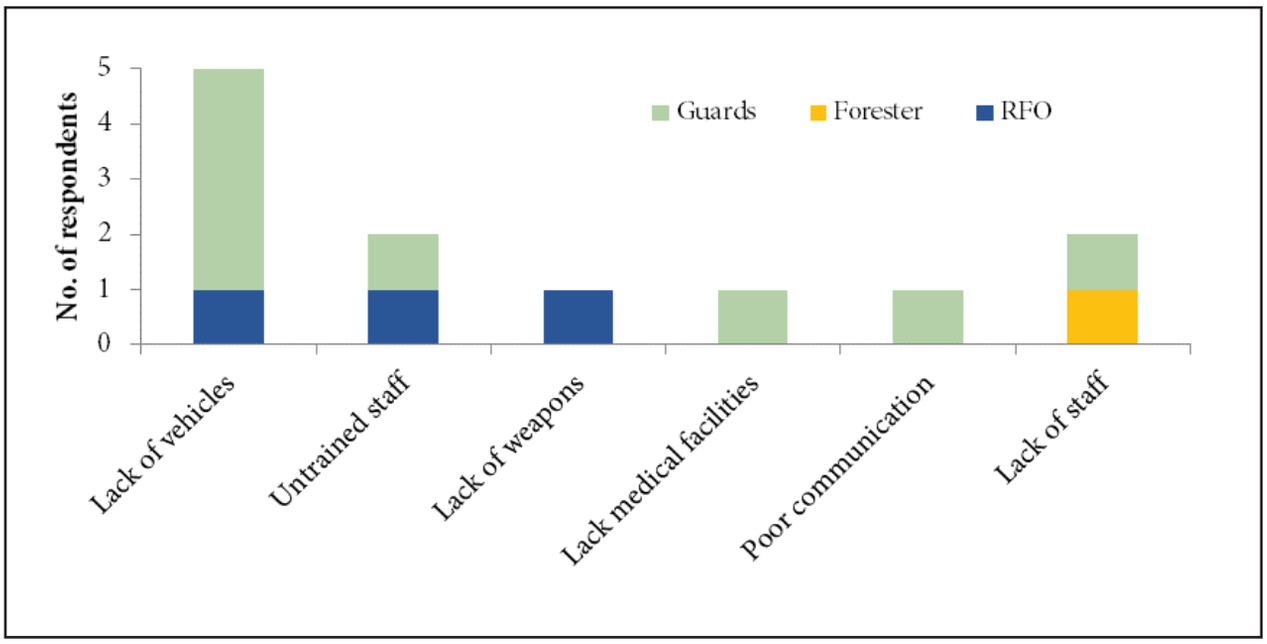


Fig. 6.14: Management issues in Udanti WLS perceived by the forest department staff

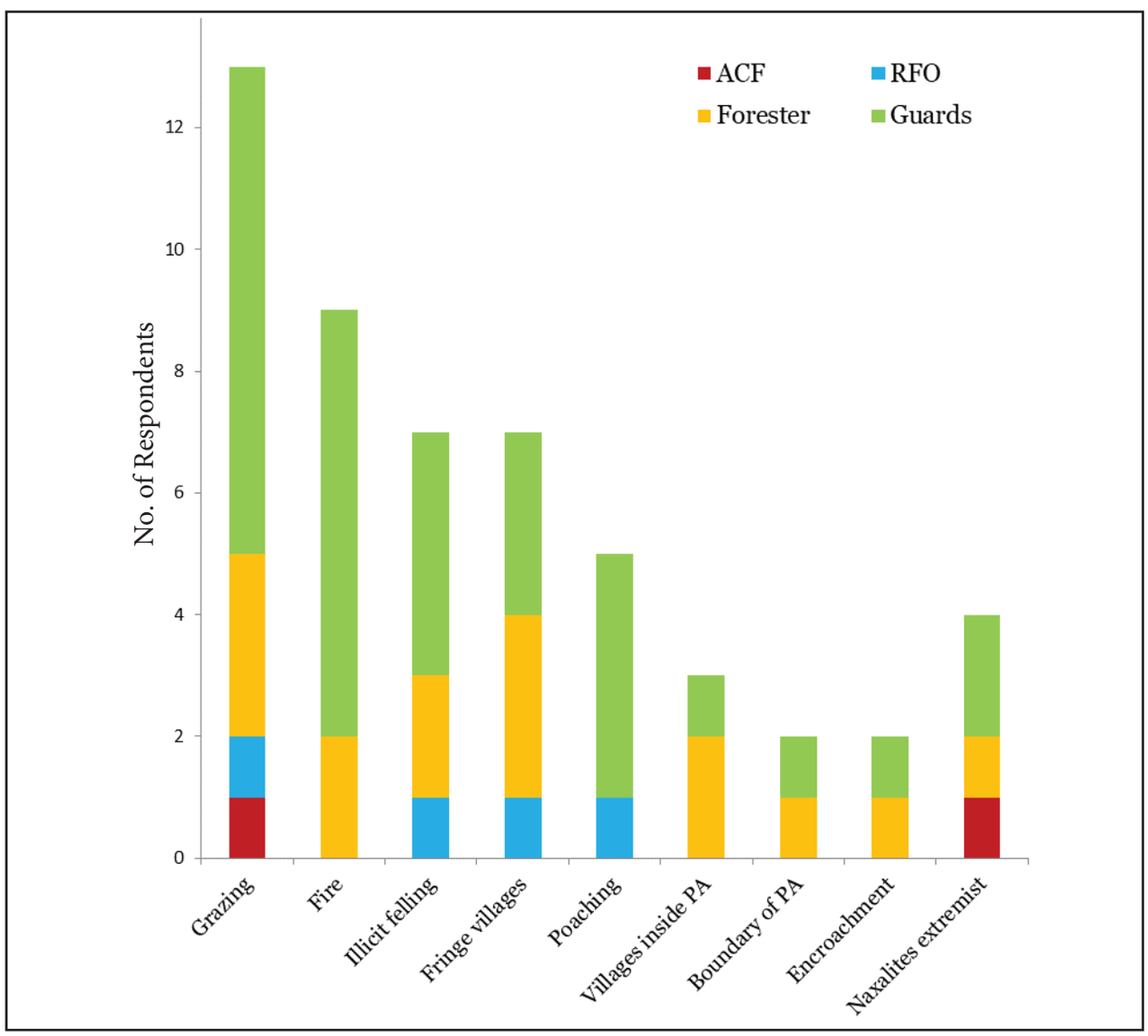


Fig 6.15: Different threats in Sitanadi WLS, perceived by the forest department staff

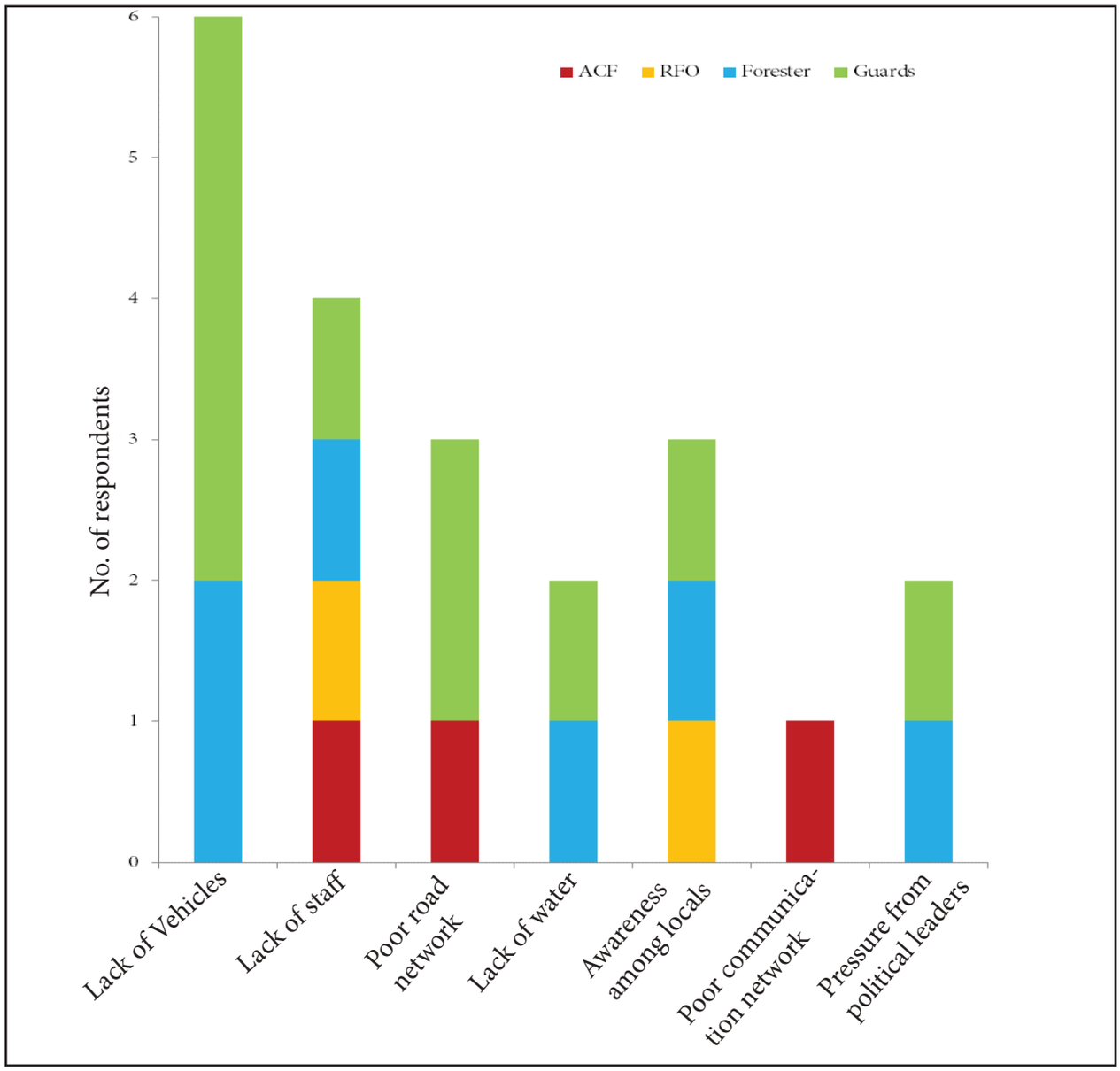


Fig. 6.16: Different management issues in Sitanadi WLS perceived by the forest department staff

noise pollution were the other issues impeding the proper management of the sanctuary (Fig. 6.16).

III. Impact of training on knowledge of participants

As per the expectation, there was some improvement in the knowledge of the participants on the Wildlife (Protection) Act, 1972 and general topics on wildlife. The same trend was observed in participants from all four ranges (Table 6.8).

IV. Field Kit distribution

Field Kits were distributed to all the 125 participants of the training. Each kit contained a backpack, a winter jacket, rain suit, field cap, water bottle and a flashlight (Fig. 6.17).

V. Post-training feedback

In the post-training feedback, the participants expressed their opinion on various aspects of the training on a

Table 6.8: Correct responses by participants before and after the training.

Course topics	% of correct responses by participants	
	Pre-training	Post-training
Udanti Range (n=53)		
Schedules of WPA, 1972	18.24	37.11
Sections of WPA, 1972	8.81	27.36
Patrolling and crime prevention	22.01	27.36
General topics on wildlife	30.19	36.79
Sitanadi Range (n=22)		
Schedules of WPA, 1972	48.48	71.21
Sections of WPA, 1972	30.30	51.14
Patrolling and crime prevention	48.48	52.27
General topics on wildlife	22.73	40.91
Risgaon Range (n=15)		
Schedules of WPA, 1972	33.3	60
Sections of WPA, 1972	31.11	49.17
Patrolling and crime prevention	51.11	66.67
General topics on wildlife	40.00	53.33
Arsikanhar Range (n=37)		
Schedules of WPA, 1972	27.03	38.18
Sections of WPA, 1972	40.54	53.15
Patrolling and crime prevention	31.53	32.43
General topics on wildlife	27.03	35.14

Fig. 6.17: Frontline field staff of USTR equipped with field gears (Left image); Mr. Vivekanad Reddy, IFS, former Dy. Director USTR handing over training certificates to participants

pre-designed feedback form. Results are summarized below:

- Course Content: About 83% of Udanti-Sitanadi TR forest staff rated different aspects of Wildlife Crime Prevention training as very good, and 12% rated it as good.

- Relevance of the course material: In response to a question about the relevance of the course material for their job requirement, 66% of the staff said it was relevant for their daily protection duty and patrolling.

- Relevance of patrolling exercise: In their feedback about the patrolling exercise during the training, 55% of the staff rated it as very relevant and useful. They also informed that the exercise would help them in their regular day-to-day patrolling.

- Duration of the training: About 71% of the respondent felt that the duration of the training was adequate.

- New information received during the training: Almost 91% of the staff indicated that they had received much new information and 3% indicated that the course content is entirely new to them. Around 95% of the trainees indicated that the exercise on mock Crime Scene Investigation was very innovative, new and useful for real-world investigation.

- The frequency at which training is needed: On their feedback about the frequency of the training, 48% of the staff expressed the need of organizing such training on a yearly basis.

- Trainers' expertise: Most of the trainees (87%) said that all the trainers were experts in their respective subjects. Many of them informed that both the classroom and field sessions were very useful and enlightened them on different aspects of wildlife law and wildlife crime prevention.

B. MODULE B (Annexure II (ii)) was followed in the refresher training (carried usually after a triennium), organized during August 10-12, 2016.

I. Training participants

Altogether 46 participants from seven forest ranges of Udanti and Sitanadi Wildlife Sanctuaries attended the training program. The participants included officers (Range Officers and above), Dy. Ranger, Forester and Forest Guard (Fig. 6.18). The list of names and designation of the participants who attended the training program is listed in Annexure III (ii)).

II. Key threats and management issues in the Udanti WLS and Sitanadi WLS

The threats and management issues related to Udanti and Sitanadi Wildlife Sanctuary, as highlighted by the trainees, are listed below:

Threats

- Poaching of wild animals, but estimates of poaching are not available
- Human-wildlife conflict due to crop raiding and cattle lifting
- Biotic pressure from the villages situated in and around Udanti
- Encroachments by villagers (for agriculture etc)
- Illicit felling
- Forest fire (anthropogenic reason during summer owing to NTFP collection)
- Roads passing through Udanti and Sitanadi Wildlife Sanctuaries

i. The Raipur-Deobhog state highway passing through Core 1 of Udanti WLS, and

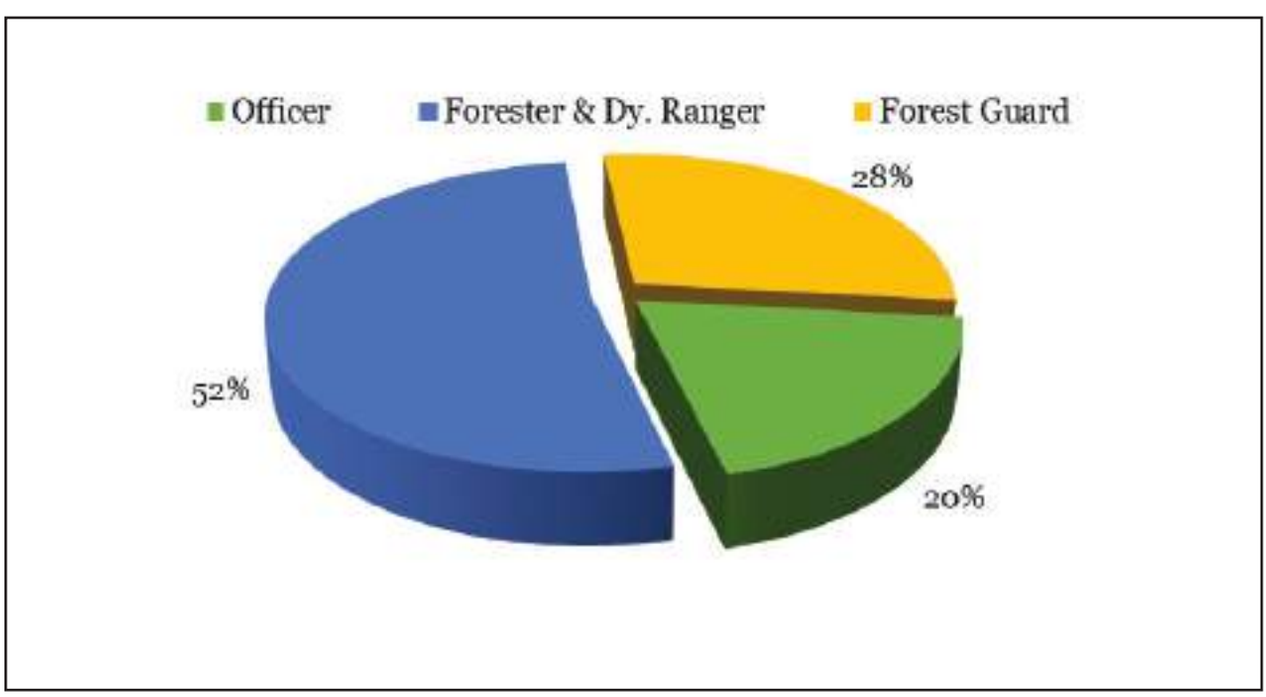


Fig. 6.18: Rank-wise number of participants who attended the training

ii. Nagri–Jhariabahra road passing through Core 2 and bisecting the Sitanadi WLS

Management issues

Among many management issues and challenges, the participants highlighted the following as key issues that affect management and protection of the sanctuaries the most:

- Lack of adequate frontline field staff
- Wildlife staff untrained in patrolling
- Poor knowledge of frontline field staff about the wildlife crime, court procedure and documentation.
- Lack of political will
- Lack of interdepartmental cooperation to mainstream tiger conservation objectives with different developmental plans.
- Lack of land-use policies

However, the trainees pointed out that many proactive initiatives have been taken by the government and WTI to protect and conserve the small wild buffalo population in Udanti in the last 8-9 years.

