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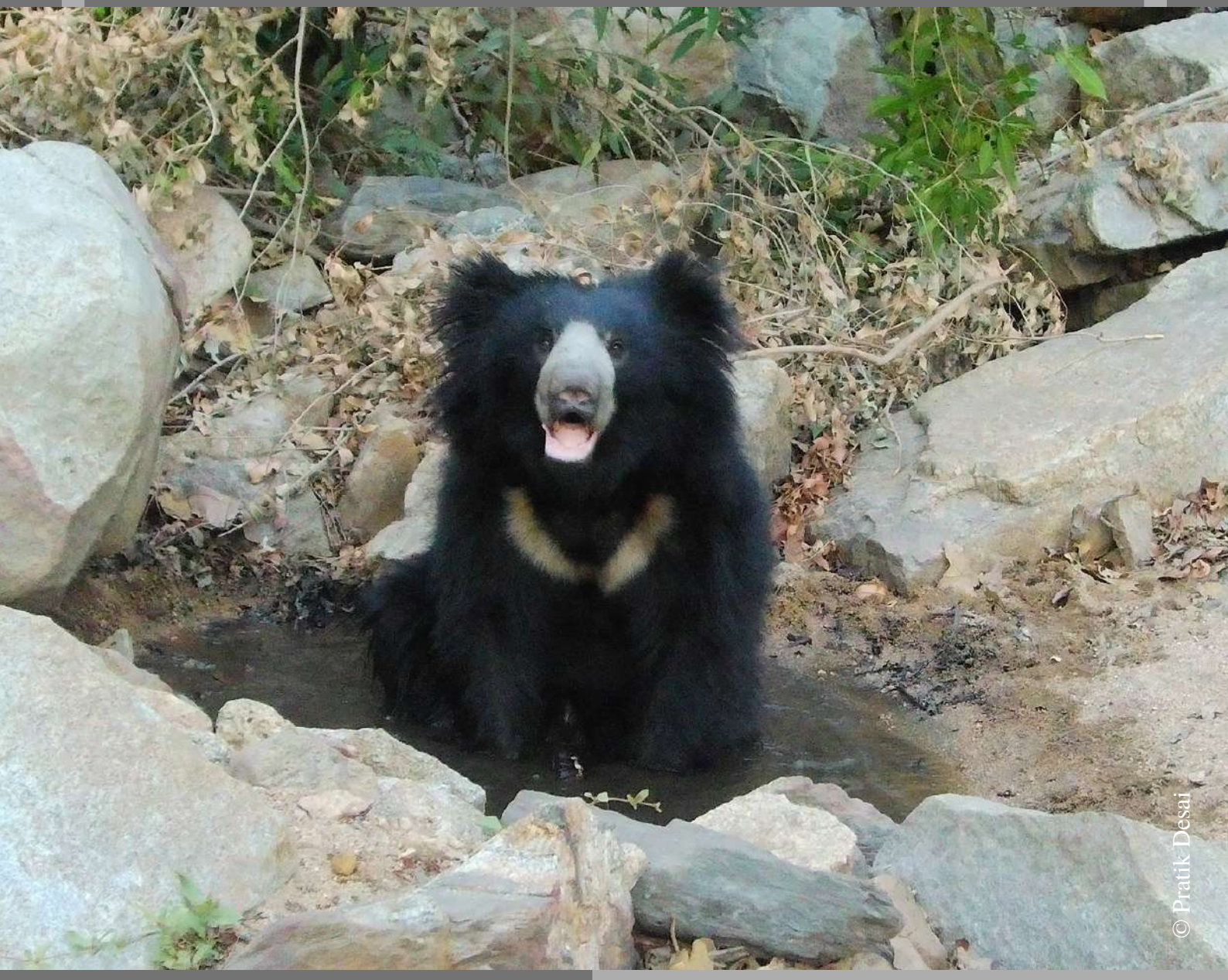

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A review on human-sloth bear conflicts in Gujarat

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EDITORIAL NOTE

पृथिवीं परितो व्याप्य तामाच्छाद्य स्थितं च यत्, जगदाधाररुपेण पर्यावरणमुच्यते |

The one that is present all around the earth and ensures its balance is called the Environment.
The environment and the respect for each of its component, maintains the balance for all the life forms on this earth. The early tribes of humans that settled and evolved as a human race, worshipped the elements of Nature as their protectors. They also worshiped plants and animals which were the primary resources used for their existence and wellbeing. The traditional festivals of multicultural India can trace back their origin to the underlying scientific thought and vision of protecting Mother Nature.

The seasonal changes in the bounty of Mother Nature bring in a series of festivals in India that are often associated with the premise of protecting the environment. Beautifully woven folklore and mythological stories that are part of generations, are often understood better when we learn to appreciate the scientific thought of restoring and rebuilding of natural wealth, by celebrating the festivals in an eco-friendly manner. The 'Pola' festival celebrated in Maharashtra, Madhya Pradesh and Chhattisgarh is dedicated to the Bulls and Oxen that are important to the farming practices. The 'Nag Panchami' is celebrated in Maharashtra to worship snakes as friends of farmers and guards of forests and a snake boat race is organized during celebrating 'Onam' in Kerala. The Elephant festival is celebrated in Jaipur as 'Gaj-Utsav' but also more popular is the Ganesh-Utsav of Maharashtra and many other parts of the country. Each state of India celebrates its harvest festivals such as Bihu, Baisakhi, Lohri, Sankranti, Pongal. 'Van-Mahotsav' is organized in different parts of India to appreciate the efforts towards forest conservation.

Though there is much information available in recent years regarding the importance of celebrating these festivals in a nature friendly manner, some of the deep-rooted superstitions still control the actions of some people. We feel saddened to read about the snakes that are kept hungry for days before Nag Panchami so that they are forced to drink milk on the festival day and may loose their lives due to indigestion. Or the uncontrolled massacre of young tender Banyan shoots before the festival of 'Vat-Pournima', where many Banyan trees lose their ability to regenerate. Atrocities on animals such as Elephants are beyond comprehension of a sensitive mind. More often our understanding of the role of wild animals in stabilizing nature's cycle and their protection is limited to celebrating the 'National Tiger Day' or 'National Bear Day'. The real danger lies in promotion of these Mega celebrations without generating awareness or monitoring the actions of over enthusiastic volunteers, especially the social media crazy newbies. The overall conservation efforts lie in the hands of few scientists, wildlife workers and the government policy makers. What is missing is the common link that would transcend beyond personal beliefs and connect all the nature warriors through a common minimal program that would work towards ensuring sustainable future for all the earth's inhabitants. Let each day become a festival of Nature, celebrating the existence of our Mother Earth…Prithivya wishes all its readers a very happy Green Festival time and invites articles about their contribution in being the torch bearer of a Green Warrior !!!

Prof. Sagarika Damle
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DIRECTOR'S COLUMN

I am confident that our Journal "Prithivya" is serving its best to the conservation community. I and the entire team of Prithivya is overwhelmed by the kinds of feedback we are receiving from the readers and quality of research articles we are receiving. I am also happy to see the new website of "Prithivya" with some user-friendly features and making the process of submission easier. I specially thank Dr Vishal Mewada and Pratik Desai for their endless efforts to prepare this website.

The foundation is completing three years of adding science to conservation of our wildlife and natural resources. We had a very successful and productive journey during these three years with five research projects, more than 25 interns, eleven scholarly research publications and two chapter in books and several news columns in reputed journals and magazines. This gives me an immense pleasure to share that Dr Rajesh Senma, a life member of the foundation has written a book on "Biodiversity" which is soon be published by the foundation. One can read all the reports and publications on our website. From the next year, we are going to introduce WCB small grants for UG and PG students and inviting student memberships to involve more students in the field of wildlife conservation.

At this juncture, on the behalf of the entire WCB family and Team Prithivya I would like to farewell, thank and show our gratefulness to two very important members of our family, who are resigning from their positions and moving forward in their career. 1. Ms Jhanvi Patel (Admin officer of the foundation) and 2. Ms Krishna Pithva (Editorial officer of Prithivya). We have no words to thank these girls for their services and performing their best role in the foundation. Thank you, Jhanvi and Krishna, you will be always remembered by everyone of us.

On behalf of the entire WCB Family and Team Prithivya, I would like to extend warm gratitude to all our readers, supporters, partners and collaborators for being with us during this journey.

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Leucism in Five-Striped Palm Squirrels: A Rare Phenomenon record in Gujarat, India

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Unusual coloration in mammals and other animals is a congenital disorder known as hypopigmentation, which is related with genetic diversity and mutations. This disorder often manifests as albinism or leucism. Leucism is a genetic condition linked to many pigments, whereas albinism is linked to just one pigment. The color of the eyes is the primary means of differentiation between leucism and albinism. Albinos have red eyes whereas leucism refers to the partial or total decolouration of certain body parts while retaining the typical color of eyes, and nails (Bensch et al., 2000). Several factors contribute to the occurrence of leucism, including pollution, environmental changes, poor diet, and follicular damage (Møller & Mousseau, 2001).

Leucism is more common in small and isolated populations due to inbreeding, which allows recessive alleles to be expressed. There have been documented cases of leucism in the five-striped palm squirrel, a small rodent species belonging to the Sciuridae family. This species has four subspecies native to India and Sri Lanka, with the studied population endemic to the west part of India. Previous records also suggest habitat fragmentation to

Figure 1: Photograph of the white squirrel recorded at Thol Bird sanctuary

influence leucism in individuals, based on observations made from semi-forest and human habitation areas (Kumar & Princy, 2021).

The leucistic Palm Squirrel was observed at the Thol Lake Bird Sanctuary by Kunal, Rushika and photographs were taken by Saman under the leadership of senior bird watcher Bharatkumar Patel. This bird sanctuary is located between 23.25 and 23.50N and 72.500 and 72.75E. The man-made Thol Lake, which was originally made for irrigation purposes, was later designated as a sanctuary looking to its floristic diversity and providing feeding and resting grounds for residential and migratory avifauna (Vyas & Patel, 2015). The Nikon A211 binoculars were used for observations, while the Panasonic Lumix DC-G9L camera and 100-400 mm Lumix lens was used to capture further photographic evidences. To avoid human intervention, all observations (~20 total) were made from a minimum distance of 8 feet. The observed squirrel displayed a complete white coloration with pinkish snout, ears, and limbs, while its eyes maintained a normal color (Figure 1,2,3). Until now, there have been no reported cases of leucism in Five-striped Palm Squirrels from Gujarat. Therefore, this leucistic Palm Squirrel sighting in Gujarat, India, could potentially be the first recorded instance. The first case of leucism was documented from Maharashtra's Satara District (Sayyed & Mahabal, 2016). The Ghazipur squirrel represented the second recorded case of leucism in *Funambulus pennanti* in India (Sayyed & Mahabal, 2016). Leucism in other Funambulus species has been reported in Tamil Nadu and Goa (Kumar & Princy, 2021).

