

CONSERVING

GREAT INDIAN BUSTARD

LANDSCAPES THROUGH SCIENTIFIC UNDERSTANDING
AND PARTICIPATORY PLANNING





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FINAL REPORT 2020



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BACKGROUND

Status

The Great Indian Bustard *Ardeotis nigriceps* (hereafter GIB) is one of the heaviest flying birds and among the rarest species in the world. With ~150 individuals left, almost exclusively in India, it is Critically Endangered (IUCN 2018) and protected under Schedule I of the Wildlife (Protection) Act, 1972. Their populations have steadily declined by 75% in last 30 years and are facing imminent extinction risk unless serious conservation actions are put in place (Dutta et al. 2011). Historically distributed across the hot arid and semi-arid grasslands and desert, GIB are currently restricted in only five isolated regions. The largest population of 128 (19SE) birds occur in c9252 sqkm Thar landscape of Rajasthan (Dutta et al. 2018). Other populations are <10 birds each, occurring in Gujarat (Lala-Naliya Sanctuary and its neighbourhood in Kachchh), Maharashtra (GIB Sanctuary in Solapur, alongside Chandrapur and Nagpur), Andhra Pradesh (Rollapadu Wildlife Sanctuary and its neighbourhood in Kurnool) and Karnataka (Ballari) (Dutta et al. 2011).

Threats

The species has declined due to compounding effects of direct and indirect human exploitation on their slow life-history traits. Past hunting and egg collection had reduced their population to ~1260 birds in 1969 (Dharmakumarsinhji 1971). Their decline has continued under prevailing habitat loss as dry grasslands are marginalized as 'unproductive wastelands' and diverted to other land uses. Recent developments in irrigation and farming technologies have changed cropping practices from seasonal to year-round inorganic crops. This change has led to resource scarcity and pesticide contamination. Infrastructure development such as power projects and roads have caused severe habitat degradation. Being low and heavy flyers, GIB collide with power lines that are difficult to detect from afar. Populations of free-ranging dogs and pigs have increased in bustard habitats, and along with native predators (fox, mongooses, and cats), have increased the predation pressure on nests and chicks. Mismanagement of open areas by developing tree plantations and protection infrastructure are further reducing the last remaining bustard habitats.



Past efforts of creating bustard Sanctuaries over large human-use landscapes, without appropriate settlement of land rights, have generated resentment among local people, and have caused persecution and local extinctions of the birds from some sanctuaries. Traditional ways to manage these habitats are eroding due to rapid socioecological changes driven by state policies (Dutta et al. 2013). Although most remaining breeding habitats are protected to some level, vast movements expose them to these threats in the larger landscape and defeat the purpose of small breeding reserves. Since these large landscapes cannot be freed from human uses, a mixed approach of Protected Area based conservation of breeding habitats and compatible human landuses/ infrastructure in adjoining landscapes will be most effective. However, the unavailability of vital information such as ranging patterns, magnitude of threats, and how to mitigate them, impede such conservation efforts.



Rohit Kolharker

Conservation

Indian conservation circles have voiced the need of recovery actions for bustards as flagships of dry grasslands since many years. The National Guidelines for Bustard Recovery Plans (Dutta et al. 2013) developed by Ministry of Environment, Forest and Climate Change (MoEFCC) recommend creating inviolate breeding areas to boost recruitment, prioritize areas in the landscape for mitigating threats and improving protection, engaging communities in conservation through incentives and implementing a conservation breeding program for insurance. State Forest Departments in collaboration with research and conservation institutions are implementing these actions with mixed success.

The Project

The Rajasthan Pollution Control Board (RSPCB) funds were utilized to identify priority areas and threats in GIB landscapes for optimizing the allocation of conservation resources. These activities are being carried out in collaboration with State Governments, local NGOs and research organizations, to pool knowledge/expertise and ensure timely and effective implementation. Additionally, we are undertaking holistic ex-situ and in-situ conservation for GIB in Rajasthan and other bustard range states since 2016 with funding support from National Compensatory Afforestation Fund Management and Planning Authority (CAMPA) Advisory Council (NCAC). GIB habitats support a plethora of other endangered wildlife, such as the spiny-tailed lizard *Saara hardwickii*, chinkara *Gazella bennettii*, foxes *Vulpes spp*, Indian wolf *Canis lupus pallipes*, and blackbuck *Antelope cervicapra* that will be benefitted by some of these conservation measures.

- Identify priority areas by undertaking population and habitat surveys
- Understand ranging patterns and habitat use through biotelemetry
- Characterize threats such as power-lines, free-ranging dogs, and pesticides
- Implement pilot GIB-friendly land uses
- Propose appropriate policy and legislative changes for conserving priority bustard areas

OBJECTIVES



Bipin C. M.



G.S. Bharadwaj



Mohib Uddin



STUDY AREA

The area falls in Desert Biogeographic Zone (Rodgers et al. 2002) with arid (Jodhpur) to hyperarid (Jaisalmer and Bikaner) conditions. Rainfall is scarce and erratic, at mean annual quanta of 100-500 mm that decreases from east to west (Pandeya et al. 1977). The climate is characterized by very hot summer (temperature rising up to 50°C), relatively cold winter (temperature dropping below 0°C), and large diurnal temperature range (Sikka 1997). Broad topographical features are gravel plains, rocky hillocks, sand-soil mix, and sand dunes (Ramesh and Ishwar 2008).

The vegetation is Thorny Scrub, characterized by open woodlot dominated by *Prosopis cineraria*, *Salvadora persica* and exotic *Acacia tortilis* trees, scrubland dominated by *Capparis decidua*, *Zizyphus mauritiana*, *Salvadora oleoides*, *Calligonum polygonoides*, *Leptadenia pyrotechnica*, *Aerva pseudotomentosa*, *Haloxylon*

salicornicum and *Crotalaria bhuria* shrubs, and grasslands dominated by *Lasiurus indicus* and *Dactyloctenium indicum*.

Notable fauna, apart from the ones mentioned before, include mammals like desert cat *Felis silvestris*, birds like Macqueen's bustard *Chlamydotis macqueenii*, cream-coloured courser *Cursorius cursor*, sandgrouses *Pterocles spp.*, larks, and several raptors. Thar is the most populated desert, inhabited by 85 persons per sqkm that largely stay in small villages and dhanis (clusters of 2-8 huts), and depend on pastoralism and dry farming for livelihoods. A fraction of this landscape (3,162 sqkm) has been declared as Desert National Park (Wildlife Sanctuary), which is not inviolate and includes 37 villages (Rahmani 1989). A large number of renewable (solar and wind) energy projects with associated transmission lines are expanding in this landscape.

PROJECT ACTIVITIES





1. POPULATION AND HABITAT SURVEYS

We conducted joint surveys with Rajasthan Forest Department with the help of trained volunteers, to understand the current status, distribution patterns, and local contexts of GIB and associated wildlife in Thar. Four surveys (2014–17) were conducted and detailed reports are available as Appendices 1, 2, 3, & 4. Here we report findings of the 2017-18 survey.

Delineating the potential great Indian bustard landscape in Thar:

We mapped the past distribution area of GIB in western Rajasthan by collating historical (post 1950s) records (Rahmani 1986; Rahmani and Manakadan 1990) and bounding the outermost locations. We removed areas where the species has not been recorded in recent times (sources: Rajasthan Forest Department, Ranjitsinh and Jhala 2010). Additionally, extensive sand dunes, built-up and intensive agriculture areas were considered unsuitable based on prior knowledge (Dutta 2012). These areas were identified from land-cover maps, Digital Elevation Model and night-light layers in GIS domain, Google Earth imageries, and extensive ground validation surveys. The remaining landscape, an area of 20,000 sqkm, was considered potentially habitable for great Indian bustard and subjected to sampling (Figure 1).

The Project team assessed the status of native and conservation-dependent species such as the GIB, chinkara and desert fox, non-native species such as free-ranging dogs, pigs *Sus spp.* and nilgai *Boselaphus tragocamelus* that live alongside the habitat of the GIB, and anthropogenic pressures across 19,728 sqkm in Thar spanning Jaisalmer, Jodhpur and small parts of Bikaner and Barmer districts of Rajasthan. Systematic surveys were conducted in 144 sqkm cells from slow-moving vehicles along 29.2 ± 8.0 SD km transects to record species detections, habitat characteristics in sampling plots, and secondary information on species occurrences (Figure 1).

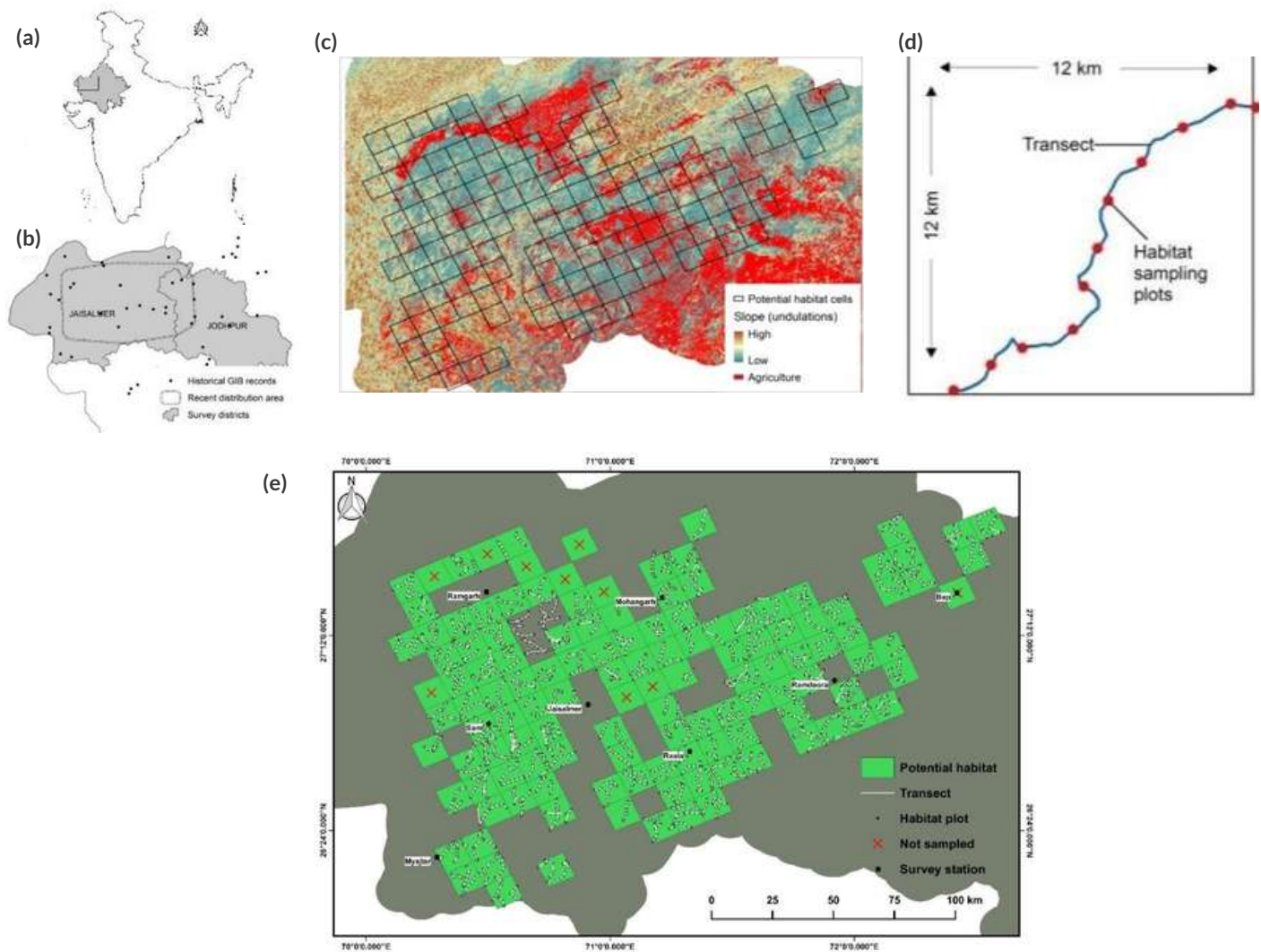



Figure 1. Sampling design for Great Indian Bustard, associated species and habitat assessment in Thar landscape: (a) location of study area; (b) delineation of bustard landscape from existing information on species' occurrence; (c) remotely sensed habitat information and distribution of transects in 144 sqkm cells overlaid on potential habitat; (d) habitat sampling plots at two-km interval on sample transect; and (e) survey efforts in 2017-18.

Multiple teams comprising of field biologists and Rajasthan Forest Department staff rapidly sampled 121 cells along 3,529 km transects (extensive surveys) with additional 635 km transects in five GIB occupied cells (intensive surveys) during 2017-18. Extensive surveys provide information on bustard (and associated species') occurrence across landscape and intensive surveys provide information on bustard density in occupied cells. GIB and other key species detection data were analysed in Occupancy (MacKenzie et al. 2006) and Distance Sampling (Thomas et al. 2010) framework to estimate proportion of sites occupied and species density/ abundance.

During 2014-17, 38 (2014), 40 (2015), 37 (2016) and 37 (2017) GIBs were detected. Their detection/ non-detection in two-km transect segments (spatial surveys) across cells (2017) showed that $6.7 \pm 2.9\text{SE} \%$ of sites were occupied (naive occupancy 5%). Bird density was estimated at $0.48 \pm 0.10\text{SE}$ per 100 sqkm across all sites and $7.49 \pm 1.63\text{SE}$ per 100 sqkm in used sites (cells where at least one bird was detected). Abundance was estimated at $95 \pm 21\text{SE}$ individuals in the 19,728 sqkm landscape, pooling data across 2016-17. This estimate was negatively biased due to inadequate surveys in high-density sites within the Pokhran Field Firing Range (PFFR).



Later, the project team liaised with the Commanding Officer of the Indian Army and was granted special permission for the year 2018 to access PFFR to survey. We conducted follow-up distance based line transect surveys in the subset of landscape where the species is distributed (western Thar: 4068 sqkm area, and Pokhran Field Firing Range: 5184 sqkm area) jointly with Indian Armed Forces in March–April 2018. The PFFR has stretches of untouched grasslands that are critical for bustards. The lack of substantial human interference lends this area to be the most conducive to GIB. With an area of > 3,000 sqkm, the range offers a valuable insight into the last remnants of the species as well as to serve as an iconic representation of what erstwhile grasslands were in India.

Based on these surveys, abundance was estimated at $128 \pm 19SE$ individuals in 9252 sqkm GIB distribution area in Thar. But, there might be a real decline in numbers, as comparison of species' encounter rate across years, keeping sampled sites constant, indicated a non-significant but declining trend between 2014-15 ($1.00 \pm 0.41SE$ per 100 km) and 2016-17 ($0.83 \pm 0.30SE$ per 100 km).

Additional ancillary information based on power line carcass surveys (two GIB mortalities in 20 km high tension power lines surveyed seven times) indicated that about 18 birds were expected to have died because of the 152 km high tension power lines distributed across bustard occupied sites (Figure 2).

Chinkara was found in 89% of sites and its' density at landscape-scale was estimated at $205 \pm 14SE$ per 100 sqkm, yielding abundance of $40,442 \pm 2,811SE$ in 19,728 sqkm landscape (2017). Desert fox was found in 41 % of sites, with estimated density of $15.03 \pm 2.39SE$ per 100 sqkm, and abundance of $2,965 \pm 471SE$ individuals in 19,728 sqkm landscape.

For meaningful comparison of population trends for our focal species, we computed mean + 1 SE animal encounter rates per 100 km across cells, which were surveyed in all years. Additionally, annual occupancy estimates were derived from our dynamic occupancy models to infer trends (Table 1). These results showed a rapid increase of free-ranging dogs, an increasing trend of pigs, declining trend of chinkara and a non-significant but declining trend of GIB that needs to be ascertained in subsequent surveys.

Table 1: Species' population trend across years (2014–2017) in Thar landscape, estimated as mean (SE) number of animals per 100 km. For each species, encounter rates have been computed for all cells sampled in a year (first row) and the subset of cells sampled in all years (same cells).

Species	Sample	2014	2015	2016	2017
Great Indian Bustard	All cells	0.82 (0.32)		0.59 (0.2)	
	Same cells	1 (0.41)		0.83 (0.3)	
Chinkara	All cells	83.44 (11.98)	85.58 (14.94)	60.71 (7.44)	80.75 (8.8)
	Same cells	78.72 (15.31)	85.48 (17.6)	59.93 (10.86)	79.37 (12.78)
Desert fox	All cells	3.56 (0.61)	2.64 (0.81)	1.87 (0.38)	2.76 (0.4)
	Same cells	3.29 (0.79)	3.06 (0.98)	2.27 (0.54)	2.64 (0.52)
Indian fox	All cells	0.21 (0.12)	0.1 (0.1)	0.29 (0.15)	0.22 (0.08)
	Same cells	0.26 (0.19)	0.12 (0.12)	0.28 (0.22)	0.18 (0.09)
Dog	All cells	3.47 (1.15)	5 (1.22)	5.08 (0.92)	18.6 (5.44)
	Same cells	4.32 (1.77)	4.59 (1.28)	5.46 (1.24)	23.11 (9.39)
Nilgai	All cells	3.07 (1.42)	4.88 (1.8)	9.28 (3.15)	3.93 (1.11)
	Same cells	4.41 (2.38)	5.06 (2.08)	5.63 (2.03)	5.42 (1.8)
Pig	All cells	0.85 (0.85)	1.28 (0.91)	2.33 (0.93)	1.98 (0.75)
	Same cells	1.45 (1.45)	0.89 (0.89)	2.92 (1.35)	2.26 (1.22)
Cattle	All cells	217.5 (32.18)	687.9 (194.62)	465.09 (67.15)	484.49 (62.84)
	Same cells	237.79 (43.93)	558.58 (166.01)	450.43 (83.28)	469.53 (101.8)
Sheep & Goat	All cells	1252.6 (124.76)	1539.42 (209.83)	2187.03 (228.66)	2065.83 (138.8)
	Same cells	1389.71 (165.7)	1622.77 (248.21)	2146.63 (291.9)	1868.28 (137.6)



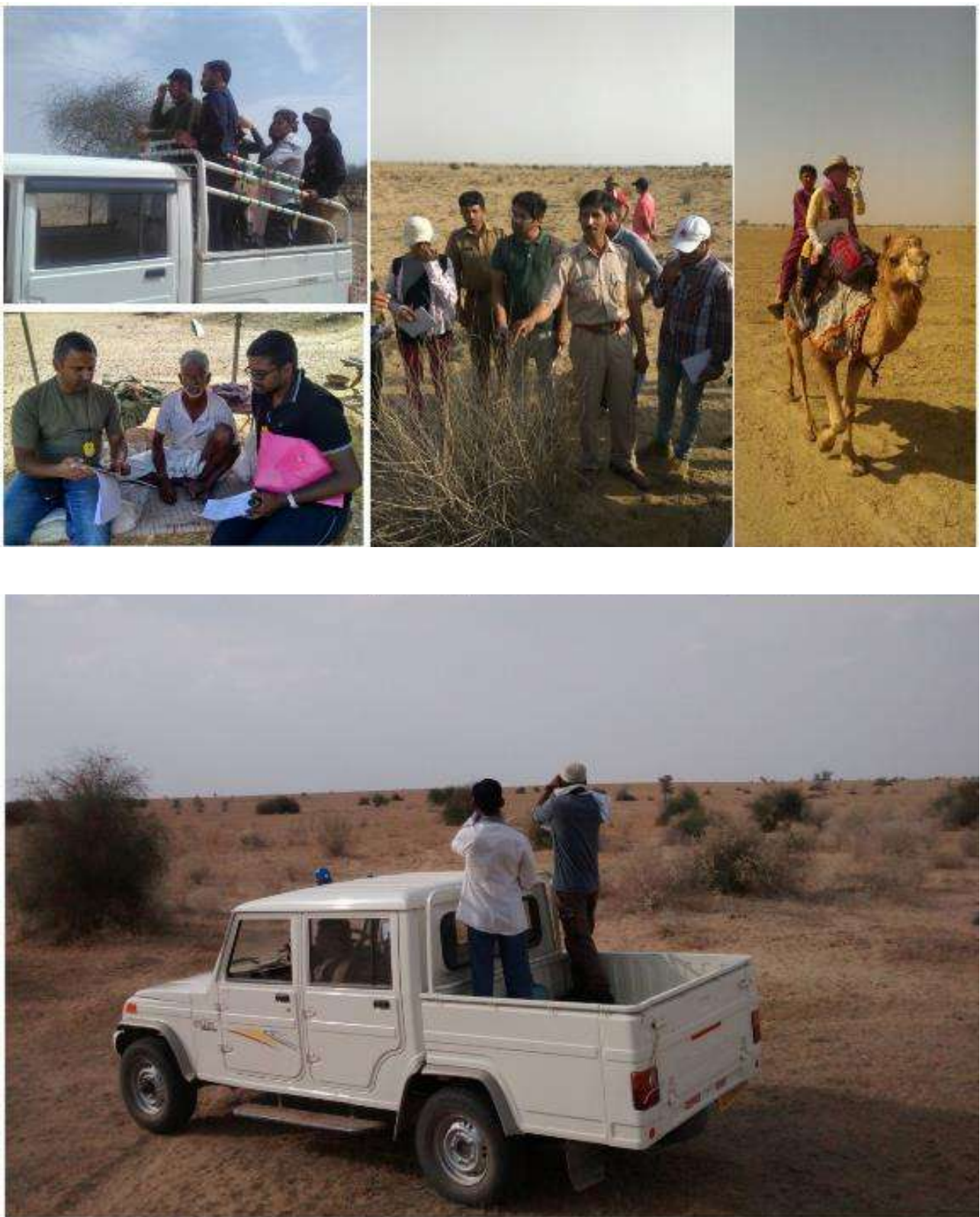


Image 1. Field activities (training, surveys and questionnaires) for status assessment of Great Indian bustard, associated fauna and habitat in Thar. © WII

