ACTION HISTORY OF RTI REQUEST No.WLIOI/R/E/21/00036

Applicant Name VENKAT POONIA

Text of Application Subject Matter In view of the letter dated 11.07.2019 written by the Ministry of Environment, Forests and Climate Change, Wildlife Division (Government of India) to the National Green Tribunal, the Applicant is requesting to obtain Annexure 10a and Annexure 10b enclosed with the letter dated 11.07.2019. Details of information requested In the matter of Centre for Wildlife and Environment Litigation (CWEL) v. Union of India and Ors. (OA No. 385/2019), the National Green Tribunal (NGT) vide order dated 04.04.2019 directed the Ministry of Environment, Forests and Climate Change, Wildlife Division (Government of India) (MoEFCC) to furnish a factual report on the deaths of Great Indian Bustard within 2 months. In compliance of the same, MoEFCC submitted its report vide letter dated 11.07.2019 to the NGT. The Applicant herein humbly requests to seek Annexure 10a and Annexure 10b, enclosed with the letter dated 11.07.2019, the details of which are stated herein below: a. Annexure 10a _ Power line mitigation to conserve bustards. WII Report. b. Annexure 10b _ Action and budget proposal _ Mitigation plan for high tension power lines in Great Indian Bustard habitat of Thar Desert, Jaisalmer, January, 2019. Period to which the information relates 04.04.2019 to 11.07.2019.

Reply of Application please see the attached cover letter and Annexure

SN.	Action Taken	Date of Action	Action Taken By	Remarks
1	RTI REQUEST RECEIVED	05/05/2021	Nodal Officer	
2	REQUEST FORWARDED TO CPIO	08/05/2021	Nodal Officer	Forwarded to CPIO(s) : (1) P.K.Aggarwal
3	REQUEST UNDER PROCESS	17/05/2021	P.K.Aggarwal-(CPIO)	
4	REQUEST DISPOSED OF	22/06/2021	P.K.Aggarwal-(CPIO)	

Print

सूचना का अधिकार
RIGHT TO INFORMATION

भारतीय वन्यजीव संस्थान
Wildlife Institute of India
ONLINE PORTAL

No. WII/RTI/CPIO/2021-22 (Qtr-I)/10

Date: June, 2021

To,

MR. VENKAT POONIA
B-195 (BASEMENT),
LAJPAT NAGAR - PART 1,
NEW DELHI -110024
Email: venkat.poonia@desaidiwanji.com

Sub.: Information under RTI Act, 2005–reg.

Ref.: Your Online RTI No. WLIOI/R/E/21/00036 dated 05/05/2021

Sir,

Please refer to your application cited above under RTI Act, 2005. In this context, point-wise response to your queries is given below:

Information Sought under RTI	Reply
Details of information requested In the matter of Centre for Wildlife and Environment Litigation(CWEL) v. Union of India and Ors. (OA No. 385/2019), the NationalGreen Tribunal (NGT) vide order dated 04.04.2019 directed theMinistry of Environment, Forests and Climate Change, WildlifeDivision (Government of India) (MoEFCC) to furnish a factual reporton the deaths of Great Indian Bustard within 2 months. In complianceof the same, MoEFCC submitted its report vide letter dated11.07.2019 to the NGT. The Applicant herein humbly requests to seekAnnexure 10a and Annexure 10b, enclosed with the letter dated11.07.2019, the details of which are stated herein below:	
a. Annexure 10a _ Power line mitigation to conserve bustards. WIIReport.	Please see attached **Annexure-I**
b. Annexure 10b _ Action and budget proposal _ Mitigation plan forhigh tension power lines in Great Indian Bustard habitat of TharDesert, Jaisalmer, January, 2019 Period to which the information relates 04.04.2019 to 11.07.2019.	Please see attached **Annexure-II**

The information/ documents is being sent by email. If you are not satisfied with the aforesaid reply, you may appeal to the **Appellate Authority i.e. "Director, Wildlife Institute of India, Post Box 18, Chandrabani, Dehradun – 248 001, Ph. 0135-2640910".**

Thanking you,

Yours faithfully,

NO & CPIO (RTI)

Encl.: as above.

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Action and budget proposal

Mitigation plan for high-tension power lines in Great Indian Bustard habitat of Thar Desert, Jaisalmer

Background: Power lines, especially high-voltage transmission lines with multiple overhead wires, is the most important current threat to the critically endangered Great Indian Bustard (GIB). Research shows that the poor frontal vision and heavy flight of bustards make them highly vulnerable to fatal collision with power-lines (Martin and Shaw 2010). Research on GIB carried out by Wildlife Institute of India (WII) shows that power-lines across their habitats in Thar are contributing to an unsustainably high mortality rate (mortality of ~15% of population and 5 deaths detected in 2017-18). Besides bustard, power-lines are causing mortality of ~1 lakh birds of over 49 species annually in ~4000 sqkm in/around Desert National Park (WII 2018). There is an urgent need of mitigating this threat by undergrounding high-risk power-lines and marking medium-risk power-lines with diverters. Without this immediate intervention, the GIB is likely to go extinct in the near future (WII 2018). Rajasthan Forest Department (RFD) and WII carried out joint sensitization meetings with power agencies (2016–18) to implement these mitigation measures, wherein prototype diverters procured by WII were pilot installed by power agencies for testing. A 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.