Figure 2: Photograph of the white squirrel with black eyes

It was amazing to see an albino squirrel with regular eye color; it seems as if the squirrel was powdered from the bottom up. Watching this marvel was enjoyable. It is worth noting that the survival rate of leucistic animals tends to be lower compared to non-leucistic individuals. This is

primarily due to their distinctive features, which makes them more noticeable and easy prey to predators.

Figure 3: Photograph of the leucistic Palm Squirrel.

Acknowledgment

We owe our sincere gratitude to the Gujarat Forest Department and All the ground staff members of Thol Lake Bird Sanctuary.

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The city cat conundrum: Evidence, conjecture and conservation support for leopard in Guwahati city, northeast India

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Large carnivore conservation is a challenging endeavor due to their need for large home ranges, sufficient prey, access to water, and low human interference. These factors render urban landscapes challenging areas to sustain large carnivores, especially, if the landscape is a metropolitan city with an estimated human population of 1.1 million and growing each year. This is presently the case of Guwahati city of Assam in India, where cases of human-leopard conflicts are a common occurrence. The city is spread over 216.79 km^2 area with an altitude of 49.5–55.5 m, and is surrounded by 18 hills with eight reserve forests and two wildlife sanctuaries and a Ramsar site within city limits (Purkayastha 2018). Although the space available in the form of hills within the city and surrounding protected areas might seem enough for leopard persistence, in reality these hills within Guwahati are isolated islands with very little to no connectivity at all. This has inevitably resulted into human-leopard conflicts in Guwahati and it is on the rise.

To solve such a problem there is a need for proper diagnosis which is unclear in case of human-leopard conflicts in Guwahati. A substantial grey area persists in leopard ecology and the drivers of leopard-human conflict in the region. There is no answer to even the most basic question of how many leopards are present in and around the city. While it has been claimed repeatedly in newspapers and magazine articles, and recently in Guha (2020), that a 'good' number of leopards are resident in the hills in and around Guwahati city; however, there is no reliable estimate available. Moreover, the claim of a 'good number' is worrisome and leads us to question, what is a good number?

Furthermore, while it has often been claimed that there is an ongoing rampant encroachment and hence conflicts are on the rise, there has been no study on the scale or intensity of loss of habitat or connectivity. Another factor mentioned for rising conflicts is the livestock depredation which aggravates locals and compels them to retaliate. However, there is no concrete evidence or published information on the number or scale of livestock loss and general perception of locals towards leopards. It has been claimed that leopardsdepend on livestock; however, several studies reported that the feral dogs are the major part of their diet in the city. While conjecture plays a crucial role in science, its validity in conservation support and use in formulation of management or mitigation strategies is questionable. This lack of information is the foremost reason behind no such management strategies being formulated in the city on this issue.

However, in response to the reported growing conflict, it is fortunate to see rise in support for leopard conservation from civil society organizations in Assam and especially Guwahati. The involvement of primarily journalists, activists and students is welcome. The *living with leopard* initiative (http://cpreecenvis.nic.in) supported by WWF India is a major education, outreach and capacity building drive that is active in Guwahati and other parts of Assam. Another important campaign which started in 2014 was the '*Save the Phantom*' (https://www.wti.org.in/news/save-the-phantom/) supported by Wildlife Trust of India Rapid Action Project (WTI RAP) and David Shepherd Wildlife Foundation (DSWF), which now operates as an NGO named Phantom for the leopard conservation cause in the region. While education, outreach, capacity building are essential tenets of conservation, this needs to be supported by evidence and sound ecological science. A major missing thread in thrust towards leopard conservation and mitigation of conflict is the involvement of a dedicated ecological research team which thrives to understand the drivers of leopard presence, and rising conflicts to provide and communicate sound mitigation strategies.

It is heartening to see that the North Kamrup Forest Department has indeed initiated a camera trapping study in Amingaon area(https://www.eastmojo.com)with 50 cameras installed in Sila Reserve Forest of Changsari, this a welcome first step in regards to understanding leopard presence and behaviour in the outskirts of the city and the results of the study are early awaited.

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A brief account of the history and development of Jawaharlal Nehru Tropical Botanic Garden and Research Institute, Palode, Kerala

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History and development

In 1949, Prof A Abraham, an educationist, administrator, and conservationist conceived the idea of a botanical garden in Kerala to conserve rare and endangered plant taxa. However, it took him several years to convince the state political leadership about the need for a garden in the state that itself was a garden due to the vast diversity of plants. The first united nations conference on Human Environment was held in 1972 in Stockholm. Prof. A Abraham identified this as an opportunity to push his idea hard across to the ministry. Finally, In 1979, the Department of Planning and Economic Affairs of the State government announced the formation of the Tropical Botanic Garden and Research Institute. Hence it may be said as the relentless efforts of Prof A Abraham for 30 years resulted in today's garden called JNTBGRI. In 1982, the government approved a grant on the lease of 300 acres of land close to the forests in the foothills of Agasthyamalai forests for garden development. Late Mr. Roy A Bee, Ex-Director, of Park Systems from Royal Botanic Gardens, Kew had supervised the design and layout of the garden and helped the young scientists- recruited then- to have a vivid vision of the garden. The founder director, Prof A Abraham, who is also the first author of Introduction to Orchids, a classic book on orchids of the southern Western Ghats, then established the orchid conservatory and plant biotechnology programs for the purpose of orchid breeding and plant multiplication.

According to the Convention on Biological Diversity (1972), the framework for botanic gardens includes plant identification (Art.7), the establishment of conservatories (Art.9), bioprospecting

(Art. 10), and public education/awareness (Art. 13). The visionaries involved in the initial stages of the development of TBGRI designed programs inclusive of all of the above mission.

One of the milestones for the Institute was benefit sharing with the indigenous tribe "Kani" in the Agasthayamalai region when obtained a patent for the preparation of a drug, 'jeevani' of which intellectual rights still belong to the tribe. Once established, a large number of projects were launched with the help of international, national funds and regional scientists and researchers in various fields. The institute successfully carried out surveys and documentation of the flora, structuring of living plant collections, selection and enhancement of species with potential economic value, development of their cultivation practices, and capacity-building programs for the community such as training, self-employment, and income generation in horticulture. Through nationwide explorations, rare orchids, anthuriums, medicinal plants, rattans, wild fruits, tree species, palms, curcumas, Piper, Zingibers, Citrus, bananas, cacti, succulents, and wild ornamentals were collected and conserved. A gene bank was created comprising field, seed, meristem, and cryobank activities. JNTBGRI developed a state-of-the-art laboratory/Central Instrumentation Facility to promote and serve plant-based studies and enterprises. In the last decades, molecular markers were developed for the identification of genotypes. All through four decades, endemics received particular attention in all the research initiatives. Department of Biotechnology, Government of India provided grants to establish the G15 National gene bank for medicinal and aromatic plants in TBGRI In 1992-93. In 1994, the Ministry of Environment and Forests, Government of India granted the status of the Centre of Excellence in conservation research to TBGRI. In 1996, the Saraswathy Thangavelu Extension Centre, the Bioinformatics component of the Institute came into existence in Puthenthope on the coasts of Trivandrum. In 2003, TBGRI was brought under the newly formed Kerala State Council for Science, Technology, and Environment (KSCSTE). In 2011, the institute was renamed in fond memory of Pandit Jawaharlal Nehru, the visionary Prime Minister of India to Jawaharlal Nehru Tropical Botanical Garden and Research Institute/JNTBGRI.

In 2020, JNTBGRI received the 'GGI Gardens Award' issued jointly by Botanic Gardens conservation international (BGCI) and the United States Botanic Garden (USBG) for the second time. The institute created a collection of plants endemic to the Western Ghats with the help of this grant. The research advancement of this is that this collection is now part of the Global

Genome Biodiversity Network (GGBN). This network allows DNA and tissue collections to be accessible to global researchers through 108 biobanks. The collection from JNTBGRI added 58 new taxa (57 species) belonging to 47 genera under 28 families to the GGBN portal. These biorepositories can help us conduct advanced research on biodiversity, and encourage collaborations and multidisciplinary research. It could generate an understanding of the spread of invasive species, and threats to species due to climate change, promote value addition and hence plant-based industrial ventures; and preserve data for the future.

Today, JNTBGRI is one of India's largest conservatory botanical gardens with eight research divisions (conservation biology, plant genetic resources, biotechnology and bioinformatics, ethnomedicine and ethnopharmacology, garden management, microbiology, phytochemistry and phytopharmacology, and, plant systematics and evolutionary science) and about 50000 accessions. Research community that includes research students and staff lead quality research in the Institute in the areas of conservation, bioprospecting, evaluation, validation, product development, and benefit sharing. JNTBGRI Library functions as a knowledge-disseminating centre in the state for students and researchers. The institute is now recognized as a 'National Centre of Excellence in ex-situ conservation and sustainable utilization of tropical plant diversity' by the Ministry of Environment and Forests, Government of India, and the Centre for Science & Technology of the Non-Aligned and Other Developing Countries (NAM S&T Centre). During the past 43 years, KSCSTE – JNTBGRI has flourished into one of the premier R&D centers in Asia, devoted to its vision, conservation, and sustainable utilization of tropical plant diversity for the well-being of people.

(Details adopted from JNTBGRI Website)

Photo courtesy: JNTBGRI Library

Jawaharlal Nehru Tropical Botanic Garden in 2023

Photos: Jis Sebastian

Pseudomonas fluorescens as biocontrol agent

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Abstract

This review paper provides an overview of the potential of *Pseudomonas fluorescens* as a biocontrol agent for plant pathogens. *P. fluorescens* has broad-spectrum antifungal, antibacterial, and antiviral activities due to the production of various secondary metabolites, including antibiotics, siderophores, enzymes, and volatile organic compounds (VOCs). These secondary metabolites can inhibit the growth of plant pathogens, stimulate plant growth, and enhance plant defence mechanisms, thereby improving plant health and productivity. *P. fluorescens'* biocontrol mechanisms can be classified into two categories: direct and indirect mechanisms. Direct mechanisms involve the direct inhibition of plant pathogens by *P. fluorescens*, while indirect mechanisms involve the stimulation of plant growth and enhancement of plant defence mechanisms. *P. fluorescens* has been successfully applied as a biocontrol agent in various crops against a range of plant pathogens.

Key words *Pseudomonas fluorescens*, Biocontrol, Antibiotics, Secondary metabolites, Siderophore

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Introduction

The gram-negative bacteria *Pseudomonas fluorescens* is a member of the *Pseudomonas* genus. This ubiquitous microbe, which has been found in both soil and water, is well known for its capacity to create a range of secondary metabolites with bio controllable properties. Due to its capacity to inhibit the growth of many plant diseases through a variety of methods, *P. fluorescens* has received substantial research as a possible biocontrol agent. This review paper seeks to give a general overview of *P. fluorescens*' potential for biocontrol and the processes behind its biocontrol functions.

Biocontrol potential of *P. fluorescens*

P. fluorescens has been shown to have broad-spectrum antifungal, antibacterial and antiviral activities, making it a promising biocontrol agent for various plant pathogens. The biocontrol potential of *P. fluorescens* is attributed to the production of various secondary metabolites, including antibiotics, siderophores, enzymes, and volatile organic compounds (VOCs) that can inhibit the growth of plant pathogens (Mishra *et al,* 2018). These secondary metabolites can also stimulate plant growth and enhance plant defence mechanisms, thereby improving plant health and productivity.