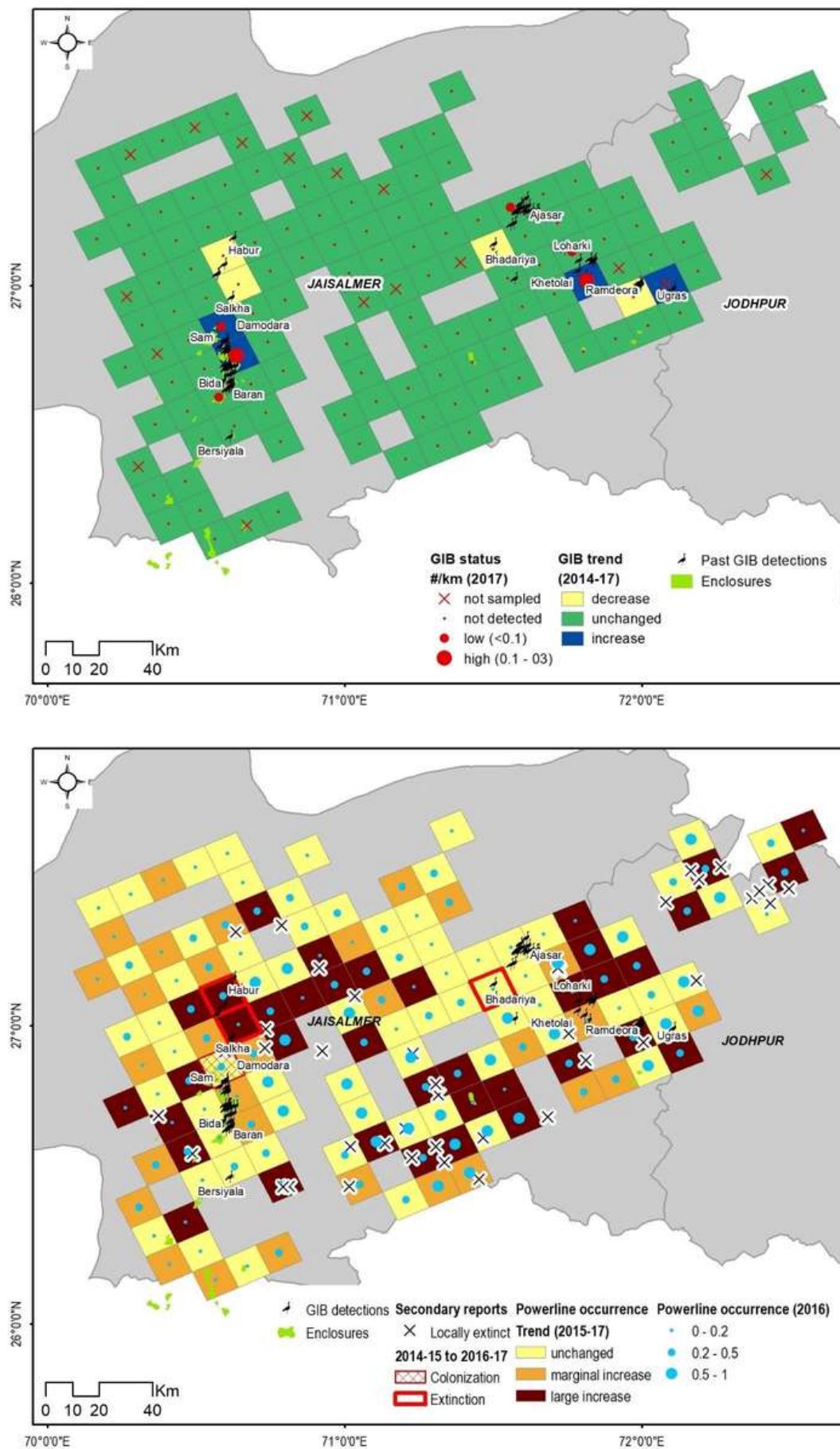


Figure 2. Status, distribution and trend of Great Indian Bustard population (pg11) against the distribution and trend of power-line networks in Thar landscape (2014-18).

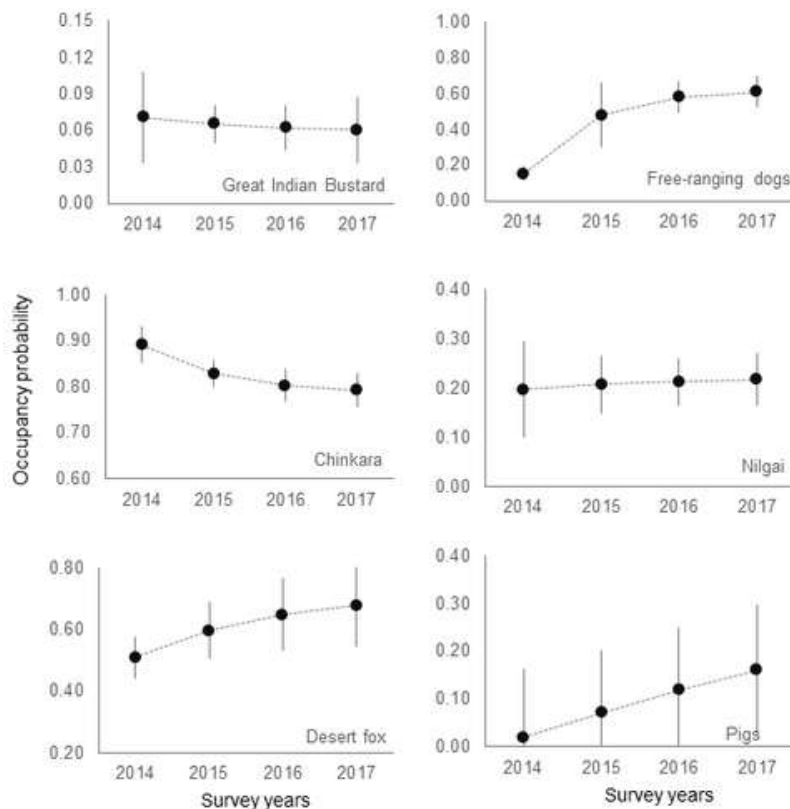


Figure 3. Species' distribution trend across years (2014–17) in Thar landscape, estimated as mean+1SE proportion of sites occupied using dynamic occupancy models, for native/ 'important' (left) and non-native / 'potential problem' species (right).

Our threat surveys showed an expansion of human artefacts across survey years, wherein the proportion of sampling plots with water source, power-lines, farm-huts and wind turbines had increased annually by 0.12, 0.09, 0.07, and 0.03, respectively, over the last three years (Figure 4). Correspondingly, population of free ranging dogs showed a remarkable expansion over these years, wherein the proportion of sites occupied increased from $0.15 \pm 0.04\text{SE}$ (2014) to $0.61 \pm 0.09\text{SE}$ (2017), and their encounter rate increased from $4.32 \pm 1.77\text{SE}$ to $23.11 \pm 9.39\text{SE}$ per 100km in sites that were monitored across all years (Table 1).

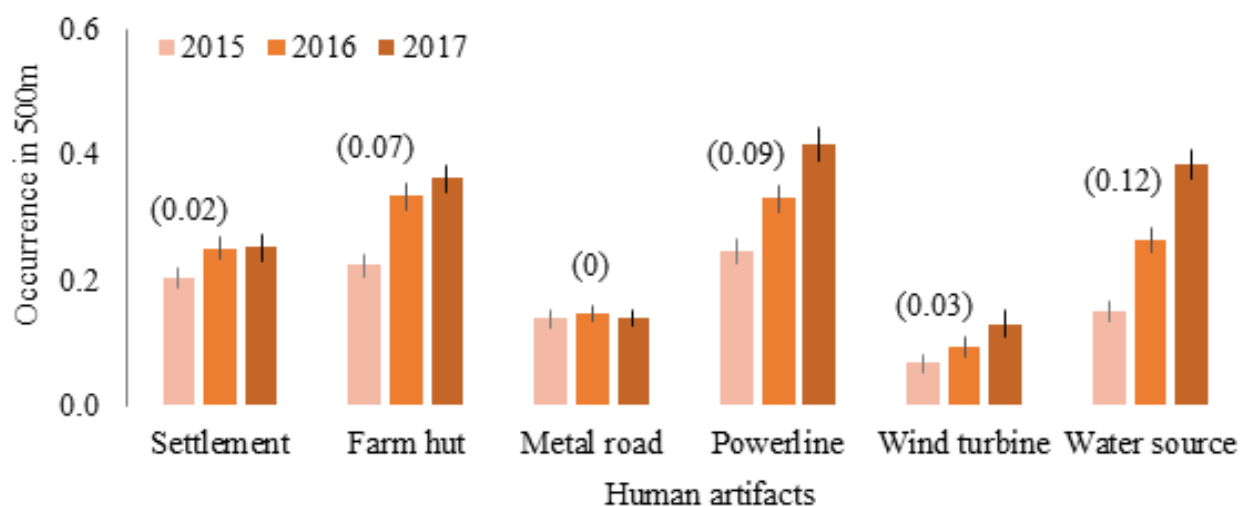


Figure 4 : Occurrence probability of human artifacts in sampling plots across Thar landscape from 2015 to 2017. Error bars are 1 SE across 144-sqkm cells, and values in parentheses are regression slopes against years that are indicative of temporal trends.

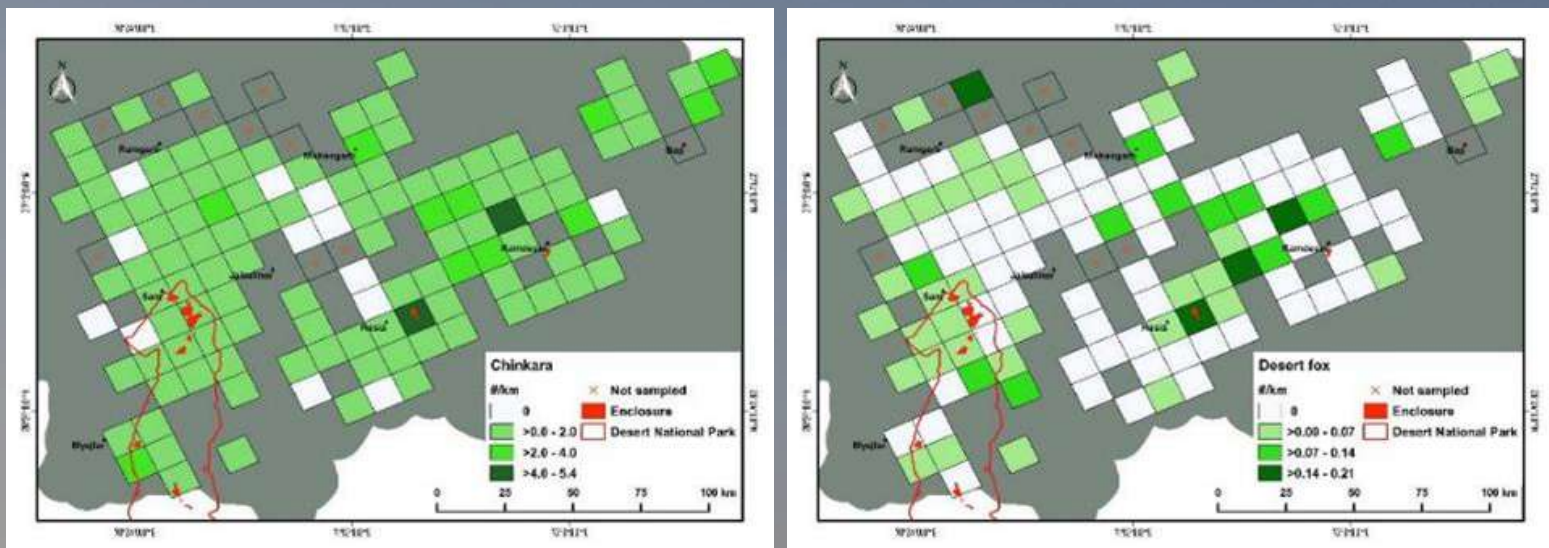


Figure 5. Status and distribution of key species associated with Great Indian Bustard in Thar landscape (2017).

Recommendations

Based on our results and from field knowledge, we strongly recommend:

a) Expeditiously mitigating power-lines by undergrounding all lines within priority area (this is the only fool proof measure for conserving the great Indian bustard), and marking lines with bird diverters in potential areas,

b) Improving Great Indian Bustard recruitment in existing enclosures using predator-proof-fences and nest-predator removal,

c) Creating more enclosures or conservation/community reserves in priority conservation cells,

d) Smart and intensive patrolling to control poaching and generate management information,

e) Continue targeted research to understand local ecology of Great Indian Bustard, characterize threats at a finer scale, and ranging patterns,

f) Balancing local livelihood concerns with conservation goals through social research and incentivized bustard-friendly land-uses, and

g) Engaging local communities to monitor and protect wildlife through outreach and incentive programs.

TELEMETRY BASED RESEARCH

Overview

We received permission to tag the Great Indian Bustard in February 2019, and tagged five birds in Desert National Park and Pokhran areas of Thar between March 2019 and July 2020. We captured birds using nylon noose traps in foraging paths, nests and water guzzlers. We fitted birds with solar powered GSM/GPRS backpack PTTs (E-obs and Microwave telemetry) using elastic harness material that weighed <1% of body weights. These tags have GPS and/or acceleration sensors and transmit data using mobile and internet networks. Birds transmitted data for 64 – 542 days. There was no mortality within the first month or any apparent anomaly in their behavior. The table below provides telemetry statistics at a glance (Table 2).

Table 2. Ranging patterns of tagged Great Indian Bustard in Thar (March 2019 – Sep 2020)

BIRD	1-HR FIXES	RADIO-DAYS	DAILY DISTANCE IN M (SE)	95% MINIMUM CONVEX POLYGON HOME RANGE AREA (SQKM)
DALI	1,409	64	7,684 (6,735)	1,037.65
5946	1,495	74	8,585 (3,583)	103.87
5947	1,865	161	4,062 (3,351)	98.28
5948	1,129	94	2,932 (3,510)	37.79
5949	8,229	542	5,747 (4,276)	158.57
OVERALL	14,127	935.457	5,802 (2,375)	

Tagging team: Dr. Y. V. Jhala, Dr. Sutirtha Dutta, Dr. Tushna Karkaria, Dr. Shravan Rathore, Bipin C.M., Mohib Uddin, Devedradutta Pandey, Sourav Supakar, project assistants, interns and field assistants. Technical assistance in trapping: Mr. Ali Hussain and Mr. Aslam. Expert inputs by Dr. Juan Carlos Alonso, Senior Professor, Natinal Museum of Science, Spanish Council for Scientific Research, Spain

In consultation with Rajasthan Forest Department officers and staff: Mr. Arindam Tomar (CWLW), Mr. G. S. Bharadwaj, Mr. Anoop K.R., Mr. Kapil Chandrawal (DFO, WL) Jaisalmer, Mr. Sagar Pawar (ACF, WL), Mr. Vijay Borana (ACF, WL), Mr. Sriram Saini (RO, Sudasari), Mr. Jethmal (RO, Sudasari), Mr. Danveer, Mr. Harish Bishnoi, Mr. Ramswaroop Meena, Mr. Amba Ram (Forest guards).



Image 2. Great Indian Bustard tagging team in Desert National Park, Jaisalmer. © WII



Image 3. Glimpses of Great Indian Bustard tagging exercise in Jaisalmer. © WII

The GPS fixes acquired from tagged birds were plotted on GIS domain to assess their home range and movement patterns with respect to conservation areas and land-uses. Bird home range was estimated from 1-hour interval fixes (for independence and uniformity between tags with varying data resolutions) using 95% Minimum Convex Polygon (MCP) technique.

HOW TAGGED BIRDS USE THE LANDSCAPE

Four birds were tagged in RKVY, Sudasari and Chowani enclosures of Desert National Park. These individuals were largely restricted in/around these enclosures of the Park with occasional movement towards Salkha and Khaba. One bird was tagged near Askandra that ranged more widely between Ajasar, Khetolai and Ramdevra. Areas used by birds matched the species census locations and were mostly within the priority landscape identified by the Wildlife Institute of India (https://wii.gov.in/gib_powerline_maps). The Didhoo-Askandra Oran used by a bird was outside the priority landscape.

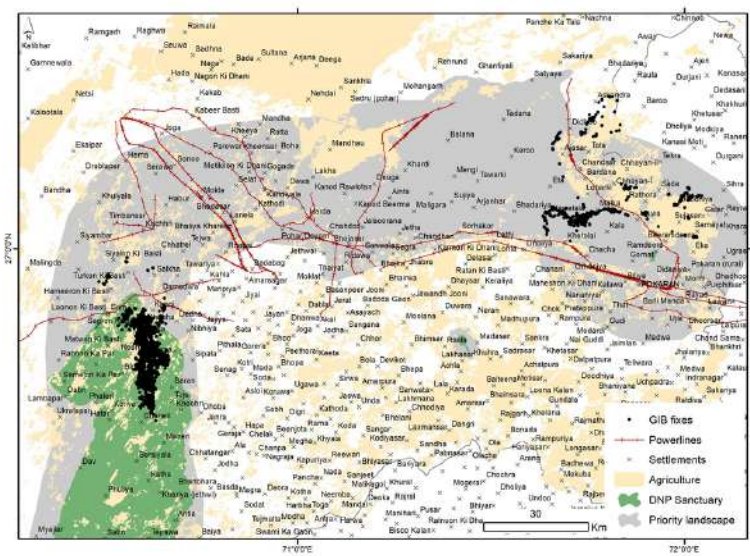


Figure 6. Landscape use of Great Indian Bustard in Thar: GPS fixes of tagged birds (Mar 2019 – Sep 2020) overlaid on conservation areas, village names, land-uses and infrastructure.

Our research identified power-lines as an important threat to GIB, by causing collision induced mortalities.(Table 3)

Table 3. Power line segments identified for immediate mitigation measures in Thar based on evidence obtained from tagged Great Indian Bustard movements.

S.N	Company	Route	Capacity	Segment Length	Segment Start location	Segment End location	GIB Crossing locations
1	RVPNL	Askandra - Pokran	132 kv	70 km	27.37882, 71.69873	26.89509, 71.9451	1) 27.29952, 71.70029 2) 27.09591, 71.85597 3) 27.08798, 71.87539 4) 27.14222, 71.77416
2	Jodhpur Discom	Sarn - Dhanana	33 kv	40 km	26.90964, 70.71879	26.81479, 70.35356	1) 26.84224, 71.53579 2) 26.87938, 70.61688
3	Windworld	Kanol - Salkha	33 kv	21 km	26.83226, 70.72348	26.94493, 70.57802	1) 26.86094, 70.64640 2) 26.88256, 70.61791

These power line segments were recommended for mitigation (Tables 7 & 8) and should be prioritized for immediate undergrounding of cables.