III. Pre and post evaluation test result

Comparison of pre and post-training test scores enabled us to gauge training success and the participant's (127) course content comprehension and recall. The exercise indicated the level of pre-training knowledge among staff about the wildlife of the area, various sections of the Wildlife (Protection) Act, 1972 and patrolling protocols and methods. In the pre-training assessment, 40% of the staff scored more than or equal to 50%, while more than 88% of the forest staff could achieve this level.

Subject-wise comparison of the score obtained in pre and post-training assessment showed an increment in the proportion of participants scoring better in the Schedules and Sections of WPA (1972) and Patrolling and Crime Prevention, however, a marginal

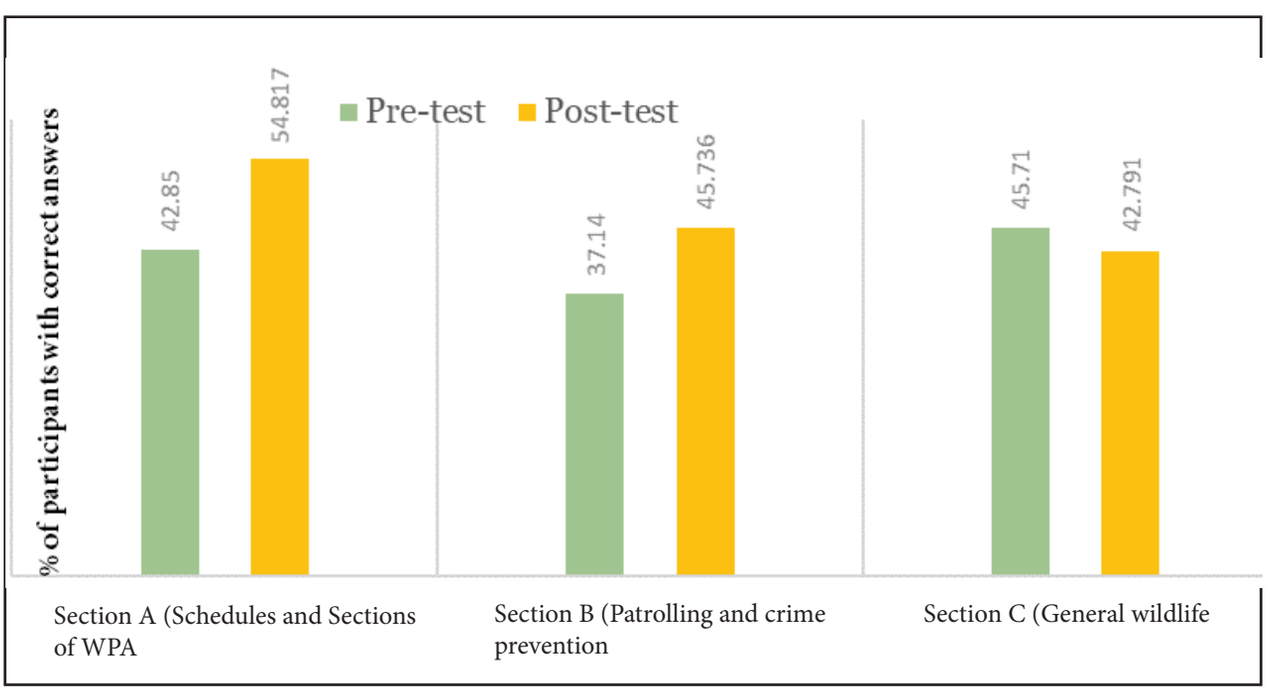


Fig. 6.19: Participants scoring correct answers in different sections of Pre and Post-training assessments (n=46)

decline in the General Wildlife section was recorded (Fig. 6.19).

IV. Post Training Feedback

- **Course content:** The frontline staff rated the course content in the present training 5%, 68%, and 27% as very good, good and medium, respectively.

- **Relevance of the course material:** In response to a question regarding the relevance of the course in relation to their job description, 62.5% rated it as very relevant and 37.5% moderately relevant.

- **Relevance of patrolling exercise:** About 67% of the participants rated the patrolling exercise undertaken during the training as very relevant and useful, whereas 33% regarded it as moderately relevant.

- **Feedback on the trainers:** Respondents rated and ranked the trainers on three parameters: teaching methods, teaching speed and knowledge of the trainers. 70% of them rated the teaching method as very good and 30% as good.

- **Duration of the training:** 64% of the respondent felt that the duration of the training was adequate. However, 33.5% felt that the duration was very short and advocated to increase the duration (three days) in the next trainings. 2.5% of the trainees informed that they want to undergo more elaborate training on wildlife crime prevention.

- **Organization of training:** The majority of the participants rated the logistics at the training as very good (50 %) and good (47.5 %) and only 2.5 % rated it as average.

- **New information received during the training:** Almost 23% of the staff indicated that they had received entirely new information, and 36% indicated that they received moderately new information.

- **Frequency at which training is needed:** 40.5% of the staff felt the need for yearly training. However, 42.5% felt that this should be done twice a year and the remaining 17% felt that this should be organized once in two years.

- **Fulfilment of expectations from the training:** In response to a question whether the staff expectations were fulfilled by the training provided, 75% felt that this was completely met, and the remaining 25% felt that this was partially met.

d. Veterinary care:

Apart from physical threats such as poaching, the threat from infectious diseases is of serious concern to wildlife, especially when its population is low, as in the case with wild buffaloes of USTR (DNWPC, 2020). The contact (shared grazing spaces) between wild buffaloes and cattle or other domestic animals, has the potential to expose the species to different infectious diseases ranging from bacterial (brucellosis, haemorrhagic septicaemia), viral (Foot and mouth-FMD), fungal, protozoan (*babesiosis*) and endo-parasitic diseases. These are the commonly reported infectious and contagious diseases reported from livestock in the state. The domestic buffaloes (*Bubalus bubalus*) and cattle (*Bos taurus*) being the closest relatives of the wild buffalo inhabiting the Udanti landscape, the potential of these infectious diseases transmitting from one taxa to another

Fig. 6.20: Cattle vaccination program carried out in USTR

was high. Even the wallowing behaviour predisposes buffaloes to different diseases like leptospirosis, brucellosis, fascioliasis and schistosomiasis (Villanueva *et al.,* 2018).

The Central India Wild Buffalo Recovery project took cognizance of this issue and put in place corrective measures. To minimize the threat by disease transmission from domestic livestock, vaccination drives were carried out jointly with the Chhattisgarh Forest Department and state Veterinary Department across the known home range of free-ranging wild buffaloes in USTR (Fig. 6.20). Across 17 villages, more than 3200 livestock were vaccinated against haemorrhagic septicaemia, black quarter, and FMD, using the three-in-one Trio vaccine.

Additionally, to ensure that the individuals held in the in-situ enclosure (Udanti WLS) were in good health, regular health check-ups were organized by bringing in WTI and Chhattisgarh Forest Department's vets (Fig. 6.21). They were also vaccinated with the Trio vaccine from 2010 onwards intermittently. All these veterinary interventions helped in minimizing the possibility of contracting infectious diseases.

e. Augmenting the population through conservation breeding and translocation

Given the precarious situation of the wild buffalo population in USTR, the priority is not only to protect the remnant population but also to take concerted efforts to increase the numbers. For a population that has declined to such low numbers, conservation breeding[36] with assisted reproduction measures seems to be the only option to increase the numbers in a relatively quick time (Fig. 6.22). Since only one female (Asha) was

[36] *Involves the captive propagation of endangered species to help maintain genetic diversity, produce viable individuals for release and ultimately mitigate species' extinction.*

Fig. 6.21: Dr. J.K Jadiya, Wildlife Veterinarian, Chhattisgarh Forest Department, conducting one of his regular check-ups on a wild buffalo in the enclosure at USTR

Fig. 6.22: Asha, the female wild buffalo grazing with one of her male calves in USTR

left in USTR, the need to bring in females from other wild buffalo populations for establishing a breeding population at USTR was realized.

While the breeding of the available stock in USTR is on, simultaneously, efforts are also underway for a conservation translocation[37] of female wild buffalo from Assam. The need for such an initiative was put up by WTI in the Governing Council Meeting; (Fig. 6.23). Members of the IUCN/ SSC specialist groups also visited Udanti and gave their recommended course of action for recovering the buffalo population in USTR (Annexure I). One of their recommendations was to capture and relocate wild buffaloes, especially females from other PAs, to augment (via conservation breeding) the wild buffalo population, which the Chhattisgarh Forest Department agreed to.

As recent studies have shown the closeness of buffaloes from Assam to those in Central India (Gaur & Mishra, 2019 and Pacha *et al*., 2020), the threat of any possible genetic pollution was considered insignificant. The decision was to bring six individuals (five females and one male) from the state of Assam to initiate a conservation breeding in Chhattisgarh. The wild buffalo population in Manas National Park was chosen over those in Kaziranga National Park as the habitat in Manas was closer to the forested habitat in Udanti. The IUCN conservation translocation guidelines (IUCN/SSC, 2013) also stipulates that the source population physically closer to, or from habitats that are similar to, the destination may be genetically suited to destination conditions. Moreover, choosing Manas instead of Kaziranga would also curtail an additional traveling distance of about 280 kilometres.

The chemical capture operation was carried out in Manas NP from the 12th of February to the 15th of April 2020. Adults were avoided, and only sub-adults or juveniles of less than three years of age were targeted, considering their ease of transportation and the lifespan they will have for contributing to the conservation breeding program for restocking in Udanti Tiger Reserve. The individuals captured in the end were two juveniles, a male and a female. The adult males in Udanti, being solitary and in

Fig. 6.23: Governing Council meet in Raipur, Chhattisgarh

[37] *Conservation translocations are the deliberate movement of organisms from one site to another where the primary objective is a conservation benefit, IUCN/SSC. (2013). Guidelines for reintroductions and other conservation translocations. Gland: IUCN Species Survival Commission.*

extremely low number, could be located with ease using the services of trackers. This was not the case in Manas, where the targeted individuals were females that lived in herds that frequented some locations of the park at certain times of the day. Though the designated herd was habituated to the approach of the captive elephant's beforehand, only one could be captured from captive elephant back. All the rest of the attempts were made after herding the buffaloes to a vantage point (treetop platforms).

Unlike in Udanti, where Etorphine and Azaperone combination was used on all three occasions (two buffaloes and one gaur), Etorphine was given in combination with three other drugs, namely Xylazine hydrochloride, Thiafentanil and Azaperone. Details of the drugs used, dosage, reaction or induction time and the supportive medications given have been given in the Table 6.9. Naltrexone was used as the reversal agent on all occasions. Recumbency was not achieved in any of the buffaloes darted in Manas. Partially sedated animals had to be physically restrained and loaded into the truck for transportation to the boma.

The two captured juvenile buffaloes were temporarily held in a boma (100 m x 100 m) made of *Bombax ceiba* poles reinforced with solar power fence, both inside and outside (Fig 6.24). They were transported by road to Barnawapara WLS (Chhattisgarh) in a specially designed truck on the 15th of April 2020. Capture and translocation of 3 or 4 more individuals, for which permission has already been obtained, would be carried out after relaxations in the Covid-19 pandemic.

Table 6.9: Details of the chemical capture operation in Manas

	Buffalo 1	Buffalo 2
Age and sex	< 2 yrs (F)	< 2 yrs (M)
Date of darting	12-02-2020	15-02-2020
Estimated weight	250 kg	200 kg
Etorphine (Total dose)	4.9 mg	4.9 mg
+ combination of	Xylazine (100 mg)	Xylazine 80 mg
Darting distance	30 meters	35 meters
Darted from	Elephant back	Elephant back
Visual contact	Maintained	Maintained
Distance travelled after darting	100 meters	30 meters
Induction time	4 minutes	7 minutes
Naltrexone	25 mg IV	25 mg IV

Fig 6.24: The two juvenile wild buffaloes that were translocated approx. 1900 kms from Manas NP (Assam) to Barnawapara WLS (Chhattisgarh)

Fig 6.25: Translocated wild buffaloes in Barnawapara WLS (Chhattisgarh)

CHAPTER 7

MAKING A CHANGE IN PERCEPTIONS AND ATTITUDES ABOUT WILD BUFFALO

Sandeep Ghosh, Rajendra Mishra, Rahul Kaul, Madhumay Mallik and Saymanti Bandyopadhyay

Campaigns lead to behavioural and perception changes in target groups, resulting in the desired conservation support. One such example is the whale shark conservation in the Indian state of Gujarat (Choudhary *et al.*, 2008, Matwal *et al.,* 2014). Due to lack of legal protection, the whale shark was brutally hunted and ritually slaughtered on a large scale along the shores of western India till 2001. Continued lobbying efforts for promoting the legal status of the whale shark (*Rhincodon typus*) and other relevant approaches have been successful, converting the exploiters of the past into protectors of the species. Another such successful campaign is the Buffalo Field Campaign (Shanahan *et al.,* 2010), which actively publicized the plight of the bison (*Bison bison*), and advocating for the long-term protection of viable populations of wild bison and year-round habitat. Buffalo Field Campaign actively engaged the American public to honour and protect their cultural heritage by allowing the wild buffalo to exist as an indigenous wildlife species fulfilling their ecological role on their native landscape.

A campaign is necessary when human attitude, perceptions and behaviour are conservation's greatest challenges.

Rapidly shrinking habitats of the wild buffalo in its distribution range in India and the impact of increased anthropogenic pressure are some of the reasons which have resulted in the rapid decline of the once reasonably abundant population. Lack of empathy by the human population and the failure to take cognizance of the negative impact on the population has also contributed to the decreasing numbers. The Chhattisgarh Forest Department, with the assistance of WTI, has addressed the direct threats for more than 10 years to halt this decline. However, a bottleneck situation persisted due to the lack of popularity of the wild buffalo among the citizens. Hence, concerted efforts were made among the stakeholders to sensitize and instil a sense of pride about their state animal.

A campaign is necessary when human attitude, perceptions and behaviour are conservation's greatest challenges. However, negative messaging or sermonising may not evoke the desired emotions for change in attitude, perceptions or behaviour. Combining emotion and logic, a campaign that inspires pride in community, pride in natural heritage, pride in tradition, and establishes a tangible connection to this pride, will succeed in creating a path for change as has been demonstrated in the Whale Shark Campaign where hunters turned protectors, and the whale shark has turned into a much-loved icon representing a conservation win.

I. Formative Research

A pre-campaign survey was needed to explore the minds of the local population as well as the administration towards the issue at hand, their level of pride towards their state animal, their cognizance of the depleting population of the species and reasons therein. The idea was to exploit the triggers to raise a sense of pride among stakeholders in favour of the continued existence of the wild buffaloes.

A dipstick survey to baseline awareness levels amongst the target audience was commissioned to TNS and was conducted in 2016.

II. Highlights from the pre-campaign report

Some key findings of the pre-campaign survey report are:

- A large segment of respondents (both rural and urban) who could recall the names of Kanha or Udanti failed to place them in either of the two states.
- Only 35% of the youth could correctly identify them as part of their respective states.
- Only 20% of the youth and adolescents could link the wild buffalo to Udanti WLS, and 48% of youth were not aware of any endangered animal.
- 64% of the total respondents could not believe that the number of wild buffaloes was once down to seven, and 65% of youth and 74% of the government servants were greatly concerned about this fact.

An awareness or pride campaign was recommended based on the pre-campaign survey plan to mobilize people's participation and to reaffirm the wild buffalo as the state animal of Chhattisgarh in people's minds.

However, there was still a sizeable proportion of the population who were unaware of the existence of Udanti WLS, a smaller proportion who were unaware of the wild buffalo being the state animal, and even a smaller proportion who can make the link between the two, a matter which is still a concern. Following are the findings on key parameters to baseline Knowledge, Attitude and Practice of the target group surveyed:

a. Awareness of the water buffalo as an integral part of Udanti WLS

Of those who were aware of Udanti, 44% knew that it was a wildlife sanctuary and, 45% stated that it was famous for the wild buffalo (59% among government servants). These are not very large proportions, especially when college students and high school students were largely unaware of this fact (less than a third). When asked

specifically regarding the types of animals found in Udanti, overall, only 58% of the respondents mentioned water buffalo (this was highest among government servants - 82%). For the general population, their favourite animals were either the tiger, followed by 'rabbits', and to a lesser extent, cows and dogs (with no clear favourite). For adolescents and college students, it was the tiger (clear favourite); and for government servants who were older, it was again the tiger followed by the 'lion'. These findings indicate a clear need for establishing these ground realities before other associations can be explored down the line to promote a 'Pride campaign' to save the animal in question.