P. fluorescens produces a wide range of antibiotics that can inhibit the growth of various plant pathogens. For example, *P. fluorescens* strain CHAO produces 2,4-diacetylphloroglucinol (DAPG), which has broad-spectrum antifungal activity against a range of plant pathogens (Suresh *et al,* 2022). DAPG inhibits fungal growth by disrupting fungal cell membranes, altering fungal gene expression, and inducing reactive oxygen species (ROS) production in fungi (Lima *et al,* 2021). In addition, *P. fluorescens* strains also produce pyrrolnitrin, phenazine, and pyoluteorin, which have been shown to have antifungal activity against various plant pathogens (Castaldi *et al,* 2021). *P. fluorescens* also produces siderophores, which are small organic molecules that can chelate and sequester iron from the environment. Since iron is an essential nutrient for the growth of many plant pathogens, the production of siderophores by *P. fluorescens* can inhibit the growth of these pathogens by limiting their access to iron (Ahmed and Holmström, 2014). Siderophore production by *P. fluorescens* has been shown to be effective in controlling plant pathogens such as *Fusarium oxysporum* and *Rhizoctonia solani* (Fadhal *et al,*

2019). *P. fluorescens* produces a range of enzymes that can degrade the cell walls and extracellular matrices of plant pathogens, thereby inhibiting their growth and virulence. For example, *P. fluorescens* strain Pf-5 produces chitinases and proteases that can degrade the cell walls of fungal pathogens such as *Botrytis cinerea* and *Sclerotinia sclerotiorum* (Flury *et al*, 2016). *P. fluorescens* also produces exopolysaccharides (EPS) that can inhibit the growth and virulence of plant pathogens.

Table 1 Pseudomonas fluorescens Characteristics

Characteristic	**Description**
Kingdom	Bacteria
Phylum	Proteobacteria
Class	Gammaproteobacteria
Order	Pseudomonadales
Family	Pseudomonadaceae
Genus	Pseudomonas
Species	Pseudomonas fluorescens
Gram Stain	Negative
Shape	Rod-shaped
Motility	Motile
Oxygen Requirement	Aerobic
Temperature Range	4°C to 30°C
Optimal Growth pH	6.0 to 7.0
Flagella	Present
Biofilm Formation	Capable of forming biofilms
Production of Pyoverdine	Yes
Production of Pyocyanin	Yes
Nitrate Reduction	Positive
Citrate Utilization	Positive
Role in Agriculture	Plant growth promotion, biocontrol
Pathogenicity	Generally non-pathogenic
Environmental Impact	Important in bioremediation processes

P. fluorescens produces a range of volatile organic compounds (VOCs) that can inhibit the growth and virulence of plant pathogens. These VOCs can also induce systemic resistance in

plants, thereby enhancing their defence mechanisms against pathogens (Raza *et al*, 2016). For example, *P. fluorescens* strain CHAO produces 2,3-butanediol, which can induce systemic resistance in plants against various pathogens (Meena *et al*, 2020). In addition, *P. fluorescens* produces VOCs such as hydrogen cyanide, which has been shown to have antifungal activity against various plant pathogens.

The biocontrol mechanisms of *P. fluorescens* can be classified into two categories: direct and indirect mechanisms. Direct mechanisms involve the direct inhibition of plant pathogens by *P. fluorescens*. These mechanisms include the production of antibiotics, siderophores, enzymes, and VOCs discussed earlier. The production of these secondary metabolites can inhibit the growth and virulence of various plant pathogens. Indirect mechanisms involve the stimulation of plant growth and enhancement of plant defence mechanisms by *P. fluorescens*. These mechanisms include the production of growth-promoting hormones, such as indole-3-acetic acid (IAA), and the induction of systemic resistance in plants. The production of IAA by *P. fluorescens* can promote plant growth and enhance plant stress tolerance (Chen *et al*, 2017). In addition, *P. fluorescens* can induce systemic resistance in plants by activating various defence-related genes and inducing the production of defence-related compounds such as phytohormones and phenolic compounds (Vleesschauwer *et al*, 2008).

Advantages and limitations of *P. fluorescens* as a biocontrol agent

The use of *P. fluorescens* as a biocontrol agent has several advantages over chemical pesticides. First, *P. fluorescens* is environmentally friendly and does not have any negative impact on non-target organisms. Second, the use of *P. fluorescens* can reduce the use of chemical pesticides, thereby reducing the risk of pesticide residue accumulation in crops and the environment. Third, *P. fluorescens* can enhance plant growth and productivity, leading to increased crop yields. However, the use of *P. fluorescens* as a biocontrol agent also has some limitations. One of the major limitations is the variability in biocontrol efficacy under different environmental conditions. The biocontrol efficacy of *P. fluorescens* can be affected by factors such as temperature, pH, and moisture content (Ownley *et al*, 2003). In addition, the efficacy of *P. fluorescens* can also be influenced by the presence of other microorganisms in the soil, which can affect its colonization and biocontrol activity (Dandurand and Knudsen, 2002). Another limitation is the cost and availability of commercial formulations of *P. fluorescens*.

Conclusion

P. fluorescens is a promising biocontrol agent that has the potential to control various plant pathogens through a range of mechanisms, including the production of antibiotics, siderophores, enzymes, and VOCs. In addition, *P. fluorescens* can also stimulate plant growth and enhance plant defence mechanisms, leading to improved plant health and productivity. The application of *P. fluorescens* as a biocontrol agent has several advantages over chemical pesticides, including its environmental friendliness, reduction in pesticide residues, and enhancement of crop yields. However, the efficacy of *P. fluorescens* can be influenced by various environmental factors, and its use as a biocontrol agent may require careful consideration of the specific conditions and pathogens present in a given crop.

Further research is needed to better understand the mechanisms underlying the biocontrol activity of *P. fluorescens* and to develop more effective formulations for its application in different crops and environments. In addition, the potential interactions between *P. fluorescens* and other microorganisms in the soil need to be further investigated to better understand the impact of *P. fluorescens* on soil microbial communities and ecosystem functions. Overall, *P. fluorescens* is a promising biocontrol agent that can offer sustainable and effective solutions to plant disease management. Its potential to enhance plant growth and productivity also makes it a valuable tool for sustainable agriculture. With further research and development, *P. fluorescens* has the potential to play an increasingly important role in the transition towards more sustainable and environmentally friendly agricultural practices.

Conflict of interest

The authors declare that there are no conflicting issues related to this research article.

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A review on human-sloth bear conflicts in Gujarat: Identifying drivers and mitigation strategies

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Abstract

Human-sloth bear conflict is becoming an issue of concern in India, especially in the state of Gujarat. North and Central parts of Gujarat are considered to have the highest population and densities of sloth bears; previous research revealed that sloth bears are wandering outside the protected areas in close proximity to humans. Despite the growing numbers, the status of the sloth bear is still vulnerable due to the degradation of remaining sloth bear habitats and an increase in human-bear conflicts. As human populations increase and encroach into sloth bear habitats, higher incidences of bear attacks emerge. These conflicts can put human life and safety at risk, reduce tolerance towards bears and threaten their numbers, thereby diminishing conservation efforts. This paper aims to understand the nature of human-sloth bear conflicts in Gujarat, in the light of escalating encounters, by examining the major drivers of conflict, and assessing conflict prevention and mitigation strategies that focus on the protection and welfare of local communities as well as the conservation of the sloth bears and their habitat.

Key words Conflict; conservation; Gujarat; local community; vulnerable

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Introduction

One of eight bear species in the world, the Sloth bear (*Melursus ursinus*) is endemic to the Indian subcontinent. It is one among four found in India, the others being the Himalayan brown bear (*Ursus arctos isabellinus*), Asiatic black bear (*Ursus thibetanus*), and Sun bear (*Helarctos malayanus*), and the only one to inhabit the state of Gujarat. The sloth bear is found in diverse habitats - wet and dry tropical forests, savannah, scrubland, rocky outcrops and grasslands usually below an elevation of 1700 m (Garshelis et al,1999; Dharaiya 2009).

Unique among bear species for its feeding habits, the sloth bear is an opportunistic feeder. As a myrmecophagous species, it has a diet consisting primarily of termites and ants. Its physical characteristics have evolved to support its insectivorous diet: a keen sense of smell to sniff out ant colonies and termite mounds with sickle-like claws for digging and tearing them to the ground, a protrusible (extended) lower lip and broad palate (earning the name 'labiated bear'), lack of upper incisors to allow it to suck up hundreds of termites, and self-closing nostrils to keep them out of its nose (Wildlife SOS,2020). It also consumes ground-layer vegetation, sweet and fleshy fruit, nuts, seeds, flowers and honey. On rare occasions, a sloth bear will scavenge on carrion. Predominantly crepuscular and nocturnal, these bears like to rest in caves and crevices of boulders or under shady trees and bushes during the day. Sometimes, females with cubs can be found searching for food even in the daytime. Sloth bears can climb trees to feed but prefer to stay on ground when confronted by a predator. Due to the warm climate, they reside in, unlike other bear species, these bears do not hibernate in the winter.

Vulnerable status

Historically, sloth bears have been the targets of human exploitation for centuries. Reported to be abundant during the mid -1800s, the sloth bear population declined severely between the late 1800s and mid 1950s due to habitat loss and hunting (Prater, 1948; Krishnan,1972). They were also captured and cruelly subjected to dancing and performing tricks by the impoverished nomadic Kalandar tribes. Taken from the wild, their teeth were smashed, a hole burnt through their snout with a hot metal rod and a rope threaded through it to make them 'dance' in agony. (Satyanarayan, 2022). Though banned in 1972, the inhumane practice was eradicated only in 2009. Despite conservation efforts, the sloth bear continues to be threatened. It is declared

vulnerable by the IUCN (International Union for Conservation of Nature) and listed in Schedule 1 of the Indian Wildlife Protection Act, 1972 (Dharaiya et al, 2020).

Sloth bears are keystone species without which the ecosystem would be out of balance. They are pivotal to the health of the forest. As ecosystem engineers, they assist in the control of termite and ant populations and play an important role in seed dispersal for the regulation and regeneration of many plant species in the forest. There is a pressing need for the conservation of this bear species.

Geographical spread

The IUCN estimates that fewer than 20,000 sloth bears survive in the wild of the Indian subcontinent. Besides India, these bears are also native to Nepal and Sri Lanka. According to the IUCN Bear Specialist Group, they are now regionally extinct in Bangladesh and presumably in Bhutan too in the past decade (WWF India, n.d.), as well as extirpated in some areas in India (Krishnan,1972; Garshelis et al,1999). With a smaller presence in Nepal and Sri Lanka, India stands as the final stronghold for the species with 90% of its global population. According to several reports, the sloth bear population has dropped by 40-50% over the last three decades due to habitat loss and fragmentation, poaching and increasing human-bear conflict (Satyanarayan, 2022). The IUCN Red List of Threatened Species predicts that sloth bear populations may continue declining, at an increasing rate, resulting in a >30% loss over the next 30 years. (Dharaiya et al, 2017). Unless urgent action is undertaken, a tragic fate looms before the sloth bears.

