DEVELOPING A MODEL GRASSLAND RESERVE FOR THE CONSERVATION OF THE GREAT INDIAN BUSTARD

An initiative to secure the last remaining habitat patches in Non-Protected Areas of the Thar Desert, Jaisalmer

FINAL REPORT

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Photo credits

Cover photo - Great Indian Bustard near BNHS base camp Tarkik Verma

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SUMMARY

According to Champion and Seth (1968), pre-climax grasslands are found in India. Ecologists suggest that grasslands also benefit from biotic factors such as verbivore grazing and occasional fire (Champion and Seth 1968; Dabadghao and Shankarnarayan 1973; and Gadgil and Mahar-Homji 1958). Protected areas like Keoladeo NP, Ranthambore NP, and Sariska Tiger Reserve also have small patches of secondary grasslands, as observed by Islam and Rahmani (2011). In 2006, the task force on grasslands and deserts reported to the Planning Commission, Government of India, that the grasslands and deserts are the most neglected ecosystems.

The state of Rajasthan falls under the Dichanthium-Cenchrus-Lasiurus type of grassland (Dabadghao & Shankarnarayan 1973); Lasiurus sindicus is one of the most critical grasses of the Thar region and is underrepresented. The other essential herbs of this region are Bui Aerva psuedomentosa, Murat Brachiaria ramose, Phog Calligonum polygonoides, Bhurat Cenchrus biflorus, Chag Crotalaria burhia, and Ganthia Dactyloctenium sindicum. The Thar Desert is home to many bird species, including the critically endangered Great Indian Bustard Ardeotis nigriceps (Rahmani 1997).

Grasslands are combinations of different grass species, legumes, and herbs that act as carbon sinks, preventing erosion and being a source of nitrogen fixation (Carlier et al., 2009). In India, for instance, Rajasthan is home to the Dichanthium-Cenchrus-Lasiurus type of grassland, which is underrepresented and critical to the region. The importance of grasslands cannot be overstated. They provide a home for various flora and fauna act as carbon sinks, prevent erosion, and contribute to nitrogen fixation. Unfortunately, grasslands are often neglected, and their value needs to be fully appreciated.

The Thar Desert is a mosaic of grasslands and farmlands due to rapidly changing land use patterns in recent times. The grasslands and croplands in Khetolai village is the home to the Critically Endangered Great Indian Bustard (GIB). To work in the non-protected area under the capacity building programme, we initiated programme for garnering local support and sensitizing the local youth of the Khetolai Village. Despite the challenge faced by the grassland habitats from factors such as invasion of exotic species, overgrazing due to spike in livestock population and land use change at landscape level owing to mushrooming of renewable energy infrastructure, efforts are being made to protect and restore grasslands. For example, in the Khetolai village area of the Thar Desert, local support is being garnered to help preserve the Critically Endangered Great Indian Bustard by addressing the local issues like regulating the use of pesticide and the menace of free ranging dogs.

By sensitizing the local youth in such a landscape which includes non protected areas and building capacity, we can work towards preserving these valuable ecosystems and the species that depend on them.

A glimpse of dry arid or desert grassland © Sujit Narwade

A male chinkara with stretched front foot is in response to threat stimulated © Pankaj Bishnoi

NEED FOR A GRASSLAND RESERVE

About GIB

In the past, the GIB was spread across a wide area from the Punjab plains in the north to Tamil Nadu in the south and from Pakistan's Sindh region to the Chhota Nagpur Plateau in the east. Unfortunately, this majestic bird has suffered a significant population decline, and it has vanished from almost 90% of its historic range. The Great Indian Bustard, also known as Godawan in Rajasthan, is a Critically Endangered bird species native to the Indian Subcontinent and mainly found in the Thar Desert. Its current population stands at a maximum of 100 individuals in India, with about 75 individuals residing in the Thar Desert of Rajasthan. Unfortunately, these birds are only found in three pockets in Rajasthan: one in the Desert National Park (DNP), Pokhran, and third on the boundary of India and Pakistan. Despite this, the Thar Desert still hosts a viable population of GIBs. These birds mainly occupy two areas: the Desert National Park, a protected area, and the PFFR, a non-protected area.

Conservation initiative by the Government of India

Fortunately, the Government of India has taken steps to protect the Great Indian Bustard. At the CMS-COP 13 held in Gujarat, the species was included in Appendix I of the Convention on Migratory Species (CMS). In addition, the Ministry of Environment, Forest and Climate Change (MoEF&CC) initiated Species Recovery Plans for the bustards in India under its centrally sponsored scheme, 'Integrated Development of Wildlife Habitats,' in 2011.

BNHS bustard program

To address these challenges, the BNHS Bustard Program has been initiated to conserve the last viable population of the GIB outside the protected area by conducting landscape-level surveys and garnering local support to address the threat. However, the conservation program's key challenge is securing optimal habitat for these birds. Currently, viable populations of GIB in the Thar Desert are confined to just three small pockets. The Desert National Park is a Protected Area with a management plan in place, and hence mostly not affected by the new renewable energy infrastructure.

On the other hand, the Pokhran Field Firing Range (PFFR) and surrounding village areas are the last refuge for the few remaining bustards in non-protected areas. Degrai Mata Oran, which was once excellent habitat, is now a death trap for the birds due to the rampant mushrooming of high-tension power lines and renewable energy projects. Finally, the Border areas between India and Pakistan are controlled by the Border Security Force (BSF), and the condition of habitat and birds was poorly known until a recent survey with prior permission from BSF.

THE KHETOLAI VILLAGE AND SURROUNDING AREAS - A CRUCIAL LANDSCAPE FOR THE GREAT INDIAN BUSTARD (GIB)

Khetolai is a village in Pokhran tehsil, which falls under the Jaisalmer district. The village covers an area of 9,723 hectares and is home to 1,698 people living in 302 houses. The village panchayat is situated on the outskirts of the government-restricted area of Field Firing Range Pokhran, and it plays a crucial role in maintaining the surrounding grasslands.

These grasslands and croplands are vital for the survival of the endangered Great Indian Bustard, with an estimated 30 to 35 individuals residing in this area. The bird breeds within the PFFR from summer to monsoon season, while it moves outside the PFFR during winter. Unfortunately, the rising cattle population, invading exotic species, and several upcoming renewable energy projects pose a threat to their habitat, leading to habitat degradation and fragmentation. The High Tension Transmission Lines erupting from the renewable energy farms acts as an ecological barrier for low flying bird species such as GIB, Demoiselle Cranes and even variety of raptor species.

Surveys revealed that the grassland surrounding the village panchayat Khetolai is infested by Prosopis juliflora. This invasive species has caused significant damage to the grasslands and various floral and faunal species thriving in it. There is an urgent need to restore the habitat to its natural state.