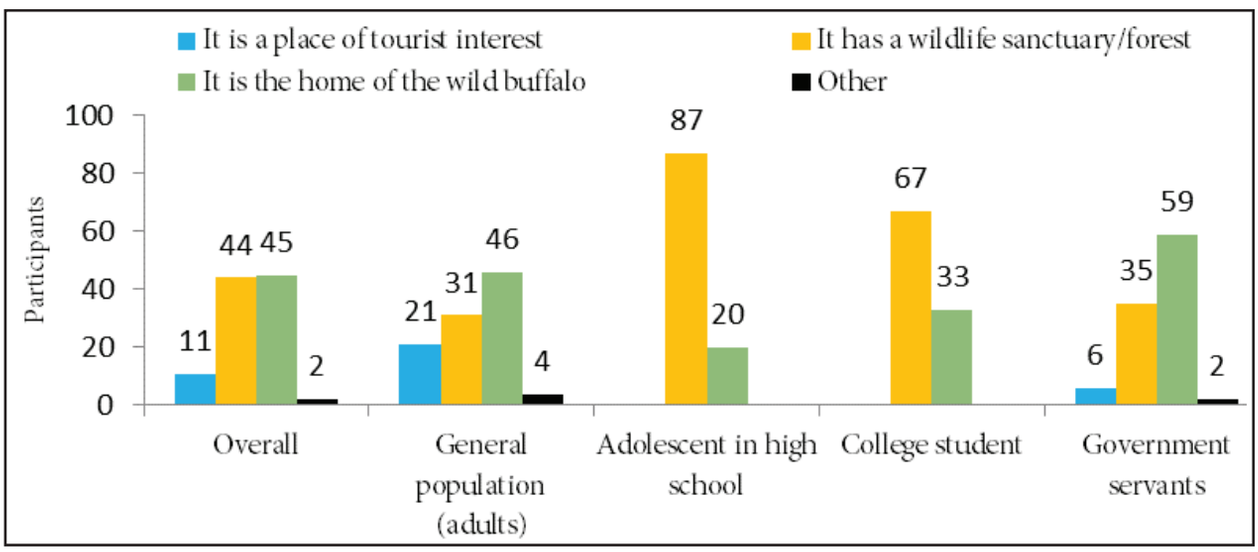


Fig. 7.1: Perception of respondents about why Udanti WLS is famous

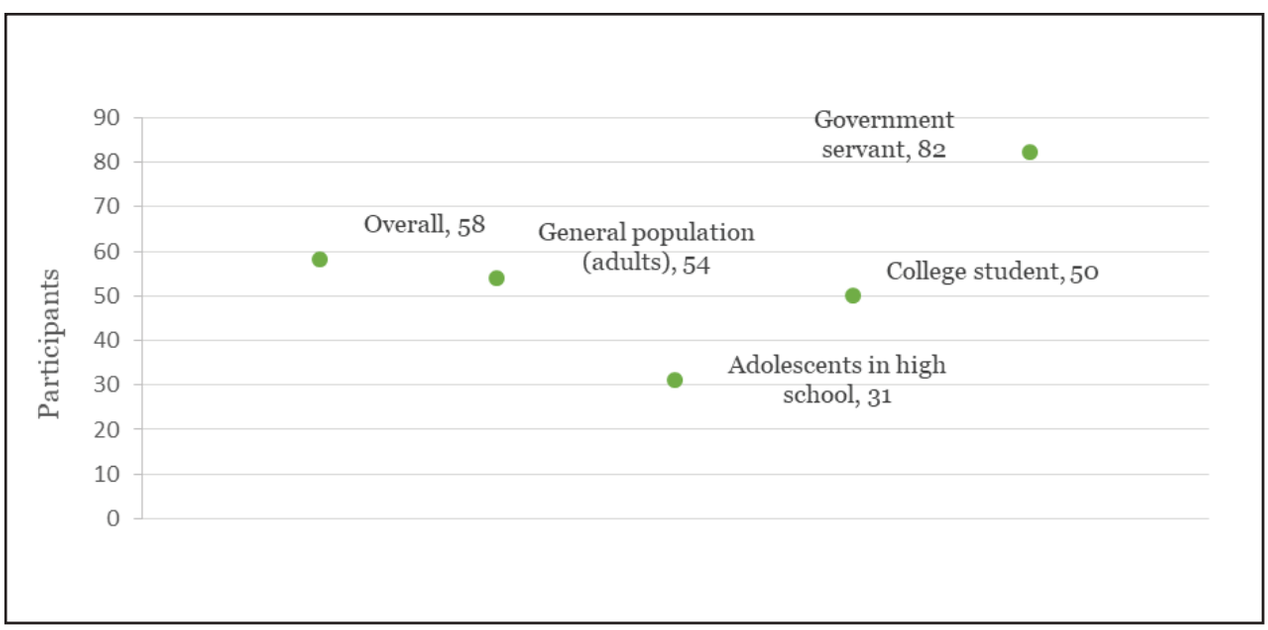


Fig. 7.2: Proportion of respondents who mentioned water buffalo as one of the animals in Udanti WLS

b. Awareness of the reasons behind reduction in the number of animals in the forest

Overall, respondents were consistent in their understanding of the reasons behind the depletion of animals in the forest. The primary reasons cited (in descending order) were deforestation, poaching, population expansion leading to animals migrating, and successive droughts leading to drying up of watering holes. These reasons were more or less consistent across all respondent categories (Fig 7.3). The very fact that the relevant stakeholders understand that a large part of the problem is actually human-induced was a positive platform to build the campaign.

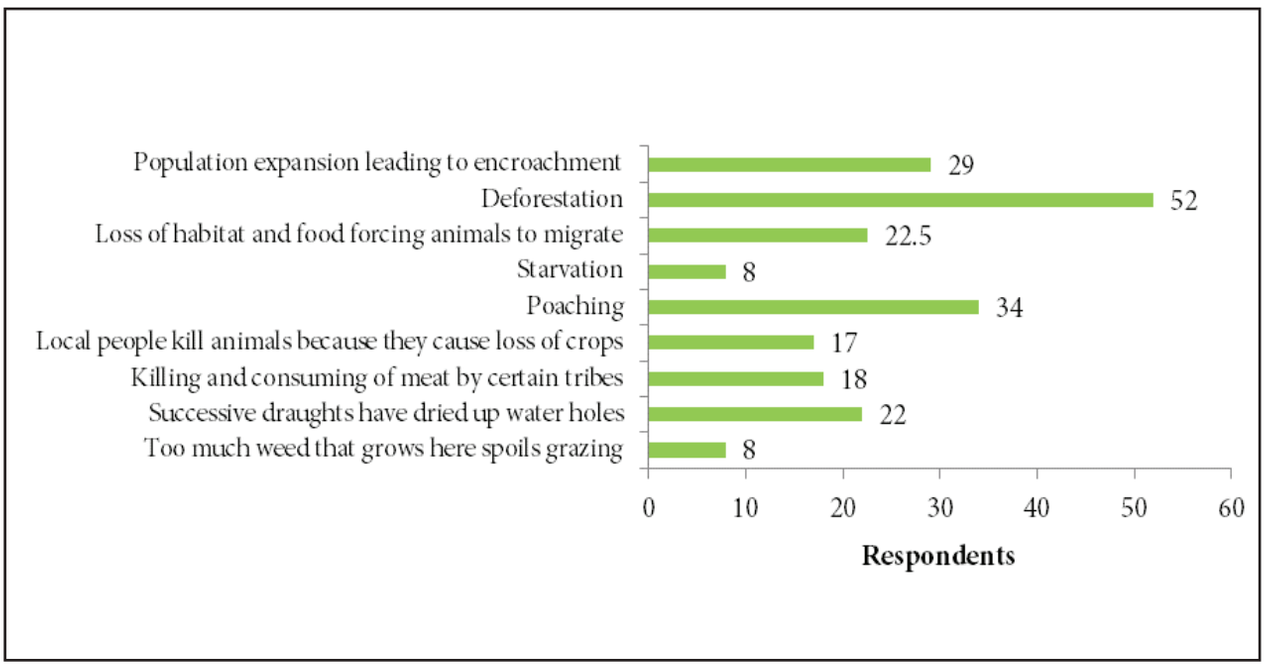


Fig. 7.3: Extent of awareness on the reasons behind the dwindling numbers of wild buffaloes

c. Awareness of the concept of endangered species

43% of the respondents (highest of 67% among government servants) knew that the wild buffalo was an endangered animal in the state, followed by the tiger (38%) (Fig 7.4). This is a good sign given that tigers have been in the news for their dwindling numbers for many years now and the network coverage that tiger has received is far greater than any discourse or discussion on the water buffalo. 30% of the respondents however had no idea of any animal being endangered (Fig 7.5). This leads us to believe that the issue is perhaps not just confined to the wild buffalo alone. The proposed campaign should also touch upon the wider picture of conservation of wildlife species and their habitat.

d. Awareness of the state animal

Nearly everyone who participated in the survey knew that the tiger was our national animal. However, even though 79% of the respondents claimed that they knew what the state animal of Chhattisgarh was (86% among government servants), overall, only 65% knew that it was the wild buffalo. Thirteen per cent felt it was either the tiger or barasingha (Swamp deer, *Rucervus duvaucelii*), which was the state animal of the undivided Madhya Pradesh (Fig 7.6).

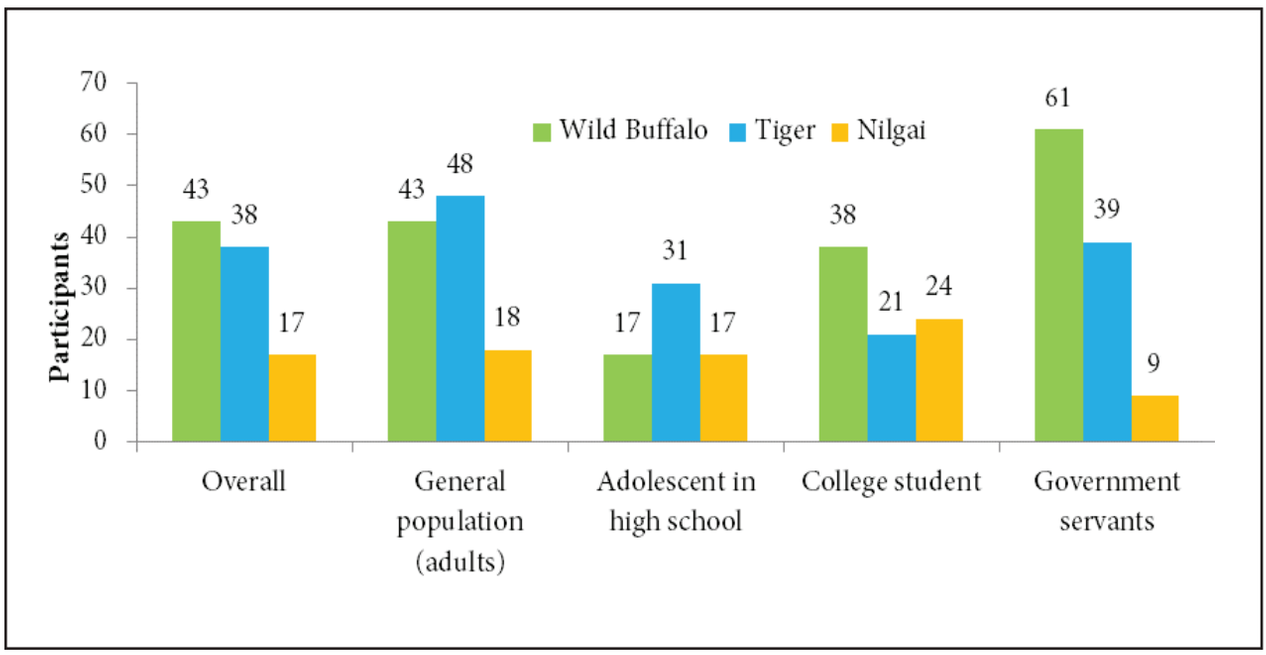


Fig 7.4: Perception about animals that are endangered in Udanti WLS

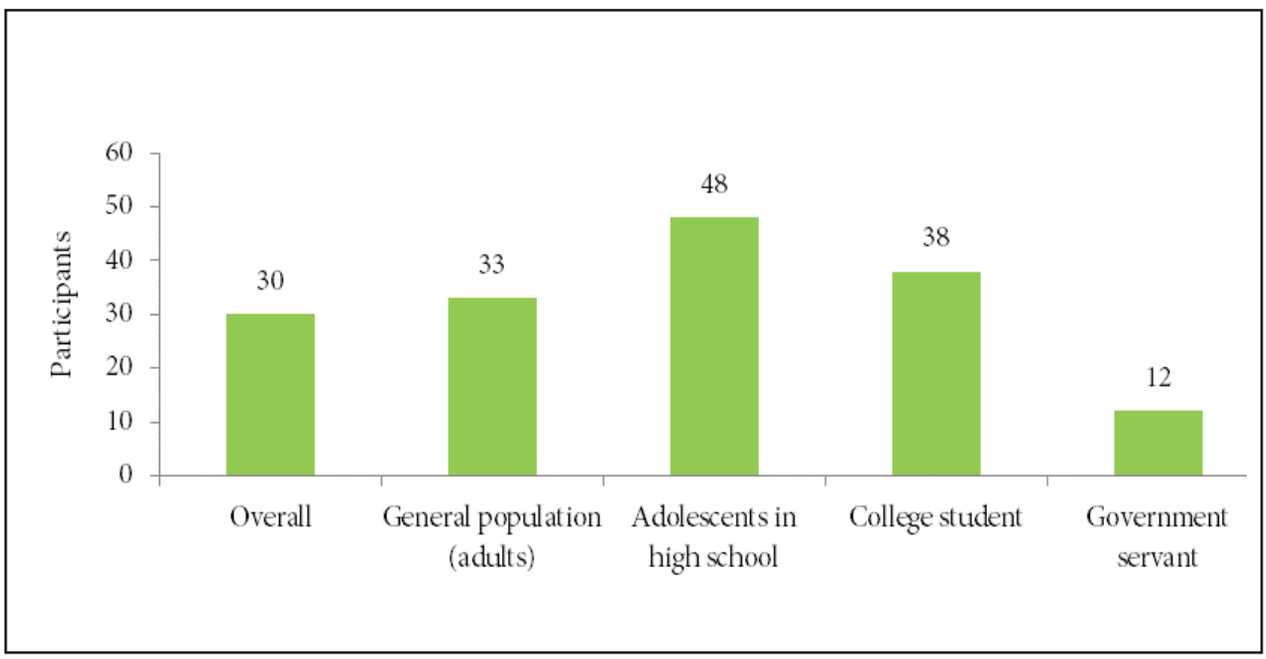


Fig. 7.5: Proportion of the respondents who were not aware of any animal being endangered

e. Awareness of the present predicament

Overall, 32% of the respondents (14% among government servants) could not offer an opinion as to how many water buffaloes were left in Udanti WLS. Only 10% felt the number remaining was 10 or less. 33% felt the number was 30 or less. Around 35% felt it was more than 30 individuals. When they were told that the real number was just 7, only 36% found this to be completely believable. Acceptance of this as a fact was highest among government staff (54%) and lowest among adolescents (10%) (Table 7.1).

With respect to the top two contributory reasons behind the drastic decrease in the number of water buffaloes in Udanti WLS, the favoured reason cited was successive droughts leading to the drying up of water holes (60%). Around a quarter of the people also mentioned that human-animal conflict led to people killing the buffaloes as they destroyed standing crops. About a fifth believed the killing of the animals for their meat was a contributing factor (Fig 7.7).

III. Method and Approach

This pride campaign was launched to elevate the wild buffalo to an iconic status, like any other charismatic animal. Central India Wild Buffalo Recovery Campaign was planned based on the Rare Pride[38] (Jenks, *et. al.*, 2010) that inspires pride around unique natural assets and creates a clear path for local change. The Pride Campaign disseminates messages to evoke the desired behaviour.

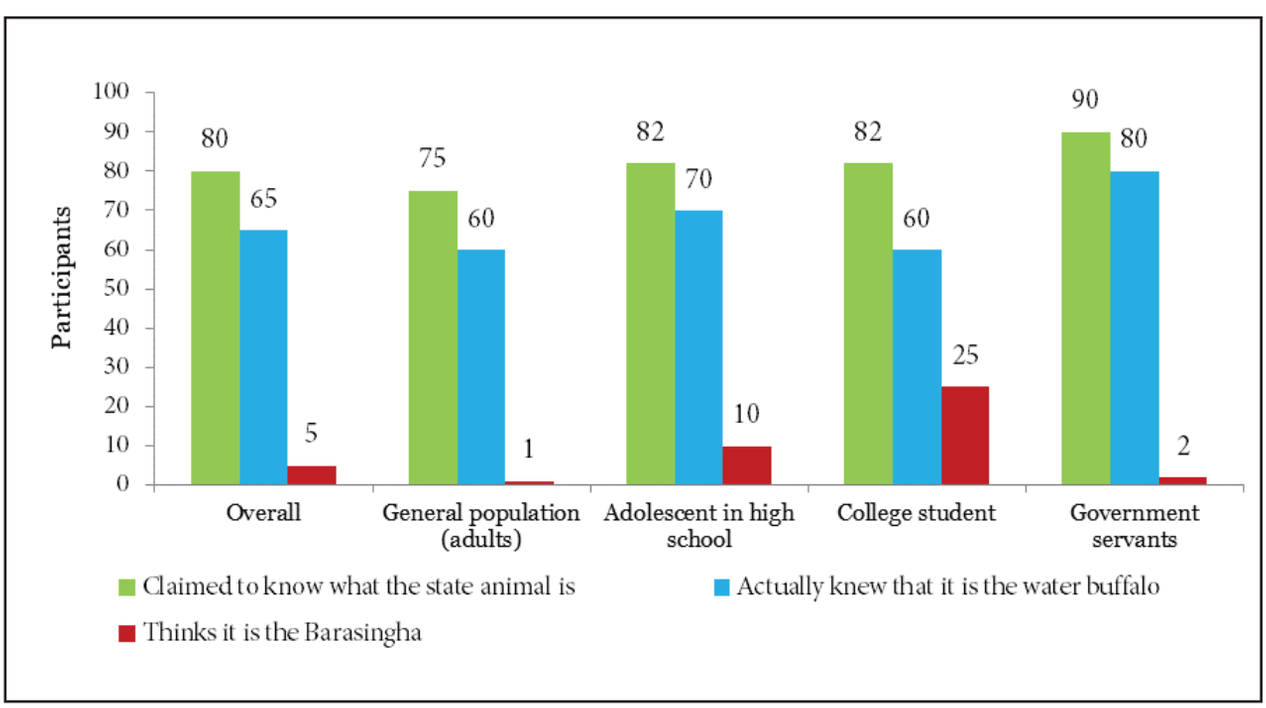


Fig 7.6: Respondents knowledge on Chhattisgarh's state animal

[38] *Rare Pride is a social marketing program that stimulates human behaviour change in order to promote biodiversity conservation in critically threatened regions in developing countries.*