In India, 81% of its sloth bear population resides in 20 of the country's 29 states (Figure 1). Its range spans the Western Ghats in the south to the foothills of the Himalayas in the north, and the Aravalli hills of Rajasthan in the west to Assam's floodplains in the east. However, baseline information on their distribution and present status in India is lacking. The current distribution of sloth bears in India is better known within protected areas. They are reported to exist in 174 protected areas in India, which includes 46 National Parks and 128 Wildlife Sanctuaries (Chauhan, 2006).

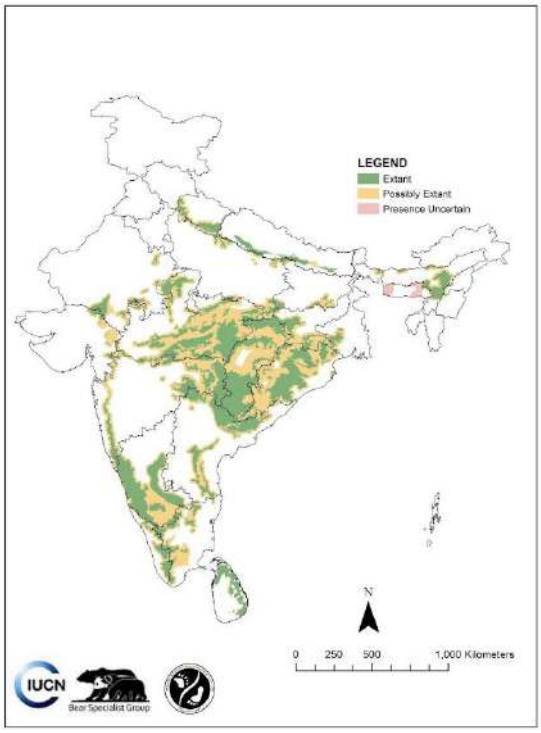

Figure 1: Sloth bear distribution in India. Source: Dharaiya et al. (2017)

In Gujarat, in 2011, the bear estimation was 293, increasing to 342 in 2016. According to the official figures from the 2022 census of the forest department, about 358 sloth bears inhabit the state. Here, sloth bears are reported in five protected areas viz. Shoolpaneshwar, Jambughoda, and Ratanmahal in Central Gujarat and Jassore and Balaram Ambaji Wildlife Sanctuaries in North Gujarat (Figure 2). These areas of our study mark the westernmost edge of the bear's distribution range with its population patchily distributed in protected and non-protected forests.

Figure 2. Sloth bear habitats in Northern and Central Gujarat. Source: Dharaiya and Singh (2018)

Understanding Human-Sloth Bear Conflict (HBC)

Human-Wildlife conflict (HWC), i.e. interactions between people and wild animals with negative outcomes (Messmer, 2009) is increasing worldwide. As human populations rise, the resulting competition with wildlife for space and food resources poses a major challenge for man and animal (Singh et al, 2018). Anthropogenic activities have slowly caused humans to encroach into territories originally inhabited solely by wildlife, resulting in greater proximity than before and thus, interactions between the two (Singh et al, 2018).

Sloth bears and humans have been cohabitating for decades in the area of study. While sloth bears are considered aggressive and unpredictable, they avoid human contact whenever possible. As these bears spend most of their time actively foraging with their nose to the ground, they can often be taken by surprise, feel threatened and attacked. Across India, forest officials have reported a steady increase in human- sloth bear (HBC) conflict. Sloth bear attacks have increased by 30% in the last decade with many not reported by the Forest Department (Dharaiya, 2018). Though the Indian government doesn't tally up attacks at the federal level, it's fair to say from state data that the sloth bear is one of the deadliest animals in India, and is responsible for more human fatalities per capita than any other type of bear (Dickie, 2020). In fact, the number of sloth bear attacks annually rivals and may even exceed the total number of all bear attacks from the seven other extant bear species combined (Research Outreach, 2021). This has resulted in a negative perception of sloth bears and as a consequence, an increasing hostility towards them.

More than 300 sloth bear attacks have been recorded in the past 10 years in Gujarat (Smitha, 2018). In December 2021, a 42-year-old tribal woman from a village in Gujarat's Dahod district died in a sloth bear attack. The victim was grazing cattle when she was attacked by the bear (The Indian Express, 2021). In June 2022, three more were injured by sloth bear attacks at Jessore Sloth Bear Sanctuary in Banaskantha district of Gujarat which is considered a conflict-prone area (The Times of India, Ahmedabad, 2022). Two of them were tribal farmers; the last incident involved a temple priest. (The Times of India, Rajkot, 2022). The same month, four people including a teenage girl were injured after a sloth bear attacked them in Lavaria village of Devgadh Baria taluka, Panchmahal district in Gujarat. It also injured an ox around the same time.

The area has a good growth of Indian jujube or *ber* fruits which the sloth bears eat and tribals collect as a minor forest product for consumption and sale in local markets. The bear may have come to the area to eat the fruit and had an accidental encounter with the humans it injured (The Times of India, Vadodara, 2022). Such deadly incidents are on the rise. In addition to human mortality or permanent physical injury that sometimes occurs, injuries inflicted to the head and face by sloth bears can result in social and economic hardship (Ratnayeke et al, 2014).

In India, flagship species like the tiger, elephant and rhino dominate the spotlight with conservation skewed in their favour. The sloth bear, on the other hand, has not benefited much from these projects. In 2012, the Indian government released a national Bear welfare and conservation action plan, but unfortunately it wasn't enforced. More recently, India has designated some areas specifically for the protection of sloth bears. Gujarat is home to two of the three Indian refuges dedicated solely to the bears' survival. New guidelines have also been formulated in 2023 by the Ministry of Environment, Forest and Climate Change (MoEFCC) for human-bear conflict mitigation.

Sloth bear Behaviour

Understanding sloth bear behaviour helps us evaluate human-bear conflicts and propose solutions that can help curb attacks and protect both the bear and the people. Scientists offer various theories to explain sloth bear behavior. It has been noted that sloth bears have an "innate defensive-aggressive response to surprise (sudden) encounters" possibly due to having co-evolved with formidable predators like tigers and leopards, and thus unleash the same ferocity on humans (Gupta, 2022). Perhaps they choose fight over flight because, although their long claws are ideal for digging, they don't allow adult sloth bears to escape danger by climbing trees. Perhaps their violent toll on humans is greater because they don't bluff charge humans as much, but initiate a physical attack almost immediately (Gupta, 2022). Whatever the reason, studies have shown that attacks by sloth bears are a defensive response and not predatorial by nature.

Drivers of Conflict

Human-bear conflict (HBC) is a multifaceted challenge, and thus, an integrated and holistic approach is needed to find solutions for prevention and mitigation. The first step is to effectively

identify the drivers of conflict. A comprehensive understanding of why these conflicts occur will translate into formulating impactful conflict-mitigation strategies (Mesaria et al, 2021).

Sharing of resources

One of the major factors leading to HBC is their common dependency on forest products. This sharing of resources has led to frequent encounters between the two. People residing in and around sloth bear habitats rely mostly upon forests for their survival. They venture into the wild to collect firewood for fuel and non-timber forest products (NTFP) which typically consist of flowers, fruits, leaves, honey, mushrooms, as well as medicinal plants (Singh et al, 2018).

Non-timber forest products (NTFP) are extracted from trees like the golden shower tree (*Cassia fistula*), mahua (*Madhuca indica*), jujube (*Zizyphus jujuba*), date palm (*Phoenix sylvestris*), and flame of the forest (*Butea monosperma*) (Garcia et al, 2016). The fruits and flowers from many of these trees are preferred foods of the sloth bears too. Also found in the forest are *tendu* or *timru* leaves (as they are known in Gujarat) which are primarily used to wrap *beedis* (locally made cigarettes). They are a prominent source of seasonal income and employment for forest communities, enticing them to venture into the forest for their procurement. This puts the foragers in the path of the sloth bear. In addition, locals walk several kilometers into the dense thicket in order to graze their cattle. During livestock grazing or NTFP collection, people are usually alone or with just one other person, making them more susceptible to attacks. In short, unexpected confrontations are inevitable for those that rely on the forest to survive (Singh et al, 2018).

Scarcity of water

Extreme temperatures, owing to global warming, have become a common phenomenon worldwide. Gujarat is no exception; the state has experienced severe heat waves in recent years. In summer, water becomes a limited resource pushing thirsty sloth bears outside of their typical habitat. Human settlements in the vicinity of the bear's habitat are often the only water source available to animals. Studies have revealed regular sightings of sloth bears near water sources and villages after dark in summer (Sultana et al, 2015), with some reports indicating their presence within 500m of water sources irrespective of the season (Bargali et al, 2012). Furthermore, the number of attacks in Gujarat has increased over the past decade with more than

300 reported, primarily, in the hot dry summer (Malik et al, 2018). These patterns support the fact that water is a major factor in driving sloth bears into human settlements where conflicts can occur.

For instance, one of the most pressing concerns in Gujarat's Jessore wildlife sanctuary, containing the highest sloth bear density in the state, has been the lack of water. Villagers and farmers say the sloth bears are increasingly leaving the sanctuary in search of water. In June 2019, after the bears attacked four people, the local government replenished water holes with a tanker. But a long-lasting, natural solution to the bear's water woes needs to be found.

Habitat loss and degradation

A major threat to sloth bears and a direct cause of HBC is habitat degradation and fragmentation, mainly due to a burgeoning human population, altered land use patterns, and uncontrolled development (Garcia et al, 2016). Only about 10 percent of India's remaining forests are considered secure and suitable for sloth bears (Dickie, 2020). India's population has more than doubled since 1980; the country has become the world's most populous nation and is projected to reach 1.66 billion by 2050. Urbanization is encroaching into whatever precious wilderness remains. Mining activities near boulders and hillocks, which sloth bears like to inhabit, results in human infiltration leading to habitat loss and a threat to the bear population (Dharaiya, 2009). Anthropogenic pressures in the form of overgrazing cattle, excessive felling of trees, fire, change in land use, and an over-extraction of resources threatens the remaining sloth bear habitat. Particularly susceptible to this are the dry forests of Gujarat (Mesaria et al, 2021). Reduced forest cover and dwindling food resources, especially outside protected regions (Akhtar et al, 2004), have prompted sloth bears to forage for food and water elsewhere. Sloth bears are adaptive and have the ability to also thrive near human habitation making them vulnerable to anthropogenic risks (Gupta, 2022).