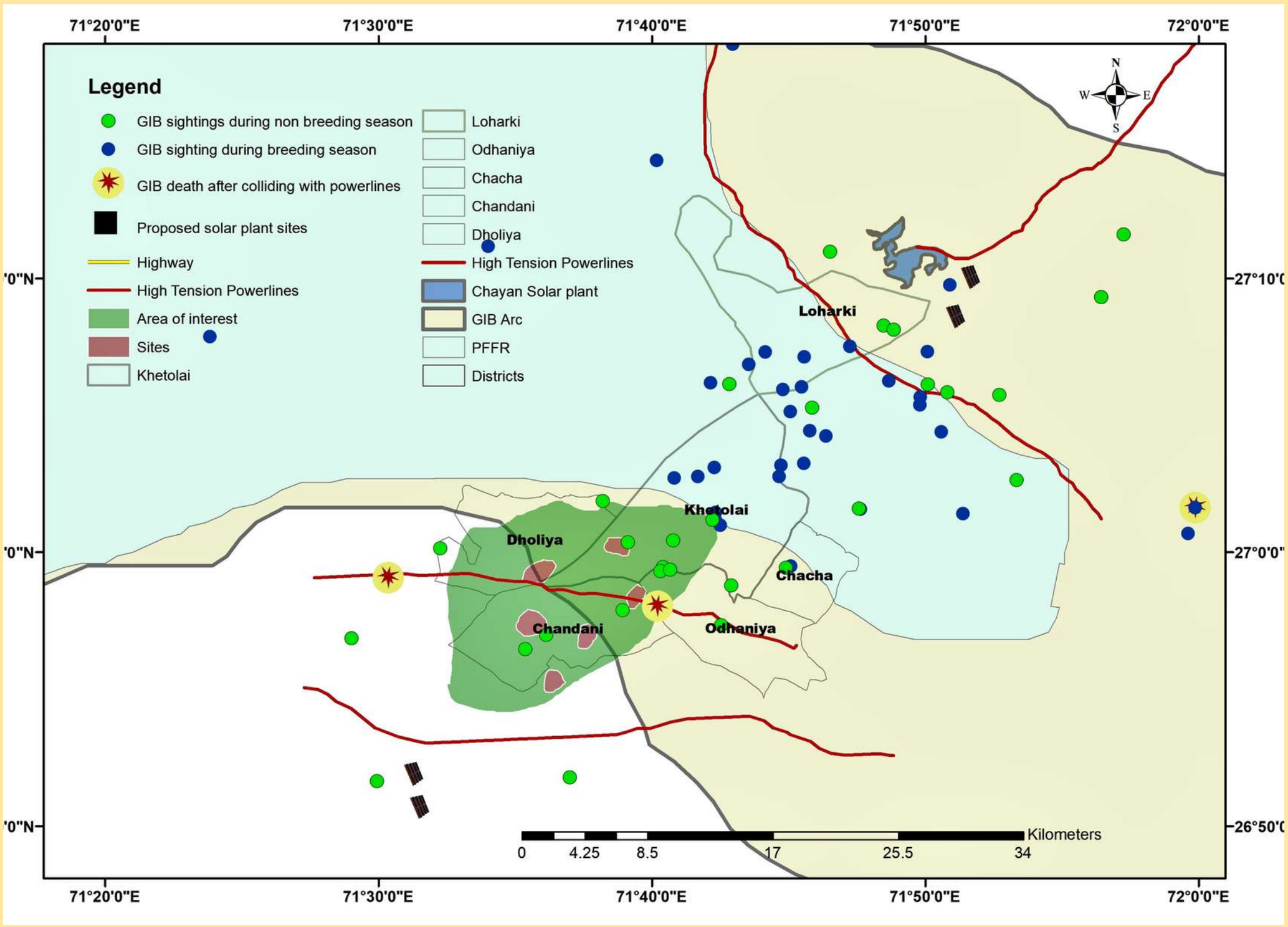


Figure 01. This particular region in Pokhran area serves as a significant habitat for the Great Indian bustard, as they rely heavily on the undisturbed large area, availability of required resources and safety - map prepared by Sujit Narwade

CHALLENGES IN PROTECTION OF GRASSLAND HABITAT

A small population of GIBs still exists in the border regions of India and Pakistan. However, the Indira Gandhi Nahar Pariyojana project has significantly impacted the bird's habitat. The project has resulted in changes in land use including changes in cropping patterns, a sharp increase in livestock population, the introduction of alien species, and the growth of the renewable energy sector. In conclusion, the GIB faces significant challenges to its survival. Therefore, protecting and preserving this bird species is crucial to ensure its continued existence. Three pressing issues require immediate attention to preserve this fragile ecosystem. Overgrazing has become a significant concern due to the livestock population surge, which has put grasslands under immense pressure, resulting in the degradation of these vital ecosystems; grasslands play a crucial role in maintaining the balance of Thar's biodiversity.

Secondly, the encroachment of invasive species has become a growing threat to the natural habitat. These invasive species have the potential to cause extensive damage to the environment, which could have long-lasting impacts on the survival of many species. Finally, powerline networks have been identified as a fatal threat to birds, which is a cause of concern for the future of our avian population. We must take immediate action to avoid new infrastructure and mitigate existing lines to ensure the continued survival of our environment.

Therefore, the Following threats need to be tackled on a priority basis

1) Overgrazing - The exponential increase in livestock population has increased pressure on the grasslands
2) Encroachment by invasive species - fragmentation and degradation of habitat by exotic species
3) Network of powerlines forming a death trap for the large flying and soaring birds.