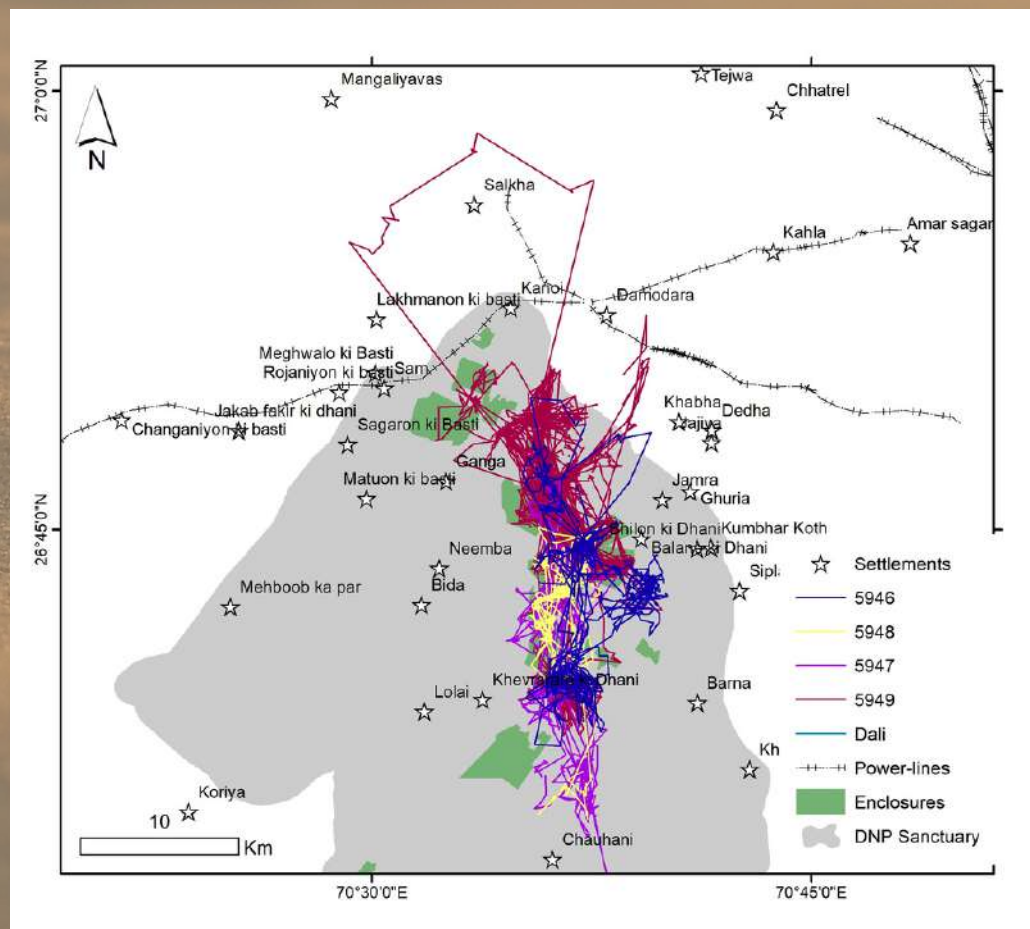
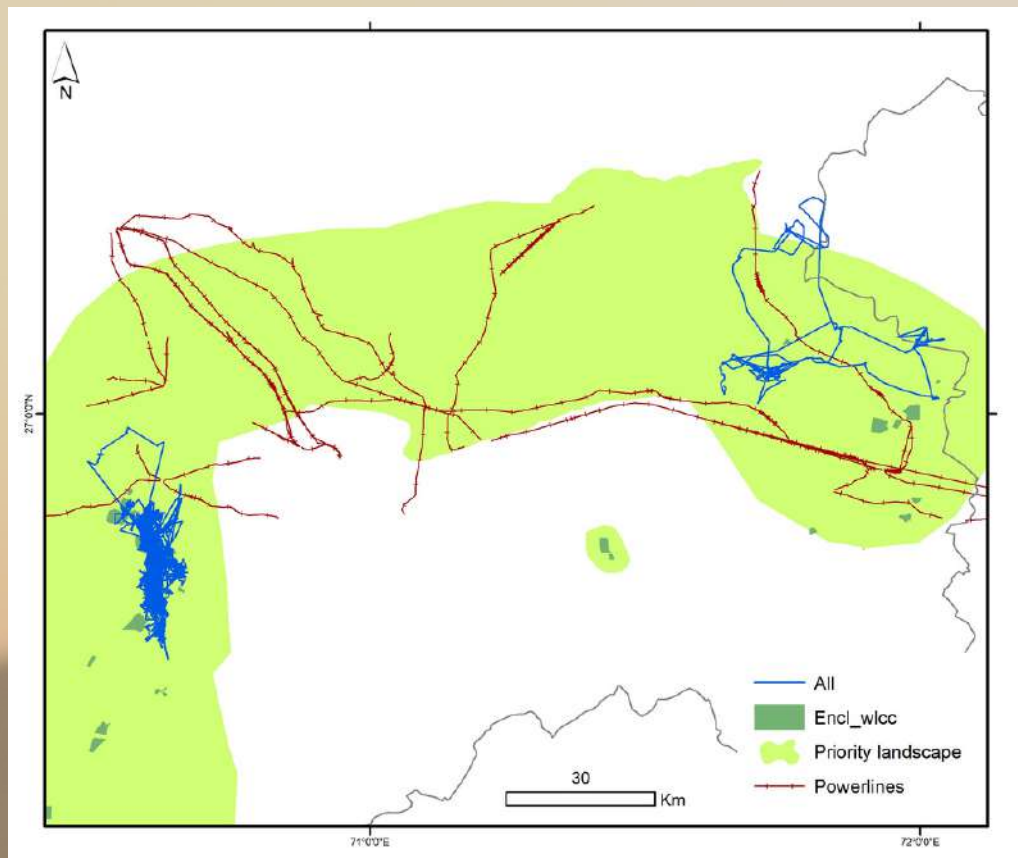


Figure 7. Great Indian Bustard movements across transmission lines in Thar at the landscape (top) and Desert National Park (bottom) scales during Mar 2019 – Sep 2020.

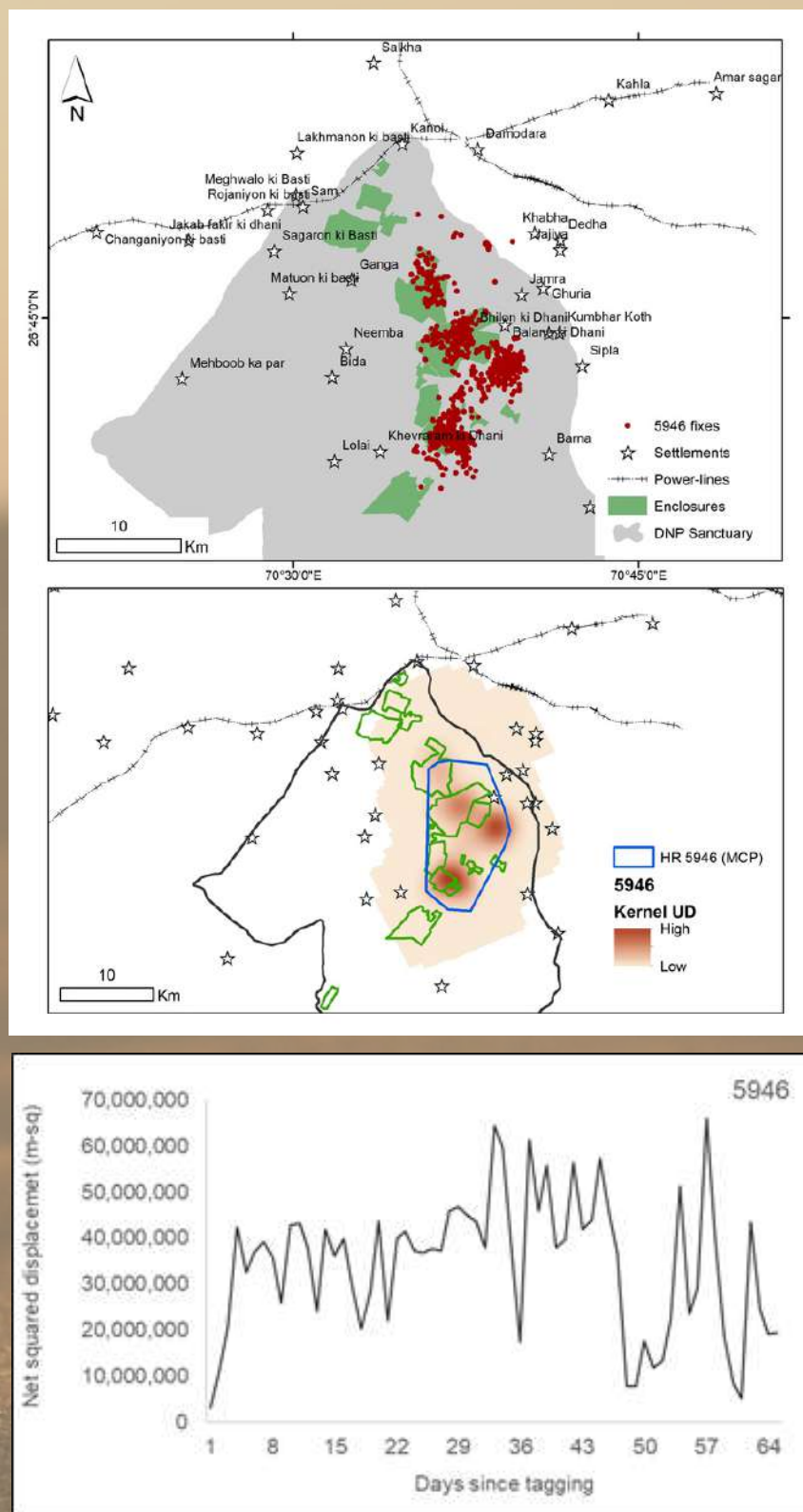


Figure 8. GPS fixes (top), home range estimated as 95% Minimum Convex Polygon (center) and net squared displacement (bottom) of tagged Great Indian Bustard 5946 in Thar.

Individual 5947 was tagged in RKVY on 15th April 2020 and continues to transmit data. In 161 radio-track days, the tag yielded 1,865 one-hour interval locations. The bird used RKVY, Sudasari, Gajaimata enclosures and Dhaneli crop fields, and nested four times in RKVY and Sudasari enclosures. One of its eggs was collected and artificially hatched in the Bustard Conservation Breeding Center at Sam, Jaisalmer. The MCP home range area was 98 sqkm (Figure 9).

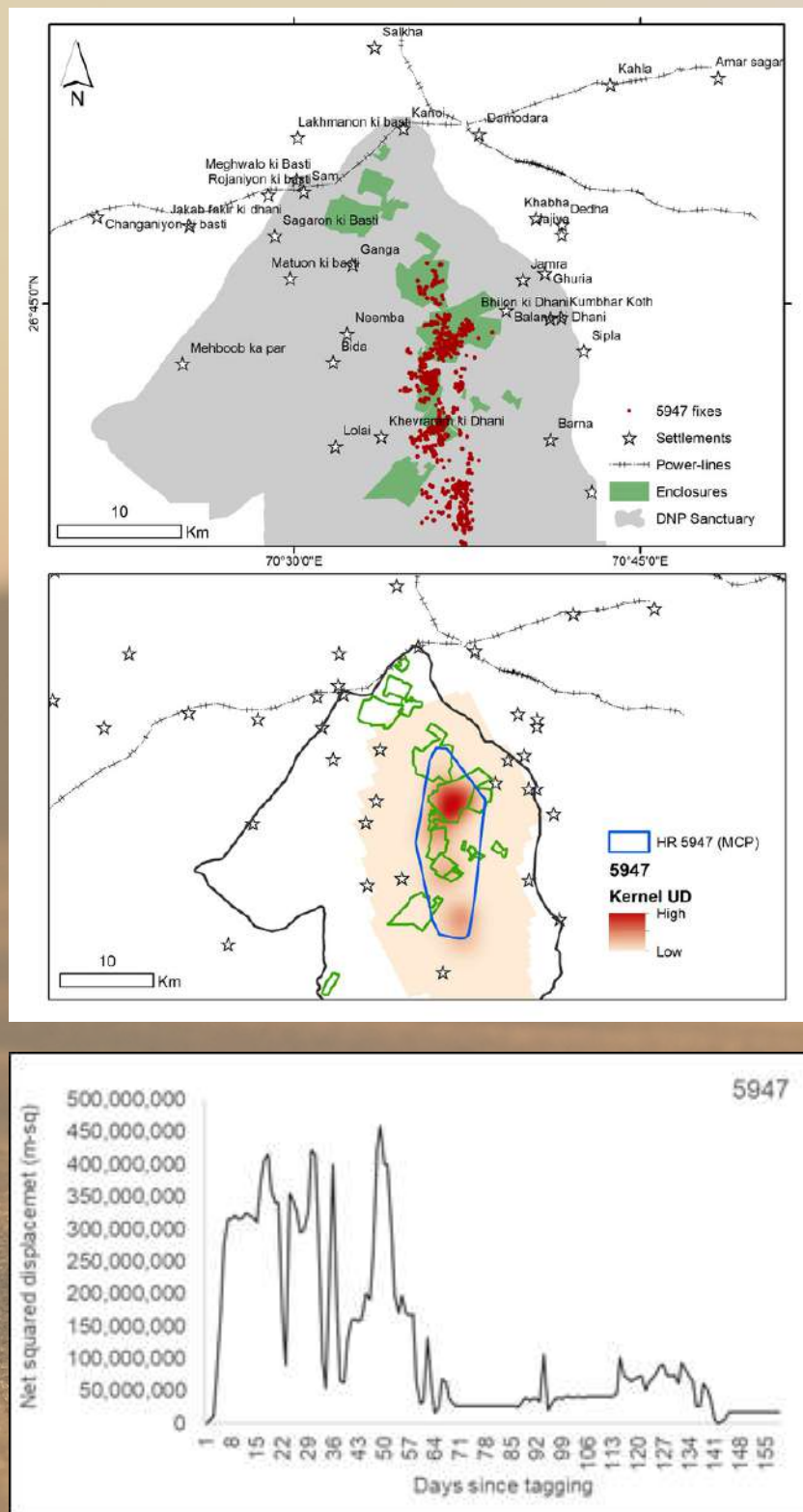


Figure 9. GPS fixes (top), home range estimated as 95% Minimum Convex Polygon (center) and net squared displacement (bottom) of tagged Great Indian Bustard 5947 in Thar.

Individual 5948 was tagged in Chowani-PPC enclosure on 21st June 2020 and continues to transmit data. In 94 radio-track days, the tag yielded 1,129 one-hour interval locations. The bird used Sudasari, Gajaimata, Chowani-PPC enclosures and Dhaneli crop fields, and nested twice since tagging.

One of its eggs has been artificially hatched in the Bustard Conservation Breeding Center. Its MCP home range area was estimated at 37 sqkm (Figure 10).

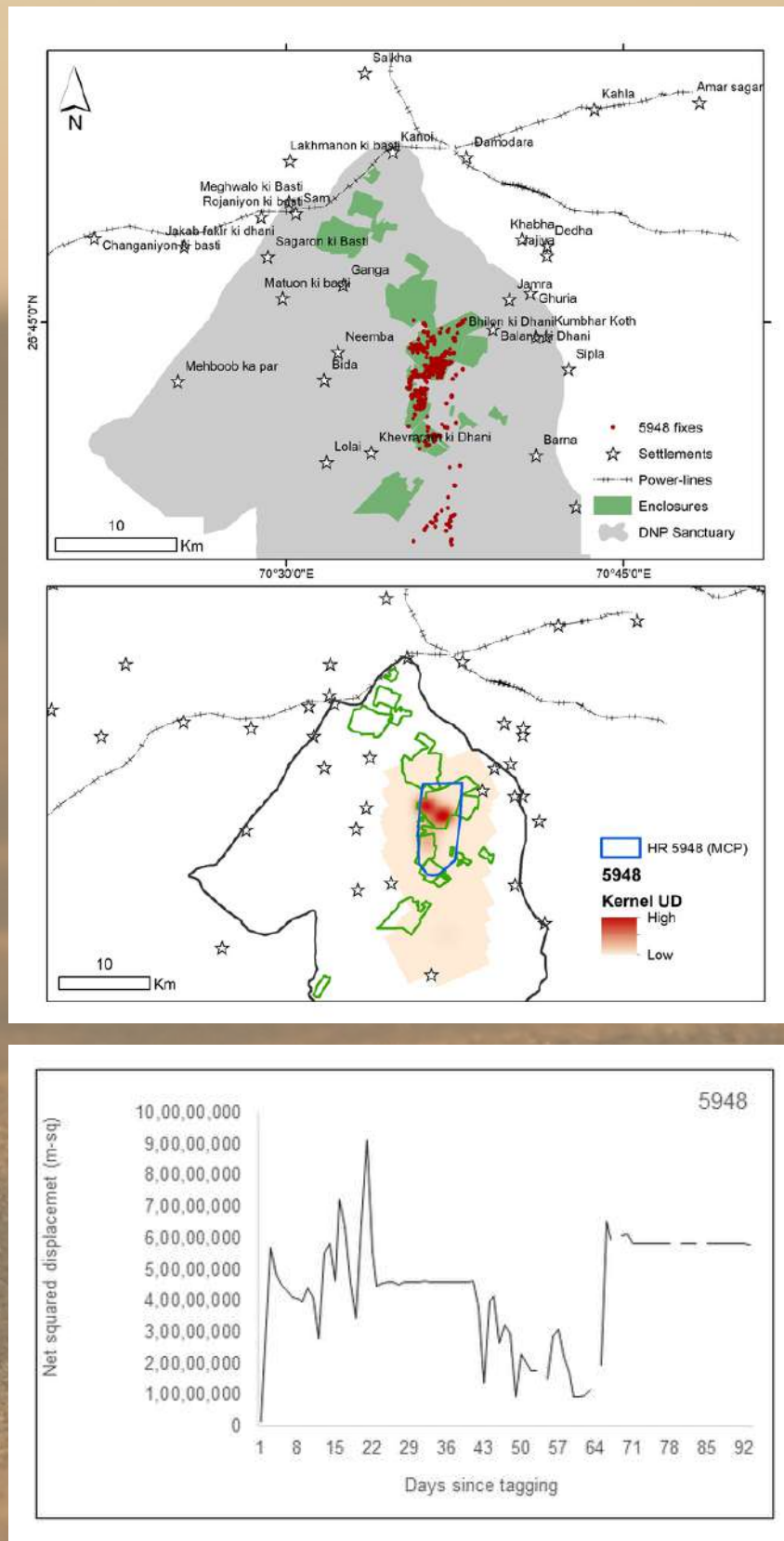


Figure 10. GPS fixes (top), home range estimated as 95% Minimum Convex Polygon (center) and net squared displacement (bottom) of tagged Great Indian Bustard 5948 in Thar.

Individual 5949 was tagged outside RKVY on 31st March 2019 and continues to transmit data. In 542 radio-track days, the tag yielded 8,229 one-hour interval locations. The bird used Kali Mali crop fields and RKVY, Sudasari, Chowani-PPC enclosures, and nested four times since tagging. One of its egg has been artificially hatched in the Bustard Conservation Breeding Center. Its MCP home range area was estimated at 159 sqkm (Figure 11).