Table 7.1: Awareness about the wild buffalo being Chhattisgarh's state animal

	Overall	General Population (adults)	Adolescent in high school	College student	Government servants
Don't know	32	35	55	38	14
10 or less	10	10	0	18	15
11 to 30	23	18	20	27	35
More than 30	35	37	25	17	36

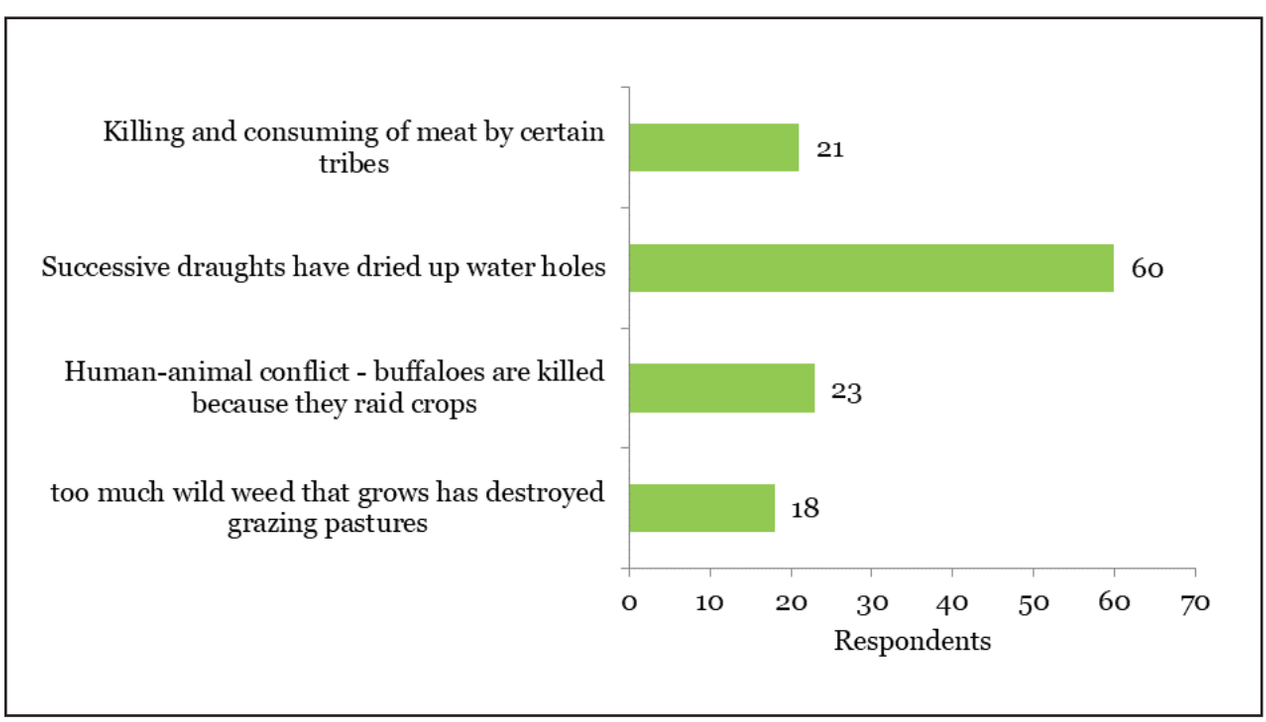
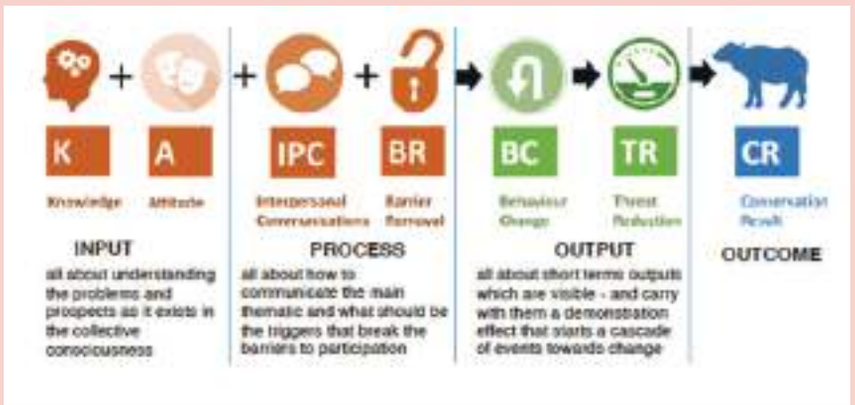


Fig 7.7: Perception of why wild buffalo numbers are dwindling in Udanti WLS

Highlights

The Pride Program operates in the 'grey area' between traditional conservation education and pure social marketing focusing on behavioural change.

The headline of the campaign addressed the emotional connection with *"only a few individuals of the State Animal are left in the forests of Udanti and the species is facing extinction if urgent steps aren't taken"*. The campaign headline was successful in capturing the attention of the audience, regardless of the respondent's cultural, social or educational affiliations.



Strategies employed to influence the success of campaign structure

- Captivate the target group
- Peer pressure and the 'IN' Crowd
- Keep it positive
- The things people will do
- Making a commitment

Fundamentals of the design

***Casual Hypothesis*:** A lack of awareness, understanding and appreciation leads to unsustainable practices and affects the natural systems because:

- People cannot understand the critical inter-relationships between man and nature.
- People cannot visualize other options that help sustain their livelihood with nature.
- People are not told of, or provided with, credible options to employ in their daily lives.

***Intervention Hypothesis*:** By providing an intensive, well-organized conservation education program, a target population will better understand and appreciate the value of their natural patrimony and recognize their role in the natural world, leading to changes in knowledge and attitude and fostering a more sustainable use of their resources.

***Action Hypothesis*:** By promoting awareness and understanding of the natural, and local people.

Fig 7.8: The pride campaign framework

A tailored campaign in line with the conservation approach of WTI was planned to help in the arrest of the declining population of wild buffalo in Chhattisgarh. The strategically planned pride campaign was an intensive, structured programme highlighting the role of the target population in this conservation effort, stressing on the project outcomes, which can lead to an increase in the popularity of the wild buffalo in the state.

The campaign strived to generate a groundswell of public advocacy and peer pressure, one that can help improve the knowledge, attitudes and behaviour towards the wild buffalo.

Changes in unsustainable behaviour cannot be achieved through coercion. Furthermore, the solutions to environmental crises rest neither with scientists nor with government officials. Ultimately, they rest with an informed and committed public. Creation of an endearing wild buffalo mascot was expected to lead to a groundswell that would add a buzz to the conservation effort. Personification of the mascot to popularise and bring it closer to the citizens' hearts was planned to be the first step. The mascot (Fig. 7.9, Top) was given a distinct identity and an appealing local name.

The pride campaign used a 'theory of change' hypothesis that defines social and biological shifts needed to sustain conservation results. Using the pre-campaign data, the target group was classified into three broad categories— policymakers, citizens, students. A customised pride campaign plan was implemented on the set of target audiences and using customized activities catering to each target audience.

IV. Target Group selection

a) Policymakers: Policymakers possess legal authority and are constitutionally empowered to engage in the formulation of public policy. As the pre-campaign data shows, their knowledge about the status quo was better, and they showed a heightened interest in the campaign objectives. The involvement of policymakers in this campaign was one of the initial steps taken to generate the required momentum for the campaign. Reaching out to the policymakers in the region can positively impact this campaign.

b) Public: Data from the pre-campaign survey suggested that the urban public were unaware of the reality of the situation and needed to be involved in order to improve conservation efforts through community participation. Citizen's opinions play a vital role in policymaking. The largest share of the local population in and around the WLS was tribal, who would be the crucial stakeholder in the efforts and contribute to a large share. Most of the local population's livelihood was dependent on the forest, and introducing them to sustainable efforts would help in the gradual restoration of the wild buffalo's degrading habitat.

c) Students: The campaign followed a captivating activity pattern and use of vivid collaterals, resulting in drives like the wall painting, painting competition, and quiz competitions and games, where students were actively involved. Students involvement was a crucial step in reaching out to families through youth. Working with children also gave us the opportunity to influence young minds and the chance to shape the new generation into responsible citizens. For these specific target groups, a curated set of activities was planned, which involved active engagement aiding in knowledge percolation.

V. Campaign collaterals

The mascot "Shyamu",[39] the wild buffalo, was commissioned by WTI to one of India's most talented caricaturists Rohan Chakravarty. The state animal mascot features the state bird of Chhattisgarh, the Hill Myna (*Gracula religiosa*), aptly named Radhe, thus paving the way for future collaterals to be designed incorporating dialogues between Radhe and Shyamu as subtle campaign messages and homilies.

Collaterals like T-shirts featuring the mascot (Fig 7.9) and Calendars (Fig 7.10) were expected to present our message on potential platforms but need to be repeated at regular intervals for the effect to last. Annual Calendars, posters, shirts and caps were produced for propagating the campaign message.

VI. Actions

It is true that no conservation effort is complete unless a partnership of the principal authorities are roped in – and in this case, it was the Chhattisgarh Forest Department and the State forest ministry.

Activities like the Wildlife Week 2017 celebrations and the 2018 calendar launch helped us reach out to stakeholders in strategic decision making positions.

Activity undertaken:

i. Wild buffalo mascot launch and installation

On the initiatives of the Chhattisgarh forest department, the *Radhe-Shyamu* sculpture

Fig. 7.9: Top: Radhe Shyamu, the mascot of the Wild Buffalo Campaign, courtesy of Rohan Chakravarty; Bottom: A 360° view of the t-shirt design used in pride campaign in Chhattisgarh.

[39] *Shyamu was one of the surviving male wild buffaloes in USTR*

Fig. 7.10: Wild Buffalo calendar launch by Shri Mahesh Ghagda, Honourable Forest Minister of Chhattisgarh.

(Fig 7.11) was launched and approved[40] to be put up at Naya Raipur by the Naya Raipur Development Authority.
The State wildlife board went on to suggest that the wild buffalo mascot "*Shyamu*" would compulsorily feature in all government materials henceforth.

ii. Wildlife Week events

Every year wildlife week[41] is celebrated with Chhattisgarh Forest Department. Strategic showcasing of conservation efforts through banners were put at the Marine Drive, the centre of the Raipur city, for a span of seven days.

A rally of more than 550 students in the year 2018 was organized wherein students marched for more than three kilometres raising slogans for the conservation of wildlife in the USTR. The students were from the schools of the fringe villages of Udanti WLS. The rally had the participation of more than seven schools. The assembly was also accompanied by a vehicle rally constituting top government officials, including the Forest Management Committee of Udanti, the District Panchayat Head of Gariaband, Block Panchayat President and its members and other forest staff and volunteers in Mainpur.

[40] Wild buffalo mascot was approved and launched on 14 November, 2017 at the State Wildlife Board Meeting, Raipur, Chhattisgarh.
[41] The Wildlife Week is celebrated every year from 2 to 8 October in India. The main objective of this campaign is to promote the conservation and protection of animal life.

Fig. 7.11: Sculpture of wild buffalo mascot in Naya Raipur

Fig 7.12: Right to Left: Shri R K Singh PCCF (WL), Chhattisgarh Forest Department and Dr Rahul Kaul, Chief of Conservation, WTI at Bhainsa Chowk, Raipur.

Mass involvement through drawing, painting, photography competition, students rally was also planned for the last two years. Collaterals like posters, brochures and, stickers of wild buffalo were distributed. During the weeklong events, prominent journalists also visited the events. The certificate and awards to winners were distributed by the Field Director USTR. A brochure and sticker of wild buffalo were distributed to Joint Forest Management Committee (JFMC) members, school teachers, and students during the programme.

iii. Special Day Celebration endorsed by Policy makers

International Day for Biodiversity (22nd May) and Global Tiger Day (29th July) were celebrated with the Chhattisgarh Forest Department and the Chhattisgarh State Biodiversity Board. Local NGOs also joined hands to strengthen the effort. These events saw participation from several tiers of citizens and dignitaries. Emphasis was given to improve the viability of the key faunal species of the reserve forest. Mass involvement through painting, essay competitions and spot quizzes were held to raise interest.

For General masses

a) Street Plays: *Nukkad Natak,* as they are popularly called, is a form of theatrical performance in open spaces. It has been considered a convenient tool, as the subject can be customised, and the messaging can be delivered to a mass of people through local languages.

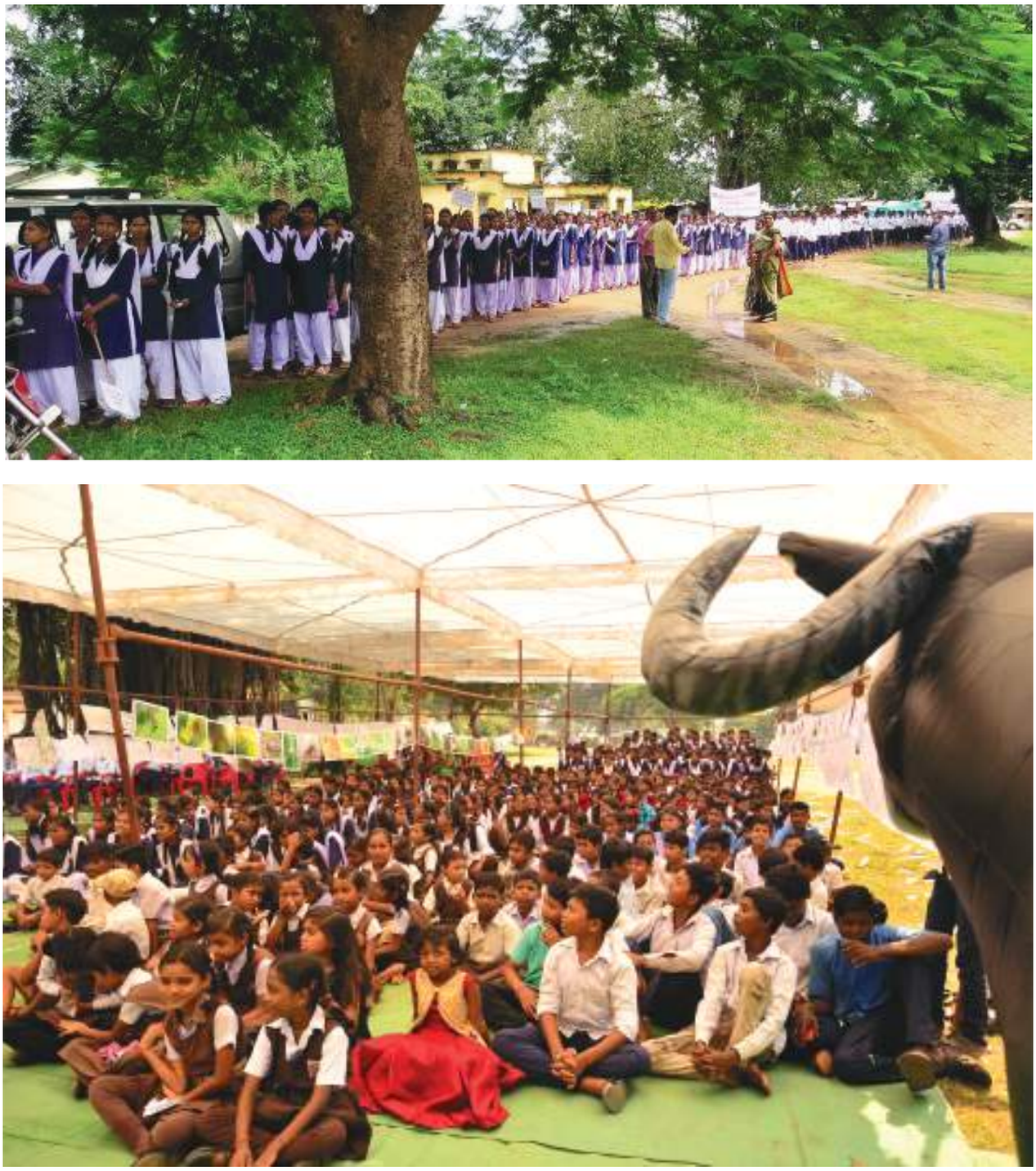


Fig 7.13: Wildlife Week Rally (Top) and Wildlife Week event involving school kids at Mainpur, Udanti WLS (2018)

WTI has been implementing this tool for the appropriate propagation of conservation messaging in rural scenarios. The cultural *Nukkad Natak* was mostly portrayed by the local drama group. The act revolved around the importance of forest and how each animal plays a role in its protection. Artists dressed in costumes depicting wild animals voiced concerns through poems and acting in regional dialect about the degrading forests and how we can and should help save them. The wild buffalo and the hill myna (the state animal and bird of Chhattisgarh, respectively) were the main protagonists in the play (Fig 7.15).

Fig. 7.14: Project team conducting special day events. Celebrations on International Day for Biodiversity (Top) and the inaugural ceremony of the Nukkad Natak organized in Mainpur Township (Bottom)

b) Flash mob: To highlight the conservation plight of wild buffalo, a 'Flash Mob' was organised by the students of MATS University, Raipur, in 2018. The idea was to ignite the interest of the citizens by performing an impromptu skit. The performance emphasized current conservation concerns and the plight of wild buffaloes in Chhattisgarh. Raipur got a lot of attention and accolades from the audience around. The sheer nature of the campaign triggered an overwhelming response of more than 200 people around the performing circle. The event generated attention from local news media also (Fig 7.16).

c) Cycle rally events: Every month, the Nagar Nigam organizes a daylong event for sensitizing locals about the environmental benefits of cycling over using automobile. Using the platform, WTI collaborated with Raipur Nagar Nigam in a cycle rally event held in 2018 to promote the 'Save the Wild Buffalo' campaign by adorning the T-shirts during the rally. It was appreciated by the local populace.