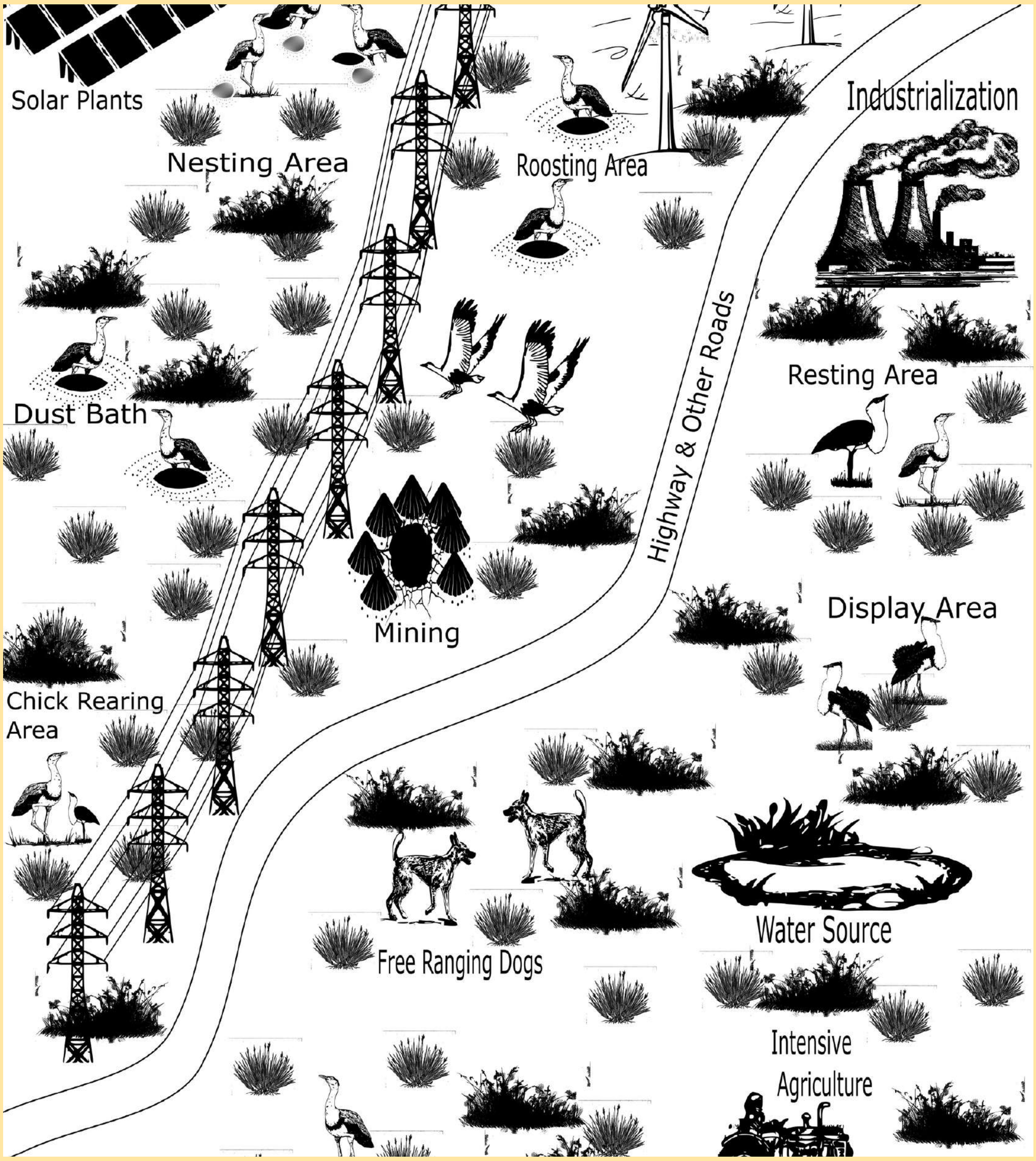
Sketch depicting a male Great Indian Bustard © Amey Parkar

Due to the constant grazing, the grass is unable to regrow and as a result, the soil is left exposed to the environment. This exposure leads to soil erosion, whereby the top layer of soil is eroded by rain or blown away by wind which affects grassland generation. Over time, this erosion can lead to a decrease in soil fertility and productivity, which can have significant consequences for both the environment and the economy.© Pankaj Bishnoi

On the left side of the landscape, various exotic plant species have taken root and begun to flourish, potentially disrupting the local ecosystem. Meanwhile, on the right side, renewable energy industries have constructed power line networks © Neelkanth Bora

MINIMUM REQUIREMENTS OF BUSTARDS

The Bustard is a grassland obligate species; hence, it has some basic requirements for a suitable habitat. It has a slow life history, giving just one or two eggs annually. Only the mother is rearing the chick, and the male GIB has no active role in parental care. The chick can be seen following mothers even up to the age of one and a half to two years. This sometimes leads to confusion among the watchers as a juvenile male looks more significant than the mother and is considered as a male partner. The male and female come together only at the time of courtship display and mating. The male GIB has a strong site fidelity and has specific locations where they perform breeding displays year after year, competing with fellow males; the females select the best among the males; this phenomenon is called the Lek mating system. It also has specific roosting, nesting, and foraging areas. The sketch below represents the basic requirements of bustards and threats faced due to changes in land use.



It is of utmost importance that we take immediate action to establish safe and appropriate habitat for the Great Indian Bustard (GIB) to protect them from the threat of extinction © Digital sketch Pratik Pansare

GIB MOVES OUT OF THE FIELD FIRING RANGE IN AREAS DOMINATED BY BISHNOI COMMUNITY

GIB is a magnificent bird that relies on various microhabitats to raise its young. Specifically, it utilises grasslands, farmlands, and fallow land to provide their offspring with a safe and nurturing environment. However, during the winter, the Indian Army increases the military practices in the area. This heightened activity causes the bustards to become more mobile, moving out of the Pokhran Field Firing Range (PFFR) and into surrounding areas.

Late September marks the beginning of a new season, bringing a flurry of activity for the GIB. Young ones of the bustards learn how to forage from their mother. This includes fruits like melons, berries like Zizyphus and pods of native legumes, as well as various insects that can be found in the fallow land.

The Bishnoi community has taken great strides to ensure the safety and protection of the GIB outside PFFR. Poaching is strictly prohibited, and selected Bishnoi families have worked alongside the BNHS to set aside land for the creation of a reserve that provides a safe haven for the birds. This commitment to nature conservation is rooted in the teachings of Guru Jambheshwar, and it serves as a testament to the community's dedication to preserving the nature and wildlife of the region.

In the case of a GIB female being in the company of her chick, it is observed that the male chick appears to be larger in size when compared to the adult female. This is an interesting phenomenon worth noting in the context of this particular species ©Pankaj Bishnoi

The male chick following the mother and learning the basic life skills to survive in the nature ©Kamlesh Kumar

GIB's taking shelter in the bushes to avoid the scorching sun rays in winters. ©Pankaj Bishnoi

The images shows use of various landscape by the GIB to rear its chick and school with some basic life skills essential for its survival.

SITE SELECTION AND MAPPING

To conserve the Great Indian Bustard (GIB), the BNHS comprehensively surveyed the Pokhran tehsil region. Through their diligent efforts, the team identified several locations that GIBs frequently visit during the winter. These locations spanned private and public farmland, making it clear that conservation efforts would require buy-in from various stakeholders. With this in mind, the BNHS began engaging with like-minded individuals who shared their passion for wildlife conservation. These individuals were eager to help create a grassland reserve that would provide a safe and luring habitat for the GIB. Their enthusiasm and willingness to spread the word and collaborate with others was truly inspiring, and it helped to provide a much-needed boost to the initiative. As the project moved forward, the BNHS team made sure to follow proper procedures to facilitate the development of the reserve. This included signing agreements with landowners who were willing to lease their land for the noble cause of conservation. Their cooperation and support were absolutely crucial in bringing the project to fruition, and the BNHS is grateful for their partnership. Ultimately, it is through these kinds of collaborative efforts that we can make a real difference in protecting threatened species like the Great Indian Bustard.

Figure 02. After conducting thorough exploration, a 35-hectare expanse has been designated as a model grassland reserve. This area has been carefully selected to ensure the preservation and conservation of the GIB as well as native flora and fauna - map prepared by Neelkanth Bora

Following the necessary approval from the land title holders, we went ahead and started the on-ground project with utmost care and consideration for everyone's interests. To ensure transparency and avoid complications, we drafted and executed a simple agreement between the landowners and BNHS, outlining the terms and conditions of the development. The land designated for the enclosure was meticulously demarcated with the aid of advanced GPS equipment under the supervision of the local administration.

To ensure that the project did not cause any inconvenience to the neighbouring farmers, we took their views into account and established a mutually agreed-upon right-of-way. We also made sure to maintain minimal standard deviations throughout the process, thus ensuring the accuracy of the project. With our meticulous planning and attention to detail, we aim to create a safe and secure environment for all stakeholders involved in the project.