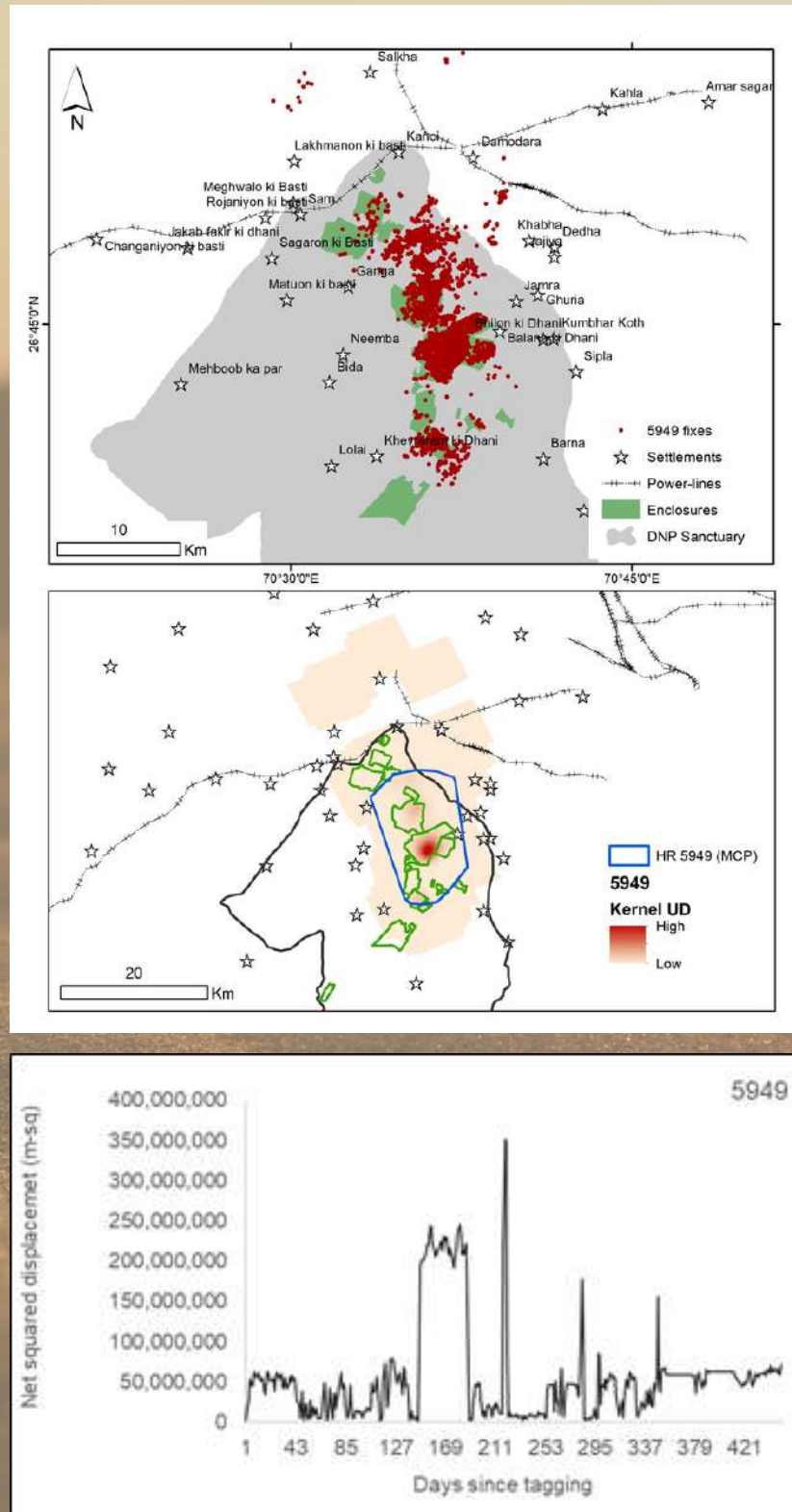


Figure 11. GPS fixes (top), home range estimated as 95% Minimum Convex Polygon (center) and net squared displacement (bottom) of tagged Great Indian Bustard 5949 in Thar.

HOW FAR DOES GREAT INDIAN BUSTARD TRAVEL DAILY ?

An average tagged bird moved 5802 (SE 2375) m daily, ranging from 2932 m (5948) to 8585 m (5946). It should be noted that these are underestimates of actual distance moved as any movement less than an hour is ignored. All birds showed large variation in daily distance moved that indicated non-uniform activity level against time (figure 12)

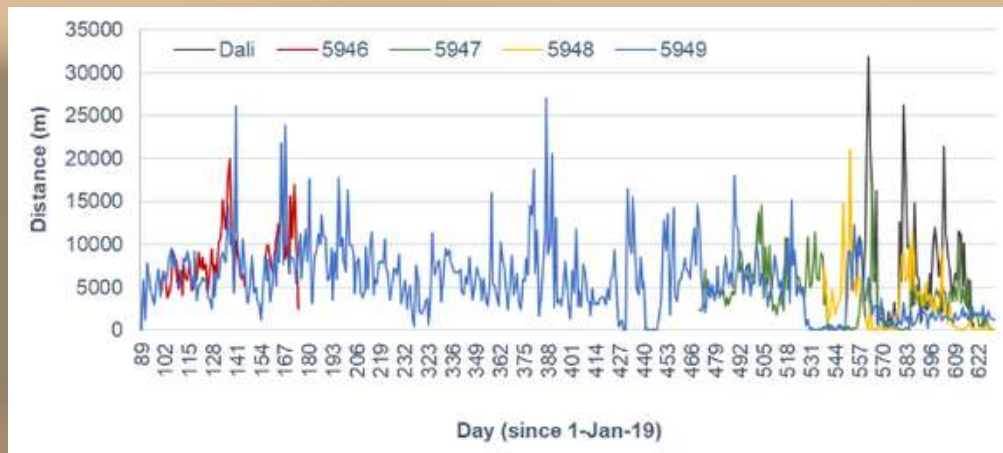


Figure 12. Distance traveled by tagged Great Indian Bustards in Thar

THE DAILY ACTIVITY CYCLE OF BIRDS

The E-obs GSM/GPRS tags collect information on the bird ground speed using Doppler effect. Ground speed is a reliable surrogate of bird activity/movement, and reflected the crepuscular pattern of GIB activity with peak movements during 6-10 h and 18-20 h in summer (figure 13)

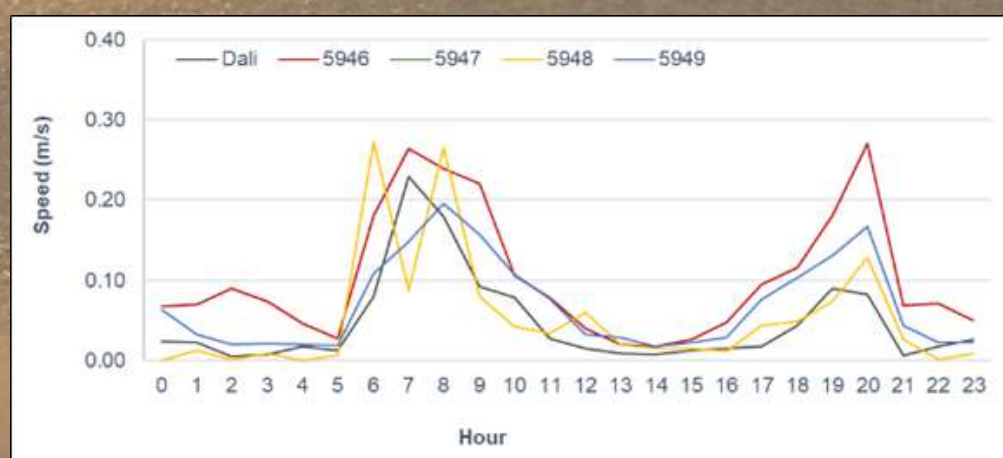


Figure 13. Ground speed estimated by tag using Doppler effect for tagged Great Indian Bustard in Thar.

Based on ground-speed, a very small proportion of movements indicated potential flights (>2 m/s or >7 km/hr ground speeds). (Figure 14)

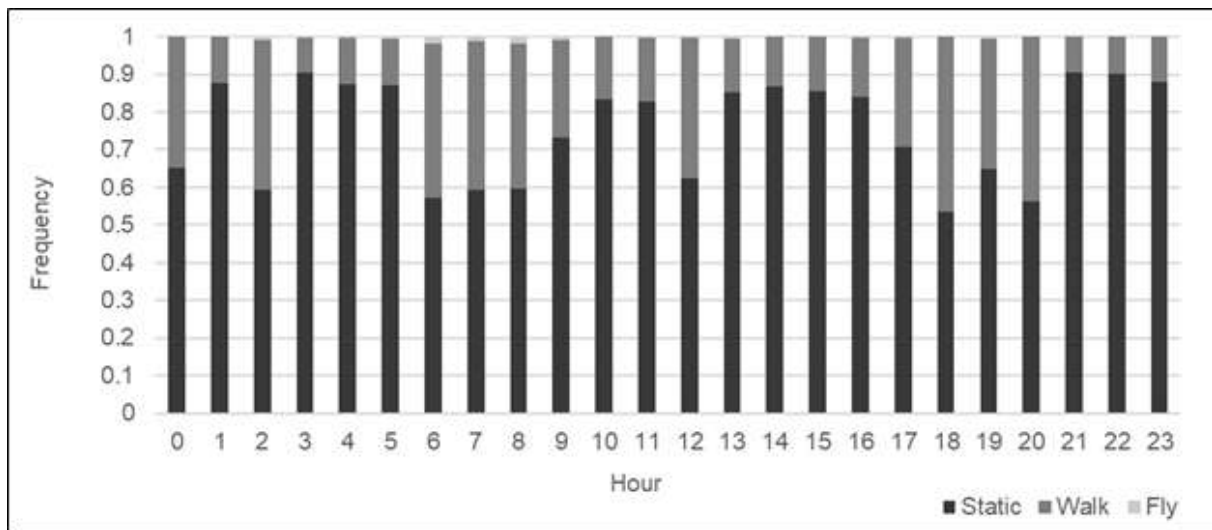


Figure 14. Frequency of independent events (separated by 1-hour for uniformity) classified into three movement classes: static (ground speed <0.3 ms⁻¹), walk (0.3–2.0 ms⁻¹) and fly (>2 m/s) against hour of the day for tagged Great Indian Bustard in Thar during Mar 2019 –Sep 2020.

LAND-USES THAT THE BIRDS PREFER

Enclosures established by State Forest Department occupies 1.01% of the area, yet contained 70.17% fixes of all GIB. Birds showed strong selection towards enclosures (Ivlev index 0.97, Ivlev 1961) and avoidance of outside areas (-0.54). This finding corroborate the recommendation of National Bustard Recovery Guidelines that enclosures of 10-20 sqkm that are scientifically managed (predator proofing and habitat management) can accommodate the birds' ecological needs to a great extent. We also identified three sites outside of enclosures that were extensively used by birds: Kali mali cropfields, Bhilo ka khet and Dhaneli cropfields.

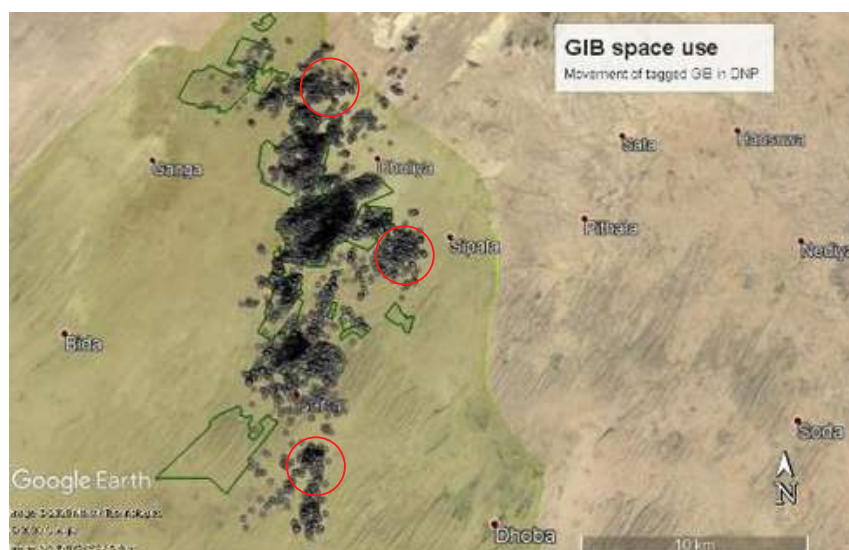


Figure 15. GPS fixes of four tagged Great Indian Bustards overlaid on enclosures and habitat, indicative of intensive usage of enclosures, and few adjoining agricultural sites (marked in open circles) in Desert National Park during Mar 2019 – Sep 2020.





Tanya Gupta

3. CHARACTERIZING THREATS

3.1. Power-line mapping

Bustard habitats are experiencing a rapid increase of wind turbines, solar farms, and power lines. Power lines pose a critical threat to bustards globally, due to their low and heavy flying nature and poor frontal vision. We mapped power lines in GIB habitats so that segments within bird usage areas can be identified and flagged for mitigation measures. We digitized an ecological boundary of prime GIB habitat in consultation with Rajasthan Forest Department based on current and past 10 years GIB locations in Thar and proposed that area as an eco-sensitive zone. The landscape is too large to map infrastructure manually. Therefore, low and high tension power lines, wind and solar power projects, roads, and settlements were digitized from very high resolution satellite imagery available with Google Earth TM. This task was outsourced to M/S. Science Pvt. Ltd. We did ground truthing of digitized power lines (Figure 16) and wind turbines (Figure 17), and refined the maps. We identified power lines and wind turbines with their owner agencies to sensitize them for mitigating this threat and also plan mitigation actions (Table 4).



Devesh Gadhvi



Bipin C.M.

Table 4. Details of high tension power lines present in priority Great Indian Bustard habitat of Thar landscape that needs to be mitigated.

Name of Power Company	Power (KV)	Name of Line	Length (km)
Rajasthan Vidyut Prasaran Nigam Limited (RVPNL)	132	132kv Jaisalmer – Ramgarh - 1	40
	132	132kv Jaisalmer – Ramgarh - 2	40
	132	132kv Askandra	50
	220	220kv Amarsagar – Ramgarh	40
	220	220kv Amarsagar - Lilo	5
	220	220kv Amarsagar - Phalodi	125
	220	220kv Amarsagar - Dechu	120
	400	400kv Akai - Ramgarh	55
	Sub total		475
Suzlon	33	33kv Small pylons Kuchri	20
	33	33kv Big pylons Kuchri - Habur	20
	132	132kv Kaladungar	20
	220	220kv Habur - Ramgarh	35
	220	220kv Amarsagar - Mokal	20
	Sub total		115
Jodhpur Discom	33	Sam - Dhanana	40
	33	-	60
	Sub total		100
Wind World	33	Kanoi - Salkha	20
Greenko	220	Amarsagar - Ramgarh	40
Gamesa	33	Amarsagar - Ludarva	4
Total			754

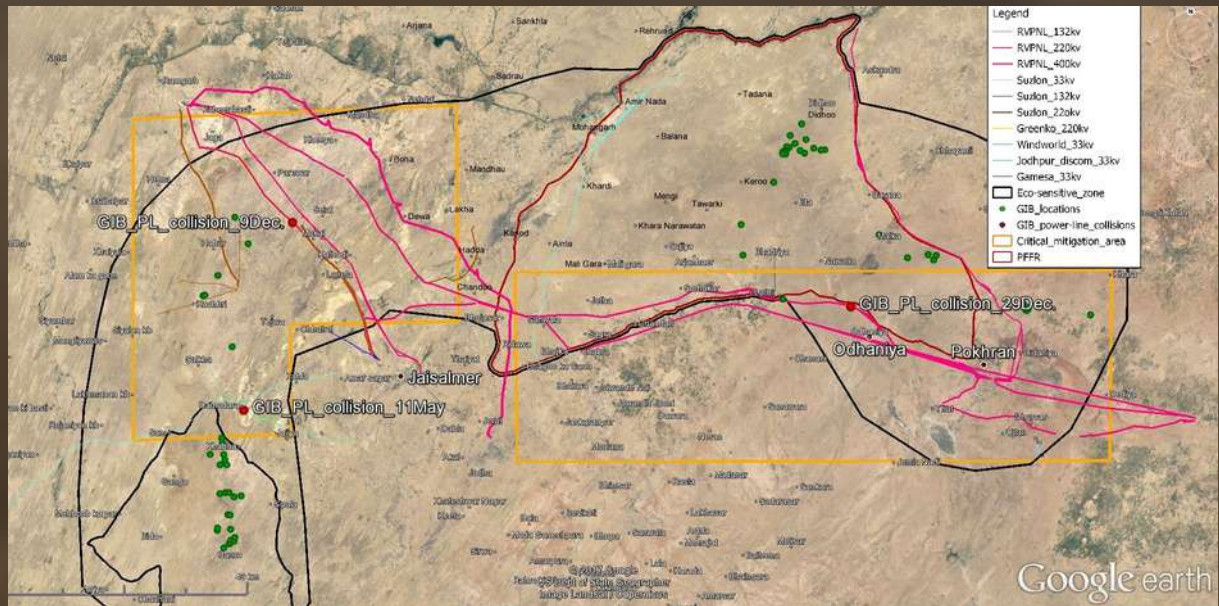


Figure 16. Map of power infrastructure (high tension power lines) in Thar with high priority mitigation areas (2017-18).

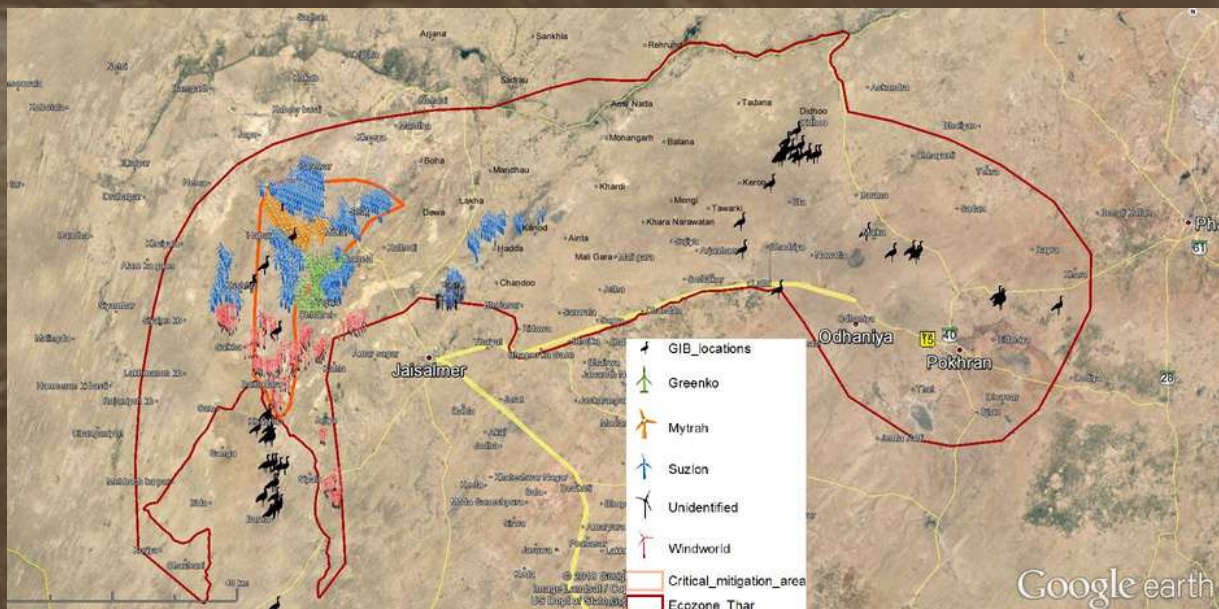


Figure 17. Map of power infrastructure (wind turbines) in Thar landscape (2017-18).

3.2. Bird mortality due to power lines

We assessed bustard and associated bird movement and mortality rates across power lines. To compare power-line induced mortality with that due to natural agents, we surveyed beneath overhead wires (n=50) and randomly laid belt transects of similar dimension (2000 m × 60 m) without power lines (n=20), once in January 2017 (Figure 18). Bird carcasses were not detected in any random transect (n=20 transects), indicating the relatively low natural prevalence of bird mortality (Figure 19).