Mapping activity: To mitigate this threat, WII had mapped power-lines across ~20,000 sqkm Thar landscape through digitisation of very high resolution Google Earth imagery in the first phase. Power-lines within the priority GIB habitat (GIB Arc or Ecozone), 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 for preparing the project proposal on mitigation, 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 powerlines) inside the GIB Ecozone to the Project staff of WII. WII team followed up with every power line company operating in this area and obtained available data by 15th January 2019. Whenever this data was non-existent, WII team digitised 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 undergrouding high voltage lines ($\geq$132 kV) were not available locally and could not be calculated. The cost of diverters were calculated at 10,000 INR/piece (inclusive of production and shipping costs), which is a liberal estimate, based on procurement of small numbers of high-quality devices by WII. Cost of installing diverters and undergrounding of cables is provided below.

Diverter installation	**Undergrounding**
Diverter cost calculated at 10000 INR/pc and number of diverters calculated as one at every 15 m on the earthwire and on conductors in a staggered design, i.e., 67 diverters/km wire, such that there is at least one diverter every 5 m on the powerline as whole. No. of diverters is calculated for 70% of the total length of power lines to leave pylons and their vicinity. The installation cost is 20% of diverter cost. **However, diverter cost can be reduced to 40% of existing cost with the development of more economic local diverters**	Undergrounding cable available for 33kV power lines cost ~ 21 lakh/km with the 40% installation cost of total power line cost

In total, 1342 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 (Table I), along with the priority map of mitigation (Figure I), and image of a prototype diverter / reflector (Image I).

References:

Martin, G.R. and Shaw, J.M., 2010. Bird collisions with power lines: failing to see the way ahead?. Biological Conservation, 143(11), pp.2695-2702.

WII, 2018. Power-line mitigation to conserve bustards. Wildlife Institute of India, pp 8.

Dutta, S., Bipin C.M., Bhardwaj, G.S., Anoop, K.R., Jhala, Y.V. 2016. Status of Great Indian Bustard and Associated Wildlife in Thar. Wildlife Institute of India, Dehradun and Rajasthan Forest Department, Jaipur.

Table I

List of power-lines prioritised for bird diverter installation and undergrounding in Thar, Jaisalmer.

Phase	Power-line Company	Power in KV	Name of Line	No. of Wires	Length (km)	No. of Diverters	Cost of Diverter/ Undergrounding	Cost of Installation	Total Cost
Undergrounding									
I	Wind World/ Innercon	33	Kanoi – Salkha	13(7)	21	6895	20,41,400/km (4 Cables) 17,14,77,600 (Undergrounding)	40% of cost of wire 6,85,91,040 (Undergrounding)	24,00,68,640 (Undergrounding)
							10000/Diverter 6,89,50,000 (Diverter)	20% of Diverter Cost 1,37,90,000	8,27,40,000 (Diverter)
	Jodhpur Discom	33	Sam – Dhanana	4(3)	45	6332	20,41,400/km (1 Cables) 9,18,63,000 (Undergrounding)	40% of cost of wire 3,67,45,200 (Undergrounding)	12,86,08,200 (Undergrounding)
							6,33,20,000 (Diverter)	1,26,64,000	7,59,84,000 (Diverter)
	Suzlon	33	Tejuva-Kuchri	7(4)	17	3190	20,41,400/km (2 Cables) 6,94,07,600 (Undergrounding)	40% of cost of wire 2,77,63,040 (Undergrounding)	9,71,70,640 (Undergrounding)
							3,19,00,000 (Diverter)	63,80,000	3,82,80,000 (Diverter)
		33	Khuchri horizontal - parallel	6(3)	21	2955	20,41,400/km (2 Cables) 8,57,38,800 (Undergrounding)	40% of cost of wire 3,42,95,520 (Undergrounding)	12,00,34,320 (Undergrounding)
							2,95,50,000 (Diverter)	59,10,000	3,54,60,000 (Diverter)
Total (undergrounding)					104	19,372	41,84,87,000 (Undergrounding)	16,73,94,800	58,58,81,800 (Undergrounding)
							19,37,20,000 (Diverter)	3,87,44,000	23,24,64,000 (Diverter) ++
Diverter installation									
I	Rajasthan Vidyut Prasaran Nigam Limited (RVPNL)	132	132kv Jaisalmer – Ramgarh – 1	4(3)	40	5628	10,000/Diverter 5,62,80,000	20% of Diverter Cost 1,12,56,000	6,75,36,000
I		132	132kv Jaisalmer – Ramgarh – 2	4(3)	40	5628	10,000/Diverter 5,62,80,000	20% of Diverter Cost 1,12,56,000	6,75,36,000
I		132	132kv Askandra (Pokran to Askandra)	4(3)	30	4421	10,000/Diverter 4,42,10,000	20% of Diverter Cost 88,42,000	5,30,52,000
II		132	132kv Askandra (Pokran to Askandra)	4(3)	20	2814	10,000/Diverter 2,81,40,000	20% of Diverter Cost 56,28,000	3,37,68,000
I		220	220kv Amarsagar – Ramgarh	4(3)	40	5628	10,000/Diverter 5,62,80,000	20% of Diverter Cost 1,12,56,000	6,75,36,000
I		220	220kv Amarsagar – Lilo	7(4)	8	1501	10,000/Diverter 1,50,10,000	20% of Diverter Cost 30,02,000	1,80,12,000
I		220	220kv Amarsagar – Phalodi	4(3)	54	7598	10,000/Diverter 7,59,80,000	20% of Diverter Cost 1,51,96,000	9,11,76,000