The current situation regarding the preservation of the GIB species is concerning as their last remaining habitat is being threatened by the encroachment of heavy energy infrastructure. This includes the installation of solar plants that emit a significant amount of light during the night, which may negatively impact the habitat as well as natural behavior of the birds.
(c) Pankaj Bishnoi

METHODS AND MATERIALS USED FOR FENCING THE RESERVE

Bustards move out of the PFFR with the onset of winters and spend time in areas adjacent to the range mostly dominated by Bishnoi community. The region is under immense pressure from various anthropogenic activities such as increased livestock pressure, land use change as the agricultural activities have intensified and various renewable energy infrastructure units are setting in and threats from natural predators and invasive species such as Free Ranging Dog. BNHS has collaborated with local people from Khetolai and got support from SITA inc., to develop safe habitat by creating model grassland reserve for the bustard devoid of any external pressure.

Head	Khetolai with fence	Khetolai without fence	Deg Rai Mata Oran with fenc
Area	25 Ha	20 Ha	15 Ha
Support	MNREGA	BNHS	Seeds provided by BNHS
Seed sowing period	August 2021	July 2021	September 2021
Seeds sown	200 kg	200 kg	100 kg
Germination success	30%	5%	0%
Water provisioning	After sprouting of Sewan grass	No	No
Grazing pressure	No	High	Limited

All experiments of grassland developement indicates that without fencing it is impossible to control overgrazing and movement of predators like free-ranging dogs (c) Tarkik verma

In summers with the shortage of fodder, grasslands face immense burden from ever increasing livestock population, even the last of the grass blades are a bone of contention (c) Pankaj Bishnoi

The conveyance of resources to the remote desert spot proved to be an immensely challenging and intricate endeavor, requiring a great deal of planning, coordination, and execution. Ts ©Pankaj Bishnoi

With assistance from tractors, a multitude of stone pillars, barbed wire rolls, and iron fences were successfully transported to the designated site. The use of such sturdy materials required for a durable and secure boundary for the area © Pankaj Bishnoi

Strong fencing is required to create safe habitats for the wildlife

BUILDING STRONG FOUNDATION FOR ERECTION OF FENCE IN SANDY HABITAT

The land chosen for the grassland enclosure was surrounded by symmetrical stone pillars, each standing at a height of eight feet. To ensure the safety of the enclosure, only one entry point was created and regulated to prevent any unauthorized entry by livestock. The area had some undulations, which required the workers to level out the sand mounds and ditches to reduce any potential weak spots in the fence. The fence was reinforced with binding wires and barbed wires to add strength, and it was constructed to a height of six and a half feet to prevent intrusion from Neelgai.

A skilled mason diligently installing a stone pillar. It requires precision and care to sustain in Desert habitat ©Pankaj Bishnoi

The visual representation exhibits a precisely balanced and proportionate configuration of solid stone columns.©Pankaj Bishnoi

Establishing boundary limits with the placement of upright structures at predetermined spots

STEPS TAKEN TO PREVENT OVERGRAZING

The spike in livestock population in the villages surrounding the PFFR chiefly due to better availability of water due to advent of Indira Gandhi Nahar Pariyojana has given a boost to the dairy industry in the region. Along with this more than 30 thousand cattle in the Bhadariya Rai Goshala, imparts intensive grazing pressure in the region. In summers with scarcity of fodder these animals are set free to graze, which intern has led to degraded grassland habitat. To prevent intrusion of these cattle barbed wire fencing has been commissioned in the selected area.

While construction of the fence, laborers are fastening barbed wire onto multiple levels of stone pillars

the stone pillars are being reinforced with additional support for the purpose of installing wire fencing. This will ensure that the fencing is securely attached and provides adequate protection

The stone pillars, which serve as a sturdy foundation for the fencing, has an impeccably organized arrangement of wires.

Different stages of fencing in the development of the grassland enclosure ©Pankaj Bishnoi

STEPS TAKEN TO PREVENT INTRUSION OF PREDATORS

In wild the adult Great Indian Bustard has very few natural predators. GIB makes its nest on the ground, it has a incubation period of 26 to 28 days, the hatching is done by female only. In the scorching heat female has to leave the nest multiple times to quinch its thirst, at this point of time the eggs face multiple threats such as trampling from grazers and increased chance of predation by foxes, wild boars and even Free Ranging Dogs. To reduce the chances of intrusion by these predators we came up with a solution of putting up a fence designed specifically to even prevent entry of Nilgai.

There have been a significant amount of occurrences where Free Ranging Dogs have been observed preying on Chinkara. This trend has raised concerns amongst wildlife conservationists and authorities, as it poses a threat to the survival of these graceful animals. ©Pankaj Bishnoi

Mason and his colleagues are diligently engaged in the task of dismantling a sand mound, with the aim of achieving a perfectly level alignment for the fencing ©Neelkanth Bora

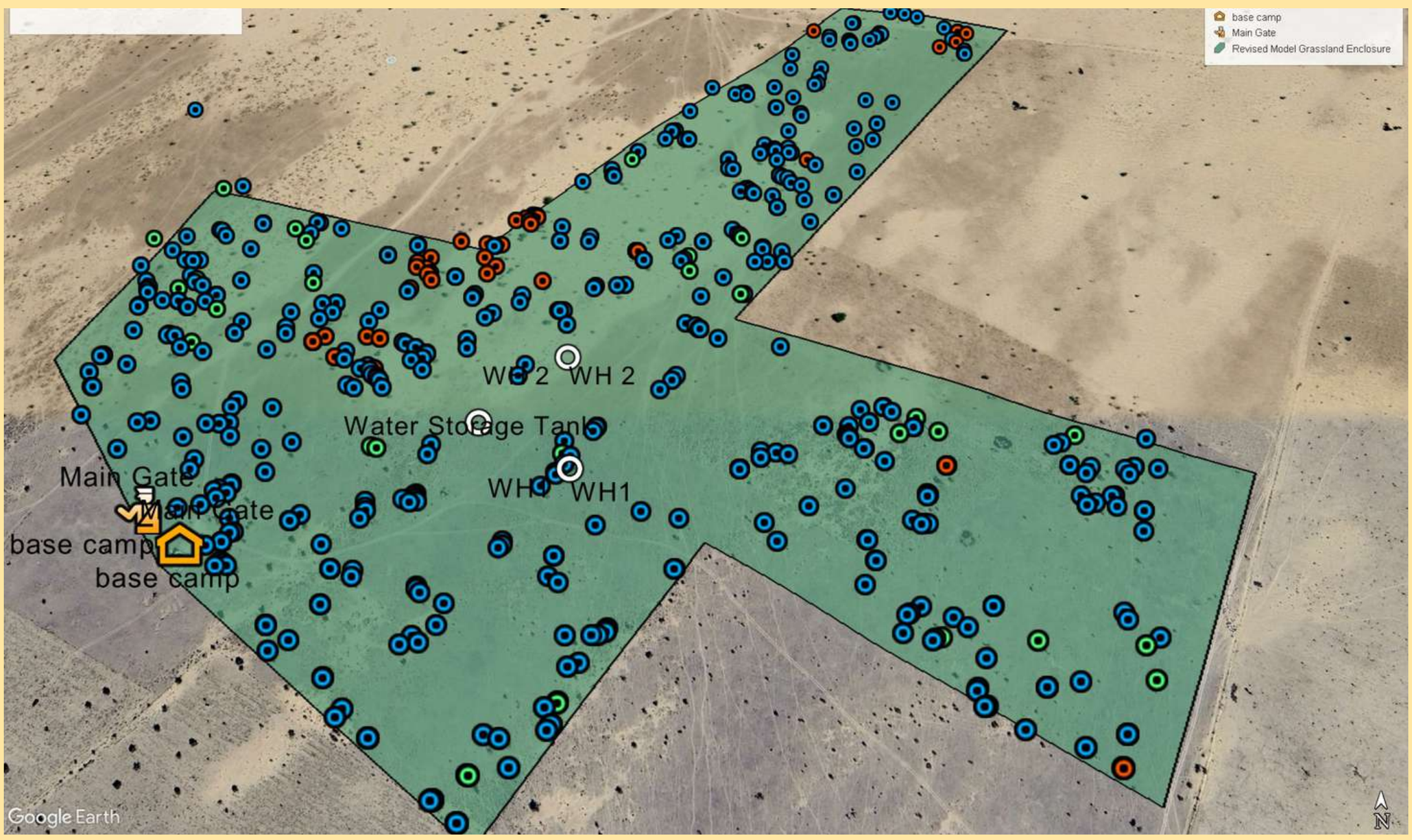
Field staff supervising the workers as they erect fencing using sharp barbed wire and solid stone pillars ©Neelkanth Bora