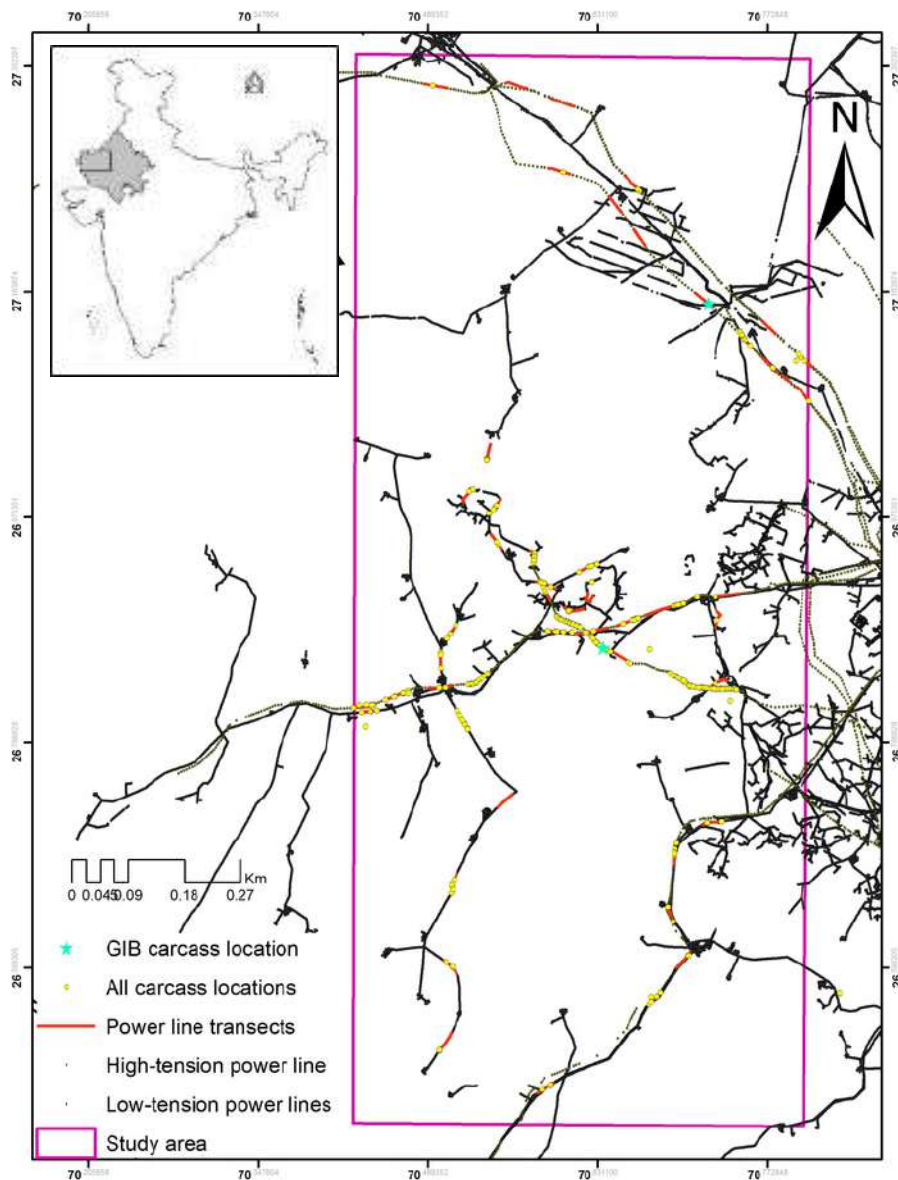


Figure 18. Map showing power line study area, high & low tension power lines, sampled transects, carcass location of Great Indian Bustard and other birds found on power line transects in Thar landscape during 2017-18.

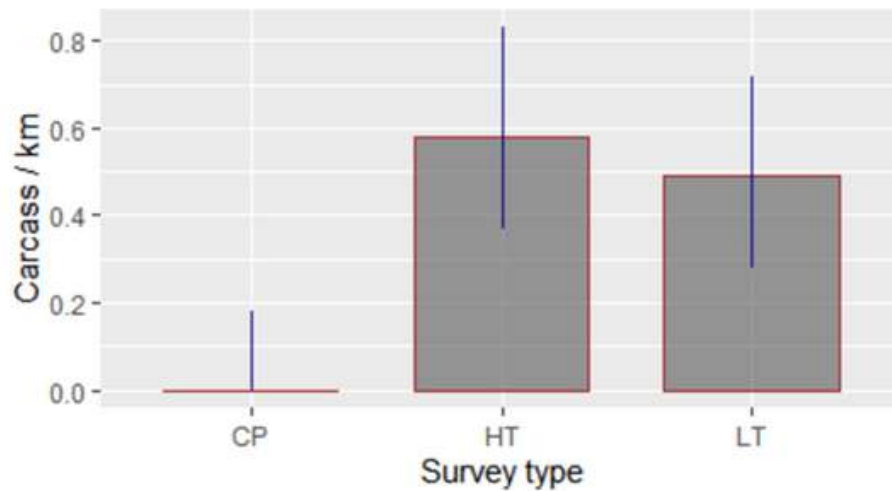


Figure 19. Mean (95% CI) bird carcass encounter rate (per km) at random transects (CP), >33 kV (HT) and <33 kV (LT) power-lines in Thar landscape during 2017-18.

To assess collision rates, we randomly selected 40 two-km power line segments (20 high tension and 20 low tension) from the network of power lines in prime GIB habitat (Figure 20) and sampled 30m width on either side under these power lines for bird carcasses six times during March – December 2017. All carcasses were removed prior to sampling.

We found 289 bird carcasses out of which 55% carcasses could be identified up to taxa level.

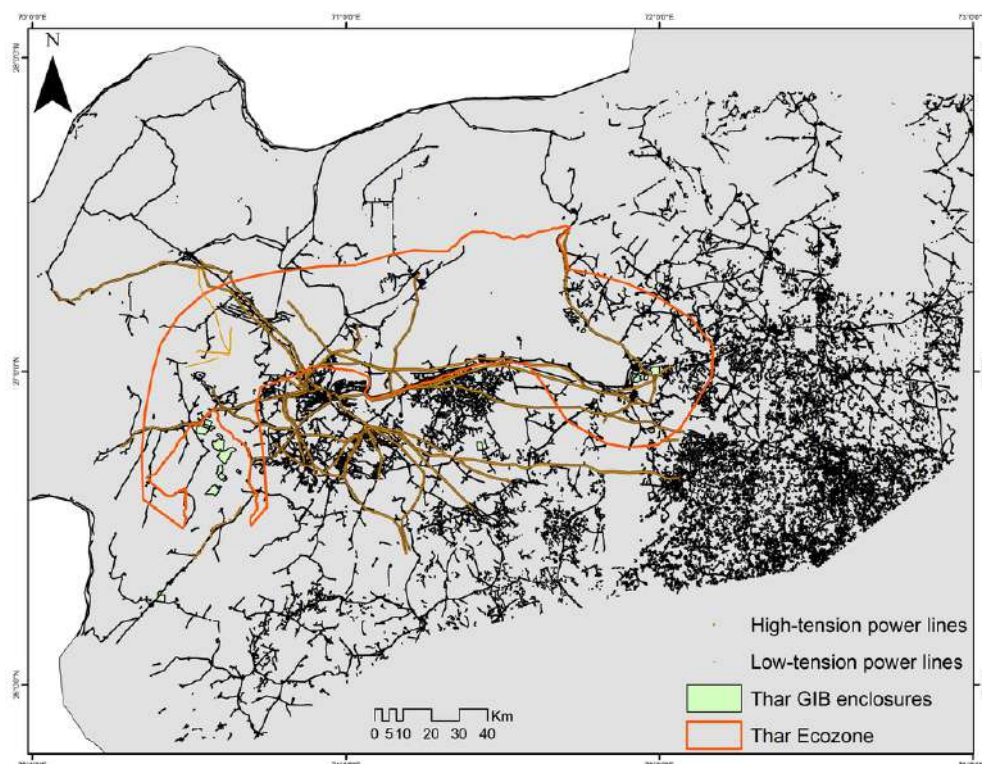
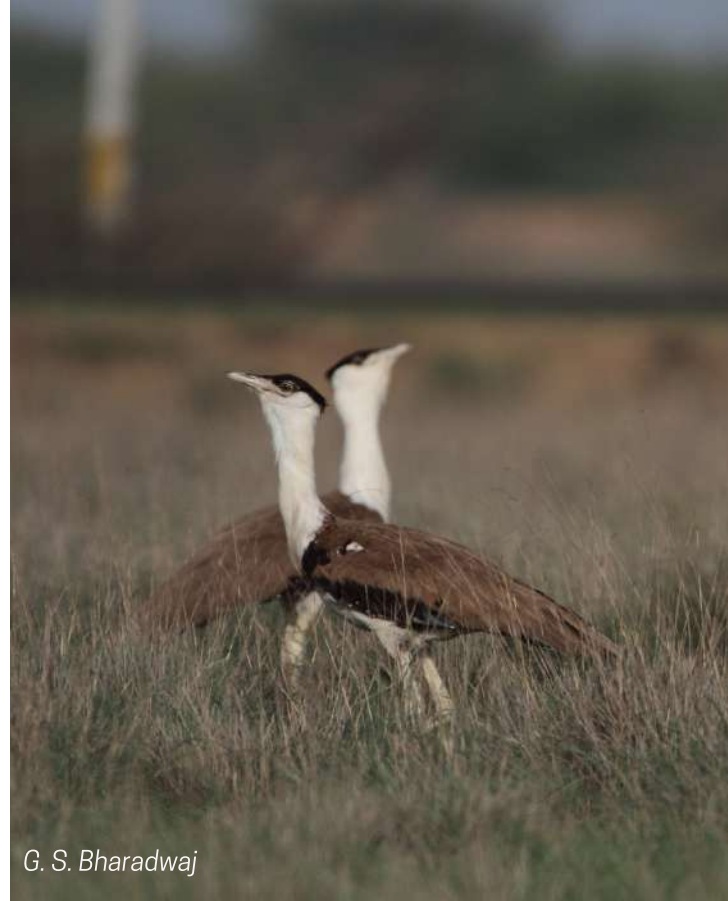


Figure 20. Map showing power line network in Thar landscape.

Since there is a chance of missing the carcasses during surveys because of observer detection bias and carcass disappearance because of decomposition, and displacement by scavengers prior to surveys, we carried out experiments to incorporate detection and decomposition rates of carcasses. To conduct these experiments 10 powerline segments of 2 km each were randomly selected and 80 fresh bird carcasses of various size (50 – 5000g) were placed under these power line segments. These carcasses were monitored on day- 2, 3, 5, 7, 10, 15, 30 and 60 since placement, to record if the carcass persisted or disappeared. To conduct detectability experiments we placed 56 of these carcasses at random locations under six power line segments. These segments were surveyed by three/ four observers to detect carcasses in a blind trial.

We found that carcass detectability increased asymptotically with body mass of bird. It was estimated at 0.64 (0.31 – 0.87) for small (<100g), 0.80 (0.68 – 0.89) medium (100-1000g) and 0.97 (0.82 – 1.0) for large (>1000g) birds (Figure 21). Carcass persistence also depended on bird size. We found median persistence time of 2 (2 – 2) days for small, 3 (3 – 4) days for medium, and 15 (4 – 32) days for large birds (Figure 22). We estimated geometric mean carcass encounter rate based on monthly surveys as 0.28 (SE 0.09) per km per month. It was comparatively higher in winter than summer. Carcass detections per km per month were estimated as 0.21 (0 – 0.46) for low – tension and 0.45 (0.21 – 0.75) for high- tension power lines (Table 3). We adjusted mortality rates using bias correction factor and pooled it over size classes, mortality



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rates were estimated at 3.22 (0.9 – 6.27) per km per month for low – tension and 6.25 (2.65 – 10.85) per km per month for high tension power lines. We extrapolated these estimates to 1200 km low and 500 km high tension lines and estimated annual mortalities of 83,868 (SE 24,825) birds in study area of 4,200 sqkm.

During our surveys, two GIB carcasses were detected. To understand the seriousness of this threat to bustards we extrapolated our findings on total length of high - tension power lines across prime GIB habitat in Thar estimated that ~18 GIB die annually due to collision with powerlines.

To estimate the bird crossing rates across power lines, we observed bird movements at 10 randomly selected two-km power line segments (five low tension and high - tension power lines each) in prime GIB habitat. The maximum coverage for observing movement from one point was 850m.

A team of two observers recorded bird movements across power lines for 12 hours a day using binoculars and field scopes. This exercise was conducted in winter, summer, and post monsoon to capture seasonal differences in bird composition. Bird movements across power line, flight height from wires, and use of wires, poles and pylons for perching/ roosting were recorded, and segregated into taxa/ size groups. Collision events during these observations, if any, were recorded.

We recorded a total of 6,732 individuals of 49 species. The most numerous species was Eurasian collared dove *Streptopelia decaocto* (27.59% of total individuals), followed by larks (19.38%), green bee-eater *Merops orientalis* (7.07%) and white-eared bulbul *Pycnonotus leucotis* (6.01%). Our initial results show that comparison of crossing vs. collision rates indicated Ploceidae, Anatidae and Charadriidae as the most collision-prone families.

Table 5. Mean (95 % CI) encounter rate, correction factor for persistence and detection biases, and bias-corrected mortality rate of small, medium and large birds against low (<33 kV) and high (>33 kV) tension lines in Thar Desert, 2017–18. Birds whose taxonomy / weight class could not be determined (unknown) was assumed to have similar weight composition as identified birds, based on which total carcass mortality rate was estimated.

Bird Size	Power Line Type	Bird Carcass (per km per month)	Bias Correction Factor	Bird Mortality (per km per month)
Small (< 100g)	<33 kV	0.03 (0 - 0.11)	0.04 (0.04 - 0.05)	2.32
	> 33 kV	0.11 (0.04 - 0.19)	-	5.14
Medium (>100–1000 g)	<33 kV	0.06 (0.01 - 0.12)	0.16 (0.15 - 0.18)	0.77
	> 33 kV	0.06 (0.01 - 0.12)	-	0.82
Large (> 1000g)	<33 kV	0.03 (0 - 0.07)	0.47 (0.43 - 0.5)	0.13
	> 33 kV	0.07 (0.03 - 0.11)	-	0.29
Unknown	<33 kV	0.08 (0 - 0.27)	-	-
	> 33 kV	0.23 (0.05 - 0.44)	-	-
Total	<33 kV	0.21 (0 - 0.46)	-	3.22
	> 33 kV	0.45 (0.21 - 0.75)	-	6.25

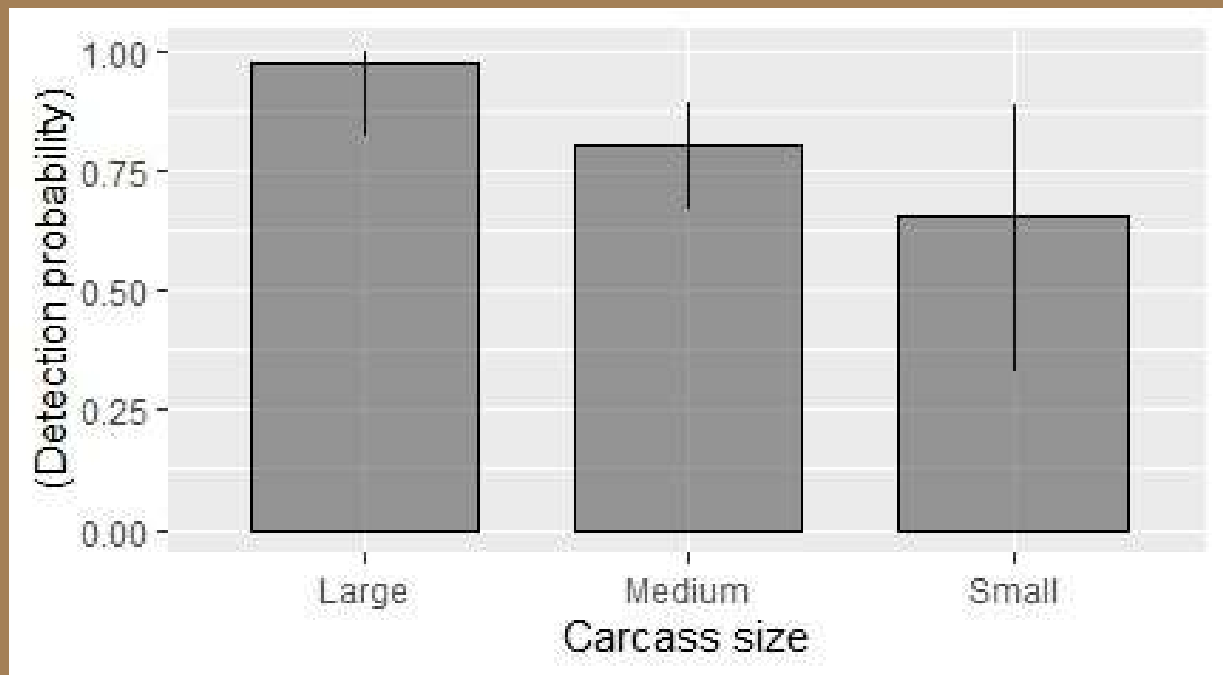


Figure 21. Probability of detection along body mass of birds estimated from carcass detection experiment in Thar landscape during 2017-18.

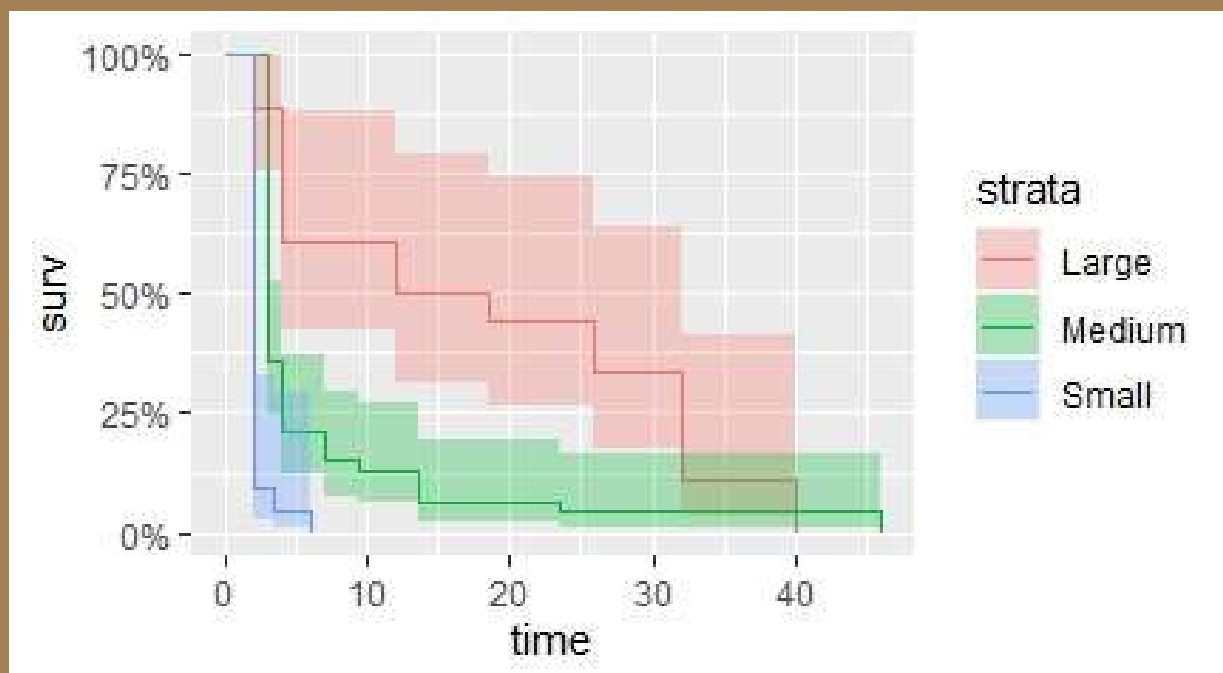


Figure 22. Probability of bird carcass persistence along time since placement under power lines for small (<100 g), medium (100-1000 g) and large (>1000 g) birds in Thar landscape during 2017-18.



Image 4. Field activities related to assessment of bird mortality caused by power-line collisions (left, middle) and power line observations (right) in Thar during 2017-18 © Mohib Uddin



Image 5. Carcass of Great Indian Bustard found during power line surveys in Thar landscape in May 2017 © Bipin C.M.



3.3. PREDATION ECOLOGY OF FREE-RANGING DOGS

How many dogs?

Thar holds a large population of free-ranging dogs that partially depend on village based resources and also depredate wildlife, including GIB nests, thereby being an important threat that needs to be managed. We assessed population status of free-ranging dogs in/ around Desert National Park. A pilot survey was carried out in select settlements during September – October 2016 in collaboration with Humane Society International – India and international consultant Dr. Lex Hiby, wherein a smart-phone application (OSM) based mark-recapture technique was used to enumerate dogs. Subsequently, a comprehensive study was undertaken that included the following activities:

Count surveys: Dogs were counted in 18 settlements. Observers walked on predesigned route recording the number of dogs present with consistent effort of ~ 8 km walk in two hours per square km of settlement area. This activity generated crude counts of dogs in all settlements within the GIB habitat in/ around Desert National Park.

Mark-recapture surveys: In six of these villages (Sam, Salkha, Lakhmano, Kuchhri, Neemba and Beeda) and the dog telemetry area, dog abundance was estimated in mark-recapture framework which is robust to imperfect detection. A point and shoot digital camera with 83X magnification and zoom lens smartphone were used to capture dogs and identify individuals based on distinguishable natural marks (flanks, head, tail, other body marks). Four photo-capture surveys were conducted in each settlement and abundance was estimated



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following standard closed population mark-recapture analysis (Otis et al. 1978, White & Burnham 1999). Dog counts in these villages were calibrated against the mark-recapture abundance estimates to generate a correction factor (double sampling approach) that can be used to estimate dog abundance in all settlements (Figure 24).