III		220	220kv Amarsagar – Phalodi	4(3)	71	9990	10,000/Diverter 9,99,00,000	20% of Diverter Cost 1,99,80,000	11,98,80,000
I		220	220kv Ramgarh Dechu	7(4)	49	9193	10,000/Diverter 9,19,30,000	20% of Diverter Cost 1,83,86,000	11,03,16,000
III		220	220kv Ramgarh Dechu	7(4)	43	8067	10,000/Diverter 8,06,70,000	20% of Diverter Cost 1,61,34,000	9,68,04,000
II		220	220kv Ramgarh Dechu	7(4)	50	9380	10,000/Diverter 9,38,00,000	20% of Diverter Cost 1,87,60,000	11,25,60,000
II		400	400kv Akai – Ramgarh	8(4)	55	10,318	10,000/Diverter 10,31,80,000	20% of Diverter Cost 2,06,36,000	12,38,16,000
Sub-total		500				80,166	80,16,60,000	16,03,32,000	96,19,92,000
III	Suzlon	33	Tejuva – Kuchadi	7(4)	138	25889	10,000/Diverter 25,88,90,000	20% of Diverter Cost 5,17,78,000	31,06,68,000
II		33	Kaladongar	4(3)	70	9849	10,000/Diverter 9,84,90,000	20% of Diverter Cost 1,96,98,000	11,81,88,000
III		33	Mokla – Habur – Sanu	4(3)	301	42,350	10,000/Diverter 42,35,00,000	20% of Diverter Cost 8,47,00,000	50,82,00,000
III		132	Tejuva – Kuchadi	4(3)	25	3518	10,000/Diverter 3,51,80,000	20% of Diverter Cost 70,36,000	4,22,16,000
II		132/220	Kaladongar	4(3)	47	6613	10,000/Diverter 6,61,30,000	20% of Diverter Cost 1,32,26,000	7,93,56,000
I		132/220	Mokla – Habur – Sanu	4(3)	43	6051	10,000/Diverter 6,05,10,000	20% of Diverter Cost 1,21,02,000	7,26,12,000
Sub-total		624				94,270	94,27,00,000	18,85,40,000	113,12,40,000
II	Jodhpur Discom	33	Chandan Via Bhagu ka Gaon to Mohangarh	4(3)	70	9849	10,000/Diverter 9,84,90,000	20% of Diverter Cost 1,96,98,000	11,81,88,000
Sub-total		70				9849	9,84,90,000	1,96,98,000	11,81,88,000
I	Greenko	220	Amarsagar – Ramgarh	4(3)	40	5628	10,000/Diverter 5,62,80,000	20% of Diverter Cost 1,12,56,000	6,75,36,000
Sub-total		40				5628	5,62,80,000	1,12,56,000	6,75,36,000
III	Gamesa	33	Amarsagar – Ludarva	4(3)	4	563	10,000/Diverter 56,30,000	20% of Diverter Cost 11,26,000	67,56,000
Sub-total		4				563	56,30,000	11,26,000	67,56,000
Total		1238 KMs of Power line for Diverters				1,90,476			228,57,12,000 228.57 Cr
		104 KMs of 33 kV lines (for Diverters)				19,372			23,24,64,000 23.25 Cr ++
		104 KMs for Undergrounding							58,58,81,800 58.58 Cr
Grand-total									287,15,93,800 (287.16 Cr)

* Diverter cost can be reduced to 40% of existing cost i.e. 91.43Cr with the development of more economic local diverters authenticated by Wildlife Institute of India and Rajasthan Forest Department. Expected time for producing these diverters is 6 months.

++ For 33 kV lines prioritized for undergrounding, cost of diverters have also been indicated.