Complete fencing and development of model grassland enclosure being inspected by Director, BNHS and bustard team ©Pankaj Bishnoi

HABITAT ASSESMENT POST FENCING

In order to thoroughly investigate the impact of fencing on grass species in a carefully regulated environment without cattle grazing, a comprehensive set of baseline data was diligently collected before any alterations to the vegetation. This approach ensures that any subsequent analyses are based on a solid foundation of accurate information and allow for more precise conclusions to be drawn

Initial inferences drawn showed that Zizyphus mauritiana and Capparis decidua were the tallest species whereas Dactyloctenium sindicum had the maximum habitat cover percentage.



Map showing locations of the trees across the grassland reserve - prepared by Sujit Narwade

During the month of April in the year 2023, a comprehensive tree count was carried out within a grassland enclosure. The results of the count indicated the presence of 36 Khejri trees, 455 Ber trees, and 48 Ker trees within the designated area. The information obtained from the tree count will be valuable in assessing the health and sustainability of the grassland ecosystem, and will aid in the development of future conservation efforts © Sachin Bishnoi

It is quite evident that the modification in the surroundings is apparent via the regrowth of the grassland post-fencing. The changes in the habitat are quite visible, and the regrowth of the grassland is a clear indication of this transformation. © Pankaj Bishnoi

VEGETATION

The process of collecting data on vegetation cover percentage comosition and average height involved the use of numbered grids measuring one hundred by one hundred meters. In order to achieve a representative sample, random sites were selected from a total of five different grids. This systematic approach allowed for a comprehensive and accurate analysis of the vegetation cover and height across the selected areas.

Vegetation data was collected and the bar graph represents the change in dominant vegetation in the grassland reserve native species such as Lasiurus scindicus, Aerva persica, Cenchrus biflorus and Indigofera cordifolia were recorded these grasses are highly palatable and have been under great pressure from the impact of overgrazing due to increase in livestock population in the Thar Desert.

Species that are native to grasslands depend on the presence of these grasses to sustain themselves in this delicate ecosystem. These obligate species have evolved to thrive specifically in grasslands and cannot survive without the unique conditions provided by these habitats. As such, it is crucial to preserve and protect these grasslands in order to maintain the biodiversity and health of these ecosystems.

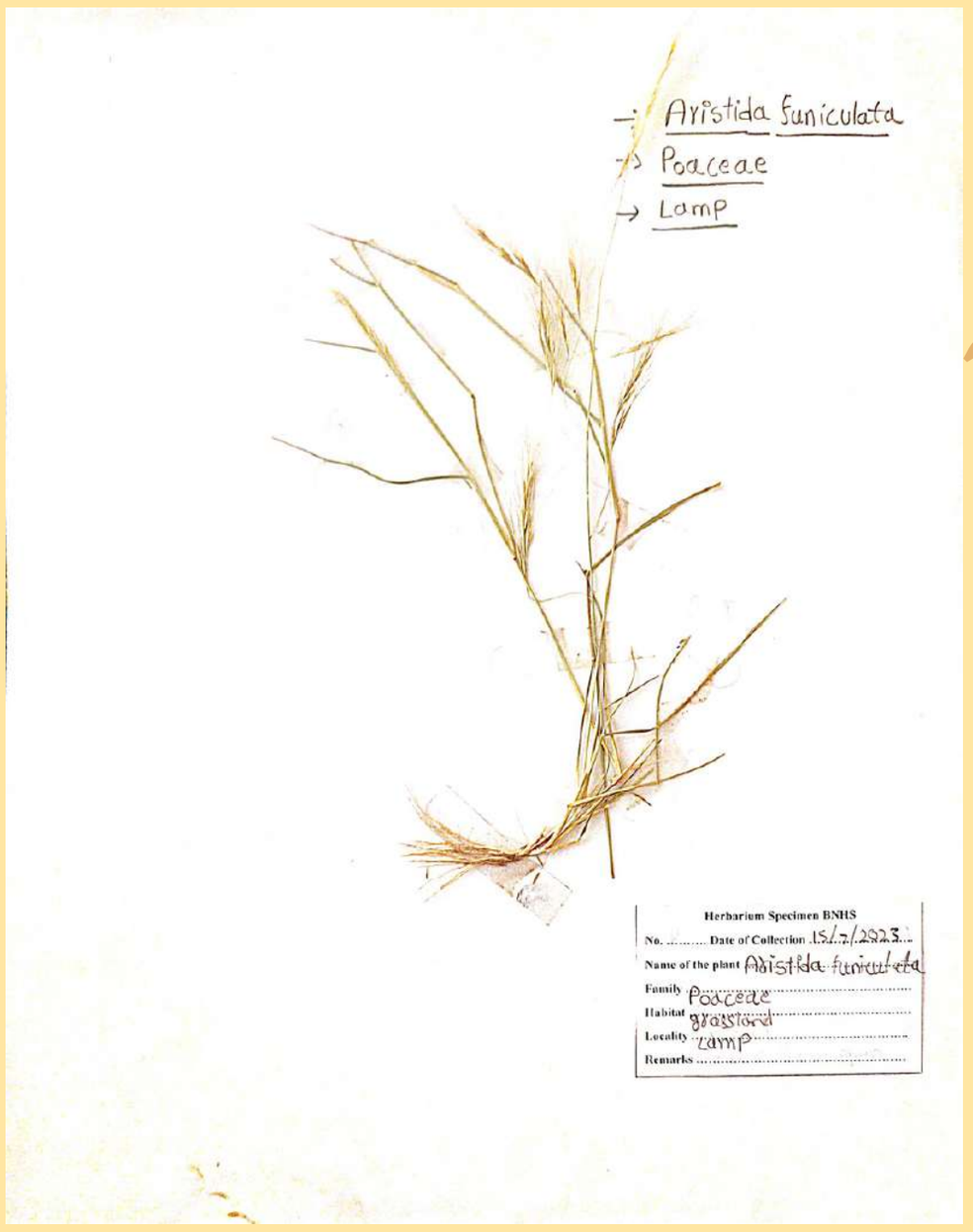
Figure 03. The baseline data prior to fencing and vegetation in fenced grassland reserve have been established. Graph prepared by Neelkanth Bora