Figure 23. MS Access database to catalog and match dog photographs for mark-recapture based population assessment.

Vehicle transects were also laid to assess the density and distribution of free-ranging dogs in wildlife habitats. This activity generated baseline information on numbers and distribution of dogs in GIB habitat of Thar that helped us in planning sterilization/ control programs and monitor the effectiveness of these programs in reducing the number of dogs within manageable limits.

Where dogs range and what they eat

Radio-tracking: We determined ranging patterns and resource utilization of dogs using biotelemetry. Nine dogs were fitted with radio-collars and ground tracked using VHF technology on vehicle for 112 days. GPS locations, time and associated variables (habitat type, activity of animal and associated individuals) were recorded at every 15 minutes (Figure 23).

Locations of radio-collared dogs were analysed using Minimum Convex Polygons (MCP) and Kernel methods to estimate home range size and habitat use. Time and location data was analysed to assess temporal activity pattern, proportion of time spent in settlement vs. wildlife habitats, and time-activity budgets.

Behavioural sampling:

Each radio tracked dog was observed using focal animal sampling for ~150 hours, including 24 hours continuous monitoring for five days, to determine their activity patterns, feeding habits and inter-specific interactions. Data on scavenging, active predation and interactions with conspecifics and potential competitors (fox, cat, raptor etc.) were recorded.

Carcass availability:

We assess carcass availability in the combined MCP with two-km buffer. A fixed zigzag route of 127 km was digitized using Google Earth™ that was surveyed once every 15 days to record carcasses. Data on condition, distance of carcass from trail, and presence of scavengers around the carcass were collected. This field activity yielded information on predation rates of wild prey and livestock by dogs.



Image 6. Field activities related to understanding and management of the impact of free-ranging dogs on wildlife in/ around Desert National Park. © Monisha Mohandas and Devendradutta Pandey

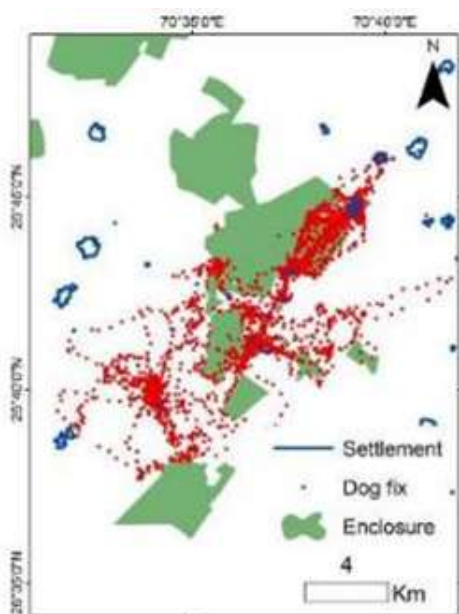


Figure 24. Radiolocations of free-ranging dogs (n=9) overlaid on enclosures and settlements in Desert National Park during 2017-18.

A total of 761 ± 109 SE dogs in human habitation and a total number of $1,804 \pm 462$ SE dogs in 1,008 sqkm landscape were estimated. Home range (95% MCP) estimate of free-ranging dogs was 19.81 ± 4.79 SE sqkm with no difference between males (19.80 ± 2.65 sqkm) and females (17.25 ± 1.60 sqkm). Space-use was two-fold in/ around enclosures (prime wildlife resource patches) and threefold in/ around settlements (human-derived resource patches) than expected under random use (Figure 24). Activity budget and temporal activity pattern showed that dogs were crepuscular, mostly active during 0600-0900 hrs and 1800-2100 hrs, and resting for 75% of the day. Prey densities (individuals per sqkm) were estimated to be 7 ± 1.22 SE chinkara, 0.46 ± 0.23 SE nilgai, 4,681 spiny-tailed lizards and $2,861 \pm 203$ SE jird. Goat and sheep carcasses contributed most to the diet (54% feeding time) and were also most selected (Ivlev's index = 0.96goat and 0.95sheep) followed by predation on nilgai and chinkara. Potential predation rates of chinkara and nilgai were estimated to be 9.67 and 10.95 per dog per year respectively, albeit with a small sample. Radio tagging of free-ranging dogs showed that an unsustainable 33% of chinkara population is cropped annually.



Image 7. Free ranging dogs hunting Chinkara in packs. © Devendradutta Pandey

3.4. Pesticide prevalence

Rapid assessment of locust outbreak to prevent

Locust outbreak was first reported from Great Indian Bustard habitats in Thar after a rainfall between 12th and 15th May 2019, followed by announcements of warnings and control measures by District administration. Locust swarm is one of the threats to agriculture in African and Asian countries. Natural interventions such as thunderstorms or the passage of depressions in summer are known to induce locust outbreaks (Bhatia 1939). Some of the locust outbreak centers were located within the areas intensively used by GIB. We carried out a rapid assessment of locust infestation in GIB landscape near Pokhran/ Ramdevra from 28th May to 3rd June 2019 to identify the outbreak centres and whether they overlapped with areas intensively used by GIB to suggest mitigation measures against pesticide exposure.



Data on locust population was collected based on Food and Agriculture Organization (FAO) guidelines (Cressman 2001). Survey area was divided into multiple 36 sqkm grids. Five plots in each grid was sampled to estimate locust density. At each plot, foot transect of 100 meters (length) and 3 meters (effective detection width in 300 sqm area per plot) was walked and direct count method was used to enumerate locust numbers (adults and hoppers). Other associated habitat variables viz., land cover (grassland/ agriculture/ barren), vegetation density (dense/ medium/ low), presence of soil moisture, last date of rainfall and presence of animal carcasses were also recorded.



(a)

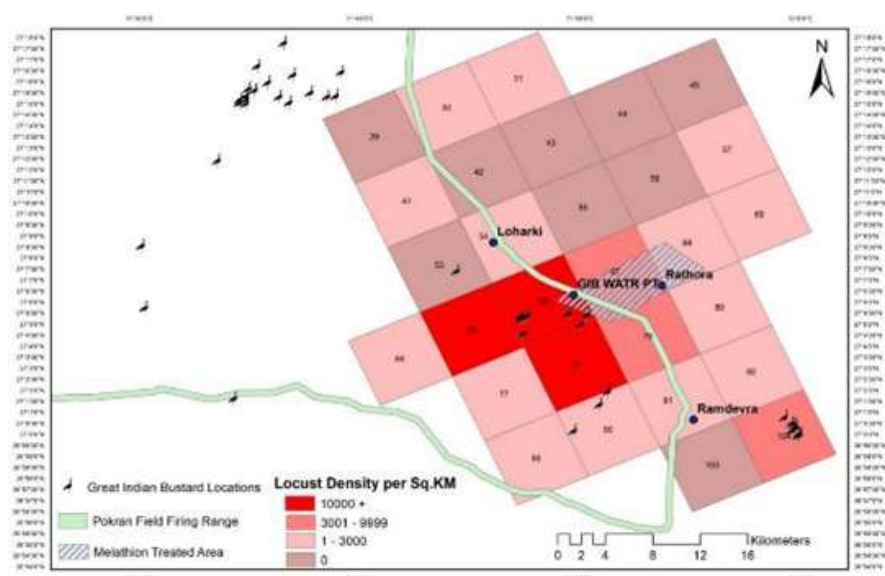



(b)

Image 8. Locust outbreak in Thar (a) Locust congregation on khimp- *Leptadenia pyrotechnica* shrub. © Bipin C.M., (b) Dead locusts collected from Malathion spray site. © Devendradutt Pandey

Total 29 grids encompassing 1,044 sqkm area was surveyed. Locust presence was recorded in 21 survey grids (Figure 25). Average density of locust in the surveyed area was estimated as 2,940.46 individuals per sqkm. Other animal carcasses were not detected during the survey.

Figure 25. Map of the surveyed area for estimating locust abundance using grid based sampling in Thar, Jaisalmer.





To control locust outbreak, a few areas near Loharki village, Jaisalmer (inside PFFR) had already been sprayed using Malathion 96%-a contraceptive insecticide, by the District administration. Some of the previous studies suggest that the chemical can be detrimental to birds. The sprayed area was a frequently used water drinking and foraging site of GIB, which increased the chances of exposure of GIB to Malathion. It was recommended to monitor the entire landscape, where locust outbreaks have occurred, insecticide has been sprayed, and should be guarded to prevent GIB visiting that particular area. Desert Locust Situation update by FAO notified that there is possibility of migration of more locust swarms in Thar Desert after mid-June till year end. Locust samples were collected from GIB habitat during 2019-20 and are being analysed in the lab.

PILOT GIB-FRIENDLY LAND-USES

Pilot installation of bird diverters

The infrastructure maps and priority mitigation areas were shared with State Forest Department, MOEFCC, power agencies and power/energy regulatory bodies such as Ministry of New Renewable Energy (MNRE), Ministry of Power and Central Electricity Authority. Several joint meetings with Forest Department were held, where we sensitized power companies on the need of mitigating power lines for conserving bustards. We distributed diverters to power agencies such as RVPNL, Jodhpur Vidyuth Vitran Nigam Limited (JDVVNL) and Suzlon that were installed in transmission lines in Khetolai, Mokla, Habur and Sanu villages during January- February 2018. We provided technical inputs to local vendors to manufacture indigenous low cost bird diverters. We procured these units and distributed to Suzlon for installation. These diverters were installed according to the design provided by WII on 250m segment of 33KV line near Mokla during July 2020. Total 105 diverters were installed in this pilot step to examine their field longevity and efficacy (Table 6). To this end, long-term studies are ongoing, since it requires many years and bird crossing/ collision events to detect the field life and effectiveness of these products in reducing crossings and/ or collisions.

Table 6. Details of bird diverters distributed to power agencies by Wildlife Institute of India and installed on power lines in Great Indian Bustard habitat in Jaisalmer, Rajasthan.

S No.	Power line agency	Diverter Type & Number	Manufacturer	G.P.S. coordinates	Installation	Capacity	Route	Area
1	SUZLON	Fire Fly and Bird Mark-3#	P & R Technologies- USA	27.05499 70.6035	February-2018	33 KV	Khuchri - Suzlon Mokla GSS	Khuchri
2	SUZLON	Fire Fly and Bird Mark-10#		27.19602 70.57894	February-2018	220 KV	Mokla - Ramgarh	Habur - Sanu
3	SUZLON	Fire Fly and Bird Mark-9#		27.03802 70.57811	February-2018	220 KV	Habur - Mandal Ka Gaon	Habur
4	RVPNL	RAPTOR CLAMP and Overhead Warning Light (OWL) -35 #	Preformed Line Products (PLP)- USA & Thailand	27.01168 71.69339	May-2018	220 KV	Amarsagar - Phalodi	Khetolai
5	SUZLON	Bird Flight LED Diverters - 48	A & S Creations, New Delhi	27.16142 70.6858	July-2020	33kv	Mokla - Ramgarh	Mokla

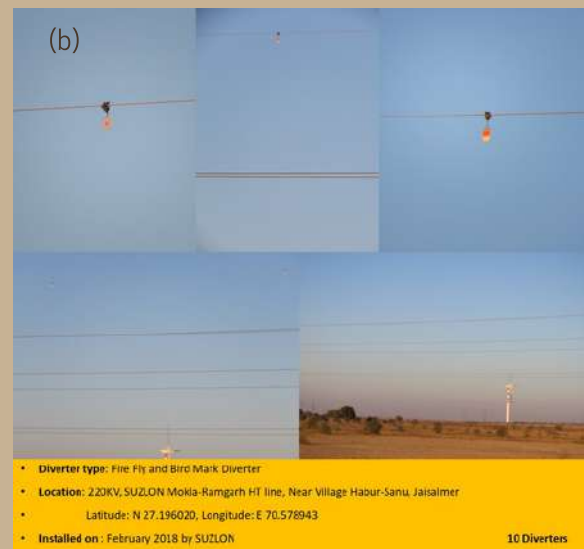
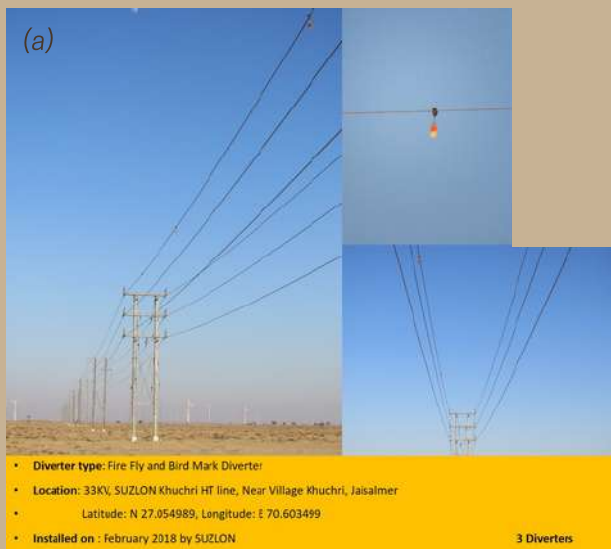


Image 9. Pilot installation of bird diverters on power lines near (a) Khuchdi, (b) Habur- Sanu and (c) Mandal ki gaon villages – priority areas for mitigating power lines for Great Indian Bustard conservation in Jaisalmer, Rajasthan. © Mohib Uddin

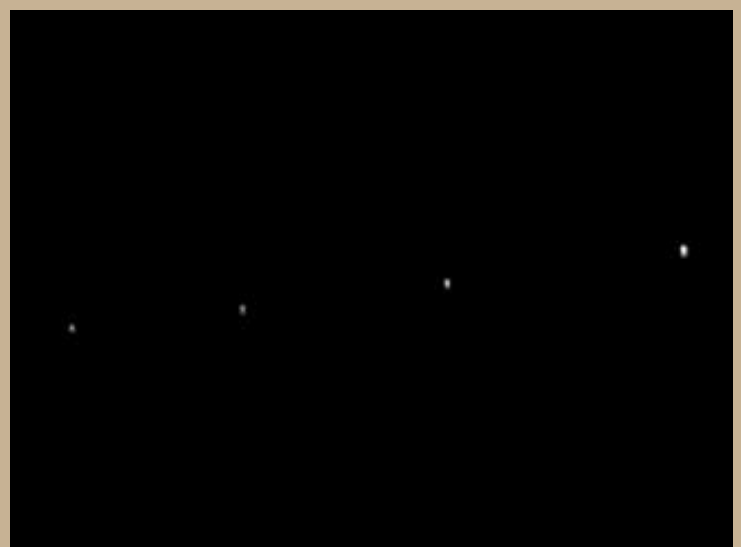


Image 10. Pilot installation of LED bird diverters on power lines near Khetolai village– priority area for mitigating power lines for Great Indian Bustard conservation in Jaisalmer, Rajasthan. © Mohib Uddin and Sourav Supakar



Image 11. Pilot installation of indigenous LED bird diverters according to the design provided by Wildlife Institute of India on power lines in Mokla – priority area for mitigating power lines for Great Indian Bustard conservation in Jaisalmer, Rajasthan. Photo credit: Suzlon and Devendradutta Pandey

Mitigation plan for power lines

Global research and our study show that power lines, especially high-voltage transmission lines with multiple overhead wires, is the most important current threat to the Critically Endangered GIB. We found unsustainably high mortality rate of GIB (~15% annual mortality and 5 deaths detected in 2017-18), and mortality of ~90,000 birds of over 49 species annually in ~4000 sqkm area in/ around Desert National Park. There is an urgent need of mitigating this threat by burying high-risk power lines and installing markers on medium-risk power lines. After a series of joint meetings by Rajasthan Forest Department (RFD) and WII with power agencies (2016–18) to implement these mitigation measures, a high-level meeting was held on 20th December 2018 under the chairmanship of Principal Secretary Energy, Govt. of Rajasthan that was attended by RFD and WII representatives. This meeting decided that mitigation measures should be urgently implemented, and directed the power agencies to place proposals with cost-estimation for this action. We were mandated with developing a technical and financial proposal for mitigating existing power lines in priority GIB habitats. To this end, we carried out the following activities:

Mapping: We mapped power lines across ~20,000 sqkm Thar landscape through digitization of very high resolution Google Earth™ imagery in the first phase. Power lines within the priority GIB habitat (GIB Arc), as identified by long-term collaborative surveys of WII and RFD (Dutta et al. 2016) were then ground validated (2016–17). Since the chance of missing power lines is high because of the vastness of GIB landscape, it was decided in the meeting that the available information on power lines should be verified by power line companies and the same should be submitted by Superintendent Engineer (SE) Rajasthan Vidyut Prasaran Nigam Limited (RVPNL) within a month's time. A follow up meeting was called by SE RVPNL Jaisalmer on 31st December 2018 in Jaisalmer that was attended by representatives from WII and power line companies including RVPNL, SUZLON, Innercon, Jodhpur Discom, Today Green Energy Private Ltd, Siemens Gamesa and Greenko. The SE RVPNL Jaisalmer asked all power line authorities to submit details of power lines (name, length, GPS coordinates of power lines) inside the GIB Arc to WII. WII team followed up with every power line company operating in this area and obtained available data by 15th January 2019. Wherever this data was non-existent, WII team digitized the risky power lines on ground and cross verified this information with the SE RVPNL Jaisalmer on 19th January 2019.

Cost calculation: Based on this information, cost of undergrounding power lines and installing bird diverters were separately calculated to aide in deciding the optimal mitigation strategy. Cost of undergrounding cables was computed based on information shared by the SE RVPNL Jaisalmer for medium voltage (33–66 kV) lines. However, the cost or technology of undergrounding high voltage lines (>132 kV) were not available locally and could not be calculated. The cost of bird diverters was calculated at 10,000 INR per piece (inclusive of production and shipping costs from abroad), which is a liberal estimate, based on procurement of small numbers of high-quality devices by WII.

In total, 1,342 km of power lines have been prioritised for mitigation by undergrounding 104 km of 33 kV lines in areas that are most intensively used by GIB and installing diverters on remaining 1238 km of overhead cables. The total cost of this implementation has been estimated at 287.16 Cr INR. However, this cost could be reduced to approx. 150 Cr INR by opting for economic but quality diverters.

The details of power lines with cost calculation and total costs of diverters and undergrounding are provided below (Tables 7, 8 & 9), along with the priority map of mitigation measures (Figure 25), and image of a prototype bird diverter/ reflector (Image 12). This mitigation plan has been submitted to the concerned ministries and power agencies for further actions. However, mitigation action on ground has not been initiated.

Table 7. List of power lines prioritised for bird diverter installation and undergrounding in Thar, Jaisalmer. Cost of installation (undergrounding)- 40% of cost of wire, Cost of bird diverter per unit- Rs. 10,000/-, Cost of bird diverter installation- 20% of bird diverter cost, ++ For 33 kV lines prioritized for undergrounding, cost of diverters have also been indicated.

					Number		Cost (Rs. in lakhs)		
Phase	Company	Power (KV)	Name OfLine	Length (km)	Wires	Diverters	Diverter (D) / Undergrounding (U)	Installation	Total
1	Wind World/ Innercon	33	Kanoi – Salkha	21	13(7)		20.414 per km (4 Cables) 1714.776 (U)	685.91 (U)	2,400.69 (U)
					-	6895	689.50 (D)	137.90 (D)	827.40 (D)
	Jodhpur Discom	33	Sam – Dhana na	45	4(3)		20.414 per km (1 Cable) 918.63 (U)	367.452 (U)	1,286.08 (U)
						6332	633.20 (D)	126.64 (D)	759.84 (D)
	Suzlon	33	Tejuva-Kuchri	17	7(4)	-	20.414 per km (2 Cables) 694.076 (U)	277.63 (U)	971.71 (U)
						3190	319.00 (D)	63.80 (D)	382.80 (D)
		33	Khuchri horizon tal - parallel	21	6(3)		20.414 per km (2 Cables) 857.388 (U)	342.96 (U)	1,200.34 (U)
					-	2955	295.50 (D)	59.10 (D)	354.60 (D)
Total		Undergrounding (U)		104	-		4,184.87(U)	1,673.95 (U)	5,858.82 (U)
		Diverter(D)		-	19372		1,937.20 (D)	387.44 (D)	2,324.64 (D) ++

Table 8. List of power lines prioritised for bird diverter installation in Thar, Jaisalmer. Cost of bird diverter per unit- Rs. 10,000/-, Cost of bird diverter installation- 20% of bird diverter cost.