Figure I

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

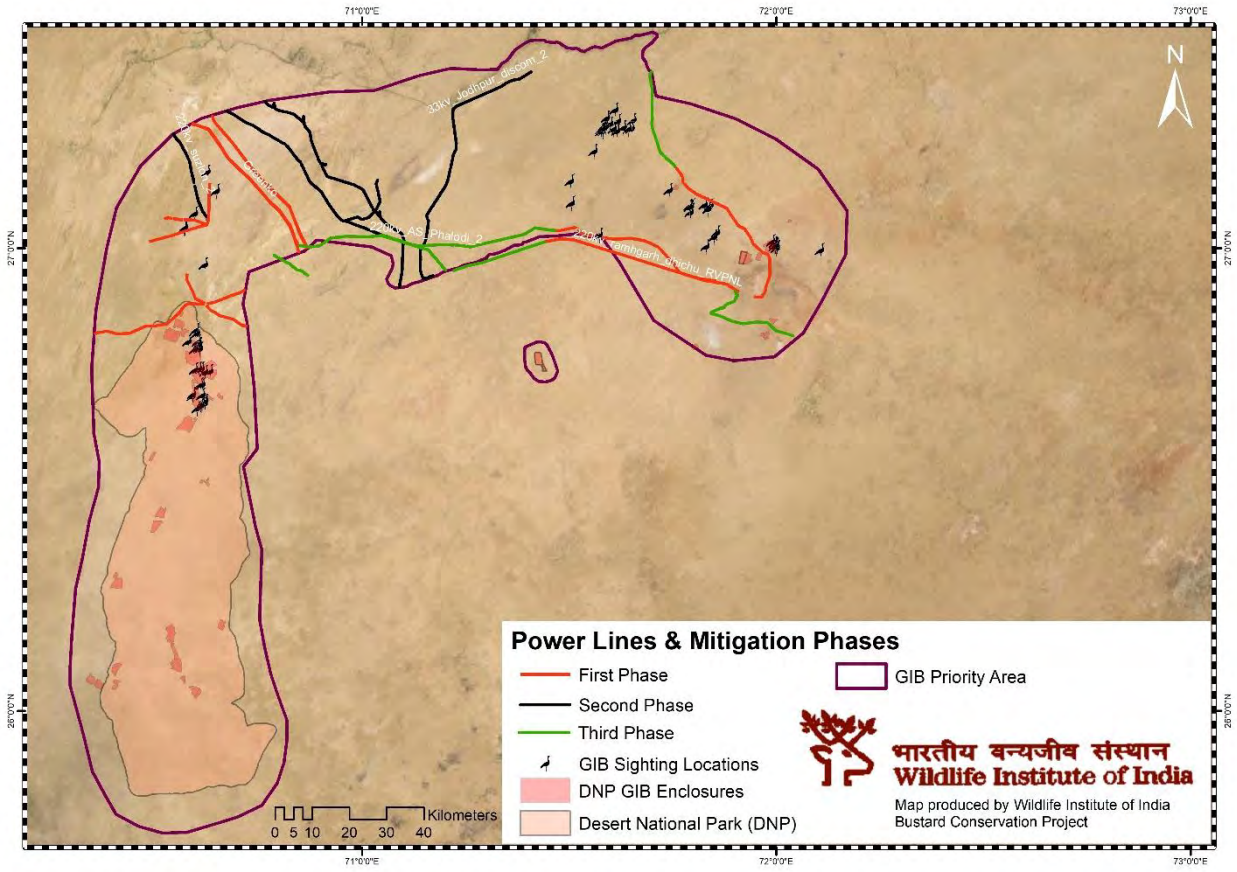


Image I

Photograph of a 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.

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

POWER-LINE MITIGATION

TO CONSERVE BUSTARDS

Citation: Wildlife Institute of India 2018 Power-Line Mitigation Measures. Second edition (2020)

Cover photo of dead male Great Indian Bustard due to power-line in Jaisalmer : Bipin C.M.

2018 | OCTOBER

HARMONIZING POWER SECTOR WITH BUSTARD CONSERVATION

The Great Indian Bustard (GIB) is a critically endangered species of bird, with 128(± 19) individuals remaining in the world. The GIB resides in the grasslands of India with the current majority of its population in Jaisalmer district of Rajasthan. There are several threats that are inching the bustard closer to extinction, however, powerlines seem to be the most significant.

EVIDENCE OF IMPACT

a) Bustards are prone to collision

Bustards have wide sideways vision to maximize predator detection, at the cost of narrow frontal vision. Because of this, and a habit of scanning the ground while flying, they cannot detect power-lines ahead of them, from far. Being heavy fliers, they fail to manoeuvre across power lines within close distances. The combination of these traits make them vulnerable to collision with power-lines. As a result, they collide with power lines and die from the impact, injuries/trauma or electrocution (Martin and Shaw 2010).

b) Evidence of bustard mortality due to power lines

Worldwide, studies have shown high mortality rates of several bustard species because of power-line collision. For example, 30% of Denham's bustards (Neotis denhami) die annually from power-line collisions in South Africa (Shaw 2009, Jenkins et al. 2010). In Spain, 8.5 km stretch of power-line killed a minimum of 25 Great Bustards in one year (JC Alonso pers. obs.). A review (Mahood et al 2017/18) of nine studies covering six bustard species from different parts of the world estimated 7 detected bustard mortalities per 10 km power-line per year. This factor causes 4 - 7% mortality of Great Bustard in areas with low power line density (Martin 2008) and 13% mortality in areas with high power line density (Alonso 2007).

c) Evidence of Great Indian Bustard collisions with power lines in India

Surveys conducted by Wildlife Institute of India (WII) in Thar covering 80 km of power lines repeated 7 times over a year found 289 carcasses of around 40 species including the Great Indian Bustard (GIB). **The study detected 8 carcasses/10 km for high tension and 6 carcasses/10 km for low tension power-lines**. Correcting these mortalities for the proportion of carcasses that are decomposed before survey or are missed during survey, mortality rate was estimated to be ~6 bird/km/month(high-tension lines), ~3 bird/km/month low-tension lines), and ~84,000 bird per year within 4200 sqkm area in and around Desert National Park. In terms of GIB, 6 mortality were recorded from 2017-2020, all due to high tension transmission lines - some of them connected to wind turbines.