LIST OF PLANT SPECIES RECORDED INSIDE GRASSLAND RESERVE

S No.	Plant species	Family	Local name	Group
01	*Acacia nilotica*	Mimosaceae	Banwal	Tree
02	*Acacia senegal*	Fabaceae	Kumta, Kumatia	Tree
03	*Aerva persica*	Amaranthaceae	Buari	Herb
04	*Anogeissus pendula*	Combretaceae	Dhokda, Dhawada	Tree
05	*Aristida adscensionis*	Poaceae	Lampro	Herb
06	*Aristida funiculata*	Poaceae	Lamp	Herb
07	*Brachiaria ramosa*	Poaceae	Murat	Herb
08	*Leptadenia pyrotechnica*	Asclepiadaceae	Kheemp	Shrub
09	*Cenchrus biflorus*	Poaceae	Bhurat	Herb
10	*Ziziphus mauritiana*	Rhamnaceae	Beri, bordi	Shrub
11	*Citrullus colocynthis*	Cucurbitaceae	Tumba	Climber
12	*Crotalaria burhia*	Fabaceae	Sanio, Jhunda, Chag, Pher	Herb
13	*Dipterygium glaucum*	Capparaceae	Moto chag	Shrub
14	*Heliotropium crispum*	Boraginaceae	Kali bui	Herb
15	*Indigofera cordifolia*	Fabaceae	Bekar	Herb
16	*Indigofera linnaei*	Fabaceae	Bekario	Herb
17	*Haloxylon salicornicum*	Chenopodiaceae	Lana	Herb
18	*Dactolectinium sindicum*	Poaceae	Ganthio	Herb
19	*Aerva javnica*	Boraginaceae	Bui	Herb
20	*Capparis decidua*	Capparaceae	Ker	Shrub
21	*Acrachne racemosa*	Poaceae	Chinki	Herb
22	*Cenchrus ciliaris*	Poaceae	Dhaman	Herb
23	*Cistanche tubulosa*	Orobanchaceae	Lonki ro mut	Herb
24	*Farsetia hemiltonii*	Brassicaceae	Hiran chabbo	Herb
25	*Mollugo cerviana*	Molluginaceae	Chiria-ro-khet	Herb
26	*Prosopis cineraria*	Fabaceae	Khejari	Tree
27	*Prosopis juliflora*	Fabaceae	Angreji bawal	Shrub
28	*Tephrosia purpuria*	Fabaceae	Bisoni	Herb
29	*Tribulus terrestris*	Zygophyllaceae	Kanti, Chota Gokhru	Herb
30	*Lasiurus scindicus*	Poaceae	Sewan	Herb

BASELINE DATA OF DOMINANT PLANTS FOUND IN GRASSLAND RESERVE POST FENCING

A comprehensive study was conducted to examine the impact of fencing on various plant species in an area free from livestock grazing. In order to accurately identify these plants, herbarium sheets were meticulously created, containing detailed information about diverse types of shrubs, herbs, and trees. These sheets were executed in accordance with the BNHS format and included essential data, such as the collection date, scientific and family names, habitat, and the local name of each species. We firmly believe that these informative sheets will be of great help to educate the younger members of the local community and students who have a keen interest in botany. More than 25 species were documented and compiled in the grassland reserve.



A) *Aristida funiculata*

B) *Tribulus terrestris*

C) *Cenchrus biflorus*

D) *Acrachne racemosa*

Plant samples collected from the Model Grassland Enclosure were used to prepare herbarium sheets ©Pankaj Bishnoi

LIST OF MAMMALS AND REPTILES SIGHTED IN GRASSLAND RESERVE

The list was prepared as per the sightings within the grassland reserve from the duration of February to July 2023

S No.	Animal Species	Common Name	Local name	Bird//Retile/Mammal	IUCN Status
1	*Gazella bennettii*	Chinkara	Hiraniyo	Mammal	LC
2	*Vulpes vulpes pusilla*	Desert Fox	Maru Lomdi, Lonki	Mammal	LC
3	*Felis margarita*	Desert Cat	Maru Billi, Minni, Rohi Minni	Mammal	LC
4	*Echis*	Saw scaled Viper	Lundi, Bandi	Reptile	LC
5	*Sus scrofa*	Wild Boar	Ginduriya, Jungli Suar	Mammal	LC
6	*Meriones hurrianae*	Indian Desert Jird	Chua, undro	Mammal	Lc
7	*Varanus bengalensis*	Bengal Monitor	Goh	Reptile	NT
8	*Varanus griseus*	Desert Monitor	Chandan Goh	Reptile	LC
9	*Hemiechinus auritus*	Indian Long-eared Hedgehog	Zau chua	Mammal	LC
10	*Eryx johnii*	Red sand Boa	Damboi	Reptile	NT
11	*Trapelus agilis*	Brilliant's Agama	Girgit, kirda	Reptile	LC
12	*Eutropis carinata*	Indian Skink	Doodh Gilhari	Reptile	LC
13	*Scincus scincus*	Sandfish	-	Reptile	LC
14	*Platyceps ventromaculatus*	Glossy bellied Racer	Kantaliyo	Reptile	LC
15	*Lepus nigricollis*	Indian Hare	Khargosh	Mammal	LC
16	*Herpestes edwardsi*	Indian Grey Mongoose	Newlo	Mammal	LC
17	*Boselaphus tragocamlus*	Nilgai	Roj/ Rojdo	Mammal	LC
18	*Acanthodactylus cantoris*	Indian frindge fingered lizard	-	Reptile	LC
19	*Cyrtopodion* cf. *scabrum*	Rough bent toed spiny gecko	-	Reptile	LC
20	*Naja naja*	Indian Cobra	Nag/ Kalinder	Reptile	LC

AVIFAUNA SEEN IN AND AROUND GRASSLAND RESERVE

The grasslands' regeneration has increased food availability for birds, including species such as seed-eating larks, insectivorous bee-eaters, and resident and migratory raptors. We collected data from late winter (February) to early monsoon (July) of 2023.

