

ACTION HISTORY OF RTI REQUEST No.WLIOI/R/E/21/00080

Applicant Name Rohit Choudhury

Text of Application 1. Provide me the copy of the letter / request / correspondences made between Assam Forest Department and Wildlife Institute of India (WII) to carry out a detailed study report to ascertain the impact of the power line passing through Deepor Beel, Assam to the avifauna. 2. Provide me the copy of the above mentioned detailed study report carried out by the Wildlife Institute of India (WII) to ascertain the impact of the power line passing through Deepor Beel, Assam to the avifauna. 3. The information may be provided by email at rohitskaziranga@gmail.com

Reply of Application Information provided in softcopy

| SN. | Action Taken | Date of Action | Action Taken By | Remarks |
|-----|---------------------------|----------------|-------------------|---------------------------------------|
| 1 | RTI REQUEST RECEIVED | 21/12/2021 | Nodal Officer | |
| 2 | REQUEST FORWARDED TO CPIO | 23/12/2021 | Nodal Officer | Forwarded to CPIO(s) : (1) Monali Sen |
| 3 | REQUEST DISPOSED OF | 04/01/2022 | Monali Sen-(CPIO) | |

[Print](#)

No. WII/RTI/CPIO/2021-22 (Qtr-III)/ 76

Date: 04th January, 2022

To,

Shri Rohit Choudhury
C/o Shri D.P. Agarwal, Village- Gormur,
P.O- Lokhujan, Bokakhat,
District-Golaghat, Assam, Pin:785612
Email: rohitskaziranga@gmail.com

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

Ref.: Your Online RTI No. WLIOI/R/E/21/00080 dated 21/12/2021

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 |
|--|---|
| 1. Provide me the copy of the letter / request / correspondences made between Assam Forest Department and Wildlife Institute of India (WII) to carry out a detailed study report to ascertain the impact of the power line passing through Deepor Beel, Assam to the avifauna. | See the attached Annexure-I containing 17 pages. |
| 2. Provide me the copy of the above mentioned detailed study report carried out by the Wildlife Institute of India (WII) to ascertain the impact of the power line passing through Deepor Beel, Assam to the avifauna. | See the attached report as Annexure-II . |

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.

①

Annexure-I



भारतीय वन्यजीव संस्थान
Wildlife Institute of India

No. WII/ESMD/2020/RSK/Deepor Beel

10.12.2021

To

Dr. Amit Sahai, IFS

The Principal Chief Conservator of Forests (Wildlife)

Aranya Bhawan, Panjabari

Guwahati-781037, Assam

Email: pccf.wl.assam@gmail.com

Sub: Submission of Final Report for the "Study to access impact of Power lines on Avian Species in and around Deepor Beel Ramsar Site, Assam" – reg.

Ref: Your letter No. WL/FG.35/Deepor Beel Conservation & Development Society/2019 Dated 09.12.2021

Sir,

This is in reference to your letter No. WL/FG.35/Deepor Beel Conservation & Development Society/2019 Dated 09.12.2021 regarding your comments on the final report of the "Study to access impact of Power lines on Avian Species in and around Deepor Beel Ramsar Site, Assam". As per your point no. 2 & 3 relating to the area of Deepor Beel WLS and its notification we have incorporated the same in the report. In point No. 5, you had mentioned that the report is silent about the electromagnetic effect of the transmission line on the movement/disorientation of various species of birds. With regard to this we would like to state that a lot of related scientific literature was studied and it was found that great deal of uncertainty surrounds the findings on the effects of EMF exposure on birds. The level of scientific knowledge on the subject is very weak. In particular, the effect of EMF on movement/disorientation of birds was also looked at and as per the available literature "The magnetic disturbance produced by electric current in power lines is generally localized and does not extend beyond a distance of several meters. Thus, the effects on the orientation of migratory birds may be minimal when birds fly well above the power lines, but clearly more work is needed on this subject (Avery, 1978)". Given this, any scientific enquiry with regard to the effect of EMF may require lot of resources, time and involvement of specialists and would not be possible within this short-term study. The revised report is enclosed here and I hope this is acceptable to you.

Thanking you.

Plenali Sen
INFORMATION PROVIDED
UNDER RTI

Yours faithfully,

(Signature)
10/12/21

(Dr. Dhananjai Mohan, IFS)

Director

Encl. Final Project Report

Copy: Conservator of Forests, Wildlife, Assam, Guwahati – 37.

2



GOVERNMENT OF ASSAM
OFFICE OF THE PRINCIPAL CHIEF CONSERVATOR OF FORESTS (WILDLIFE) AND
CHIEF WILDLIFE WARDEN, ASSAM::PANJABARI::GUWAHATI-37

Email ID: pccf.wl.assam@gmail.com

No. WL/FG.35/Deepor Beel Conservation & Development Society/2019

Date: 09.12.2021

To

Dr. Dhananjai Mohan, IFS
Director, Wildlife Institute of India
Dehradun.

- Sub: 1. Submission of Final Report for the "Study to assess impact of Power lines on Avian Species in and around Deepor Beel, Ramsar Site, Assam" -reg.
2. Mitigation measures for movement of Elephants from Rani and Garbhanga Reserve Forest to Deepor Beel across the Azara-Kamakhya Railway line in Guwahati, Assam-reg.
- Ref.: i) WII letter no. WII/ESMD/2020/RSK/Deepor Beel, dtd. 13/09/2021
ii) WII letter no. WII/AE&CB/BH/Railway Assam/2021-02, dtd. 02/12/2021

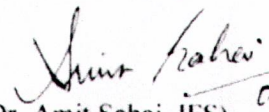
Sir,

With reference to the subject mentioned above, Assam Forest Department acknowledges the Final Study Report drafted by Wildlife Institute of India on the behest of this department to assess the impact of power lines on Avian Species in and around Deepor Beel, Ramsar Site, Assam. The comments on the report are enclosed as **Annexure-A**.