Fig 7.15: A street play, performed by the forest department staff at Mainpur

d) Presence at All India Forest Sports Meet, 2019: The 24th All India Forest Sports Meet was held from the 9th – 13th January, 2019. Chhattisgarh Forest Department hosted the event at stadiums across the capital city of Raipur. Players from 24 Indian states and six forest/wildlife institutions participated in the event. The final day of the event, at Kota Stadium, had more than 4000 people as guests. The Chief Guest at the closing ceremony was Shri. T.S. Singh Deo, Hon'ble Minister of Panchayat and Rural Development. Further, the ceremony was presided by the Hon'ble Forest Minister of Chhattisgarh State, Shri. Mohammad Akbar. Other notable guests were Shri Pramod Dubey (Hon'ble Mayor of Raipur City), Shri Cheteshwar Pujara (renowned Cricketer), Shri Vikas Upadhyay (Hon'ble MLA of Raipur West) and Shri Sunil Kumar Kujur (Chief Secretary of Chhattisgarh State).

WTI, with prior consultation from the State PCCF, had arranged for the wild buffalo mascot to be a part of the event. As a symbol for the state animal, the mascot drew a lot of attention from all kinds of crowd. (Fig 7.16) In fact, the inflatable mascot was a primary prop for taking photographs and selfies, even by the top forest officials from across the country.

e) Photography Exhibition: During Wildlife week 2018, 'wildlife' themed photographs were exhibited at a strategic venue in Mainpur. About 20 people actively participated as contributors. This again was the first of its kind for Mainpur and attracted a lot of crowds (Fig. 7.18). The event allowed a perfect opportunity to relay the message of wildlife conservation in general while at the same time instilling pride in the resources

Fig 7.16: A skit performed by MATS University at Marine Drive, Raipur

Fig. 7.17: A favourite backdrop for champions in the 24th All India Forest Sports Meet, Raipur, 2019

available. The photographs for the display were contributed by the local villagers and forest staff of Udanti.

f) Wall Painting/ Murals: Along with the above mentioned key initiatives to further the conservation message to the general populace in Raipur and Mainpur (near Udanti WLS), WTI, along with Oracle additionally, launched an extensive wall painting drive. The wall paintings (Fig 7.19 and 7.20) were created by local artists to showcase the wild buffalo. The locations for these wall paintings were strategically chosen and included prominent government buildings such as the Correctional Headquarters (one of the most important junctions in Raipur, connecting the railway

station with Raipur Bus Stand), the Naya Raipur Development Office (located on a junction that connects to the main market in the city), the State Guest House, IAS Officers' Mess, Forest Minister's House etc. These wall paintings have attracted tremendous positive attention.

their state animal, their cognizance of the depleting population of the species and reasons therein, and what triggers could be exploited to raise a sense of pride among stakeholders in favor of the continued existence of the wild buffaloes.

Fig. 7.18: Outdoor photography exhibit at Mainpur

For students (Campaign activities)

a) Customized Student Activity-Treasure hunt "Asha ki Khoj" (Finding Asha): An outdoor game, alluding to the only mature female buffalo in Udanti WLS, was designed for school students in 2018. A pre-campaign situation analysis was conducted that explored the minds of the local population as well as administration towards the issue on hand, their level of pride towards

The campaign was carried out in a two phases setup. Firstly, quizzes were conducted in schools across Raipur. Five schools and a total of 268 students participated in the same. Select students from four schools were invited on a tour to the Udanti-Sitanadi Tiger Reserve where the final phase of the game was conducted (Fig 7.20).

The game commenced by dividing the students into four teams, and each was assigned a group name, e.g. Team Asha,

Fig. 7.19: Wall paintings on the theme of wild buffalo conservation were strategically placed at prominent places across Raipur and Mainpur

Fig. 7.20: Water tank in Raipur painted with wild buffalo conservation message

Team Kiran, Team Chhotu and Team Prince, after the colloquial names of the individual wild buffaloes in Udanti. Each team was set of with one clue to find four other clues that were physically spread across our field station campus. Finding the clues included solving puzzles, both textual and pictorial. A total of 30-minutes were provided to solve the whole game by finding all the clues. The initiative was an instant success, and the school kids were thrilled to know about wild buffaloes and the habitat they live in.

b) Student Rally at Mainpur: More than 900 students from across 7 schools in Mainpur, Udanti WLS participated in the wildlife rally organized by the forest department and WTI on the 6th October, 2018. Students held banners and shouted slogans for the conservation of wildlife in the state (Fig 7.22).

c) Painting/Essay Competitions (schools in and around USTR): Painting competitions were organized in 15 schools around USTR in 2018 and 2019. This was the first time the project reached out to the last of the remote villages in the USTR, including schools of Karlajhar, Sahibin, Nagesh, Deojhar Amli, Amad, Kurrubhata, Tourenga, Jugaad and Kodomali. Added to this list were 6 schools from Mainpur. The total number of participants in the painting and essay writing competitions was above 400, while the total number of students reached in the process was about 1300. Three students from each of the fifteen schools were awarded the first, second and third prizes, along with a certificate, and wild buffalo themed goodies (Fig. 7.23).

Fig. 7.21: Winners of the treasure hunt posing with inflatable "Shyamu" mascot at the Forest rest house at Jugaad village, USTR

VII. Impact of initiatives

The aim of the wild buffalo campaign has been to make the animal synonymous with the wilderness of Chhattisgarh. The goal was that the common populace would be able to instantly connect the wild buffalo when it comes to the forests and wildlife of Chhattisgarh. At the onset, the campaign was divided into an urban campaign and a rural campaign on the basis of the different requirements. Therefore, campaign activities were carried out in urban places, especially the capital city of Raipur, where a cross-section of the society was involved. The rural campaigns carried out in the villages around USTR were more inclined towards the protection of the wild buffalo. They have always lived with the wild buffaloes in the neighborhood and knew them to be a part of the forests they depend on.

Using a KAP (Knowledge-Attitude-Practices) survey, we have been able to gauge the effectiveness of our conservation action across the state.

Fig. 7.22: Students rallying across Mainpur Township, with messages about wildlife conservation on placard

Fig. 7.23: Painting competition conducted in Mainpur Township hall

The Urban Change

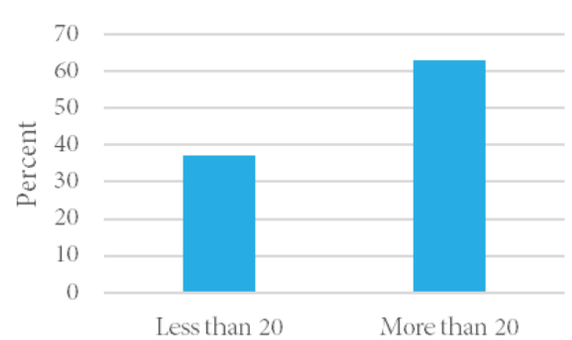
When it comes to the wild buffalo being the "State Animal of Chhattisgarh", the survey showed a high proportion of the urban population is already aware of it. However, when it came to the criticality of the wild buffalo sub-population in Central India, the "knowledge" needed a push. Currently, there are around 10 wild buffalo individuals in USTR, and more importantly, just one female (as of April 2020). Listed as endangered, it is necessary that the policies around wild habitats like USTR are designed to draw attention to this need of increasing the numbers in the future.

The urban population, though not directly linked to the field interventions around wild buffaloes and their habitat, are important drivers of change. It is necessary to make the criticality of the wild buffalo sub-population being a point of discussion among people of Raipur, they being more connected to policy-level changes. Also, it is through urban campaigns that the wild buffalo got highlighted on social media and thereby get a wider outreach, ranging from media houses to the ministries responsible for state-level decision makings.

The urban campaign has been multi-faceted. From wall paintings across Raipur to school-level discussions and flash mob presentations for the general public, we have been trying to highlight the urgency of conservation action towards wild buffalo conservation in the state. After three years of targeted campaigning, the resultant change has been quite positive, as shown by the results of a mid-campaign dipstick survey conducted in 2016 (Fig 7.24).
The main idea behind the messaging has been for the common populace to be aware of the exact situation. With continued outreach,

Pre-Urban KAP - Knowledge

Wild buffalo number in USTR	Total
Less than 20	37.08%
More than 20	62.92%
Grand Total	**100.00%**



Mid-campaign Urban Knowledge

Wild buffalo numbers in USTR	Total
Within 20	69.49%
Less than 10	30.51%
Grand Total	**100.00%**

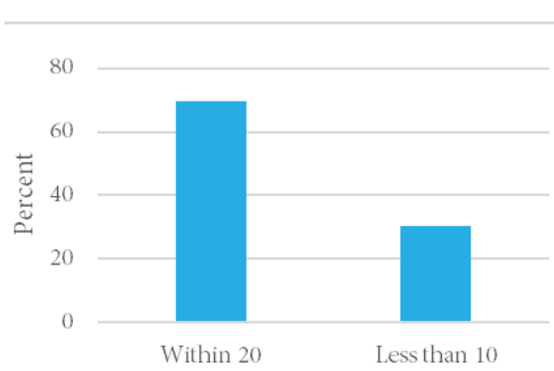


Fig. 7.24: Knowledge shift pre and mid wild buffalo campaign among the urban audience in Raipur, Chhattisgarh

the campaign aims to improve the "public knowledge" about the wild buffaloes further.

With the campaigns in place, we have been able to reach the majority of the urban population of the city of Raipur directly. This has been the main driver of the change in "knowledge". Also, the focus of the messaging has been the young demographics in the age group between 10 years and 24 years. This predominantly covers the school and college-going students. The goal is to target a generation that is still flexible to adapt and grow up to drive the required changes.

The Rural Change

The most striking difference between the urban and rural population (villages around USTR) is the latter's proximity to the wild buffalo habitat. Villages around USTR have been close witnesses to the changing scenario of the wild buffalo population in their area. As the last stronghold of the animal in the state, USTR has also been popular among local media and news agencies. Consequently, villagers have constantly been aware of the updates about wild buffalo conservation and the criticality of the situation.
The only bottleneck with the rural population has been their attitude towards the conservation initiatives and their participation in the same. Villagers had been continually adapting to the policy level changes when it comes to forest administration and management, but they were rarely informed about the necessity of the same. Consequently, while they had the know-how of the declining wild buffalo numbers, they didn't get the required push to be involved in the change.

Along with campaigning, the wild buffalo conservation project led by WTI at USTR, in collaboration with the Chhattisgarh Forest Department also integrated several community level interventions, including alternative livelihood schemes, installation and distribution of improved cook stoves, formation of Biodiversity Management Committees (BMC) at the Panchayat levels and more. While the strategy has been aimed towards reducing the footprint of the villagers in the prime wild buffalo habitat, it also started involving the local peoples in the management practices around. Through community initiatives that directly improved the livelihood of the locals, we have been able to create a platform (Table 7.2) to not just speak about the need for wild buffalo conservation but also make the people directly involved in the same.

During the phase of the initial three years, the campaign directly reached out to over 3000 school children from 27 schools, 700 graduate and undergraduate students from three colleges and one University, 3000+ villagers from 27 villages around Udanti, 3000+ urban citizens from Raipur, and 12 public service departments. It also had the distinction of reaching out to every target group involved in wild buffalo conservation.

In addition to campaign and awareness intervention, favorable policy initiatives also have the power to influence and achieve long-lasting and far-reaching positive outcomes. Some of the positive outcomes achieved by WTI through changes in policy have been the conservation of whale sharks by helping listing this species on the schedule I of the Wildlife (Protection) Act, 1972 of India, helping declaration of sanctuaries and national parks to secure habitats for threatened species and the delisting of Manas National Park from the danger list at UNESCO, to name a few.

Table 7.2 : Attitude shift pre and mid wild buffalo campaign among the rural audience in and around USTR, Chhattisgarh

Pre-rural KAP – Attitude	
Wild buffalo cause damage to crops in the field, so they should be removed from the forest	**Total**
Strongly Agree	11.31%
Agree	25.60%
Can't Say	1.19%
Disagree	61.90%
Grand Total	**100.00%**

Mid-Campaign Rural KAP - Attitude	
Wild buffaloes cause damage to the crops, so it is better they are not there in the forest	**Total**
Can't Say	7.51%
Disagree	92.49%
Grand Total	**100.00%**

WTI also lobbied to get several favorable policy changes for wild buffalo that have helped in its conservation. These have come from advocacy at the highest levels, decisions of several Governing Council Meetings of Central India Wild Buffalo Recovery Project and meetings of the Chhattisgarh State Wildlife Advisory Boards etc. Some positive changes have been:

1. Chief Ministers Office: Prior to the initiation of this project and signing a long-term MoU for the conservation of wild buffalo with the Chhattisgarh Forest Department, The Executive Director of WTI, had meetings with the first Chief Minister, Late Shri Ajit Pramod Jogi of Chhattisgarh, he emphasized the need to conserve the state animal. Subsequently, the ED of WTI also met with Dr Raman Singh during his term as the CM, and both CMs took a personal interest in the recovery and conservation of the wild buffalo and showed exemplary leadership towards this cause, especially during the state wildlife board meetings, which they chaired and where two key decisions about the wild buffalo were taken. The first one was about the acknowledgement that the buffalo population had dwindled in Chhattisgarh and a direction from the top to conserve the state animal. The present Hon'ble Chief Minister Shri Bhupesh Baghel has also keen interest in the conservation of the wild buffalo and released a special postal envelop of wild buffalo to create awareness on the species.

2. Our Coordinator has been responding to queries raised by the Hon'ble forest minister of the state alongside the Chhattisgarh forest department, especially after the natural death of a male wild buffalo showing interest and responsibility at the highest level.

3. The Executive Director also met with the Chief Secretary, Chhattisgarh and appraised him of the conservation needs of the wild buffalo and the role WTI has played in its conservation. The Chief secretary sent appropriate directions to take up tasks on high priority.

Governing Councils

Under the wild buffalo recovery project, the governing council oversees the progress and performance of the joint initiatives of the Chhattisgarh Forest Department and Wildlife Trust of India for the conservation of the wild buffalo in the state. This governing council has met seven times over the course of the project, and has deliberated on various issues confronting the wild buffalo in the state to come up with key decisions that have had and will continue having long term impacts on the wild buffalo. Most of these decisions have originated at the governing council and have then been ratified by the State Board for Wildlife. Some key discussions and decisions centered around:

a. **Constituted Task Force on Wild buffalo:** The state government has constituted a Wild Buffalo Task Force for the conservation and management of Wild buffalo.

b. **Crop loss ex-gratia to farmers:** It was here that concerns were raised about the negative effect of crop-raiding and the resulting retaliatory killing of wild buffalos. In the absence of any provisions for providing compensation for crops lost by farmers due to crop raiding by wild buffalos, the forest department was unable to pay any, to the resentment of aggrieved farmers. A decision was taken at the governing council to initiate a scheme, and this was approved by the state wildlife board. On the recommendation of WTI, the State Board for Wildlife approved and permitted to deploy satellite collar on wild buffalo for proper monitoring as well as know about the home range of wild buffalo. This was the first time satellite collars had been deployed on the wild buffalo.

c. **Buffalo buy-back:** In light of concerns raised at the governing council on the threats posed by the domestic buffalo population in the fringe villages around the Udanti Wildlife Sanctuary through direct competition of resources and the chances of disease transmission, a decision was taken to facilitate replacing the buffaloes by offering cows in exchange.

d. **Translocation of wild buffaloes from Assam:** This contentious issue which generated debate on whether wild buffalo from Assam should be used to boost local wild buffalo population was settled in the governing council and was further ratified by the State Board for Wildlife, thus paving the way for the movement of wild buffalo from Assam to Chhattisgarh.

Other policy inputs

A major policy input was the formulation of the wild buffalo plan for Central India, an initiative of the IUCN SSC Wild Cattle Specialist Group, Wildlife Trust of India, Satpuda Foundation and WildCRU, University of Oxford and with the part of the Forest departments of Maharashtra, Chhattisgarh, Madhya Pradesh, Assam and representative of the Ministry of Environment, Forests and Climate Change, Government of India, the Central Zoo Authority, CCMB, Hyderabad and several other experts. This plan became the official plan of the Chhattisgarh state and was instrumental for the financial support of the Ministry of Environment, Forests and Climate Change (MoEFCC) under the Recovery of Endangered Species scheme. This plan was revisited in 2019 with the representation of the states of Assam, Maharashtra, Chhattisgarh, Madhya Pradesh and Odisha and revised with new targets.

VIII. Discussion

The statewide campaign led by WTI was aimed to popularize the state animal by

lobbying with the Chhattisgarh Forest Department, Chhattisgarh Tourism department and other relevant state departments, in addition to various schools and colleges. In the three years that the wild buffalo pride campaign has run, WTI was able to reach out to every stratum of the populace with specially designed activities, equally supported by community interventions. The overall focus on a participatory approach thus, was imminent to ensure the conservation and management of wild buffaloes in the state of Chhattisgarh. The mid-campaign dipstick survey results (Fig. 7.24 and Table 7.2) on knowledge and attitudinal shifts display a positive trend that needs to be maintained across all target groups in the state.

Going forward, efforts should be persisted to popularize the species through a state-wide campaign. There is a need to undertake regular activities targeting policy-makers and statutory authorities. To maintain the momentum, WTI will be working with the various state departments to scale up the wild buffalo campaign across Chhattisgarh, covering all major cities. The mascot's (Shyamu) already established visibility will help position the wild buffalo at the top of mind recall and nudge the functionaries towards enhancing support for its conservation needs. Key initiatives being: integrating the mascot logo in a postal stamp, establishing a wild buffalo landmark in cities besides Raipur (in the form of wild buffalo square in a prominent part of the city), integrating the wild buffalo mascot with state tourism advertisements, showcasing of films/documentaries made on wild buffaloes across the state and through other awareness events that could be looked into. Additional support from WTI can be through a crafted state-wide social media campaign around the idea to establish pride and interest in the state animal.

While it is too early to establish and measure 'Pride', some key parameters to watch out for in the medium term are: the % of target audience expressing concern about the plight of the state animal; % who feel it is the citizen's duty to come forward to protect the state animal; % of people who feel this should be a priority government agenda and % of those who wish to come forward to participate in activities or respond to a call for action.