S No.	Animal Species	Common Name	IUCN Status	Migratory/ Resident
1	*Sylvia nana*	Asian Desert Warbler	LC	M
2	*Accipiter nisus*	Eurasian Sparrow-hawk	LC	R
3	*Circaetus gallicus*	Short-toed Snake-eagle	LC	R
4	*Aquila nipalensis*	Steppe Eagle	EN	M
5	*Aquila rapax*	Tawny Eagle	VU	R
6	*Gyps fulvus*	Griffon Vulture	LC	M
7	*Aegypius monachus*	Cinerous Vulture	NT	M
8	*Aquila heliacal*	Egyptian Vulture	EN	R
9	*Elanus cacrourus*	Black-winged Kite	LC	R
10	*Falco naumanni*	Lesser Kestrel	LC	R
11	*Francolinus pondicerianus*	Grey Francolin	LC	R
12	*Grus grus*	Common Crane	LC	M
13	*Grus virgo*	Demoiselle Crane	LC	M
14	*Ardeotis nigriceps*	Great Indian Bustard	CR	R
15	*Chlamydotis macqueenii*	MacQueen's Bustard	VU	M
16	*Cursorius corsor*	Cream-coloured Courser	LC	M
17	*Pterocles exustus*	Chestnut-bellied Sandgrouse	LC	R
18	*Columba eversmanni*	Yellow-eyed Pigeon	VU	M
19	*Upupa epops*	Common Hoopoe	LC	R
20	*Eremopterix griseus*	Ashy-crown Sparrow-lark	LC	M
21	*Melanocorypha bimaculata*	Bimaculated Lark	LC	M
22	*Eremopterix nigriceps*	Black-crowned Sparrow-lark	LC	R
23	*Ammomanes deserti*	Desert Lark	LC	R
24	*Calandrella brachydactyla*	Greater Short-toed Lark	LC	M
25	*Anthus campestris*	Tawny Pipit	LC	M
26	*Oenanthe deserti*	Desert Wheatear	LC	M
27	*Oenanthe picata*	Variable Wheatear	LC	M
28	*Turdoidescaudata*	Common Babbler	LC	R
29	*Priniasocialis*	Ashy Prinia	LC	R
30	*Cinnyris asiaticus*	Purple Sunbird	LC	R
31	*Euodice malabarica*	Indian Silverbill	LC	R
32	*Passer domesticus*	House Sparrow	LC	R

GLIMPSES OF WILDLIFE SIGHTING IN AND AROUND GRASSLAND RESERVE

The Juvenile of endangered Egyptian Vulture Neophron percnopterus got captured at water hole inside enclosure. ©BNHS archive

A mother and juvenile of critically endangered GIB Ardeotis nigriceps, sighted at 500m distance from the the reserve in June 2023 ©Pankaj Bishnoi

Among the various animals that can be observed at the water hole, one noteworthy species is the Desert Fox Vulpes vulpes. This species cane recognizable for its sandy coat and pointed ears, and it is known to inhabit arid regions such as deserts. Its presence at the water hole suggests that it relies on this source for hydration, an essential element for its survival in such a harsh environment © BNHS archive

DOCUMENTATION OF INSECT DIVERSITY IN GRASSLAND RESERVE

The insects are the most diverse and dominant group in the Animal Kingdom, It has been well documented that they perform a key role by providing various services to the ecosystem such as pollination, biological control, wildlife nutrition (Losey & Vaughan 2006; Dangles & Casas 2019). Studies conducted on feeding habits of bustards species specially Lesser Florican Sypheotides indicus has revealed that insects are a major portion of their diet in breeding and non-breeding season (Sankaran & Rahmani 1986; Sankaran 1991).

Checklist of insects encountered in Grassland Reserve.

Sr. no.	Order	Family	Scientific name	Common Name
1	Coleoptera	Buprestidae	*Julodis sp.*	Jewel Beetle
2	Coleoptera	Cicindelidae	--	Tiger Beetle
3	Coleoptera	Scarabaeidae	--	Dung Beetle
4	Coleoptera	Tenebrionidae	*Pimelia sp.*	Darkling Beetle
5	Hemiptera	Pyrrhocoridae	--	--
6	Hymenoptera	Vespidae	--	Potter Wasp
7	Lepidoptera	Nymphalidae	*Danaus chrysippus*	Plain Tiger
8	Lepidoptera	Pieridae	*Catopsilia pyranthe*	Mottled Emigrant
9	Lepidoptera	Pieridae	*Colotis vestalis*	White Arab
10	Lepidoptera	Pieridae	*Eurema hecabe*	Common Grass Yellow
11	Lepidoptera	Sphingidae	--	Hawkmoth
12	Neuroptera	Myrmeleontidae	--	Antlion
13	Odonata	Coenagrionidae	*Amphiallagma parvum*	Azure Dartlet
14	Odonata	Coenagrionidae	*Agriocnemis pygmaea*	Pygmy Dartlet
15	Odonata	Coenagrionidae	*Ischnura rubilio*	Western Golden Dartlet
16	Odonata	Coenagrionidae	*Ischnura nursei*	Pixie Dartlet
17	Odonata	Coenagrionidae	*Psudagrion sp.*	--
18	Orthoptera	Acrididae	*Acrida* cf. *exaltata*	Slantface Grasshopper

Hawkmoth Caterpillar ©Neha Majumdar

Azure Dartlet Amphiallagma parvum © Neha Majumdar

PHOTO DOCUMENTATION - WILDLIFE MONITORING AND THREATS OBSERVED IN GRASSLAND RESERVE

A team member actively collecting information regarding the diverse range of vegetation present in the grassland reserve area. This provides crucial insights on different plant species thriving in the reserve ©Neelkanth Bora

Wild Boars breaching the line of control and making passages for them ©Sachin Bishnoi

Unwanted guests like Wild Boars not only entering but also flourishing iin and around model grassland enclosure ©BNHS archive

Free Ranging Dogs were seen occasionally visiting the waterhole inside grassland reserve © Neelkanth Bora

CONCERNS AFTER FENCING

After continuously monitoring and taking photographs, it was discovered that wild boars had breached the fencing. They were regularly seen approaching the waterhole late at night. A survey was conducted along the fence to investigate any damage caused by the wild boars. It was found that the wild boars had carved out trenches in some places, particularly near the undulated sandy terrain. This paved the way for them to trespass the fencing. Additionally, it was observed that free-ranging dogs had used the same pathway to enter the premises. This situation is concerning for the future if the GIB uses this piece of land as its maternity ward.

It's important to take action to address these concerns after fencing. Here are some potential solutions:

1. **Reinforce the fencing with a stronger material that can withstand wild boars' attempts to breach it**
2. **Trenches created by the wild boars to be filled in to prevent them from using as a pathway to enter the premises.**
3. **Conduct regular checks and maintenance of the fencing to ensure that it remains secure and intact.**
4. **Could you consider implementing additional security measures, such as motion-activated cameras or security guards, to monitor the area and prevent further breaches?**
5. **Plan to drive away the Wild Boars which continues to pose a threat to the safety of the birds using new technologies such as sound deterrent tools.**

The immaculate grassland within the fenced reserve can be seen in its novel form

CHANGE IN HABITAT AT GRASSLAND RESERVE

Regeneration of grasses seen in reserve, absolute restriction over livestock grazing has resulted into sprouting of variety of palatable grasses. © Neelkanth Bora

Female GIB seen with young one foraging in the grassland reserve. © Sujit Narwade

A vigilant GIB female looking for threats in the surrounding. © Sujit Narwade

Dr Asad Rahmani, former director BNHS, visits the grassland reserve in Khetolai village. © BNHS archival

THE WAY AHEAD

1) Habitat restoration

The model grassland reserve has the presence of invasive species such as Sonamukhi Cassia aungustifolia and exotic Videshi Babool Prosopis juliflora under the management action plan, phase-wise removal of these invasive alien species will be carried out, followed by the introduction of native grass species such as Sewan Lasiurus scindicus.