Extrapolating these mortalities to the priority bustard habitat, intersected by ~150 km high tension lines, amounts to about **16 GIB deaths per year** from a population of about 128 ± 19 individuals in Thar. **Such high mortality rate is unsustainable for the species and a sure cause of extinction.** WII also tagged ten Great Indian Bustard on pilot basis in Rajasthan, Gujarat and Maharashtra, out of which two died from power line collision, corroborating the above findings.

d) Impact of power line collision on bustard population

Bustards are long-lived birds where adults have high annual survival probability (Palacín *et al* 2012). However, the excessive mortality due to power-lines are unsustainable and cause population declines or even extinction (Martin 2007). Power-line mortality can also disrupt important biological processes. Palacín et al (2012) shows that in a Great Bustard population in Spain, where migratory individuals suffered significant power-line mortality, the proportion of sedentary individuals increased over years against the reduction of migratory individuals. Here, power lines have reduced the propensity of a species to migrate, and can result in the loss of such intricate behaviors.

SOLUTIONS

e) No Power-line zones

Crucial breeding habitats of bustards have to be made free of overhead power-lines. Conservation of bustard is not possible in areas with power-lines which sooner or later kill the bird. Existing power-lines in such important habitats have to be moved underground or redesigned. No new power-lines should be permitted in such areas.

f) Mitigation of threat

Mitigation measures are available to reduce power-line mortality, such as under-grounding of cables and fitting overhead wires with bird diverters. Bird mortality and crossing rate through wires reduce, if lines are marked with diverters compared to unmitigated segments. While under-grounding of cables eliminates bird mortality, marking power line can reduce mortality by 10 % (Barrientos et al 2012) to 78 % (Barrientos et al 2011), depending on area and species, but not eliminate mortality.

IMPORTANCE OF TELEMETRY IN POWER-LINE MITIGATION

Great Indian Bustards range over large human-dominated landscapes that are facing rapid development and expansion of power-lines. Curtailing all infrastructural development across these large areas is impracticable and calls for prioritization of areas where these infrastructure should be avoided or mitigated. Use of bio-telemetry to understand GIB habitat can aide in this process, by generating fine-scale information on the birds' movement patterns that can overlaid on existing and proposed power-line maps to identify segments for mitigation measures. Thus, telemetry supplemented with bird surveys provide a powerful tool to prioritize habitats for infrastructure mitigation in particular, and conservation management in the wake of development.

Wildlife Institute of India demonstrated the potential of this tool for GIB conservation, by tagging two juvenile birds in Kachchh, Gujarat and 5 adult birds in Thar, Rajasthan using solar powered GPS tags that weighed <1% of the bird's body weight. These tags haveprovided information on bird movements for >1 year (May 2017 onwards) and have also provided evidence of one bird mortality from collision with 33 kV power-line near Lala Bustard Sanctuary. Movement data obtained from tagged birds was overlaid on habitat and infrastructure maps to identify critical areas for mitigating power-lines (see figure 1). However, individuals vary in their movement patterns and more birds need to be tagged across bustard landscapes (Thar, Rajasthan and Kutch, Gujarat) to draw population-level inferences and achieve best conservation results with finite resources and bring about a harmony between development and conservation needs of the country.

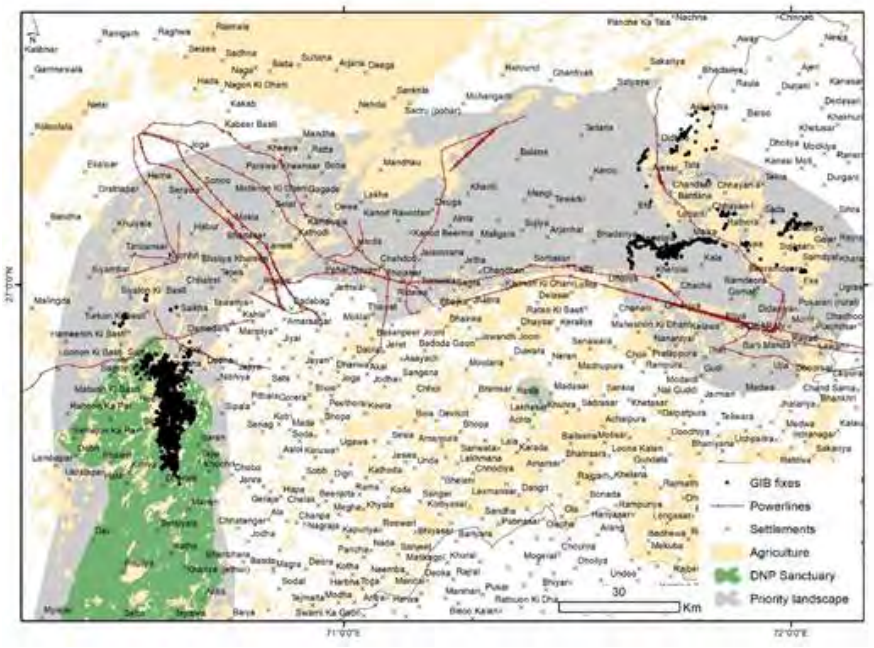
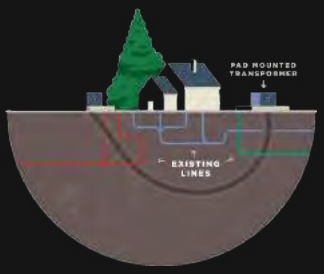