Phase	Company	Power (kV)	Name of power line	Length (km)	Number		Cost (Rs. In lakhs)		
					Wires	Bird Diverters	Bird Diverters	Installation	Total
1	Rajasthan Vidyut Prasaran Nigam Limited (RVPNL)	132	132kV Jaisalmer – Ramgarh – 1	40	4(3)	5628	562.80	112.56	675.36
1		132	132kV Jaisalmer – Ramgarh – 2	40	4(3)	5628	562.80	112.56	675.36
1		132	132kV Askandra (Pokran-Askandra)	30	4(3)	4421	442.10	88.42	530.52
2		132	132kV Askandra (Pokran-Askandra)	20	4(3)	2814	281.40	56.28	337.68
1		220	220kV Amarsagar – Ramgarh	40	4(3)	5628	562.80	112.56	675.36
1		220	220kV Amarsagar – Lilo	8	7(4)	1501	150.10	30.02	180.12
1		220	220kV Amarsagar – Phalodi	54	4(3)	7598	759.80	151.96	911.76
3		220	220kV Amarsagar – Phalodi	71	4(3)	9990	999.00	199.80	1198.80
1		220	220kV Ramgarh-Dechu	49	7(4)	9193	919.30	183.86	1103.16
3		220	220kV Ramgarh-Dechu	43	7(4)	8067	806.70	161.34	968.04
2		220	220kV Ramgarh-Dechu	50	7(4)	9380	938.00	187.60	1125.60
2		400	400kV Akai – Ramgarh	55	8(4)	10,318	1031.80	206.36	1238.16
Sub-total				500		80,166	8016.60	1603.32	9619.92
3	Suzlon	33	Tejuva – Kuchadi	138	7(4)	25889	2588.90	517.78	3106.68
2		33	Kaladongar	70	4(3)	9849	984.90	196.98	1181.88
3		33	Mokla – Habur – Sanu	301	4(3)	42,350	4235.00	847.00	5082.00
3		132	Tejuva – Kuchadi	25	4(3)	3518	351.80	70.36	422.16
2		132/ 220	Kaladongar	47	4(3)	6613	661.30	132.26	793.56
1		132/ 220	Mokla – Habur – Sanu	43	4(3)	6051	605.10	121.02	726.12
Sub-total				624		94,270	9427.00	1885.40	11312.40
2	Jodhpur Discom	33	Chandan Via Bhaguka Gaon- Mohangarh	70	4(3)	9849	984.9	196.98	1181.88
1	Greenko	220	Amarsagar – Ramgarh	40	4(3)	5628	562.8	112.56	675.36
3	Gamesa	33	Amarsagar – Ludarva	4	4(3)	563	56.3	11.26	67.56
Total		1238 km of power line for bird diverters				1,90,476			22857.12

Table 9. Summary of cost for implementing mitigation measures for power lines in Thar.

S. NO.	MITIGATION MEASURE	NUMBER OF BIRD DIVERTERS	COST (RS. IN LAKHS)
1	1238 km of power line for bird diverters	1,90,476	22,857.12
2	104 km of 33 kV lines (for bird diverters)	19,372	2,324.64
3	104 km of 33 kV lines for undergrounding	-	5,858.89
Grand total (S No. 1+3)			28,716.01

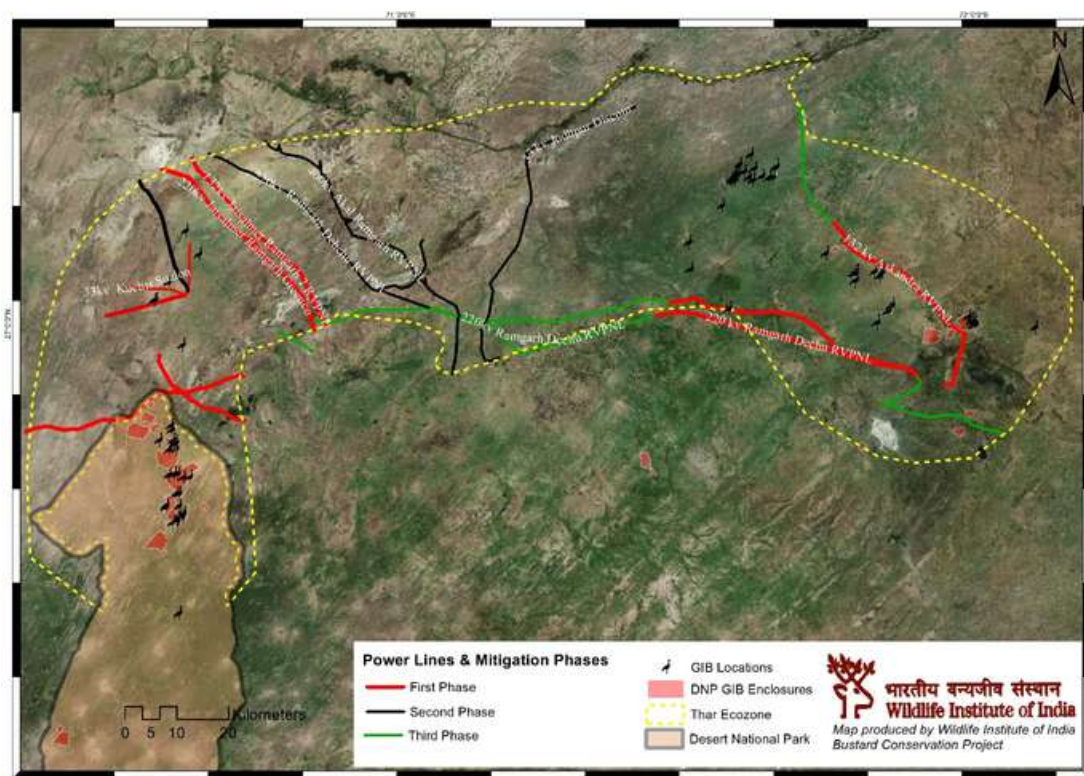


Figure 26. Map showing high tension (≥ 33 kV) power-lines divided into three phases for undergrounding and bird diverter installation.

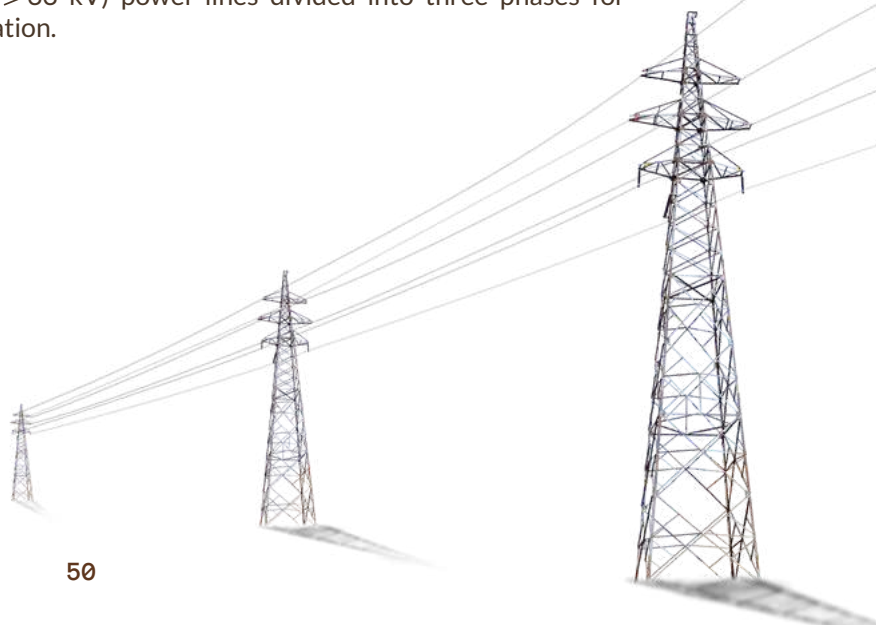




Image 12. Model Bird diverter/ reflector with rotating, reflecting and night blinking properties that has been pilot installed and field tested by Wildlife Institute of India with the assistance of power agencies in Jaisalmer.

POWER LINE MITIGATION REPORT

Technical report on power line mitigation to conserve bustards based on our findings was published for wider dissemination and public sensitization on this critical issue. The report includes scientific evidence of power-line impact on birds in general and bustards in particular, how to mitigate such threats, maps with identified critical power lines in GIB habitats of Rajasthan and Gujarat, information regarding available bird diverters and installation design as a quick reference guide. The technical report was widely disseminated to power agencies, State Forest Departments, defence personnel, conservation agencies and media. This report is available as Appendix 5.

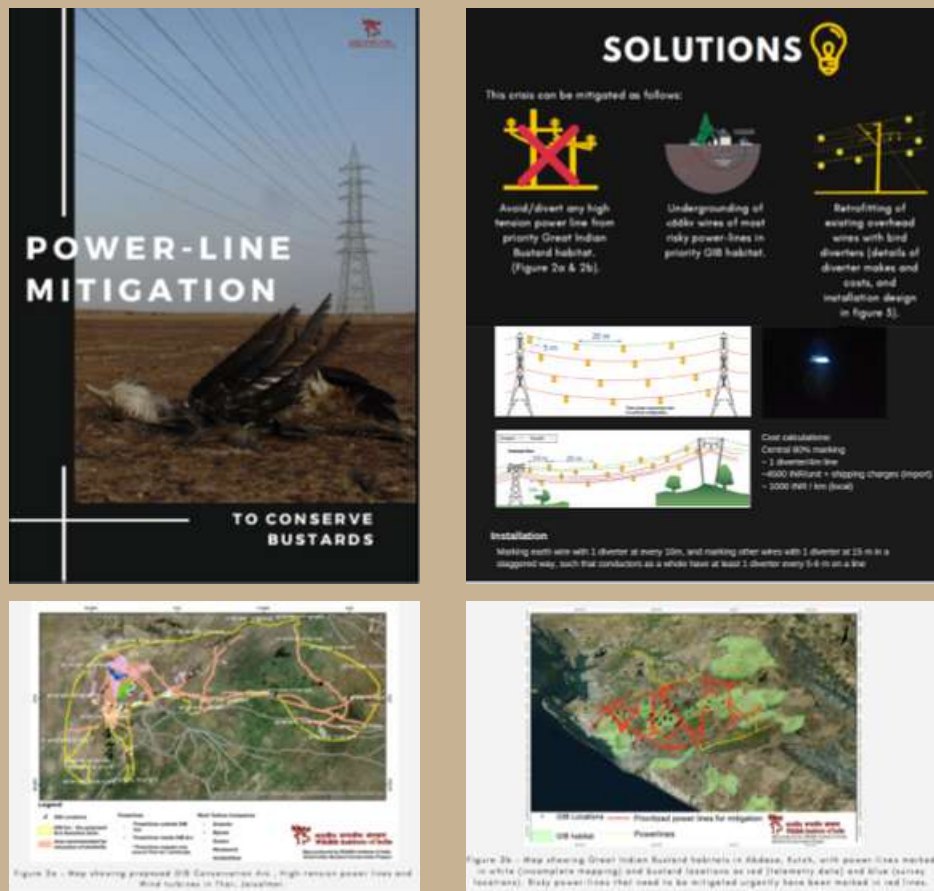


Image 13. Technical report on power line mitigation to conserve bustards published by Wildlife Institute of India.

GIB LANDSCAPE MAPS FOR POWER LINE MITIGATION

Based on our long term GIB surveys in Rajasthan, maps depicting priority and potential GIB landscape in Thar for power line mitigation were developed. The priority area and potential area identified in Rajasthan spans ~13,100 sqkm and ~ 78,500 sqkm respectively (Figure 27). In priority areas which is intensively used by GIB, it is recommended that all power lines have to be made underground or disallowed. The surrounding potential area require mitigation measures such as installation of bird diverters. The delineation of mitigation zones is an evolving exercise that needs to be refined as telemetry based information becomes available. However, since many power projects are being established in GIB habitats, the 'priority zone' will serve as a minimum area where such projects are recommended to be disallowed, to safeguard most critical bustard habitats.

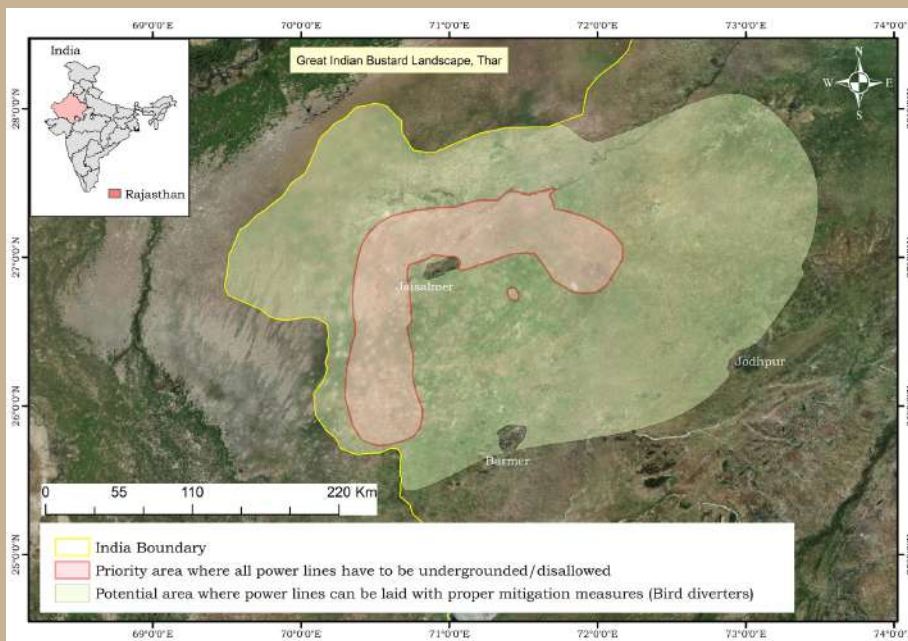


Figure 27. Great Indian Bustard landscape in Rajasthan delineating the priority and potential areas for power line mitigation.



Image 14. Great Indian Bustard mortality due to power line collision in June 2018 at Ramdevra, Jaisalmer © Bipin C.M.

MITIGATION MEASURES FOR FREE-RANGING DOGS

Free ranging dogs are a known threat to wildlife. Our assessment showed that the free ranging dogs are responsible for hunting ~33% of chinkara population annually from Desert National Park (DNP). Hence, we initiated the sterilization of dogs in/ around DNP in collaboration with Humane Society International (HSI)-India and Rajasthan Forest Department (October 2018 – January 2019). For the first phase of sterilization, 23 villages/ settlements were targeted. A temporary post-op facility was setup in Sam village. The surgeries were performed in a well-equipped mobile operation theatre van. The highest number of dogs captured for sterilization were from Sam (133) followed by Khuri (117) and Kanoi (95) (Table 10). These three villages have maximum tourism activities in their proximity that have probably attracted large dog numbers. Total 801 dogs (454 males and 347 females) were spayed/ neutered and vaccinated against rabies from 20 villages which surround the enclosures in DNP. Post-sterilization, the dogs were monitored in the post-op facility till they recuperated. Operated dogs were ear notched for future identification and released back in their respective villages as per HSI Animal Birth Control (ABC) guidelines. To evaluate the effectiveness of sterilization program and to assess the ratio of sterilized and non-sterilized dogs mark- resight based abundance surveys in six major villages (Sam, Kanoi, Salkha, Neemba, Bida, Keshawon ki Basti) and crude count in all the treatment villages were conducted in February- March 2019.



Image 14. Great Indian Bustard mortality due to power line collision in June 2018 at Ramdevra, Jaisalmer © Bipin C.M.

Table 10. Number of dogs captured for sterilization village wise in and around Desert National Park, Jaisalmer.

S. NO.	VILLAGE	DOGS CAPTURED
1	Sam	133
2	Khuri	117
3	Kanoi	95
4	Sipla	93
5	Neemba	66
6	Kumbhar Kotha	60
7	Ghuriya	54
8	Barna	38
9	Salkha	38
10	Khaba	32
11	Bida	21
12	Jamra	20
13	Bhilon ki dhani	13
14	Keshawon ki Basti	13
15	Meghwalon ki Basti	13
16	Ganga	6
17	Raydhan ki Dhani	6
18	Balanio ki Dhani	4
19	Singhalon ki Basti	4
20	Haider ki Dhani	1
Total		827

DOG POPULATION SURVEYS TO ASSESS THE EFFECTIVENESS OF SPAY NEUTER PROGRAM

We estimated the population status of free-ranging dogs in/ around DNP in 2017-2018 and again in 2019 after the dog spay neuter program, to examine the effectiveness of program and to estimate the sterilized, unsterilized dog ratio and number of lactating female which will in future add up more dogs in the population. We conducted dog population assessment using crude count and mark-resight survey that have been described in details earlier.

Count surveys were done in the 11 settlements where dog sterilization program was conducted. This exercise in conjunction with the correction factor developed through the earlier double sampling approach (described above), yielded dog abundance estimate.

Mark-resight surveys in six villages (Meghwalon ki Basti, Salkha, Kanoi, Keshawon ki Basti, Neemba and Bida) in treatment block (villages with sterilization program) and two villages (Bandha, Soro ki Basti) in control block (villages without sterilization program) were targeted for estimation of dog abundance in mark-resight framework which is robust to imperfect detection, following field and analytical methods described earlier.

Dog numbers

A total of 351 dogs were counted during the survey. The highest ratio of unsterilized dogs was found in Ghuriya Village (0.87) followed by Ganga Village (0.81). From count surveys, maximum number of dogs were estimated for Meghwalon ki Basti with 177 (5.3SE) dogs, followed by Salkha and Bida villages (Table 11). All villages showed high ratio of unsterilized dogs. The treatment and control village dog populations will be monitored in future to understand the effectiveness of this pilot sterilization program.

Table 11. Estimated population of dogs in 11 villages/settlements in and around Desert National Park using count surveys.

Village/ Settlement	Count				Ratio			Abundance ± SE (Count ÷ detection probability)	95% CI
	Sterile dog	Unsterilize d dog*	Uniden- tified dog	Total	Sterile dog	Unsterili- zed dog*	Unidentified dog		
Meghwalon ki Basti	24	82	1	107	0.22	0.77	0.01	176.55 ±5.3	166 - 187
Salkha	24	67	2	93	0.26	0.72	0.02	153.45 ±4.6	144 - 163
Bida	14	26	0	40	0.35	0.65	0	66 ±1.98	62 - 70
Keshawon ki basti	8	30	0	38	0.21	0.79	0	62.7 ±1.88	59 - 66
Ganga	2	21	3	26	0.08	0.81	0.12	42.9 ±1.29	40 - 45
Ghuriya	3	20	0	23	0.13	0.87	0	37.95 ±1.14	36 - 40
Jamra	2	7	0	9	0.22	0.78	0	14.85 ±0.45	14 - 16
Lolai	0	6	0	6	0	1	0	9.9 ±0.3	9 - 11
Lakhmanon ki Basti	1	4	0	5	0.2	0.8	0	8.25 ±0.25	8 - 9
Loonon ki Basti	2	0	0	2	1	0	0	3.3 ±0.1	3 - 4
Sagaron ki Basti	0	2	0	2	0	1	0	3.3 ±0.1	3 - 4

*lactating female with pup

Table 12. Estimated population of adult dogs in four villages/ settlements in and around Desert National Park using mark- resight survey.

Village/ Settlement		Adult dog population (SE)	95% CI
Treatment (Sterilization)	Meghwalon ki Basti	105 (5.58)	94 - 116
	Bida	26 (0.90)	24 - 28
Control (No Sterilization)	Bandha	62 (1.69)	59 - 65
	Soro ki Dhani	32 (0.51)	31 - 33

PESTICIDE CONTROL

To control the outbreak of locusts, the District Collector of Jaisalmer issued an order to spray pesticides in May 2019. The spraying of pesticides was being carried out even in GIB habitats and was counterproductive to the ongoing efforts of the Government to recover the GIB populations.