The removal of barriers from awareness to involvement and from involvement to action are true indicators of a conservation campaign's long term success.

Fig. 7.25: Wild buffalo table and wall calendar launch

REFERENCES

1. Aebischer, N. J., Robertson, P. A, and Kenwood, R. E. (1993). *Compositional analysis of habitat use from animal radio-tracking data.* Ecology 74: 1313-1325.

2. Aflalo, F. (1904). *The sports man book for India*. London.

3. Ashby, K.R., Santiapill Forsythai, C. (1986). *An assessment of the status of the banteng (Bos javanicus) with particular reference to its interaction with the water buffalo (Bubalus bubalis)*. Tiger paper 13: 10-20.

4. Bauer, G. (1987). *Reproductive Strategy of the Freshwater Pearl Mussel Margaritifera margaritifera.* Journal of Animal Ecology, 56: 691-704.

5. Bawri, M. (2014). *Studies on the ecology and distribution of wild water buffalo bubalus antee kerr. In Assam with special reference to Kaziranga national park.* (A thesis submitted to Gauhati University, Faculty of Science).

6. Beier, P. and Noss, R. (1998). *Do Habitat Corridors Provide Connectivity?* Conservation Biology. 12. 1241 - 1252. 10.1111/j.1523-1739.1998.98036. x.

7. Blanford, W.T. (1891). *Fauna of British India, including Ceylon and Burma. Mammalia (2 vol)*. London: Taylor and Francis, (OCoLC) 630186027.

8. Blyth. (1863). Published in: Proc. Zool. Soc. Lond. Vol.1863 p.155.

9. Boyce, M.S. (1992). *Annual Review of Ecology and Systematics*, 23:1, 481-497.

10. Brander, D. A.A. (1923). *Wild animal in central India.* London.

11. Buitenhuis,H, Bartosiewicz L, and Choyeke, A.M. (1998). *Archaeozoology of the near east-III*; *Proceedings of the third international symposium on the Archaeozoology of south-western Asia and adjacent areas; ARC-Publicaties 18, Groningen; The exploitation of wild and domestic water buffalo in prehistoric north western South Asia*: *Ajita K Patel and Richard H Meadow*.

12. Burnett, C. and Blaschke, T. (2003). *A multi-scale segmentation/object relationship modelling methodology for landscape analysis.* Ecological Modelling, 168(3), 233–249.

13. CAG (2006): Audit Report (Civil) for the year ended 31st March 2006: Environment And Forest Department, Pg: 74-83, *https://cag.gov.in/uploads/old_reports/state/Bihar/2006/Civil/Civil_Bihar_2006/civil_chap_3.pdf*

14. Calenge, C. (2006). *The package.* Ecological Modelling 197 (3–4), 516–519.

15. Champion, H.G. and S.K. Seth. (1968). *A revised survey of the Forest Types of India*. Manager of Publication, Govt. of India, New Delhi.

16. Charlesworth, D. & Charlesworth, B. (1987). *Inbreeding Depression and Its Evolutionary Consequences*. Annual Review of Ecology and Systematics. 18. 237-268. 10.1146/annurev.ecolsys.18.1.237.

17. Choudhary, R.G., Mookerjee, A., Menon, V. and Joshi, D. (2008). *Turning the Tide - The Story of a Campaign to Save Vhali, The Whale Shark in Gujarat.* Wildlife Trust of India, New Delhi, 14pp.

18. Choudhury, A. (1994). *The decline of the wild water buffalo in northeast India.* Oryx 28(1): 70-73.

19. Choudhury, A. (2010). *The Vanishing herds: the wild water buffalo*. Guwahati: Gibbon Books & Rhino Foundation (supported by COA, Taiwan and CEPF/ATREE).

20. Choudhury, A. (2019). *The Grand Old Buffaloes of the Savannah Need Protection*. Published in RoundGlass sustain.

21. Collins, B.M., Kelly M.,van Wagtendonk J.W and Stephens,S.L. (2007). *Spatial patterns of large natural fires in Sierra Nevada wilderness areas.* Landscape Ecology 22: 545–557. doi: 10.1007/s10980-006-9047-5

22. Converse, S. J., White, G., Farris, K. and Zack, S. (2006). *Small mammals and forest fuel reduction: National-scale responses to fire and fire surrogates*. Ecological applications: a publication of the Ecological Society of America. 16. 1717-29. 10.1890/1051-0761(2006)016[1717: SMAFFR] 2.0.CO;2.

23. Cooper, C. F. (1960). *Changes in vegetation, structure, and growth of south western pine forests since white settlement.* Ecological Monographs 30(2): 129-164.

24. Corbet, G.B. and Hill, J.E. (1992). *Mammals of the Indo-Malayan Region: A Systematic Review.* Oxford University Press, Oxford, UK.

25. Dahaban Z, Nordin M, Bennett E.L. (1996). *Immediate effects on wildlife of selective logging in a hill dipterocarp forest in Sarawak: mammals. In: Edwards DS, Booth WE, Choy SC (eds.)*

Tropical rainforest research — current issues. Kluwer Academic Publishers, Dodrecht, pp 341–346

26. Daniel, J. C. and Grubh, B. R. (1966). *The Indian wild buffalo (Bubalus bubalis) (Linn), in peninsular India: a preliminary survey*. Journal of the Bombay Natural History Society 63: 32-53.

27. Dey, S C. (1996). *Elephant Conservation in India*. Paper presented at the VIth Meeting of the IUCN/SSC Asian Elephant Specialist Group, Bangkok, Thailand, March 1996.

28. Dhamer, T.D. (1978). *Status and distribution of Asian wild buffalo (Bubalus bubalis L.) in Nepal.* M.S. thesis University of Montana, Missoula, USA.

29. Divekar, H K. (1977). *A Re-survey of the status of the Wild Buffaloes in west Bastar, Madhya Pradesh.* J. Bombay Natural History Society. 73:382-385.

30. Divekar, H. K., Grubh R. B. and Shekhar, P B. (1979). *Status and Ecology of Wild Buffalo Bubalus bubalis (Linn) in Chandrapur district of Maharashtra*. Journal of Bombay Natural History Society. 80(2): 405-409.

31. Divekar, H.K. and Bhushan. B. (1988). *Status of Wild Asiatic Buffalo (Bubalus bubalis) in the Raipur and Bastar Districts of Madhya Pradesh.* Technical Report of the Bombay Natural History Society of the Salim Ali Nature Conservation Fund, SANCF Report No. 3/1988.

32. Divekar, H.K., Gribh, R.B. and Shekhar, P.B. (1983). *Status and Ecology of Wild Buffalo Bubalus-Bubalis in Chandrapur District of Maharashtra India*, Published in Journal of the Bombay Natural History Society 80 pages 405-409 (1983).

33. DNPWC (2020). Wild Water Buffalo (*Bubalus arnee*) Conservation Action Plan for Nepal (2020-2024), Department of National Parks and Wildlife Conservation, Babarmahal, Kathmandu, Nepal.

34. Dougal, Mc. C. (1977). *The face of the Tiger*. Rivington books, London.

35. Elith J., Graham C.H. et al. (2006). *Novel methods improve prediction of species' distributions from occurrence data.* Ecography 29:129–151.

36. Elith, J. & Graham, C. (2009). *Do they? How do they? WHY do they? On finding reasons for differing performances of species distribution models.* Ecography. 32. 66 - 77. 10.1111/j.1600-0587.2008.05505. x.

37. Estavillo C., Pardini R., Rocha P.L.Bd. (2013). *Forest Loss and the Biodiversity Threshold: An Evaluation Considering Species Habitat Requirements and the Use of Matrix Habitats.* PLoS ONE 8(12): e82369. https://doi.org/10.1371/journal.pone.0082369

38. Felsenstein, J. (1985). Evolution, 39:783–791 for the conservation of wildlife. Bangkok.

39. Forsyth, J. (1871). *The Highlands of Central India: Notes on Their Forests and Wild Tribes, Natural History, and Sports.* Chapman and Hall, 1871, Original from the Bavarian State Library. Pp 472.

40. Gaur, A., and Mishra, R.P. (2019). *Technical report: Conservation status of Asiatic Wild Buffalo (Bubalus arnee) in Chhattisgarh revealed through genetic study*. Published by WTI and CCMB, Hyderabad.

41. Gee, E.P. (1964). *The Wild life of India*. Collins, London.

42. Goodman, P.S. (1977). *An evaluation of three techniques for estimating animal numbers in a wildlife population.* Unpublished mimeographed report.

43. Gray, J. E. (1821). *On the natural arrangement of Vertebrose Animals.* London Medical Repository 15: 296-310

44. Groves, C.P. and Grubb, P. (2011). *Ungulate taxonomy.* Baltimore: Johns Hopkins University Press.

45. Groves, C.P. (1996). *The taxonomy of the Asian Wild Buffalo from the Asian mainland*. 61. 327-338.

46. Grzimek, B., (ed.). (1990). *Grzimek's Animal Life Encyclopedia. Mammals I - IV. ed. Series. Grzimek, B. Vol. I-IV.* New York: McGraw-Hill Publishing Company.

47. Hansen, A.J., Knight, R.L., Marzluff, J.M., Powell, S., Brown, K., Gude, P.H., Jones, K. (2005). *Effects of exurban development on biodiversity: patterns, mechanisms, and research needs*. Ecological Applications, 15(6), 1893–1905. doi:10.1890/05-5221

48. Harvest, F., Mcneely, J. and Scherr, S. (2003). *Eco-agriculture: Strategies to feed the world and save wild biodiversity*. Bibliovault OAI Repository, the University of Chicago Press.

49. Hasan, S. M. (1980). *The enigmatic buffalo*. Hornbill 1980: 26-27.

50. Hedges, S., Baral, H., Timmins, R., and Duckworth, J. (2008). *Bubalus arnee.* The IUCN Red List of Threatened Species 2008. 10.2305/IUCN.UK.2008.RLTS.T3129A9615891.en.

51. Heinen, J.T. (1993). *Park/people relations in Kosi Tappu Wildlife Reserve, Nepal: a socio-economic analysis.* Environmental Conservation, 20 (1), 25–34.

52. Hilaluddin, J.S. Kaul,R. and Ghose.D. (2005). *Conservation implications of wild animal biomass extractions in Northeast India.* Animal Biodiversity and Conservation 28:169–179

53. Hirzel, A.H., Lay, G.Le., Helfer, V., Randin, C. & Guisan, A. (2006). *Evaluating the ability of habitat suitability models to predict species presences.* Ecological Modelling 199: 142–152.

54. Holdaway, R. & Jacomb, C. (2000). *Rapid Extinction of the Moas (Aves: Dinornithiformes): Model, Test, and Implications*. Science (New York, N.Y.). 287. 2250-4. 10.1126/science.287.5461.2250.

55. Humphrey and Bain. (1990). *Endangered Animals of Thailand.* Sandhill Crane Press, Inc. Gainesville, FL, USA.

56. IUCN 1967 Red Data Book. Vol. 1 - Mammalia. International Union for the Conservation of Nature and Natural Resources, Morges, Switzerland.

57. IUCN/SSC (2013). *Guidelines for Reintroductions and Other Conservation Translocations*. Version 1.0. Gland, Switzerland: IUCN Species Survival Commission, viiii + 57 pp. ISBN: 978-2-8317-1609-1

58. Jenks, B., Vaughan, P. W., and Butler, P. J. (2010). *The evolution of Rare Pride: using evaluation to drive adaptive management in a biodiversity conservation organization*; Eval Program Plan, May; 33(2):186-90. doi: 10.1016/j.evalprogplan.2009.07.010. Epub 2009 Aug 3

59. Jones-Farrand, D., Johnson, D., Burger, L. and Ryan, M. (2007). *Grassland Establishment for Wildlife Conservation.*

60. Kaul, R., Hilaluddin, J.S. and Mcgowan, P.J.K. (2004). *Hunting of large mammals and pheasants in the Indian western Himalaya.* Oryx 38: 426–431

61. Kaul, R., Williams, A.C., Rithe, K., Steinmetz, R. & Mishra, R. (2019). *Bubalus arnee*. The IUCN Red List of Threatened Species 2019: e. T3129A46364616. *http://dx.doi.org/10.2305/IUCN.UK.2019-1.RLTS.T3129A46364616.en*

62. Kerr, R. (1792). *The Animal Kingdom of the Celebrated Sir Charles Linnaeus: Class I. Mammalia.* London.

63. Kimura, M. (1980). *A simple method for estimating evolutionary rates of base substitutions through comparative studies of nucleotide sequences.* J Mol Evol 16, 111–120. https://doi.org/10.1007/BF01731581

64. Kinloch, C. (1885), *Large game shooting in Thibet, the Himalayas, and northern India*, Thacker, Spink and co

65. Knottnerus, M., 1907 in GBIF Secretariat. (2019). *GBIF Backbone Taxonomy.* Checklist dataset *https://doi.org/10.15468/39omei accessed via GBIF.org on 2020-08-27.*

66. Kramer-Schadt, S., Knauer, F., Kaczensky, P., Revilla, E., Wiegand, T. and Trepl, L. (2002).

Rule-based assessment of suitable habitat and patch connectivity for the Eurasian lynx in Germany. Ecological Applications. 12. 1469-1483. 10.2307/3099985.

67. Krishnan, M. (1972). *An ecological survey of the large mammals of Peninsular India*, Journal of Bombay Natural History Society, 69: 297-315.

68. Kumar A, et al. (2018). *Daughter-cell-specific modulation of nuclear pore complexes controls cell cycle entry during asymmetric division*. Nat Cell Biol 20(4):432-442.

69. Kushwaha, H.L. (1986). *Comparison of census data for wild buffalo and domestic livestock in Koshi tappu wildlife reserve.* Department of wildlife and national park and wildlife reserve, Nepal (unpublished report).

70. Lande R., Engen S. & Saether E. (2003). *Stochastic population dynamics in ecology and conservation.* Stoch. Popul. Dyn. Ecol. Conserv. i-x, 1–212.

71. Laurie. A. (1978). *The ecology and behaviour of the Great One Horned Rhinoceros.* Ph.D. Dissertation, University of Cambridge.

72. Lekagual, B. and Nelly, J.A. (1978). *The mammals of Thailand*, Association for the Conservation of Wildlife (Bangkok).

73. Linnaeus. (1758), nom. corr. Page: 618. Aleucita (Genus) Chambers, 1878, nom.

74. Lloyd, B.D. and Powlesland R.G. (1994). *The decline of kakapo Strigops habroptilus and attempts at conservation by translocation.* Biological Conservation, 69, 75-85

75. Lydekker, R. (1924). *The game animal of India, Burma and Malaya & Tibet.* London.

76. Martin, C. (1977). *Status and ecology of barasingha (Cervus duvauceli branderi) in Kanha National Park (India)*. J. Bombay Nat. Hist. Soc. 74(1): 60-13.

77. Martin, J., Kitchens, W.M. and Hines, J.E. (2007). *Importance of well-designed monitoring programs for the conservation of endangered species: case study of the snail kite.* Conservation Biology 21:472–81.

78. Matwal. M., Premjothi. P.V.R., Joshi.D., Praveenkumar. B.M., Farukhkha. B., Goutham. S., Wafar. M.V.M., Choudhury. B.C. and Kaul. R. (2014). *Gujarat's Gentle Giant — Conservation of Whale shark (Rhincodon tupus) in Gujarat.* Conservation Action Series: 20140712; Wildlife Trust of India, Noida, Uttar Pradesh.

79. McNeely, J.A., H.A. Mooney, L.E. Neville, P. Schei, and J.K. Waage (eds.). (2001). *A Global Strategy on Invasive Alien Species.* IUCN Gland, Switzerland, and Cambridge, UK. x + 50 pp

80. McRae, B. H., Dickson, B. G., Keitt, T.H. and Shah, V. B. (2008). *Using circuit theory to model*

connectivity in ecology, evolution, and conservation. Ecology 89: 2712– 2724.

81. Melton, D.A. (1978). *Ecology of Waterbuck Kobus ellipsiprymnus (Ogilby. 1833) in the Umfolozi, Game Reserve*. DSc. thesis, University of Pretoria.

82. Menon, V. (2014). *Indian Mammals: A Field Guide*. Hachette Book Publishing India Pvt Ltd.

83. Menon, V., Kaul, R., Dutta, R., Ashraf, NVK., and Sarkar, P., (Eds). (2008). *Bringing Back Manas - Conserving the forest and wildlife of the Bodoland Territorial Council*. Conservation Reference Series no.7, Wildlife Trust of India, New Delhi.

84. Menon, V., Kumar, A. (1999). *Wildlife Crime: An Enforcement Guide*. Natraj Publishers, 1999 - Wild animal trade - 110 pages.

85. Mishra, R.P & Kotwal, P.C. (2004). *Eco-biology of Indian wild buffalo (Bubalus arnee L.) in Udanti Wildlife Sanctuary, Chhattisgarh, India*. Journal of Bombay Natural History Society, Vol. 101 (2), May-Aug. 2004. Pages 252-254.

86. Mishra, R.P. & Kotwal, P.C. (2003). *Studies on Indian wild buffalo (Bubalus bubalis L.) In Udanti wildlife sanctuary, India.* Tiger. Vol. 30, No. 2. Pp. 07-11.

87. Mishra, R.P. (2001). *Studies on Indian wild buffalo (Bubalus bubalis L.) and its habitat in Udanti wildlife sanctuary.* Doctoral Degree awarded by the Pt. R.S. Shukla University, Raipur (C.G.) India.

88. Mooney, H.F. and Ry, B.N. (1929). *The distribution of Wild Buffaloes in Orissa; Miscellaneous notes.* Published in Journal, Bombay Natural History, Vol XXXIV, pg 242-245.

89. Nakhasathien, S., Cox, S., Belinda. (1990). Nomination of the Thung Yai - Huai Kha Khaeng Wildlife Sanctuary to be a U.N.E.S.C.O. World Heritage Site. Bangkok: Royal Forest Department.