Figure 1 : Movement of tagged Great Indian Bustard overlaid on network of power lines and critical areas for mitigating power-lines (red lines).

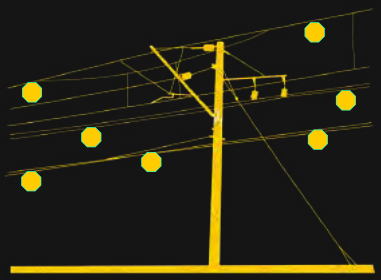
SOLUTIONS

This crisis can be mitigated as follows:

Avoid/divert any high tension power line from priority Great Indian Bustard habitat. (Figure 2a & 2b).



Undergrounding of <66kv wires of most risky power-lines in priority GIB habitat.



Retrofitting of existing overhead wires with bird diverters (details of diverter makes and costs, and installation design in figure 3).

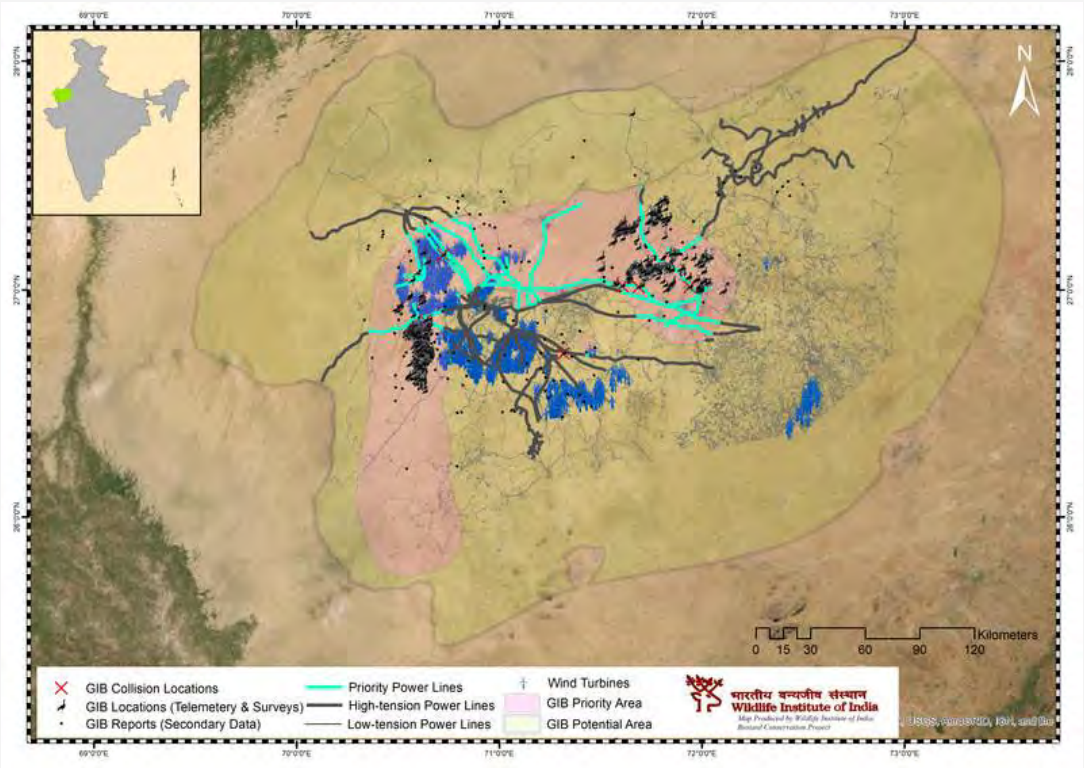


Figure 2a - Map showing Great Indian Bustard distribution, power-lines and wind turbines in Thar,Rajasthan

Figure 2b - Map showing Great Indian Bustard distribution and power-line in Abdasa, Kutch, Gujarat