Sloth bear food resources are becoming scarcer in forests because of direct competition with villagers, prompting the bears to seek food outside (Rajpurohit and Krausman, 2000). There may also be a suppression of the indigenous food plants of bears due to the overabundance of invasive alien species in the area, resulting in decreased habitat quality and a consequent increase in the movements of bears out from forested landscapes into human-dominated ones. As a result

of habitat degradation, sloth bears have been reported foraging on cultivated crops near human habitation (Garshelis et al. 1999; Bargali et al. 2005, 2012), kitchen gardens of village houses (Bargali et al, 2012) and other human-dominated areas (Mesaria et al, 2021). For instance, the sweet flowers of the *Madhuca indica* (mahua) tree are sought by sloth bears for food (Garcia et al, 2016). Mahua is also popular amongst forest communities for alcohol production; its flowers are fermented for liquor. The strong scent of its residue, disposed outside people's homes, attracts bears (Garcia et al, 2016). Likewise, the bears are also drawn to jujube or *ber* fruits stored in the house (Dharaiya, 2009). Other attractants are the fruit trees planted near villages and agricultural fields. Edges of forests are commonly used by people for agricultural purposes giving hungry sloth bears opportunities to raid farm crops.

In addition, people leave fruit as religious offerings at temples that are ubiquitous in villages of India. As a consequence, sloth bears regularly visit temples adjacent to their habitats at night to feed on these offerings, increasing the chances of a confrontation.

In short, degradation of sloth bear habitat, reduced availability of natural food, and increased availability of anthropogenic foods broadly supports the finding of most attacks occurring outside protected areas.

Hostility and retaliatory killing

This brings us to another acute cause of HBC. Encounters of people with sloth bears have resulted in death, debilitating physical injuries, loss of property, crop damage and more (Singh et al, 2018). Local communities have become more wary, less tolerant of the species and hence prone to retaliatory killing. In many cases recorded by the WCB (Wildlife and Conservation Biology) Research Foundation, a behavioural pattern has been observed. When a sloth bear finds its way into a village, people come out in hoards to see it. These mobs then attempt to frighten the bears, either in self-defence or as a means of provocation. The bear's natural inclination is to attack, following which the people attempt to kill it. This cycle has become an imminent threat to the sloth bears with hostile mobs posing a great obstacle to forest department workers.

After a sloth bear attack, people feel they have little recourse. Attack victims are entitled to financial compensation from the state, but find the money difficult to obtain when they lack amenities like a bank account, or the literacy skills to file a report. To get retribution for bear

attacks, some people kill them. Villagers have stoned, electrocuted, and poisoned sloth bears that come close to settlements. (Dickie, 2020). Sometimes, deaths are never documented at all. Increased sloth bear attacks on humans in Gujarat have increased animosity towards bears, making their conservation a challenge (Garcia et al, 2016).

Lack of proper rescue knowledge

Among sloth bear attacks, 60% take place in non-protected areas and 30% occur around villages. In spite of there being conflict mitigation strategies in place, constraints like pressure from developmental undertakings, shortage of equipment and trained staff, lack of local awareness, and the absence of rapid response units, exacerbates the problem. Furthermore, there is a need for a bear rescue and conflict management team, as well as research and monitoring.

Strategies for Conflict Prevention and Mitigation

The marked increase in human injuries by sloth bears in Gujarat in recent years warrants urgent attention. Meaningful reduction of HBC, involving human and bear safety, will be best achieved through increased awareness of sloth bear behavior, safety education, evaluation of the factors facilitating attacks on humans and implementation of multiple mitigation strategies (Garcia et al, 2016).

Habitat management

Sloth bear corridors need to be identified and conserved. Close to 67% of sloth bear attacks have occurred outside protected areas. Attacks inside protected areas usually occur near their borders. Protected areas aid in reducing attacks through the spatial separation of people and bears. Bears use areas of human occupation less when forest area is available. The Central Gujarat landscape has been identified as containing important sloth bear corridors (Dharaiya, 2018; Singh et al, 2018) but the bears live here in close proximity with people. The identification of wildlife corridors between areas of suitable habitat, and subsequent reforestation of these areas could further reduce potential encounters and, ultimately, HBC (Garcia et al, 2016). This can also include mapping of land use by bears and humans in identified conflict areas and declaring the unprotected forest patches as critical bear habitats.

20% of the forest land out of the total forest cover present in Gujarat is designated as sloth bear landscape from which, the potential conflict zones, and corridors to connect the various habitats can be identified and conserved (Dharaiya and Singh, 2018).

Identifying conflict hotspots is also critical to providing site-specific solutions to mitigate HBC. 'HWC hotspots' are areas with actual or predicted repeated occurrence of HWC incidents that result in crop/ livestock loss and human/ wildlife death and injury over temporal and spatial scales. Incidents can be static (repeated in the same place or time) or dynamic (shift in space and time over years). Conflict hotspots of HBC can be mapped through geo-spatial assessments, using both primary and secondary data, including time-series data (MoEFCC, 2023). In addition, use of remote sensing data may be explored for mapping invasive plants' hotspots and for managing the spread of invasive species which are harmful to the indigenous food plants for the bears. Moreover, forest officials need to undertake the clearing of vistas along the boundaries of forests near human habitations for improving visibility and avoiding sudden and accidental encounters with bears.

Managing water scarcity

Poor access to water is driving bears towards human settlements. Addressing this scarcity could help reduce human-bear confrontations. GIS (Geographical Information System) and hydrological analysis can help identify areas where water could accumulate naturally and the containment structure can be built. By identifying such areas, water would be provided throughout the year for wildlife, removing the need for bears to leave the sanctuary in search of it. Such measures can help alleviate HBC (Malik, 2018).

Providing alternative resources/livelihood

One of the main issues leading to HBC is the large-scale dependency of fringe communities on the forest as a source of income. Devising an alternate livelihood which does not depend on the forest for cattle grazing or the collection of fodder, fuelwood and non-timber forest produce (NTFP) could help in preventing chance encounters and allowing the bear to roam freely in these areas. Livelihood needs of communities can be addressed through skill development, poverty alleviation and alternate income generation schemes of the government. Moreover, roping these communities into sloth bear conservation efforts, would give former perpetrators of the animal a stake in upholding their protection.

Eco-tourism can be beneficial in the creation of livelihoods for local communities through jobs such as eco-guides, drivers, service providers, lodge workers, etc. as a more long-term source of income than short term extraction of land resources. When local communities have a greater vested interest in keeping natural resources intact and healthy, it creates positive attitudes towards the sloth bear and its habitat. In addition, tourism can provide a compelling incentive for governments and organizations to institute environmental policies and conservation measures for sloth bear habitat and ecosystem restoration. National parks are a good source of revenue and while there are many tiger reserves in India, sloth bear sanctuaries too can be a good draw for visitors. It is vital that ecotourism maximises environmental and economic benefits while minimizing ecological damage and disruption to local communities.

Fulfilling basic needs of toilets, gas and waste management

Many villages do not have access to basic facilities like toilets and gas, forcing their inhabitants to venture into forest areas to defecate or gather fuel wood. In doing so, they encroach into sloth bear territories and are vulnerable to attack. Government schemes aimed at providing these amenities are of utmost importance. Examples of those that are currently being implemented include *Swachh Bharat Abhiyan*, which provides toilet facilities for every household, and *Pradhan Mantri Ujjwala Yojana*, which gives people in rural areas cooking gas cylinders at subsidised rates (Singh et al, 2018). However, some people still prefer to defecate openly due to water problems with toilets and collect fuel wood in the forests. Hence, emphasis must be placed, not only on providing facilities to people but encouraging their utilization through educational programs (Singh et al, 2018). The collaborative effort of local panchayats and state electricity, water and forest departments with the support of NGOs is needed for such initiatives.

Throwing of open garbage and food needs to be avoided as it attracts sloth bears. When garbage dumps are located on the periphery of forests or inside fringe villages, the potential for accidental encounters between people and bears increases. To avoid this, a common disposal point should be decided outside the village. Preferred food items of the sloth bear such as Mahua flower residue (for alcohol production) must be disposed far from the village while *Ziziphus* (jujube) or *ber* fruits should be properly stored or concealed (Dharaiya, 2009). Unmanaged garbage may also habituate bears to moving and foraging in human-dominated landscapes, resulting in high levels of conflict. Sustainable and ecological waste disposal management should be implemented. Periodic inspection by forest officials and relevant local authorities must be

undertaken. Volunteers can be engaged for such exercises. Community awareness, signage, etc is important to facilitate effective participation by locals in waste management.

Safety messaging

The use of safety messaging is considered an effective measure to reduce conflict between people and bears. In the unfortunate occurrence of a bear attack, safety messaging can help the person survive the encounter with the least amount of injury. This messaging can be dispensed through various audio-visuals such as pamphlets, booklets, videos and workshops for those living and working in and around sloth bear habitats.

All sloth bears, irrespective of location, have an innate defensive-aggressive response to surprise encounters but their behaviour is adapted to varying environments. Hence, it is necessary to recognize that the animal's response to human encounters can vary by region. Forming precautionary measures specific to the region is key to providing effective bear safety messaging for people living in the area (Gupta, 2022).

Safety messaging outlines steps to deescalate the situation in the event of a bear attack. While they should be regionally specific, they must be simple so that, during a bear encounter, the individual will remember what to do. Attempting to recall the details of an extended message, especially under duress, can be difficult, if not impossible. The messaging needs to be accurate and to the point. Rather than dispelling heavy information, a strategy of 'less is more' is essential for instant recall value (Wildlife SOS, 2020). Cautionary measures like being alert, avoiding going into dense forests alone or after dark and keeping noise levels up (to alert the bear of one's presence) are essential guidelines. In the event the bear attacks, one must display non-threatening behaviour by immediately dropping to the ground face down and covering the head and neck with a cloth or arms. Studies have shown that when people abide by this kind of safety etiquette, encounters with bears are less and human fatalities in bear attacks are lower (Mesaria et al, 2021).

Education/outreach for community awareness

With significant reliance on forests for income generation, a complete prohibition of entry into conflict-prone areas cannot sustain people's lives. As increasing conflicts decrease the tolerance of the local people for sloth bears, education and awareness are paramount in sensitizing them to the plight of the sloth bear and instilling a more positive perception towards bears. This can be achieved through outreach programs that disseminate science-based, culturally sensitive

education to school children and adults. For instance, projects like *Aatmavat Sarvabhuteshu* in Gujarat - a joint venture between Vadodara Wildlife Division of Gujarat forest department and Wildlife and Conservation Biology (WCB) Research Foundation, attempts to increase community understanding of sloth bears and improve opportunities for peaceful coexistence (Shalu et al, 2021). Such models of cross-sector collaboration can be implemented in other parts of the state.

Briefing of vulnerable groups can also be done, including workers of crop fields, before every work season about the bear risk and safety issues. This can be achieved by providing true, authentic and scientific information about the species and involving the locals in conservation-oriented work. In an effort to accomplish this goal, a pocket booklet, *Living in the Sloth Bear Landscape,* was published in the Gujarati and English language, and distributed among the villagers (Shalu et al, 2021).