2) Grassland Development

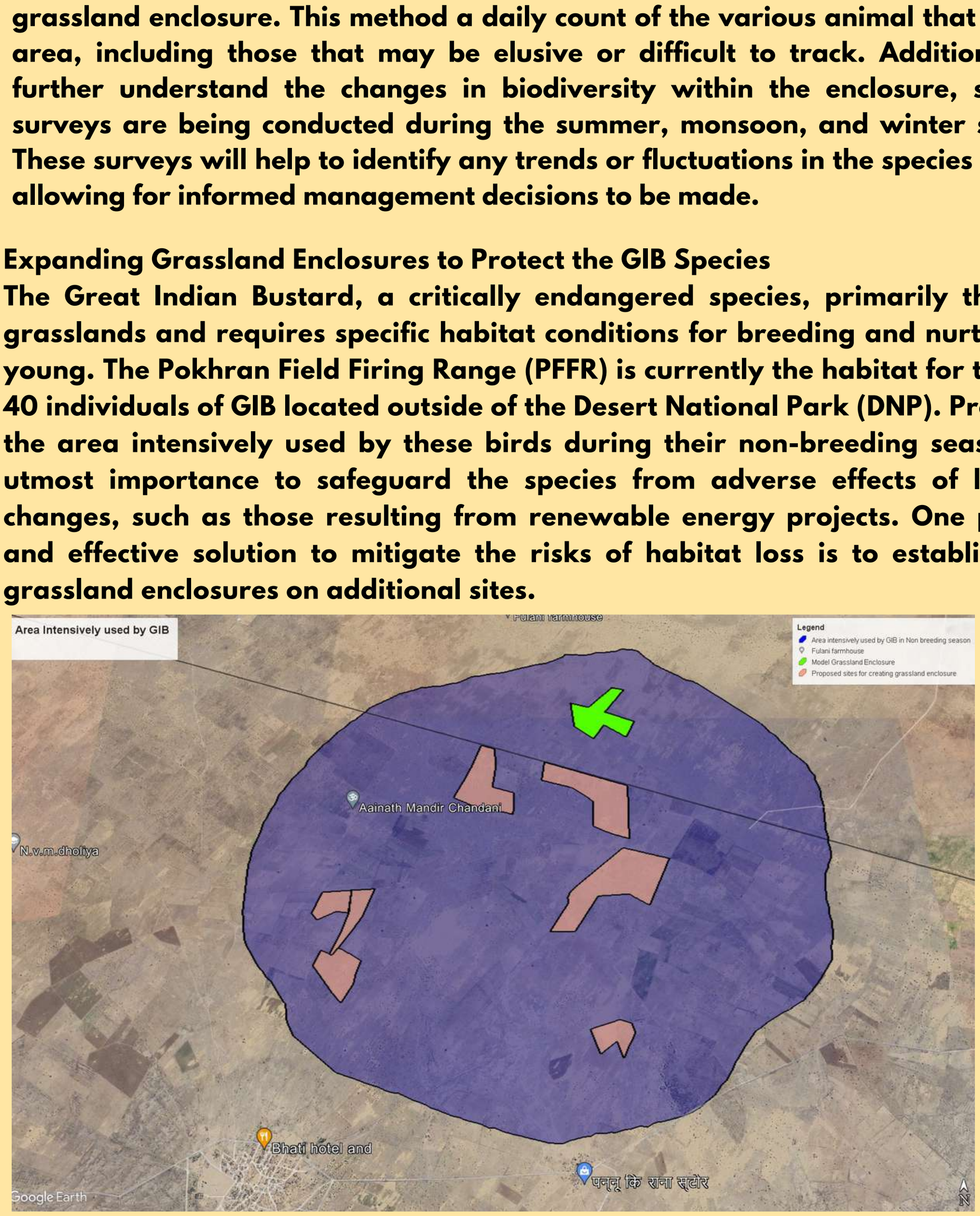
Controlled Grazing:- To address the issue of excessive grass growth, we have decided to implement a strategy of controlled grazing. This approach will be initiated within the grassland enclosure, and we will allow for a two-year buffer period to ensure the regeneration of palatable grasses in the area.

3) Seasonal Monitoring

Trap cameras near water holes - The team decided to install trap cameras near the water holes to obtain accurate and regular data on the wildlife that frequents the grassland enclosure. This method a daily count of the various animal that visit the area, including those that may be elusive or difficult to track. Additionally, to further understand the changes in biodiversity within the enclosure, seasonal surveys are being conducted during the summer, monsoon, and winter seasons. These surveys will help to identify any trends or fluctuations in the species present, allowing for informed management decisions to be made.

Expanding Grassland Enclosures to Protect the GIB Species

The Great Indian Bustard, a critically endangered species, primarily thrives in grasslands and requires specific habitat conditions for breeding and nurturing its young. The Pokhran Field Firing Range (PFFR) is currently the habitat for the 30 to 40 individuals of GIB located outside of the Desert National Park (DNP). Preserving the area intensively used by these birds during their non-breeding season is of utmost importance to safeguard the species from adverse effects of land use changes, such as those resulting from renewable energy projects. One practical and effective solution to mitigate the risks of habitat loss is to establish more grassland enclosures on additional sites.



Google Images displays the proposed sites for developing a replica of the model grassland enclosure - a map prepared by Neelkanth Bora

DOCUMENTATION OF CHANGE IN HABITAT SINCE THE FENCE HAS BEEN ERECTED

This particular snapshot was taken at the precise moment when a fence was erected around the perimeter of the area in question in April 2023, . The photograph effectively conveys the stark and barren nature of the landscape, which is devoid of any visible signs of life or vegetation. (C) Sujit Narwade

One of our colleagues, Pankaj, had the foresight to capture a photograph that unequivocally highlights the contrasting height of grass within and beyond the fenced areas in July 2023 © Sujit Narwade

As we reach the month of September in the year 2023, it is a delight to see the grassland reserve in its full glory. Thanks to the tireless efforts of field team, the reserve appears to be thriving with lush, green vegetation. This is indeed a wonderful sight to behold © Pankaj Bishnoi

NATURAL HISTORY MOMENTS CAPTURED AT THE GRASSLAND RESERVE

A stunning male reptile known as a Brilliant's Agama. With nimble movements, the lizard effortlessly navigates the rough terrain of cobblestones below, displaying its magnificent and vibrant array of colors.
© Sujit Narwade

We witnessed a Camel Spider exhibiting predatory behaviour as it attacked and captured a Rough Bent-toed Gecko. © Sujit Narwade

A Lacertidae family member is regularly seen everywhere near the field base in Khetolai ©Pankaj Bishnoi

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A subadult male chinkara captured by the trap camera placed at field station © BNHS archival.

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Board indicating contributuion of locals for developing grassland © Pankaj Bishnoi