The pesticide in use - Malathion (50% and 97% concentrations) – is an organophosphate. Organophosphates act on the nervous system by inhibiting the enzyme cetylcholinesterase which plays a similar role in all insects, birds and animals. Many organophosphates are acutely toxic to birds at very low doses (Cox 1991). There have been documented bird kills caused by the organophosphates diazinon, isofenphos, and chlorpyrifos with one kill involving thirty to forty thousand birds (Stone 1985, 1987 & 1989). A review of aerial forestry applications showed that four organophosphates reviewed, phosphamidon, fenitrothion, acephate, and trichlorofon, caused reductions in the abundance of singing males, the number of birds present, or the number of species present (Peakall & Bart 1983). In addition, organophosphate insecticides are known to cause anorexia (loss of appetite) in birds. The resulting starvation can be an important cause of death. An invitro toxicity study of malathion indicated a higher toxic potential of malathion than that is generally declared. The environmental consequences of delayed effects and embryotoxicity for bird populations in areas exposed to organophosphate insecticides, such as malathion, are obvious (Mueller-Beilschmidt 1990, Jira et al. 2012). Since Malathion has a half-life period of 2–18 days depending on the soil type, any GIB feeding on Malathion sprayed crops would likely suffer from the above stated health hazards and possible mortality. The long-term effects of the pesticide on the ecosystem and on birds that have ingested less than lethal dose would be insidious and very detrimental. Studies across the globe have conclusively shown that populations of many birds, particularly agro-grassland species have declined due to the use of chemical pesticides and fertilizers and in turn causing severe cascading effects in the ecosystem (Carson 1962, Donald et al. 2001).

GIB is a large omnivorous bird that feeds largely on insects, fruits and harvested crops. It breeds during mid-summer through monsoon (April – October), when it largely depends on protein-rich insectivorous diets. Ecological studies conducted on this species (Rahmani 1989, Dutta 2012) indicate that grasshoppers/ locusts and beetles contribute significant portion of their diet, and their breeding activity is strongly correlated with the population bursts of grasshoppers/ locusts.

Further, the survival of chicks and juveniles largely depend on the availability of insects and other food in the environment, particularly during the initial few months after breeding (Kålås et al. 1997, Lane et al. 1999, Bravo et al. 2012). Since the pesticide used affect a large spectrum of insect taxa, grasshoppers/ locusts and other invertebrate resources may be depleted, the ensuing food scarcity will be detrimental to birds. The GIB is range restricted and its distribution is currently patchy, restricted to only about ~4500 sqkm area of the Jaisalmer district, and largely to grasslands interspersed with agriculture. Based on joint surveys of the WII and Rajasthan Forest Department, the intensive use areas have been identified and overlaid on agricultural areas digitized by WII (Figure 28).

We communicated following recommendations to the Chief Wildlife Warden (CWLW), Rajasthan regarding the need of regulating pesticides in Great Indian Bustard habitats, based on the above scientific reasons:

(a) spraying of pesticides should be strictly avoided in the identified intensive use areas of GIB, apart from all other areas where such activity is legally restricted. The agricultural area identified for strict avoidance of pesticide use comprises of less than 10% of the total agriculture area in Jaisalmer. Farmers with existing crops in these areas could be compensated for their foregone production cost, based on appropriate quantification, as an incentive for not using such pesticides, using State Government funds such as CAMPA allocations.

b) Any GIB site that has already been sprayed with pesticide should be cordoned off by temporary fence with patrolling teams to ensure that these birds are not feeding on toxic crops/ insects for a period of 15-20 days until the toxicity levels are reduced.

(c) In areas adjoining the intensive usage of GIB, use of biopesticides may also be explored by the Ministry of Agriculture involving appropriate expertise. *Metarhizium anisopliae*, a biopesticide recommended by FAO for desert locust management has been tried extensively in Africa, Australia and Brazil with evidence of up to 90% control of the locust population (FAO 2007, Lomar et al. 2001). This biopesticide is available by the trade name of Green Muscle, BioMetaz, GreenMeta and Kalichakra available locally and internationally.

The CWLW Rajasthan was appraised of the situation and requested to inform the administration to prevent spraying of pesticides in areas intensively used by GIB and take urgent measures to reduce the impact of pesticides .

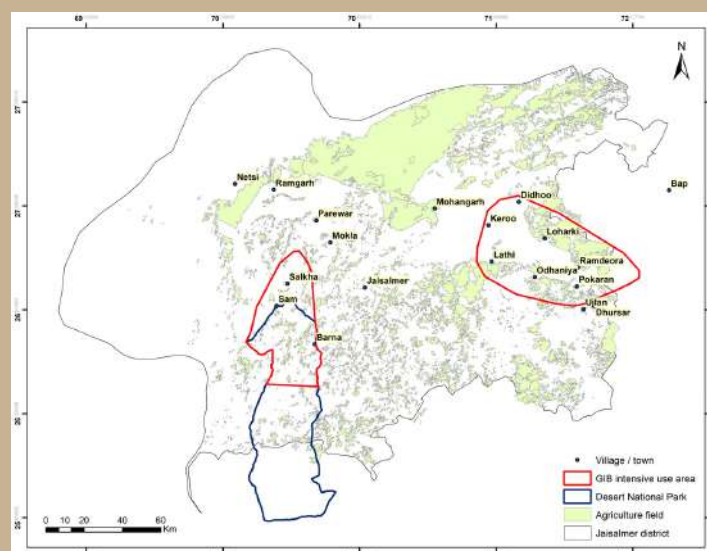


Figure 28. Map showing Great Indian Bustard intensive use areas in Jaisalmer, Rajasthan, overlaid on agriculture and Protected Area expanse for deciding the management of pesticide usage.

MEETINGS WITH STAKEHOLDERS REGARDING GIB CONSERVATION

- -Discussion with concerned officers of Rajasthan Forest Department for developing a mutually agreed roadmap on GIB conservation program in Jaipur during July 2016.
- Collaborative workshop between WII, Bombay Natural History Society and Rajasthan Forest Department on 12th July 2016 at Jodhpur to sensitize Indian Army on GIB conservation and obtain permission to monitor the GIB population in Pokhran Field Firing Range.
- Meeting with the Hon. Chief Minister, Additional Chief Secretary Forest, & Principal Chief Conservator of Forests (Wildlife) of Rajasthan State on 20th October 2016 in Jaipur wherein measures for GIB conservation were discussed in detail.
- Meeting with Rajasthan Forest Department and power agencies during December 2016 to provide technical inputs on installation of bird diverters on power lines in priority GIB areas in Thar. Based on this meeting, WII was given the responsibility to procure samples of bird diverters for installation on pilot basis by Suzlon for design/ installation demonstration.
- Consultative meeting with Rajasthan Forest Department to provide inputs in Desert National Park management plan during January 2017 in Jaipur. Meeting was attended by Chief Wildlife Warden, Chief Conservator of Forests (CCF)- Jodhpur and Deputy Conservator of Forests (Jaisalmer) where GIB census methods and priority conservation actions were discussed.
- Meeting with Hon. Minister- Environment and Forests, Rajasthan State on 31st January 2017 at Jaipur regarding measures being taken to conserve the GIB. The Minister appreciated the efforts and science behind the initiatives and assured all support for moving ahead.
- Meeting with Hon. Chief Minister, Rajasthan; Forest Minister; Forest Department, Rajasthan and Rajasthan State wildlife board on 28th April 2017 to discuss on implementing measures for GIB conservation.
- Review meeting of project updates with RSPCB and meeting with CWLW, Rajasthan on project updates at Jaipur on 29th August 2017.
- Meeting with Sarpanch and villagers of Khetolai, Jaisalmer near PFFR along with Forest Department staff during November 2017 regarding collaborative measures for conservation of GIB.
- Meeting with CCF-Jodhpur, representatives of RVPNL, SUZLON, Jodhpur Discom powerline companies, and Divisional Forest Officer (DFO)-Desert National Park on mitigation of high tension power lines in GIB habitat at Jodhpur during January 2018.
- Meeting with village representatives regarding permission & support for dog sterilization in the villages around GIB habitat in and around Desert National Park during January- February 2018.
- Meeting with officers of Indian Armed forces on the need and importance of GIB conservation in PFFR, Jaisalmer during April- May 2018.
- Meeting with District Collector, Jaisalmer on harmonizing project activities with government outreach programmes during April 2018.
- Meeting held on 20th December 2018 under the chairmanship of Principal Secretary Energy, Govt. of Rajasthan that was attended by RFD and WII representatives decided that the mitigation measures should be urgently implemented, and directed the power agencies to place proposals with cost-estimation for this action. Principle Secretary- Energy directed power agencies to install time tested imported bird diverters on all priority power lines. A mitigation plan for high tension power lines in GIB habitat of Thar Desert, Jaisalmer was developed. This plan identified critical power lines and prioritised for bird diverter installation and undergrounding in Thar, Jaisalmer including the length and cost and was submitted to Rajasthan Vidyuth Prasaran Nigam Limited (RVPNL) for further action.

- Workshop was organized at WWF-India headquarters, New Delhi on 21st February 2019 with partner agencies to sensitize power agencies and the media on GIB conservation. The workshop was attended by ~100 participants including officials from MoEFCC and State Forest Department, representatives from power agencies, conservation organizations, legal fraternity and media. The immediate need to mitigate power lines caused bustard collisions and deaths, and the necessity of conservation breeding were highlighted. The objective of this workshop was to create awareness about the plight of the bustard, develop a branding strategy to communicate to the public and all stakeholders in one language about the bustard, and to communicate to power agencies (government and private) the integral role they serve in saving this iconic species of the Indian grasslands.



Image 16. Sensitization workshop on Great Indian Bustard Conservation at New Delhi. © Tanya Gupta

- Meeting with representatives of Tata Power Mr. V.K. Nori- Chief (Corporate Affairs), Prashant Kokil- Head (Environment & Climate Change) and Mr. Amar Nayakvadi- Lead Associate (Environment & Forest, Trans. Project) on 08th July 2019 at WII regarding mitigation of power lines in GIB habitat near Pokhran area in Jaisalmer. A site inspection of Tata power 150 MW Solar Power project and 220 KV transmission line was carried out by the team along with Dr. Asad Rahmani- Former Director of Bombay Natural History Society and renowned GIB expert, representatives from TATA Power- Mr. Abhishek Ashok Bhagat- Station head- Chhayan (Operations) and Mr. Saket Porwal- Project head (Large projects) on 22nd July 2019. As a mitigation measure based on our recommendations they have installed bird diverters on the transmission line.
- Meeting with Essel Infra official- Mr. Rajnish Mehrotra, Head (Environment, Forest & Wildlife) on 08th July 2019 at WII regarding mitigation of power lines in GIB habitat in Jaisalmer.
- Meeting through skype on 31st May 2019 with representatives from Enel Green Power- Ms. Suvalaxmi Sen, Environmental Design Specialist, and other officials, for mitigation of power line in GIB habitat near Ramgarh, Jaisalmer. They decided to shelve the project which was situated inside the GIB priority zone .

- Sterlite power for procurement of bird diverters to install on power lines for prevention of bird mortality. Details regarding international and Indian bird diverter manufactures and suppliers, cost of procurement were shared with them.
- Meeting with representative from General Electric- Mr. Dheeraj Jain, Regulatory Leader- Turnkey at WII on 14th November 2019 for mitigation of power line to prevent bird mortality across India. Information on power line mitigation including the GIB priority and potential zones in Rajasthan and Gujarat, report on power line mitigation to conserve bustards, Lesser Flamingo status assessment report and details regarding international and Indian bird diverter manufactures and suppliers, cost of procurement were shared with the firm.
- Sitac Management & Development Private Limited for our assistance in identifying the habitats of GIB in India, whether their wind projects fall in the GIB habitat zone and accordingly take preventive measures. Information on power line mitigation for GIB priority and potential zones in Rajasthan and Gujarat were shared with them.
- Correspondences with - Mr. Amit Gupta, Head (ESG), Spring energy for mitigation of power lines in Jaisalmer and Jodhpur.
- Meeting with private companies for diverter procurement and manufacturing
 - Welkin conservation LLP for procurement and installation of bird diverters in Jaisalmer.
 - Indolite and A & S Creations for development of indigenous, low cost bird diverters in the country.
- Meeting at MoEFCC to draft a time bound action plan to conserve GIB as directed by National Green Tribunal (NGT) Principal Bench;

To draft a time bound action plan to conserve GIB based on the recommendations by WII as directed by NGT, meetings were held at MoEFCC on 04th September and 11th November 2019 under the chairmanship of Director General of Forest & Special Secretary. The participants included Additional Director General (Wildlife), Deputy Inspector General (Wildlife), CWLW Rajasthan, officials from MoEFCC, MNRE, Central Electricity Authority, RVPNL, Gujarat Energy Transmission Corporation, Essel Saurya Urja Company of Rajasthan Ltd, Power Grid Corporation of India Ltd, Tata Power Renewable Energy Ltd, Spring Energy Pvt. Ltd, Actis, Siemens Gamesa & WII representatives. The meetings concluded with suggestions such as exploring possibilities for declaring GIB priority zone or the arc as Conservation or Community Reserve, principle of avoidance being the best option to adopt in GIB habitat and the techno- feasibility of the mitigation measures such as undergrounding high tension power lines.

- Meeting with Mr. Yash Arora (Environmental Specialist) International Finance Corporation, World Bank Group during February 2020 regarding GIB conservation and mitigation of power line impacts.
- Indigenously manufactured bird diverters developed based on our suggestions were procured from A & S Creations, New Delhi and to check their efficacy, a batch has been distributed to Suzlon and installed on power lines in Thar.
- Meeting convened by MoEFCC through video conferencing under the Chairmanship of Director General of Forest & Special Secretary on 05th May 2020 attended by Inspector General (Wildlife), Joint Secretary- MNRE, DIG (Wildlife), CWLWs of Rajasthan & Maharashtra, Additional Principal Chief Conservator of Forests (Wildlife) of Gujarat and Karnataka, officials from Ministry of Power, RVPNL, Gujarat Energy Transmission Corporation, Power Grid Corporation of India limited, National Highway Authority of India, Spring Energy, other wind and solar farms/ projects agencies operating in Rajasthan and Gujarat to discuss on plans for protection and conservation of GIB in the country with emphasis on power line mitigation.

- Correspondences with Mr. Soumik Sarkar Dy. Manager- Project Skipper Limited, Bikaner (Rajasthan) during August 2020 regarding technical specifications & drawings of bird diverters to be installed in the upper conductor of 132 KV D/C Chhatargarh Loonkarnsar transmission line under forest area.
- Correspondence with Mr. Devesh Kumar Singh, Chief Manager, Power Grid Corporation of India Limited regarding identification of transmission line stretch infringing GIB habitats zones in Rajasthan during August 2020.
- Correspondence with Shri Dinesh Kumar, Chairman & Managing Director, Rajasthan Rajya Vidyut Prasaran Nigam Ltd during August- September 2020 regarding design of bird deflectors/ diverters and the span length & distance at which bird diverters are to be installed on the earthwire of transmission line passing through forest area (other than DNP and GIB arc) and on all conductors of transmission line passing through DNP and GIB arc for fixing of bird diverters on RVPN transmission lines to avoid bird collisions.
- Correspondence with Ms. Emma Marsden, Senior Environment Specialist, South Asia Energy Division, Asian Development Bank during September 2020 regarding mitigation measures for upcoming power projects in GIB habitat in Rajasthan.

ACTIVITIES RELATED TO LEGAL ISSUES

On matters concerning the court cases filed for conservation of GIB, the following activities were carried out-

1. Hon'ble High Court of Rajasthan, Jodhpur- Regarding the Suo moto case D.B. Civil Writ Petition (PIL) No.825/2019 filed at Hon'ble High Court of Rajasthan, Jodhpur for the conservation of GIB, responses were prepared about the details of the work on habitat improvement and conservation breeding of the GIB carried about by WII including recommendations for GIB conservation. Subsequently, meetings were held with Additional Solicitor General, Mr. Sanjit Purohit and affidavits were filed at the Court on behalf of WII.

2. Principal bench of Hon'ble National Green Tribunal (NGT)- For the Original Application No. 385/2019 filed by Centre for Wildlife and Environment Litigation before the Principal Bench of National Green Tribunal against adverse impact caused by power and wind projects on GIB, a factual report on the status of GIB and threats to their population, progress of the WII project and key recommendations based on our findings was prepared and submitted on behalf of MoEFCC. Meetings were held on 16th October and 11th November 2019 at MoEFCC to draft a time bound action plan to conserve GIB based on our recommendations as directed by NGT under the chairmanship of Director General of Forest & Special Secretary. The meetings were attended by officials from the Ministry, representatives from power agencies and WII representatives.

3. Hon'ble Supreme Court of India- Regarding the Writ Petition (Civil) No. 838 of India with I.A. No.95438/2019-Clarification/ Direction) filed by Dr. M.K. Ranjitsinh in the Hon'ble Supreme Court of India for the conservation of GIB and Lesser Florican, a report on the status of the GIB conservation breeding program and emergency response plan was drafted and submitted for further action. To represent WII and MoEFCC at the Hon'ble Supreme Court, Advocate Mr. Devendra Singh was appointed with approval from MoEFCC.

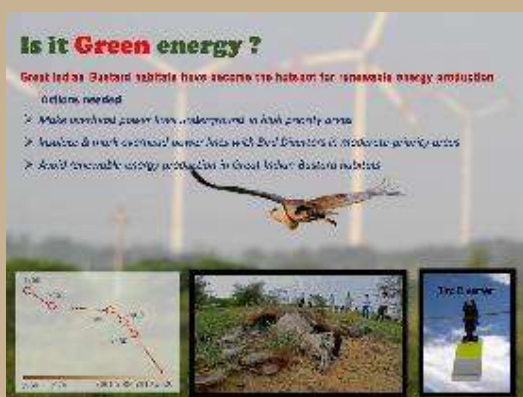


AWARENESS MATERIALS AND PUBLICATIONS

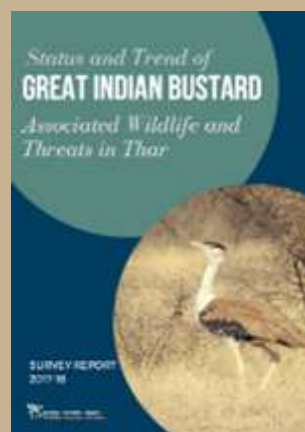
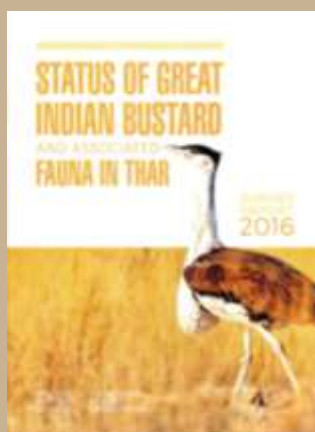
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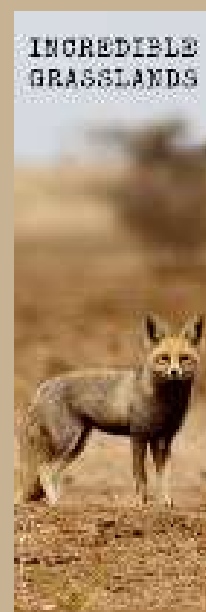
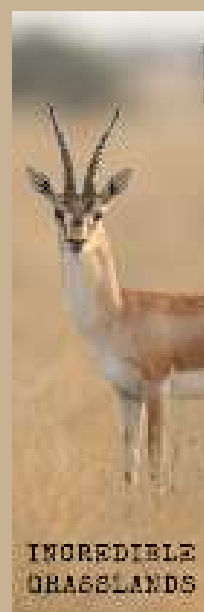
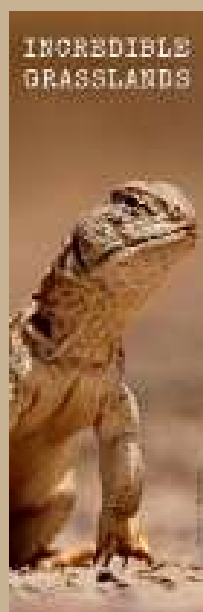
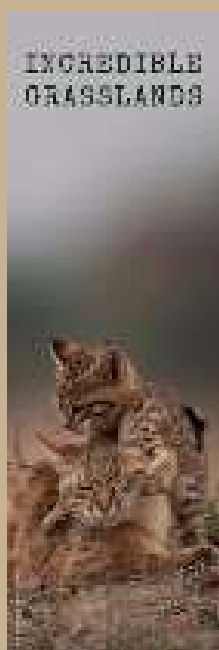
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APPENDICES

1. Status of Great Indian Bustard and associated fauna in Thar- Survey report 2014
2. Status of Great Indian Bustard and associated fauna in Thar- Survey report 2014 & 2015
3. Status of Great Indian Bustard and associated fauna in Thar- Survey report 2016
4. Status and trend of Great Indian Bustard, associated wildlife and threats in Thar- Survey report 2017-18
5. Power line mitigation measures to conserve bustards- Technical report 2018