The Vadodara wildlife division and the WCB foundation have jointly created a sloth bear conservation outreach center at Ratanmahal Wildlife Sanctuary, which is the first of its kind in India where state-of-the-art education materials about the ecology and behavior of sloth bears are developed that can be easily understood by local communities and outside visitors alike. (Shalu et al, 2021). A short documentary film *Sloth bear: The bear of the Indian subcontinent* has been made to exhibit in the center (as well as in schools and other social gatherings). Visits to schools and colleges are facilitated to meet youth and build capacity and train people in safety measures. Safety audits may be conducted each year, if feasible, to ensure that all members of the community act responsibly in case of HBC and to facilitate inter-agency cooperation.

Research and monitoring

Besides undertaking in-house research, forest officials should involve the participation of research institutions, non-governmental organizations (NGOs) and experts to carry out result-oriented research on the conflict status and mitigation measures. Mapping the bears' foraging, ranging and distribution patterns within human-dominated landscapes can serve as the baseline for conflict mitigation planning. Population dynamics and predictive modelling can aid in managing conflict. The temporal overlap and segregation of human and bear activities can be

monitored. A sloth bear monitoring manual is being developed by WCB as a field guide for the forest staff (Dharaiya, 2018).

Another important task is to monitor potential 'bears in conflict', or 'problem' bears that pose a grave threat to humans. The decision to declare a bear as a potential 'bear-in-conflict' will depend on the behaviour of that bear, the degree of risk to public safety and the proximity of the bear's activities to human-use areas. If the bear poses an imminent risk to human safety by becoming habituated or food-conditioned and continues to visit human-use areas or shows "offensive" aggression toward humans despite repeated hazing - collective action is taken by a large number of persons to drive the bear back to the forest; it may be captured, relocated or shifted to a captive facility (MoEFCC, 2023).

Forest officials must identify, manage and monitor the movements of such bears within human-dominated landscapes, as a prevention measure, to ensure that they do not lead to emergency situations. Sloth bear populations may be actively monitored, either by sign surveys, using a network of camera traps or by satellite tracking using radio-collars, so that early warnings can be provided to local communities when known bears are entering their areas. Another method of bear population estimation is scat/ hair DNA analysis, which yields precise population estimates. Monitoring the presence of fruit-bearing trees, termite mounds, and natural and man-made water resources should also be done annually.

Field staff management/EWRR system

For effective conflict management, it is important to focus on the capacity building of the forest field staff. Assistance must be provided to the forest department through the organization of field staff training for sloth bear specific rescue, communication system upgrades and enhancing field staff ground mobility.

An Early Warning and Rapid Response (EWRR) system will help enhance the overall efficiency of mitigation efforts in the field. The EWRR system is a set of tools, processes and personnel competencies needed for timely and meaningful generation and dissemination of alert information to communities, for optimal preparedness and responses at the appropriate time, to reduce the likelihood of injury, death or material damage. EWRR structurally includes an HWC

Mitigation Hub/Control Room and a system of three-tiered response teams, viz. Division-Level Rapid Response teams (Division RRTs), Range-Level Rapid Response Teams (Range RRTs) and village-/ward-level Primary Response Teams (Community PRTs) of the local community (MoEFCC, 2023).

A strong institutional mechanism is required, to respond to any emergency situation arising due to HBC. Field support is to be structured around the following key operational stages for the synchronization of activities and meeting the emergency:

- Monitoring and situational awareness
- Mitigation Hub/Control Room/helplines to receive and disseminate information
- RRT/PRT personnel, veterinary team, drugs and equipment, mobility and communication facilities to address emergency situations effectively and efficiently.

The forest department needs to ensure that all response team personnel from forest and other line departments and agencies follow a systematic approach to capacity development. A structured mechanism may be established to deploy competent personnel in the RRTs. Operating procedures, laid down in detail to ensure capacities and capabilities of the various response teams, are also established through training and role clarity. Each response team must be equipped with appropriate and adequate response equipment, personal protective equipment (PPE kits) and rescue vehicles to take immediate action during conflict situations. Regular and systematic specialized training programmes on critical operations such as rescue, capture and translocation should be conducted jointly with other key relevant departments in the form of mock-drills and simulation training sessions. Competencies of members of RRTs must be reviewed on a regular basis, and their training curricula to be fine-tuned and updated regularly. In short, the forest department must follow the MoEFCC 2023 guidelines for HBC.

Economic Responses (Government compensation schemes)

The loss of life or the physical, psychological, social and economic challenges that result from bear attacks need to be recognized. Often, the bodily injuries that arise leave lifelong disabilities, not to mention the emotional and mental trauma that ensues. The medical costs that are incurred

are unaffordable for local communities. For all these financial burdens the government is obligated to provide monetary compensations.

- In HBC hotspots, a revolving fund may be established, at the division-level, to ensure that funds are available to provide immediate relief to the victim's family/heirs. As a result, part of the ex-gratia payment can be made immediately to the victim's family/heirs, and the balance payment made at the earliest.

- In the case of an injury as a result of an encounter with a bear, the victim needs to be immediately hospitalised and ex-gratia payment made as per the norms of the state government.

- Professional counselling through qualified psychiatrists/ health workers will be useful in helping victims recover from the effects of such traumatic incidents. The forest officials and other government agencies/institutions can organise counselling sessions for such victims and support them as they recover from the psychological impact.

Unfortunately, there are instances where the locals are not aware of these financial compensations or are unfamiliar with the process of obtaining them. The lack of literacy and access to banking facilities can pose a hindrance. Hence, it is important to provide the necessary information about government compensation schemes. In general, efforts should be made to simplify the procedures for release of ex-gratia, to facilitate faster payments and ensure timely support to the affected humans. Giving compensations also delineate official records and a database of bear attacks (Dharaiya, 2010). Above all, it gives the victims much-needed financial assistance and helps reduce the hostility towards the bear.

As a consequence of HBC, there can also be crop loss or property damage. The Ministry of Agriculture and Farmers Welfare has included crop loss caused by wild animal activity under its flagship scheme *Pradhan Mantri Fasal Bima Yojana (PMFBY)*, which can be used as an important HBC mitigation instrument. Mobile apps may be used for collecting information and processing claims from farmers, after crop losses from bear activities, to ensure that there is efficiency and transparency in the system. A dialogue may be initiated with the insurance sector

to provide insurance cover for damage due to HBC. The modalities of the programme may vary from place to place according to the assessment of risk by the insurance companies.

Other Mitigation measures:

Forest fringe communities need to employ preventive measures that do not cause any harm to the sloth bears, to deter them from approaching villages, crop fields or orchards. Bears' access to non-natural food sources outside their habitats can be prevented by 'aversion conditioning' and causing fear-stimuli (MoEFCC, 2023) using the following methods:

- The use of traditional wildlife-friendly barriers, including walls and fences, by local communities must be facilitated and their effectiveness monitored. The development of barriers requires a participatory approach from all stakeholders at all stages, i.e. planning, designing, monitoring and maintenance. The engagement of communities is essential for the sustainability of such structures.

- The use of visual deterrents such as flashlights and torches while travelling at night, and flashbulbs and other bright lights in villages will deter bears. In areas where there is no electricity, solar lamps/torches should be provided.

- The use of auditory deterrents, loud noise-creating devices, such as ANIDERS (Animal Intrusion Detection and Repellent Systems), and hooters temporarily keep the sloth bear at bay till a PRT/RRT arrives. One sound making device designed by the WCB team is Ghanti Kathi, a semi-circular surface with nails and a blunt point attached to a wooden stick 2–3 m long (Singh et al, 2018). This device produces sounds while walking and can also be used as a nonlethal defensive weapon against bears.

- The use of olfactory deterrents is very effective with bears, who have an acute sense of smell. Such deterrents include pepper sprays and chili bombs. Cultivating unpalatable aromatic crops (capsicum, chilies, etc.) in kitchen gardens is also effective.

- The use of guard-dogs is helpful in raising an alarm upon sensing the presence of bears near human habitations.

- Pilgrimage management should also be undertaken. Village shrines or small temples that are parts of forested areas are big draws for pilgrims. They carry fruits to leave as offerings which attract bears. Moreover, individuals travelling alone are at risk. So, forest officials need to ensure pilgrims travel in groups to reduce encounters with the sloth bear.

- Since fruit-bearing species such as mahua, ber and guava, and crops such as corn, millets etc. attract bears, local communities residing in HBC hotpots should be encouraged to cultivate alternative crops or find effective and suitable wildlife-proof storage options.

- There is a significant correlation between food availability and bear movement. Regular monitoring of bear movement and feeding patterns by forest field staff can be helpful (Smitha, 2015). Local communities should be encouraged to plant more food species plants such as, Zizyphus, Casia, Madhuca, Ficus, etc. preferred by sloth bears in and around their habitat. This will restrict their movement considerably and be crucial in bringing down instances of such a conflict in the region (Sukhadiya et al, 2013). By giving the animals an ideal habitat that is off limits to people, conservationists hope the bears won't be tempted to wander into fringe villages.

Jessore Sloth Bear Sanctuary, for instance, is testing a variety of solutions. Across the 80 sq km arid reserve, the forest department has created artificial waterholes, constructed sloth bear dens, and translocated termites to feed the animals (Dickie, 2020). Several studies note that such multi-directional approaches – and often, site-specific conservation programmes – may be the only way to build support for a locally-feared animal that faces a multitude of conservation challenges across its range (Perinchery, 2020). Measures must be taken to strengthen the system of knowledge management to ensure that conflict mitigation measures are effective and sustainable. It is essential that field experiences, learnings, field-evidence and conceptual advances are not only shared across key stakeholders but that such knowledge is also documented, to be utilized for future strategies and plans related to conflict mitigation.

Will these measures bring about a decline in bear attacks on humans? Will they help increase human tolerance towards bears? Can they boost the sloth bear population? The answers to these questions can be evaluated through timely checks and surveys. The effectiveness of these

measures will be determined when these strategies are employed in an integrated and consistent manner with regular feedback implemented to achieve optimum results.

Conclusion

The primary goal of conservation of sloth bears in Gujarat is to ensure the harmonious coexistence of humans and bears in perpetuity. HBC hinders the protection of the species and their habitats, posing the greatest challenge to their survival. Furthermore, it raises significant issues for all stakeholders: government policy makers, researchers, NGOs, animal welfare organisations, and communities for whom the repercussions are the most impactful.

Traditionally, approaches to HBC dealt with ecological and human components separately, but for long term strategic benefits, an integrated approach is required for the modification of animal behaviour and human attitudes. A steady source of food and water for the sloth bear, the identification and conservation of ecological corridors, and efficient habitat management will ensure the bear does not trespass into human dominated areas. Meanwhile, field staff competencies can be enhanced through research and monitoring, capacity building and creation of emergency response teams. Ultimately, education, awareness and outreach programs, the fulfilment of fundamental human needs, monetary compensations, and the provision of alternative livelihoods will promote community tolerance and reduce retribution against the species. Cross-sector collaboration and involvement at all levels of policy-making, decisions, and execution is needed for successful conflict management.

Through an in-depth analysis of the connections between ecological drivers and human dimensions, we get a more holistic understanding of the issues and can create a management toolbox that deploys innovative, viable and sustainable solutions for both prevention and mitigation of conflict for humans and sloth bears in shared landscapes and environments.