90. Narain S., Panwar, H.S., Gadgil, M., Thapar, V., and Singh, S. (2005). *Joining the dots. In: Joining the dots: report of the Tiger Task Force*, pp 217.

91. Newman, D., and Pilson, D. (1997). *Increased probability of extinction due to decreased genetic effective population size: experimental populations of Clarkia pulchella*. Evolution 51: 354– 362.

92. Nowak, R. (1999). *Walker's Mammals of the World, Sixth Edition*. Baltimore and London: The Johns Hopkins University Press.

93. Pacha. A., Nigam. P., Pandav. B., Mondol. S. (2020). *Sequencing and annotation of the endangered wild buffalo (Bubalus arnee) mitogenome for taxonomic and hybridization assessment*; doi: https://doi.org/10.1101/2020.05.19.103952

94. Panwar, H.S. (1982). *Management of wildlife habitat in India: An instrumental presentation*

95. Parihar, J.S., Kotwal, P.C., Panigrahi, S., and Chaturbedi, N. (1986). *Study of wildlife habitat using high-resolution space photographs - A case study of Kanha National Park. Results from the joint Indo-Soviet remote Salyut -7.* Indian space research organization, Bangalore. Special publication ISRO - SP - 17 -86. Pp 65 -82.

96. Pearce, J., Boyce, M.S. (2006). *Modelling distribution and abundance with presence-only data*. J Appl. Ecol 43:405–412. https://doi.org/10.1111/j.1365-2664.2005.01112.x

97. Phillips S. J., Anderson R. P., Dudík M., Schapire R. E., Blair, M. E. (2017). *Opening the black box: an open-source release of Maxent.* Ecography, 40: 887–893.

98. Pocock, R.I. (1943). *The largest deer of British India*. Part II. J. Bombay Nat. Hist. Soc., 43:553-572.

99. Prater, S. (1971). *The book of Indian Animals.* Bombay History Natural Society. Bombay. presentation. Workshop on Technique in wildlife research and management. Pp. 251-271.

100. Ranjitsinh, M. K. (1997). *Beyond the Tiger – Portraits of Asian Wildlife.* Brijbasi Printers Pvt. Ltd. New Delhi.

101. Ranjitsinh, M. K., Chauhan, S. K.S., Banubakode, S.B., et al. (2000). *Status and Conservation of the Wild buffalo (Bubalus bubalis) in Peninsular India.* Wildlife Institute of India, Dehra Dun.

102. Roberts, D. L. (2013). *Refuge-effect hypothesis and the demise of the Dodo*. Conservation Biology. 27 (6): 1478–1480. doi:10.1111/cobi.12134. PMID 23992554.

103. Rodgers, W.A. and Panwar, H.S. (1988). *Planning a wildlife protected area network in India. 2 vols*. Project FO: IND/82/003. FAO, Dehra Dun.

104. Sambrook J., Fritschi, E.F. and Maniatis, T. (1989). *Molecular cloning: a laboratory manual*. Cold Spring Harbor Laboratory Press, New York.

105. Sanderson, G.P. (1896). *Thirteen years among the wild beasts of India*. London.

106. Sauer, J.R., Hines, J.E. and Fallon, J. (2004). *The North American Breeding Bird Survey, Results and Analysis 1966 - 2003.* Version 2004.1. USGS Patuxent Wildlife Research Center, Laurel, Maryland.

107. Scheffers, B.R., Oliveira, B.F., Lamb, I. et al. (1 more author). (2019). *Global wildlife trade across the tree of life*. Science, 366 (6461). pp. 71-76. ISSN 0036-8075; https://doi.org/10.1126/science.aav5327

108. Scott, R.W. (1968). *Notes on the inter breeding between domestic and wild buffalo in upper Assam*. JBNHS, Vol. 66 (1).

109. Shanahan, E., Mcbeth, M., Tigert, L. and Hathaway, P. (2010). F*rom protests to litigation to YouTube: A longitudinal case study of strategic lobby tactic choice for the Buffalo Field Campaign*. Mark K McBeth. 47. 10.1016/j.soscij.2009.10.002.

110. Singh, A.T. (1980). Feedback: *The enigmatic buffalo.* Hornbill 1980: 4.

111. Smith, C. H. (1827). *Sub-genus I. Bubalus. In Griffith, E. (ed.). The animal kingdom arranged in conformity with its organization. Class Mammalia, Volume 5.* London: Geo. B. Whittaker. pp. 371–373.

112. Spillet, J.J. (1966). *The Kaziranga wildlife sanctuary*, *Assam.* JBNHS, Vol. 63 (3) pp. 494 – 527.

113. Spillet, J.J., Tamang, K.M. (1966). The Journal of the Bombay Natural History Society. Volume: 63. Date: 1966. Page Range: 557--572.

114. Stacey, P. and Taper, M. (1992). *Environmental Variation and the Persistence of Small Populations.* Ecological Applications. 2. 18-29. 10.2307/1941886.

115. Sterndale, R.A. (1884). *Natural History of the Mammals of India and Ceylon*. Thacker, Spink, Calcutta, 540 pp.

116. Thornback, J. (1983). *Wild cattle, bison and buffaloes*. IUCN Conservation Monitoring Centre, Cambridge, U.K.

117. Uicharoensak. (1992). *Ecology and current distribution of Wild buffalo (Bubalus bubalis L 1758) in Huai Kha Khaeng wildlife sanctuary. Uthai Thani Provinces*. Unpublished report, Graduate School, Kasetstart, University, Bangkok, Thailand.

118. Villanueva, M.A., Mingala, C.N., Tubalinal, G.A.S., Gaban, P.B.V., Nakajima, C., and Suzuki, Y. (2018). *Emerging Infectious Diseases in Water Buffalo: An Economic and Public Health Concern*; DOI: 10.5772/intechopen.73395

119. Wharton, C.H. (1957): *An Ecological Study of the Kouprey, Novibos sauveli (Urbain).* Monograph no. 5, pp. 1–107. Monographs of the Institute of Science and Technology, Manila, The Philippines.

120. Winters, R., Hume, J. P. and Leenstra, M. (2017). *A famine in Surat in 1631 and Dodos on Mauritius: a long lost manuscript rediscovered.* Archives of Natural History. 44 (1): 134–150. doi:10.3366/anh.2017.0422.

121. WTI. (2009). *Struggle for survival: Conservation of Wild buffalo (Bubalus bubalis arnee) in Central India with special reference to Udanti WLS, Chhattisgarh.* Report submitted to Ministry of Environment and Forest, Govt. of India. Wildlife Trust of India

122. Yoccoz, N.G., Nichols, J.D. and Boulinier, J.D. (2001). *Monitoring of biological diversity in space and time.* Trends in Ecology & Evolution, 16, 446-453.

ANNEXURE - I

c/o Zoological Society of London[1], Regents Park, London NW1 4RY UK

Monday, 21 September 2009

Dr. Vivek Menon Executive Director

Wildlife Trust of India (WTI)

Re: the visit by Richard Kock and Mark Stanley Price to Raipur and Udanti Wildlife Sanctuary (WLS) to advise on the conservation challenges to the threatened wild buffalo (Bubalis arnee) in Chhattisgarh, India

Dear Vivek

Thank you for your and your staff's kind hospitality during our recent visit to Raipur for the 4th Governing Council for Wild Buffalo Conservation in Chhattisgarh meeting 12.9.09.and for the subsequent field visit to the Udanti WLS to observe the buffalo and to discuss matters with WTI and forest department staff. The meeting was a most valuable orientation to the issues and potentials for the recovery of the highly threatened Chhattisgarh buffalo population. This was clearly greatly helped by the excellent presentation of the microsatellite data by Dr Gaur and the contributions from staff of WTI and the Forest Department, ably chaired by PCCF Dr NK Bhagat of the Forest Department (FD).

We appreciate the dedicated and arduous field work by WTI staff and FD, which has provided a precise and comprehensive picture of the situation on the ground.

Our key observation is that while the situation of one female and 6 male wild buffalo remaining is dire and very fragile for the survival of the species in the state, nonetheless we believe recovery can be achieved through a suite of bold interventions.

We confirm that the primary issue is a demographic one; the skewed sex ratio of the remnant buffalo and the low numbers, demand that the population must be increased as rapidly as possible. We also see considerable scope for genetic management and experimentation in support of a multifaceted approach to expanding the population, retaining as many of the wild genes that will exist in an expanded wild buffalo herd.

Our recommendations fall under the following headings:

e. Management of captive wild buffalo in Udanti

Since there is no option left but to intensively manage and reinforce this remnant herd of buffalo, several measures should be instigated regarding captive buffalo.

- The current holding facility requires some upgrading. The most important reason is to reduce the risk of leopard attack; this is particularly urgent and probably best achieved with a double fence, using the old one as an outer perimeter and placing an inner fence. This will also reduce the risk of disease transmission. We recommend that Asha gives birth inside a high security compartment of the facility which will need to be built and that she and the calf are carefully protected until the calf's size is likely to deter any potential attack. The mother and calf should be fed inside the high security section and kept in each night for an extended period and with continuous, on site security whilst in the enclosure during the day.

- Raja should be released quite soon to enable adaptation to living in the wild and with the other bulls. This must be achieved before his reaching sexual maturity and being a challenge to them. Radio-collaring would be a recommended option to ensure effective monitoring of this animal during this period.

- Chottu, the young bull accompanying Asha currently, should be removed well before she returns to oestrus and he should be kept in a separate facility. He should be replaced with an alternate bull which cannot be the sire of Asha or of the expected calf.

- There should be an attempt, during any close observation or intervention with any of the buffalo, to establish the state of incisor teeth eruption (relevant for the first 6 years of life after which time the mature set of teeth are less useful for determining age).

- Every opportunity should be taken to develop protocols for wild buffalo sperm collection, superovulation and their preservation to help future efforts in assisted reproduction should that become necessary.

f. Health of the buffalo

Given that the buffalo population is now highly vulnerable to extinction, all precautions should be taken to avoid unnecessary exposure of the animals kept in the enclosure to novel infection. Free-ranging buffalo will have to take their chance as little can be done to reduce risk other than vaccination and routine treatment of buffer zone livestock and / or to remove chronically ill or infectious animals from the vicinity.

- Please note that the biosecurity of the location is poor.

- We recommend that **no vehicle** is brought (unless absolutely necessary) to within 500 meters of the pen system or across the river. In addition, the animal keepers should **not** at any time have contact with other livestock. Any visitor should be asked to ensure that their shoes and clothing are clean before coming on site. Contamination of food and tools from other livestock must be guarded against.

- A veterinary protocol regarding health and disease monitoring and biosecurity should be developed by WTI and FD (WHSG can assist, if asked, in completing this task). The health of village cattle and buffalo should be ascertained to assess potential disease risks e.g. screening for Tuberculosis. It seems data is lacking other than from government farms which are not relevant to this situation

g. Recovery options for the wild buffalo population in Udanti

There is no resilience against catastrophic loss remaining in the Udanti population and this herd is inadequate stock for recovery.

- The best immediate action is to bring in more wild buffalo from the known accessible populations as soon as possible. Females are the immediate priority but a minimum of 10 breeding animals should be the short term objective which might comprise 90% of the original population's genetic variability. We understand that there are a number of buffalo that might be captured in Indravati Tiger Reserve (adjacent to Garcharoli) during the coming dry season. This group should be continuously monitored by local trackers and their movements and daily patterns determined prior to the capture team being constituted on site. Whilst we have discussed the basic requirements and needs for a capture operation, in difficult terrain, we are available for more advice on this aspect.

- A full Population Viability Analysis would be helpful to more exactly determine the future strategy for recovery of the Udanti buffalo. We understand that the Asian Cattle Specialist Group of IUCN is planning to meet in 2010 in India: this would be an appropriate time to complete this action.

h. Genetics

The concern over hybridization may be overstated as the gene flow has been predominately wild to domestic and has probably occurred for many hundreds of years without any disastrous consequences for the wild population. This has been shown in a number of other species e.g. Bactrian camel and ibex with these species retaining their distinctive character despite occasional domestic gene inflow. The important recommendation is to restore the resilience of the wild population and reduce the risk of gene introgression which might occur with the last remaining buffalo. The problem, therefore is essentially a demographic issue.

- The molecular genetic analysis suggests that we are dealing with a genetic resource that is quite distinct from domestic buffalo but we have to assume that over the centuries there has been gene flow between wild and domestics and with scope for individual buffalo going feral and breeding back to wild ones. We expect that the observed, uniquely marked, domestic buffalo in the local herds might contain valuable wild origin genes which should be reincorporated into the wild herd if at all possible.

Above and below domestic buffalo in Udanti with wild phenotypic characters – white chest crescent neck collar and socks

- Asha is an important individual with some unique alleles when compared to the bulls, other than Raja her son. The paternity for Raja remains unclear but this should be available within a few months.

- We recommend continued efforts to clarify the relationships between the 7 buffalo and with copious comparisons from other sites. This should include genetic examination of the local domestic buffalo, specifically those with "wild" phenotypic characteristics

- We recommend that as buffalo are removed from the local villages, those considered to have wild attributes are kept as a reservoir for future genetic management should that prove necessary.

- We recommend that males should be removed from the domestic herds and domestic females are allowed to be mated by wild bulls. Ideally bull calves in the villages should be castrated.

- Depending on the success of the capture operations one female should be located at a suitable veterinary establishment for superovulation, and the use of surrogate domestic buffalo investigated to speed up the increase in population size. Protocols for subsequent rearing and integration of calves would have to be developed.

- We recommend that all available expertise on the wild (phenotypic) traits of the species should be brought to bear on the evaluation of the herd and the local domestic stock.

These are the main points but other issues will no doubt arise as matters progress and please be assured of our interest and commitment to this as time passes. This is a very worthwhile and interesting project which will have valuable lessons for future conservation efforts in India.

Good luck with all and please relay our sincere thanks to all concerned for their kind attention to our needs and engagement on this important project

Sincerely

Dr Richard Kock Co-Chair IUCN Wildlife Health Specialist Group

Dr Mark R Stanley Price, Member, IUCN Re-introduction Specialist Group cc.Dr Simon Stuart, Chair of IUCN SSC.

Wild buffalo "Chotu"

ANNEXURE - II (i) MODULE A

Wildlife Trust of India

WILDLIFE CRIME PREVENTION TRAINING

	Sessions		Trainer
Day 1	**Session 1: Introduction**		
	10:00 – 10:15	Introduction of WTI (Explaining who you are and why you are here; WTi, donors)	RPM
	10:15 – 10:20	Introduction of Trainers	RPM
	10:20 – 10:40	Introduction of Wildlife Crime Prevention Training (About the Guardians of the wild program, goals and objectives, need for the training, modules, outline of the training program, emphasizing the capacity building)	RPM
	10:40 – 11:00	Pre-assessment Test	KM/ JK
	11:00 – 11:30	Tea Break	
	Session 2: General understanding on wildlife conservation		
	11:30 – 12:00	Bio-diversity of Udanti-Sitanadi Tiger Reserve (food chain, values of biodiversity, threats of biodiversity, conservation of biodiversity)	RPM
	12:00 – 12:30	Identification of herbivores and carnivores (pugmarks, horns etc)	RPM

Session 3: Wildlife Crime Prevention		
12:30 – 01:30	What is wildlife and wildlife crime	JL
01:30 – 02:30	Lunch Break	
02:30 – 03:30	Sport hunting and commercial poaching and trade	JL
03:30 – 04:00	Tea Break	
04:00 – 04:30	Important species in illegal wildlife trade	JL
04:30 – 05:00	Methods of hunting	JL

Day 2	**Session 4: Wildlife Laws**	
10:00 – 11:00	Understanding wildlife laws in India, Definitions	YKS
11:00 – 11:30	Tea Break	
11:30 – 01:30	Different Sections of WLPA, 1972 (definitions and imp. sections)	YKS
01:30 – 02:30	Lunch Break	
Session 5: Patrolling		
02:30 – 03:30	Patrolling (factors essential for successful patrolling, recording observations during a patrol, do's and don'ts)	RPM
03:30 – 04:00	Tea Break	
Session 6: Field investigations		
04:00 – 05:30	Field Investigations (Developing an informer network; Crime scene search; Collecting evidence from a crime scene)	JL/ YKS

Day 3	Session 7: Field Work (patrolling)	
07:30 – 09:00	Patrolling in Forest (Practical)	RPM/ JC
09:00 – 10:00	Tea Break with breakfast	
	Session 8: Schedules	
10:00 – 11:00	Different Schedule of WLPA, 1972	RPM
	Session 9: Field work (Crime scene)	
11:00 – 01:00	Crime-scene Investigation - PRACTICAL	JL/ KM
01:00 – 01:30	Crime scene documentation and POR	JL/ YKS
01:30 – 02:30	Lunch Break	
02:30 – 04:00	Court Room scene…case defending	JL/ YKS
04:00 – 04:30	Tea Break	
	Session 10: Concluding session	
04:30 – 05:00	Post assessment and prizes	KM/ JK
05:00 – 06:00	Kits distribution and valediction	

ANNEXURE - II(ii) MODULE B

Time	Subject	Duration
	SESSION 1 – INTRODUCTION	
09:30 – 10:00	Registration of the trainee participants	
10:00 – 10:15	Introduction to the entire programme	15 minutes
10:15 – 10:35	Pre- Training evaluation	20 minutes
10:35 – 11: 00	Interactive exercise on commonly hunted species, hunting methods and hunting communities	25 minutes
11:00 – 11:15	Tea break	15 minutes
	SESSION 2 – WILDLIFE BILOGY	
11:15 – 12:00	Identification of hoof and pug marks, scats	45 minutes
12:00 – 01:00	Biodiversity and its threats (habitat loss, poaching of wildlife, Human-Wildlife conflict)	60 minutes
01:00 – 02:00	Lunch break	60 minutes
	SESSION 3 – WILDLIFE CRIME and LAW	
02:00 – 03:30	Wildlife and wildlife crime (commercial poaching, species in wildlife trade, methods of hunting, global trade scenario, identification of body parts)	90 minutes
03:30 – 03:45	Tea break	15 minutes
03:45 – 04:15	What is offence	30 minutes