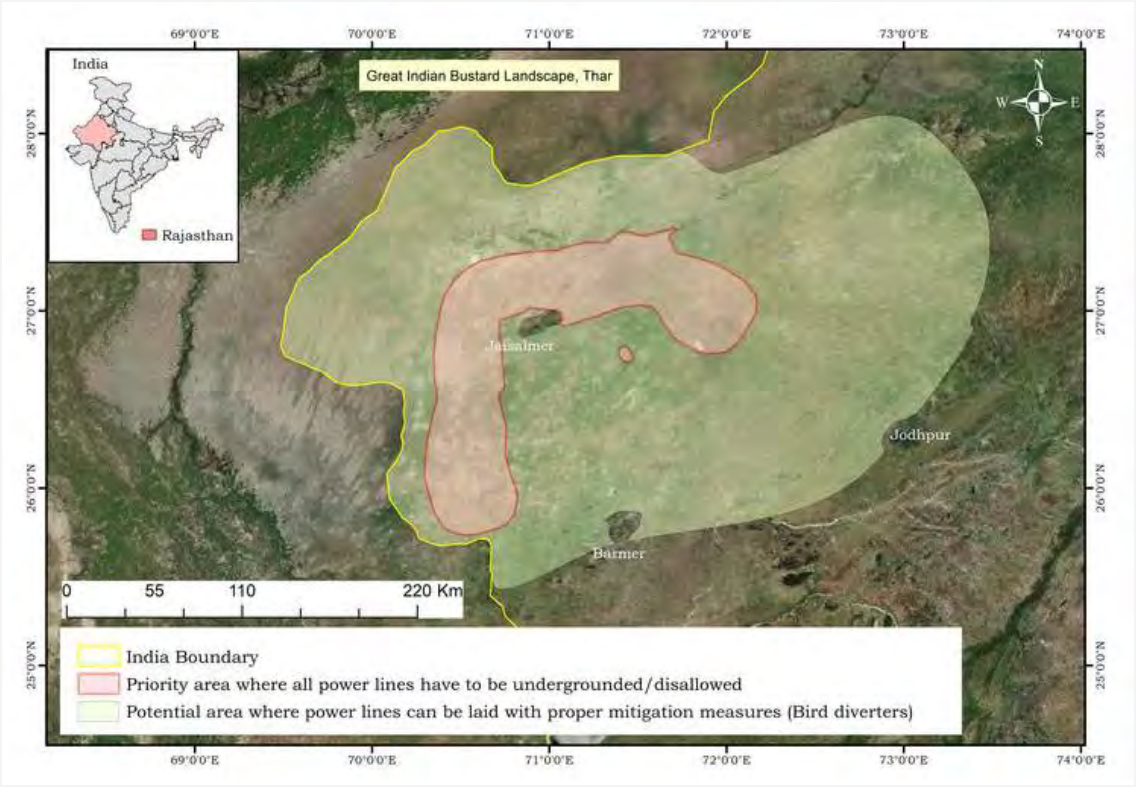


Figure 3a. Great Indian Bustard landscape in Rajasthan delineating the priority and potential areas for power-line mitigation.

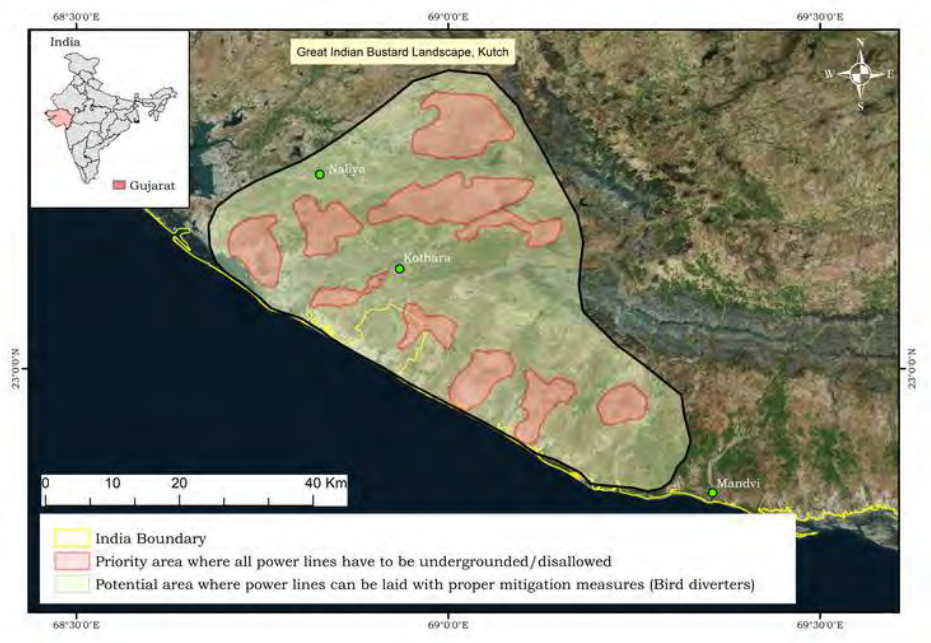
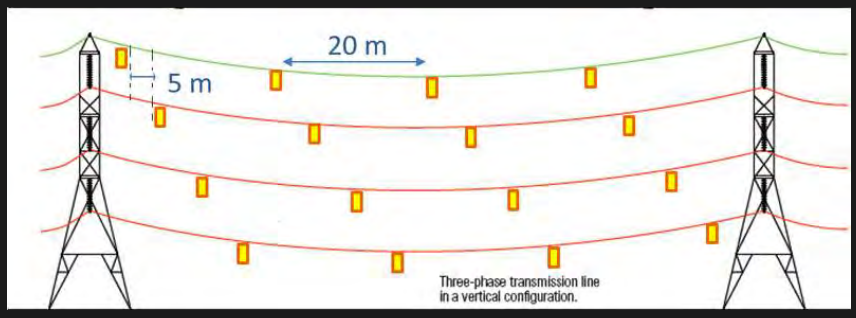
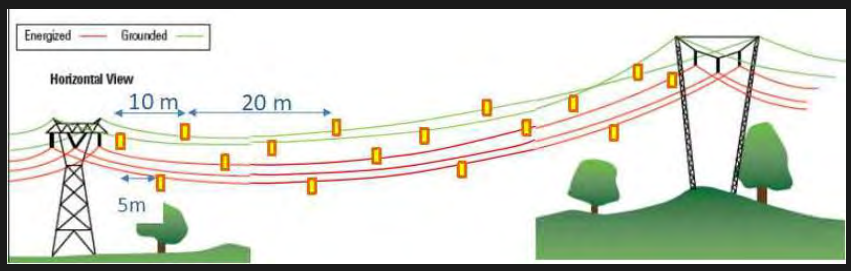