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Book: Pests: How Humans Create Animal Villains
Author: Bethany Brookshire
Publisher: Ecco
Year: 6 December 2022
Link: https://www.amazon.in/Pests-Humans-Create-Animal-Villains/dp/0063097257

"Pests: How Humans Create Animal Villains" by Bethany Brookshire is an eye-opening and thought-provoking exploration of the intricate relationship between humans and animals that are often deemed as pests. In this engaging book, Brookshire delves into the fascinating world of how human actions and perceptions shape the status of various animals as villains within our society.

With a captivating blend of scientific insight and storytelling, Brookshire navigates the complex dynamics that lead to the labelling of certain animals as pests. She skillfully peels back layers of historical, cultural, and ecological factors that have contributed to our negative perceptions of creatures ranging from rats and mosquitoes to invasive species. Through meticulous research and clear explanations, the author reveals the nuanced ways in which humans unintentionally create these animal villains.

What sets "Pests" apart is its balanced approach. Brookshire doesn't merely vilify these animals; instead, she encourages readers to question the narratives we've constructed. She sheds light on the important roles these creatures play in ecosystems and highlights the unintended consequences that arise when we disrupt their natural balance.

Brookshire's writing style is accessible and engaging, making complex scientific concepts understandable for a broad audience. The book's structure, combining scientific findings with historical anecdotes and personal observations, keeps readers thoroughly engaged while driving home important points about the human-animal relationship.

Furthermore, "Pests" offers a valuable lesson about our responsibility as stewards of the environment. It prompts readers to reconsider our role in perpetuating the "villain" status of certain animals and encourages us to adopt more informed and sustainable approaches to coexisting with the natural world.

In conclusion, "Pests: How Humans Create Animal Villains" is an enlightening book that prompts readers to reevaluate their perspectives on animals often considered nuisances. Bethany Brookshire masterfully weaves together science, history, and cultural insights to reveal the complex interplay between humans and the creatures we label as pests. This book is not only educational but also an important step toward fostering a deeper appreciation for the intricate web of life on our planet.

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Mumbai, India

Book: Indian Grey Hornbill- Unravelling the Secrets
Author: Dr. Raju Kasambe
Publisher: (LAP) Lambert Academic Publishing
Year: 2020

Dr. Raju Kasambe's book, "Indian Grey Hornbill- Unravelling the Secrets," tells the tale of hornbills and how the mysteries of their lives were revealed, as well as providing some factual information. The book is written in straightforward prose aimed at the average reader - both adults and children. In order to make the story more engaging, the author of this book occasionally inserts comparisons of human conduct. Instead of using scientific terminology, the author has at times referred to the male and female hornbills as "He" and "She," respectively. By doing this, the author hopes to bring the reader closer to these "Forest Dwellers" and make us realize that these "Seed Dispersals" own the earth just as much as we human being do!

The book covers a brief explanation of each of the nine hornbill species with their geographic distribution, and the distinctions between hornbills and toucans. This book caught my attention because, according to Ali and Ripley (1987), no previous books had discussed the Indian Grey Hornbill's incubation period. However, the author chose to learn more about it using the midden left behind rather than a web camera. Hornbills' various foraging techniques, from "Plucking to Levering" have also been covered in the book.

The difficulties the author encountered in locating the feathers that had fallen beneath the nest in the dry leaf litter is also a main theme of the book. This is because trees in Central India lose their leaves during the scorching summers. The grayish-brown color of the feathers blends in well with the ground's leaf litter. Thus, it is possible to overlook certain feathers that have dropped.

Every finding in the book is illustrated with photographic documentation. The book has covered many aspects of the Indian Grey Hornbill’s life, including how they manage to keep the sealed cavity clean. New findings about the species with photographs have also been added which gives us the glimpses of the life of these enchanting forest birds- Hornbills.

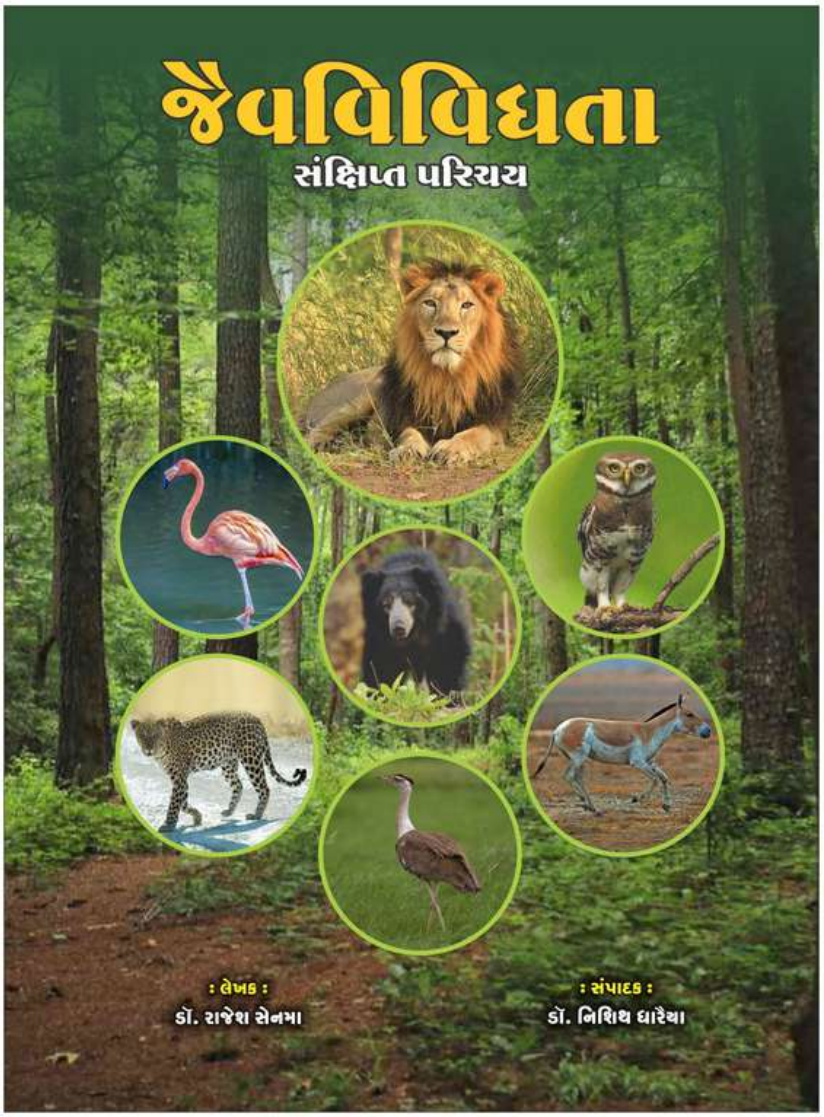
The book has visual documentation to accompany each finding. How the Indian Grey Hornbill maintains the sealed hole clean is one of the numerous facets of its life that have been discussed in the book. These fascinating woodland birds, known as Hornbills, have a fascinating life, as revealed by recent discoveries about the species, which have also been accompanied by images.

Ms. Ruchira Nigam
Research Scholar
Isabella Thoburn College University of Lucknow, Lucknow, India

Achievements

Mr. Pratikkumar Desai, *Co-founder and the Director of WCB Research Foundation has received the research fellowship from Colorado State University, USA and a Conservation and Research Award by International Association for Bear Research and Management, USA for his ongoing PhD studies on sloth bear in Gujarat. Mr. Pratik is a PhD scholar at Hemchandracharya North Gujarat University. Congratulations!!*

Ms. Sakhi Dabhi, *a Tri-annual member of WCB Research Foundation is recently awarded with the Seed Research Grants from Dr Julia Bevins from USA. Dr Julia is a member of Advisory Board of WCB Research Foundation. Congratulations Ms. Sakhi !*



We are delighted to share the news of the grand release of our very first published book, 'જૈવ વિવિધતા' an event graced by the esteemed presence of Dr. Rohit Desai, the honorable Vice Chancellor and Dr. K. K. Patel, the Registrar of HNG University, Patan.

Congratulations to the author Dr. Rajesh Senma!!

The book can be ordered by email to us or by contacting the author:
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WCB RESEARCH FOUNDATION

JOINTLY ORGANIZING

HANDS-ON WORKSHOP ON

TOOLS FOR CONSERVATION RESEARCH

DATE
16-18 SEPTEMBER, 2023

VENUE
Department of Life Sciences, HNG University, Patan

WHO CAN APPLY

MSc/PhD Students, Researchers, Professionals working in the field of Conservation

*Basic knowledge of Statistics, R and GIS is essential
*Participant must bring their laptop for the hands on practice

WHAT TO LEARN

1. Species Distribution Modelling

A. Presence-only Models
  a. Maximum Entropy
  b. Generalized Linear and Logistic Models
B. Presence-Absence Models
  a. Occupancy
C. Model Ensemble

2. Corridor Connectivity Analysis
(Circuit Theory)

LIMITED 25 SEATS
on a first-come first-serve basis

SCAN TO APPLY

KEY SPEAKERS

MR ASHISH JANGID
Project Associate II,
Wildlife Institute of India
Currently working on designing mitigation plan for linear infrastructure in Thar desert landscape.

DR NISHITH DHARAIYA
Associate Professor,
Department of Life Sciences
HNG University, Patan

FEES
3500/-
INCLUDING WORKSHOP KIT, READING MATERIALS & LUNCH
*Accommodation on paid basis
**Dinner excluded

FOR MORE INFO
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HANDS-ON WORKSHOP ON MOLECULAR BIOLOGY

A tool for wildlife species identification

Jointly Organized By
Department of Biotechnology, Sant Gadge Baba Amravati University
&
Wildlife and Conservation Biology Research Foundation
In Association With
Melghat Tiger Reserve, Maharashtra Forest Department

The workshop is designed to train participants with practical experience in fieldwork, collecting biological samples from the field, and hands-on experience in using molecular techniques to identify species using these biological samples.

WHAT YOU WILL LEARN?

- Designing a field survey, identification of wildlife signs and collection of biological samples
- Application of GPS device for spatial data collection
- Isolation of DNA from the field samples
- Use of Polymerase Chain Reaction (PCR), Agarose Gel Electrophoresis
- Sanger Sequencing for the species identification

WHO CAN APPLY?

- University students (Masters/ Research students with biology background)
- Young researchers and faculties working in the area of wildlife research
- Wildlife Forensic Science students, Professionals and Officials

LOCATION

Department of Biotechnology,
Sant Gadge Baba Amravati University,
Amravati, Maharashtra

FOR FURTHER DETAILS CONTACT

WCB Research Foundation
Email: wcbresearch@gmail.com
Phone: +91 8320519905 / +91 9665489963

WCB RESEARCH FOUNDATION

Wildlife & Conservation Biology Research Foundation

Adding Science to Conservation

Internship Opportunities

WCB invites applications (throughout the year) for Internship, Training & Dissertation in Online, Offline or Hybrid mode under the guidance of our Team of Experts in the following areas

- Mammalian Ecology
- Human Wildlife Interaction
- Animal Diversity
- Urban Ecology
- Restoration Ecology
- Conservation Genetics & Bioinformatics
- Plant Diversity
- Geo-Spatial analysis (GIS)
- Wetland Conservation
- Eco-Toxicology
- Animal Metagenome
- Animal Cell Culture

Essential Qualification

B.Sc. or M.Sc. in the respective field

M.Sc. dissertation students are encouraged to apply

Internship Duration

1, 3 to 6 months

WCB Research Foundation is committed to generate skilled human resources through our Internship, Training and Dissertation Programs .