04:15 – 05:30	Important sections of Wildlife Protection Act, 1972, Code of Criminal Procedure, 1973 and Indian Evidence Act, 1872	75 minutes

SESSION 4 - CRIME SCENE INVESTIGATION		
10:00 – 11:00	Informers Network	60 minutes
11:00 – 11:15	Tea break	15 minutes
11:15 – 12:30	Crime Scene Investigation (Recap of previous training)	35 minutes
12:30 – 01:00	Documentation of Crime scene (PIL, case diary, Panchanama)	30 minutes
01:00 – 02:00	Lunch break	60 minutes
02:00 – 02:30	Wildlife Trade and enforcement (National and International issues)	60 minutes

SESSION 5 – COURT PROCEEDING		
02:30 – 03:30	How to file a complaint (Investigation and Documentation)	60 minutes
03:30 – 03:45	Tea break	15 minutes
03:45 – 05:00	Discussion on Complaints, Court Procedures, Arguments and Judgments (with case studies from the PA)	75 minutes
05:00 – 05:30	Post-training evaluation and feed back	30 minutes
05:30 – 06:30	Distribution of certificates, kits and end with National Anthem	60 minutes

Closing session

ANNEXURE - III(i)

Staff participated in VRP training at Udanti - Sitanadi, Chhattisgarh, 2013

Udanti-Sitanadi Tiger Reserve

Staff list who attended the VRP training in 2013

S.No.	Range name	Name	Designation
1	North Udanti	P R Dhruv	RFO
2	South Udanti	G S Parmar	RFO
3	North Udanti	Dashru Ram Kurveti	Forester
4	North Udanti	Kishan Lal Sahu	Forester
5	North Udanti	M D Manikpuri	Forest Guard
6	North Udanti	Kishor Kumar Yadav	Wireless Optr.
7	North Udanti	Samaru Lal Kashari	Forest Guard
8	North Udanti	Amar Singh Rajput	Forest Guard
9	North Udanti	Girish Kumar Rajak	Forest Guard
10	North Udanti	Mani Ram Sahu	Forest Guard
11	North Udanti	Pawan Kumar Nishad	Forest Guard
12	North Udanti	Rikhi Ram Kanwar	Forest Guard
13	South Udanti	Udho Singh Dhruv	Forest Guard
14	South Udanti	Lochan Ram Nirmalkar	Forest Guard
15	South Udanti	Parmeshwar Dadsena	Forest Guard
16	South Udanti	Kapil Singh Thakur	Forester
17	South Udanti	Kripa Ram Sahu	Forest Guard
18	South Udanti	Moti Ram Patra	Forest Guard
19	South Udanti	Lal Bahadur Singh	Forest Guard
20	South Udanti	Ageshwar Kumar Sahu	Forest Guard

21	South Udanti	Manoj Kumar Dhruv	Forest Guard
22	South Udanti	Ganesh Ram sinha	Forest Guard
23	South Udanti	Baran singh Dongre	Forest Guard
24	North Udanti	Shiv Kumar Patel	Casual Worker
25	North Udanti	Ganesh Kumar Dhruv	Casual Worker
26	North Udanti	Lalit Ram Mahar	Casual Worker
27	North Udanti	Baldev Yadav	Casual Worker
28	North Udanti	Brij Lal Gaur	Casual Worker
29	North Udanti	Shyamlal Yadav	Casual Worker
30	North Udanti	Dilip Bhujia Jugad	Casual Worker
31	North Udanti	Ramkumar Jugad	Casual Worker
32	North Udanti	Balsingh Jadhav	Casual Worker
33	North Udanti	Hanuman Singh Rajput	Casual Worker
34	South Udanti	Dhanesh Yadav	Casual Worker
35	South Udanti	Shobha Chand Yadav	Casual Worker
36	South Udanti	Nawal Yadav	Casual Worker
37	South Udanti	Ghanshyam Netam	Casual Worker
38	South Udanti	Lalit Yadav	Casual Worker
39	South Udanti	Ghanshyam Kanwar	Casual Worker
40	South Udanti	Daulat Ram Kamar	Casual Worker
41	South Udanti	Puna Ram Sahu	Forest Guard
42	Udanti	K L Nirmalkar	ACF
43	Udanti	Moiz Khan	NNWS
44	South Udanti	Ramsay Sherpa	Forester
45	North Udanti	Rajnu Ram Nag	Forest Guard
46	North Udanti	Maya Ram Dhruv	Forest Guard
47	North Udanti	Moti Ram markam	Forest Guard
48	North Udanti	Anvar Ali	Driver
49	North Udanti	Human Singh Dhruv	Driver
50	South Udanti	Man Singh Nirmalkar	Driver
51	North Udanti	Pappu Miyan Qureshi	Forest Guard

52	South Udanti	Kartik Ram Baghel	Chowkidar
53	North Udanti	Vikram Singh Netam	Casual Worker
54	Risgaon	Bhukhan Lal Sori	Forester
55	Risgaon	Rikhi Ram Kuldeep	Dy. RFO
56	Risgaon	Shailendra Kashyap	Dy. RFO
57	Risgaon	Dharmendra Kumar soni	Forest Guard
58	Risgaon	Toran Nag	Forest Guard
59	Risgaon	Raj Kumar Sharma	Forest Guard
60	Risgaon	Kamlesh Yadu	Forest Guard
61	Risgaon	Chandan Ketu Mahipal	Forest Guard
62	Sitanadi	B S Rajput	Dy. RFO
63	Sitanadi	Devsharan Lal Sahu	Forester
64	Sitanadi	Kalyan Sahu	Forest Guard
65	Sitanadi	Sukhdev Nishad	Forest Guard
66	Sitanadi	Rahul Singh Rajput	Forest Guard
67	Sitanadi	Ganesh Ram Netam	Forest Guard
68	Sitanadi	Deviram Dhruv	Forest Guard
69	Sitanadi	Dhannaji Markam	Forest Guard
70	Sitanadi	Churaman Lal Dhratalhare	Forest Guard
71	Sitanadi	Uday Ram Yadav	Chowkidar
72	Arsikanhar	Rameshwar Lal Patel	Dy. RFO
73	Arsikanhar	Shantanu Ram Shandilya	Forester
74	Arsikanhar	Shankar Lal Chandrakar	Forest Guard
75	Arsikanhar	Kunjal Singh Dhruv	Forest Guard
76	Arsikanhar	Sohan Lal Nishad	Forest Guard
77	Arsikanhar	Govardhan Lal Yadav	Forest Guard
78	Arsikanhar	Sohan Lal Yadav	Forest Guard
79	Arsikanhar	Nakul Ram Bhandari	Forest Guard
80	Arsikanhar	Kunal Tiwari	Forest Guard
81	Arsikanhar	Bhuwaneshwar Prasad Sahu	Forest Guard
82	Arsikanhar	Komal Prasad Bisen	Forest Guard

83	Arsikanhar	Ashok Nirmalkar	Forest Guard
84	Arsikanhar	R S Madavi	RFO
85	Risgaon	Sohan Lal Netam	Forester
86	Risgaon	Umashankar Sakshi	Forester
87	Risgaon	Saras Chandra Sahu	Forest Guard
88	Risgaon	Vipin Chandra Bisen	Forest Guard
89	Risgaon	Ratan Lal Yadav	Forest Guard
90	Risgaon	Panna Lal Soni	Forest Guard
91	Risgaon	Rajendra Prasad Sinha	Forest Guard
92	Sitanadi	Gopal Singh Kashyap	Dy. RFO
93	Sitanadi	Taran Ram Sahu	Forester
94	Sitanadi	Danveer Chinda	Forester
95	Sitanadi	Awadh Kumar Sahu	Forest Guard
96	Sitanadi	Mani Ram Netam	Forest Guard
97	Sitanadi	Bharat Lal Markam	Forest Guard
98	Sitanadi	Shiv Lal Markam	Forest Guard
99	Sitanadi	Mishri Lal Kashyap	Forest Guard
100	Sitanadi	Chakradhar Devagan	Forest Guard
101	Arsikanhar	Kamta Lal Markam	Forester
102	Arsikanhar	Bhola Nath Chourasia	Forester
103	Arsikanhar	Shiv Prasad Dhruv	Forester
104	Arsikanhar	Narayan Singh Dhruv	Forest Guard
105	Arsikanhar	Chandra Prakash Sinha	Forest Guard
106	Arsikanhar	Chandrabhan Sahu	Forest Guard
107	Arsikanhar	Bhikh Ram Dhruv	Forest Guard
108	Arsikanhar	Uttam Singh Sahu	Forest Guard
109	Arsikanhar	Aniruddh Som	Forest Guard
110	Arsikanhar	Prabhu Lal Markam	Forest Guard
111	Arsikanhar	Jitendra Thakur	Forest Guard
112	Arsikanhar	Nand Kumar Yadav	Forest Guard
113	Arsikanhar	Sitaram Sahu	Forest Guard

114	Arsikanhar	Dhelu Ram Sahu	Chowkidar
115	Sitanadi	Lakesh Kumar Kashyap	Casual Worker
116	Arsikanhar	Chandrakant Pandey	Chowkidar
117	Arsikanhar	Amrit Lal Dhruv	Chowkidar
118	Arsikanhar	Deena Nath Yadav	Chowkidar
119	Arsikanhar	Devbrat Kumar Nagvanshi	Chowkidar
120	Arsikanhar	Chhanu Lal Prajapati	Casual Worker
121	Arsikanhar	Santosh Kumar	Driver
122	Arsikanhar	Sanjay Kumar Sahu	Casual Worker
123	Arsikanhar	Santu Ram Sori	Casual Worker
124	Arsikanhar	Gajendra Yadav	Casual Worker
125	Arsikanhar	Rohit Kumar Sahu	Chowkidar

ANNEXURE - III (ii)

Staff participated in VRP training at Udanti - Sitanadi, Chhattisgarh, August, 10-12, 2016

S. No.	PA/ Div.	Name	Designation
1	South Udanti	Kapil Singh Thakur	Forester
2	South Udanti	Motilal Ratre	Forest Guard
3	South Udanti	Lal Bahadur Singh	Forest Guard
4	South Udanti	Ratanlal Yadav	Forest Guard
5	South Udanti	Ageshwar Kumar Sahu	Forest Guard
6	South Udanti	Kriparam Sahu	Forest Guard
7	Indagaon Range	Madhusudan Singh Thakur	Forester
8	Indagaon Range	Yogesh Kumar Sahu	Forester
9	Indagaon Range	Chukeshwar Kumar Dhruw	Forest Guard
10	Indagaon Range	Takeswar Dewangan	Forest Guard
11	Indagaon Range	Kavindra Mishra	Forest Guard
12	Indagaon Range	Umed Singh Rajpoot	Forester
13	North Udanti	Dasruram Kurvti	Deputy Ranger
14	North Udanti	Kishanlal Sahu	Deputy Ranger
15	Kulharighat	Laxmidas Murchuliya	Deputy Ranger
16	Taurainga	Amarsingh Thakur	Forester
17	Taurainga	Mayaram Dhruw	Forester
18	Arsikanhar	Bholanath Chaurasiya	Deputy Ranger
19	Arsikanhar	Mishrilal Kashyap	Forester

20	Arsikanhar	Kamta lal Markam	Deputy Ranger
21	Arsikanhar	Shantanu Shandilya	Forester
22	Arsikanhar	Shivprasad Dhruw	Forester
23	Risgaon	Sohanlal Netam	Deputy Ranger
24	Risgaon	Chandketu Mahipal	Deputy Ranger
25	Risgaon	Rikhiram Mahipal	Deputy Ranger
26	Risgaon	Laxman Singh Jain	Forester
27	Arsikanhar	Anasram Dhruw	Forester
28	North Udanti	M.D. Manikpuri	Office Assistant
29	Sitanadi	Basantlal Dhruw	Forester
30	Sitanadi	Devsaranlal Sahu	Forester
31	Sitanadi	B.S. Rajpoot	Deputy Ranger
32	South Udanti	Lochanram Nirmalkar	Forest Guard
33	North Udanti	Motiram Makram	Forester
34	South Udanti	Punaram Sahu	Forest Guard
35	North Udanti	R.D. Rajak	Range Officer
36	North Udanti	Girish Kumar Rajak	Forest Guard
37	Arsikanhar	Gopal Kashyap	Range Officer
38	Indagaon Range	A.K. Mishra	S.D.O.
39	Kulharighat	R.N. Sori	Range Officer
40	Sitanadi	J.R. Markam	Range Officer
41	Taurainga	V.C. Bisen	Forester
42	Sitanadi	R.K. Rayasth	Asst. Director
43	Taurainga	Sunil Kumar Sharma	Asst. Director
44	Udanti	D.S. Patre	Asst. Director
45	Udanti	Parmeshwar Dadsena	Forest Guard
46	Udanti	Vivekanand Reddy	Deputy Director

WTI PUBLICATIONS

A. OCCASIONAL REPORTS

Tribal Territories:
Impact assessment around the Jarawa tribal reserve, middle and south Andaman Islands

Jumbo Express:
A scientific approach to understanding and mitigating elephant mortality due to train accidents in Rajaji National Park.

Elephant in Exile:
A rapid assessment of the human-elephant conflict in Chhattisgarh

Against the Current:
Otters in the river Cauvery, Karnataka

Silent Stranglers:
Eradication of mimosa in Kaziranga National Park, Assam

Living at the Edge:
Rapid survey for the endangered Ladakh urial (*Ovis vignei vignei*) in Leh district of Ladakh Trans-Himalaya

Search for Spectacle:
A conservation survey of the Phayre's leaf monkey (*Tranchypithecus phayrei*) in Assam and Mizoram

Awaiting Arribadda:
Protection of Olive Ridley turtles (*Lepidochelys olivacea*) and their nesting habitats at Rushikuliya rookery, Orissa

Living with Giants:
Understanding human-elephant conflict in Maharashtra and adjoining areas

Crane Capital:
Conservation strategy for Sarus Crane (*Grus antigone*) habitat in Etawah and Mainpuri Districts, Uttar Pradesh

Carnivore Conflict:
Support provided to leopards involved in conflict related cases in Maharashtra

India at the International Whaling Commission:
A policy document on India's involvement in the IWC 1981-2003

Sighting Storks:
Status and distribution of Greater adjutant storks (*Leptoptilos dubius*) in the Ganga and Kosi river floodplains near Bhagalpur, Bihar

Bait and Watch:
Popularization of alternatives to dolphin oil among fishermen for the conservation of the Ganges river dolphin (*Plantanista gangetica*) in Bihar

Captive Concerns:
Health and management of captive elephants in Jaipur

Fair Concern:
Health and management of captive elephants in Sonpur

Ganesha to Bin Laden:
Human-elephant conflict in Sonitpur district of Assam

Healing Touch:
Health and Management of captive elephants in Kaziranga (2003, 2004, 2005)

Dog and Bull:
An investigation into carnivore-human conflict in and around Itanagar Wildlife Sactuary, Arunachal Pradesh

Making Way:
Securing the Chilla-Motichur corridor to protect elephants

No Mast Kalandar:
The Beginning to the Ens of Dancing with Bears

Deadly Tracks:
A scientific approach to understanding and mitigating elephant mortality due to train hits in Assam

Hunt for Hangul:
Establishing the presence of Hangul outside Dachigam NP, J&K

Civet Chronicles:
Malabar Civet Report

Bear Necessities:
A Scientific approach to understand and mitigate Human Sloth bear Conflict in Madhya Pradesh

B. CONSERVATION ACTION REPORTS

Beyond the Ban:
A census of Shahtoosh workers in Jammu & Kashmir

Biodiversity, Livelihoods and the Law:
The case of the 'Jogi Nath' snake charmers of India

Goats on the Border:
(First edition 2005 and Second edition 2007) A rapid assessment of the Pir Panjal markhor in Jammu & Kashmir distribution, status and threats

The Ground Beneath the Waves:
Post-tsunami impact assessment of wildlife and their habitats in India

Goats beyond the border: (Second edition)
A Rapid Assessment of the Pir Panjal 10 Markhor in J&K Distribution, Status and Threats

Walking the Bears:
Rehabilitation of Asiatic black bears in Arunachal Pradesh

Mountain Migrants:
Survey of Tibetan Antelope (*Pantholops Hodgsonii*) and Wild Yak (*Bos Grunniens*) in Ladakh, J&K

Predator Alert:
Attacks on humans by leopards and Asiatic black bear in the Kashmir valley – Analysis of case studies and spatial patterns of elevated conflict

Turning the Tide:
The campaign to save Vhali, the Whale Shark (*Rhincondon Typus*) in Gujarat

Tiger Country:
Helping Save Bhutan's Natural Heritage

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Coral Reef Recovery in Mithapur

The Last Dance:
Kalandar Alternative Livelihood Project/ Sloth Bear

Gujarat's Gentle Giants:
Conservation of Whale Shark in Gujarat

Living with the Wild:
Mitigating Conflicts between Humans and Big Cat species in Uttar Pradesh

Safe Passage, Safe Habitation:
Securing the Thirunelli-Kudrakote Elephant Corridor through Voluntary Relocation

CONSERVATION ACTION SERIES

When population surveys in the state of Chhattisgarh revealed that there were fewer than 50 Asian wild buffalo (*Bubalis arnee*) with only seven remaining in Udanti Tiger Reserve, the state governmnet partnered with Wildlife Trust of India (WTI) in 2005 for an intensive recovery program of their State Animal.

This Conservation Action Report documents the measures taken to bring back the population through core science, ecology, policy, enforcement and capacity building, community engagement and campaigns with Indian and International experts.

Wildlife Trust of India

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