Figure 3b. Great Indian Bustard landscape in Gujarat delineating the priority and potential areas for power line mitigation.

Figure 4 : Details of diverter makes and costs, and installation design





Cost calculations:
Central 70% marking
~ 1 diverter/4m line
~4500 INR/unit + shipping charges (import)
~ 1000 INR /unit (local)

Installation

Marking earth wire with 1 diverter at every 10m, and marking conductors with 1 diverter at 15 m in a staggered way, such that power-line as a whole has at least 1 diverter every 5-6 m.

UNLESS POWER-LINES MORTALITY IS MITIGATED URGENTLY, EXTINCTION OF GIB IS CERTAIN.

REFERENCES

- *Alonso JC. (coord.) 2007. La Avutarda Común en Andalucía. Gypaetus-Junta de Andalucía, Jaén. 219 pp*
- *Alonso, J. C., J. A. Alonso, and R. Mu˜ noz-Pulido. 1994. Mitigation of bird collisions with transmission lines through ground wire marking. Biological Conservation 67:129–134.*
- *Alonso JC, Martín CA, Palacín C, Magaña M, Martín B. 2003a. Distribution, size and recent trends of the Great Bustard Otis tarda population in Madrid region, Spain. Ardeola 50 (1): 21-29*
- *Barrientos, R., Alonso, J. C., Ponce, C., & Palac, C. (2011). Meta-Analysis of the Effectiveness of Marked Wire in Reducing Avian Collisions with Power Lines Abstract :, 25(5), 893–903. https://doi.org/10.1111/j.1523-1739.2011.01699.x*
- *Barrientos R, Ponce C, Palacı´n C, Martı´n CA, Martı´n B, et al. (2012) Wire Marking Results in a Small but Significant Reduction in Avian Mortality at Power..doi:10.1371/journal.pone.0032569*
- *Jenkins, A.R., Smallie, J.J., Diamond, M., 2010. South African Perspectives on a Global Search for Ways to Prevent Avian Collisions with Overhead Lines, in press, doi:10.1017/S0959270910000122.*
- *Martín CA, Alonso JC, Alonso JA, Palacín C, Magaña M, Martín B. 2007. Sex-biased juvenile survival in a bird with extreme size dimorphism, the Great Bustard Otis tarda. Journal of Avian Biology 38: 335–346.*
- *Martín B. 2008. Dinámica de población y viabilidad de la avutarda común en la Comunidad de Madrid. PhD thesis, Universidad Complutense de Madrid, Madrid*
- *Martin, G. R., & Shaw, J. M. (2010). Bird collisions with power lines : Failing to see the way ahead ? Biological Conservation, 143(11), 2695–2702. https://doi.org/10.1016/j.biocon.2010.07.014*
- *Palacin, C., Alonso, J.C., Martin, C.A. and Alonso, J.A. 2012. The importance of traditional farmland areas for steppe birds: a case study of migrant female great bustards Otis tarda in Spain. Ibis, 154: 85-95.*
- *Shaw, J.M., 2009. The End of the Line for South Africa's National Bird? Modelling Power Line Collision Risk for the Blue Crane. Masters Thesis Percy Fitzpatrick Institute of African Ornithology, University of Cape Town.*


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Photo Credits

Graphic image of flying GIB through power-lines - Devesh Gadhavi

Dead GIB due to electrocution in Maharashtra - Devesh Gadhavi

Network of power-line and windmill - Tanya Gupta

Tagged GIB in Gujarat - Devesh Gadhavi

Red Eléctrica de España

Designed by: Tanya Gupta