Stipend: There is no any provision of stipend; however local travel and accommodation will be covered in case of ongoing WCB Projects. A Certificate of completion will be provided after the successful completion of the internship.

Application process: Send your application along with a CV, a statement of interest and a letter of reference to our email wcbresearch@gmail.com.

Note: WCB Research Foundation charge a small token fee for the internship, that includes internship materials, fees to the mentors and helping in data analysis, report preparation and publication.

For more details, contact
us on +91 8320519905/ 9712313698
or visit our website
www.wcbresearch.in

Governing Council of WCB Research Foundation

Hon. Director of Research	**Dr. Nishith Dharaiya**	*Associate Professor, HNG University, Patan (Gujarat) India* *nadharaiya@ngu.ac.in*
Director of Operations	**Mr. Pratik Desai**	*Ph D Scholar,* *WCB Research Lab, HNG University, Patan (Gujarat) India* *pratikdesai825@gmail.com*
Member	**Prof. Sagarika Damle**	*Director, Savida Agricom, Mumbai, India* *visaanika@gmail.com*
Member	**Dr. Nuria Selva**	*Associate Professor* *Institute of Nature Conservation* *Polish Academy of Science, Krakow, Poland* *nuriaselva@gmail.com*
Member	**Dr. Rajesh Senam**	*Assistant Professor* *Department of Zoology, Government Science College, Vankal, Surat (Gujarat) India* *rcsibis@gmail.com*
Member	**Dr. Shivangi Mishra**	*Post-Doctoral Associate* *Arctic Institute of North America University of Calgary Alberta, Canada* *mishrashivangi11@.com*
Member	**Dr. Rushika Patel**	*Bioinformatics Scientist* *Molecular Department SN Genelab Pvt Ltd, Ahmedabad (Gujarat), India* *rush2907@gmail.com*

Guidelines to contributors

Prithivya publishes original Research articles, Short Notes, and Comments about wildlife (Flora and Fauna) and conservation biology. Methodological and technical contributions are also welcome. Only submissions in English will be considered for publication. Identification of species, annotated checklists, trip reports, new species records, book reviews, letters, announcements, notices, news from the wildlife world are also welcome.

The text and captions of tables, figures, photographs and appendices should be combined in one Microsoft Word® (".doc," ".docx") file format. The preferred font is 'Times New Roman' in 12 point, with single space.

Photographs, artwork, maps, diagrams, etc. should have at in 300dpi resolution, after the final acceptance, we may ask to send a JPEG file with maximum quality as separate attachments.

Plagiarism: Prithivya is strictly following the ethics of research and publication and we publish the articles with less than 15% of similarities. The articles submitted to Prithivya will be checked for the plagiarism and will be return to the author, in case of similarity more than 15%.

Types of Manuscript
The word counts include the Abstract, whole text and References. The Table and Figure captions are excluded from the word count.

1. Research articles: up to 5000 words
2. Short notes: 1500 words
3. Important sightings: 250-350 words with proper GPS location
4. Important findings: 250-500 words with proper justification,
5. Research paper: Up to 10,000 words (excluding appendix)

Preparation and submission of manuscripts
Submitted manuscripts should follow the standard structure of scientific manuscripts: Abstract, Introduction, Methods, Results, Discussion, Acknowledgments, and References However, Prithivya has certain flexibility in the section structure. The MS not prepared according to these guidelines will be send back to the authors and subjected to rejection.

Title: Try to keep short and concise
Author/s name: Last name first
Affiliation of Author/s and email of corresponding Author
Abstract: 250 words, should contain a summary of all major findings of the work. Abstract is not necessary for Short Note papers.
Keywords: 4-5 words for indexing and literature searching; do not repeat words in the titles

Introduction: should provide a review of the state-of-the-art and existing knowledge on the topic as well as state the hypothesis, explain the issues or problems that motivate the research and the knowledge gaps and or the main questions to be answered.

Methods: Include information about the study species, area, number of samples, studied population(s), methods (both field and statistical), and equipment. It should be enough clear so anybody could repeat the study.

Results: This section describes the findings of the study, without any further explanation or comment on the findings. Results are presented often in Tables and/or Figures with proper labeling/numbering. The caption of Tables and Figures should be self-explanatory. Photographs are also allowed. Species checklists should be presented as appendix.

Discussion: Summarize the main findings of the study (but do not repeat results), explain and comment the results in relation to previous research. Discuss limitations of the study and potential needs in future research.

Conclusion: Optional. It should contain 10-15 sentences, concisely stating the main outcomes of the study.

References: Strictly follow the APA style of referencing. References should be arranged alphabetically by first author. Following are some examples for references.

Unpublished sources
"(Harkirat Sangha, in litt., e-mail/letter dated 02 January 2013)"; if oral, "(Rajah Jayapal, verbally, dated 15 December 2013)".

Journal articles
Naoroji, R., & Sangha, H. S., 2011. Threats to habitat and wildlife in Changthang and Rupshu areas of Ladakh: a case study at Hanle. Prithiviya7 (1): 2–6.

Books
Futehally, Z. (ed.) 2006. India through its birds. 1st ed. Bangalore, India: Dronequill Publishers Pvt. Ltd. Pp. 1–214.

Book chapter
Pittie, A., 2011. Stray Feathers (1872–1899) (p. 247). In: Priority! The dating of scientific names in ornithology: a directory to the literature and its reviewers. Dickinson, E. C., Overstreet, L. K., Dowsett, R. J., & Bruce, M. D. (eds.). Northampton, UK: Aves Press Limited.
Website
2013. Kadalundi makes history with new gull species. The Hindu (Thiruvananthapuram ed.) dated February 7, 2013. Website: http://www.thehindu.com/todays-paper/tp-national/tp-kerala/kadalundi-makes-history-with-new-gull-species/article4388171.ece. [Accessed on 21 July 2014.]

Acknowledgements: Contains funding support, persons who helped during the project or research or findings, name of university other than affiliated.

ETHICAL MATTERS

Authors involved in the usage of experimental animals and human subjects in their research work should seek approval from the appropriate Institutional Animal Ethics Committee in accordance with "Principles of Laboratory Animal Care". The material and methods section of the manuscript should include a statement to prove that the investigation was approved and that informed consent was obtained.
Publication Charges/ Processing fees:
As Prithivya, as an official newsletter of WCB Research Foundation, according to the policies of the foundation, there will be no any publication charges or article processing fees; however, for a printed hard copy of the article (reprint) may available on request by author/s with the printing and shipping cost payable.
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- The editor reserves the right to make necessary changes in manuscripts in consultation with the author.

All submissions are evaluated under the assumption that the conditions listed here have been understood and accepted by the author(s). All manuscript will take 3-4 weeks for review and taking a decision for approval or rejection.

Contact
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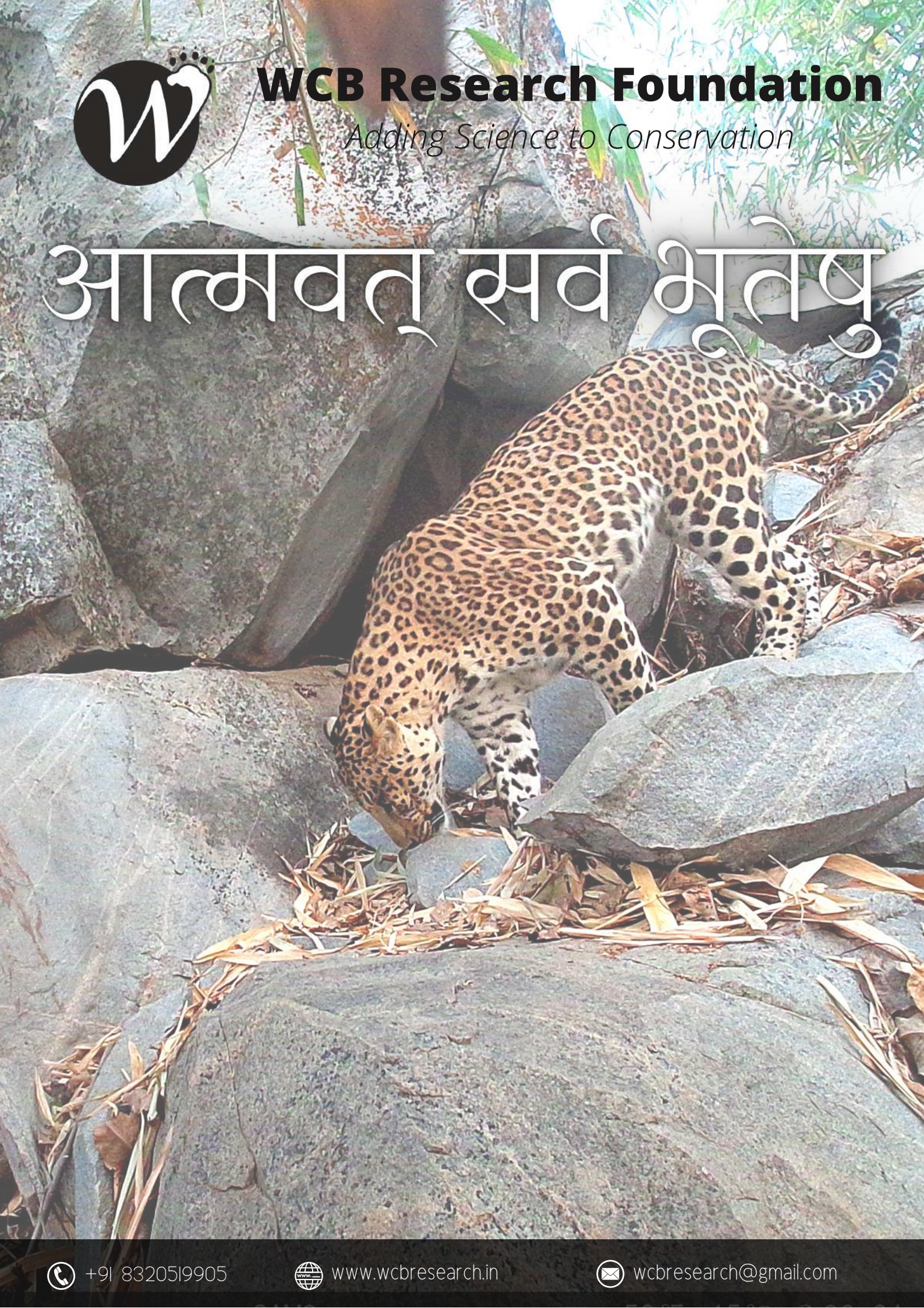
E-mail: prithivya.wcb@gmail.com



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Adding Science to Conservation

आत्मवत् सर्व भूतेषु

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