Further, Assam Forest Department also acknowledges receiving of a copy of the report on Mitigation measures for movement of Elephants from Rani and Garbhanga Reserve Forest to Deepor Beel across the Azara-Kamakhya Railway line, as requested by the NF Railway. The comments of the department on this report are also enclosed as **Annexure-B**.

Yours faithfully

Encl.: As above.

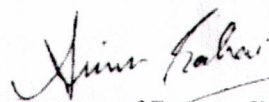

(Dr. Amit Sahai, IFS) 09/12/2021

Principal Chief Conservator of Forests (WL), Assam
Aranya Bhawan, Panjabari, Guwahati

Copy for kind information to:

1. The Principal Chief Conservator of Forests & HoFF, Assam, "Aranya Bhawan", Panjabari, Guwahati-37.
2. The APCCF & CWLW, Assam, "Aranya Bhawan", Panjabari, Guwahati-37.

010
**INFORMATION PROVIDED
UNDER RTI**


Principal Chief Conservator of Forests (WL), Assam
Aranya Bhawan, Panjabari, Guwahati

3



भारतीय वन्यजीव संस्थान
Wildlife Institute of India

No. WII/ESMD/2020/RSK/Deepor Beel

16.11.2021

To

The Principal Chief Conservator of Forests (Wildlife) &
Chief Wildlife Warden

Aranya Bhawan,

Guwahati-37, Assam

Email: pccf.wl.assam@gmail.com

Sub: Comments on the "Study to access impact of Power lines on Avian Species in and around Deepor Beel Ramsar Site, Assam" Final Report submitted to your office – reg.

Ref: Our letter No. No. WII/ESMD/2020/RSK/Deepor Beel dated 13.09.2021

Sir,

This is to bring in your kind knowledge that we had submitted the final report on the study to access impact of Power lines on Avian Species in and around Deepor Beel, Ramsar Site, Assam on 13th September 2021 through email. We are awaiting your comments, if any and request your kind response following which we will go ahead with the final printing of the report. Looking forward to hearing from you at the earliest.

Thanking you.

Yours faithfully,

(Dr. Dhananjai Mohan, IFS)

Director

Copy: Conservator of Forests, Wildlife, Assam, Guwahati – 37

INFORMATION PROVIDED
UNDER RTI

पत्रपेटी सं. 18, चन्द्रबनी, देहरादून-248 001, उत्तराखण्ड, भारत
Post Box No. 18, Chandrabani, Dehradun - 248 001, Uttarakhand, INDIA
ई.पी.ए.बी.एक्स : +91-135-2640100, 2640114, 2640115, फ़ैक्स : 0135-2640117
EPABX : +91-135-2640100, 2640114, 2640115, फ़ैक्स : 0135-2640117
ई-मेल/E-mail : wii@wii.gov.in, वेब/Website : www.wii.gov.in

4



भारतीय वन्यजीव संस्थान
Wildlife Institute of India

No. WII/ESMD/2020/RSK/Deepor Beel

13.09.2021

To
The Principal Chief Conservator of Forests (Wildlife) &
Chief Wildlife Warden
Aranya Bhawan,
Guwahati -37, Assam
Email: pccf.wl.assam@gmail.com

Sub: Submission of Final Report for the "Study to assess impact of Power lines on Avian Species in and around Deepor Beel Ramsar Site, Assam" – reg.

Sir,

This is to bring to your kind knowledge that we have completed the study to assess impact of Power lines on Avian Species in and around Deepor Beel, Ramsar Site, Assam that was assigned to us. A report on the same has been finalized and is enclosed here. Owing to Corona related restrictions, the fieldwork and report writing was partially delayed, which has led to this delay in submission of the final report and my sincere apologies for that. I thank you once again for the opportunity given to WII to undertake this important activity and look forward to being associated with the department in future.

Thanking you.

Yours faithfully,

(Dr. Dhananjai Mohan, IFS)
Director

Encl.: Copy of Final Project Report

Copy: Conservator of Forests, Wildlife, Assam, Guwahati – 37.

INFORMATION PROVIDED
UNDER RTI



भारतीय वन्यजीव संस्थान
Wildlife Institute of India

No. WII/ESMD/2020/RSK/Deepor Beel

13.07.2021

To
The Principal Chief Conservator of Forests (Wildlife) &
Chief Wildlife Warden
Aranya Bhawan,
Guwahati -37, Assam
Email: pccf.wl.assam@gmail.com

Sub: Final Report on the "Study to access impact of Power lines on Avian Species in and around Deepor Beel Ramsar Site, Assam" – reg.

Ref: Your letter No. WL/ FG.35/ Deepor Beel Conservation & Development Society/ 2019 dated 08.07.2021


Sir,

This is with reference to your letter No. WL/ FG.35/ Deepor Beel Conservation & Development Society/ 2019 dated 08.07.2021 regarding the submission of the final report on the "Study to access impact of Power lines on Avian Species in and around Deepor Beel, Ramsar Site, Assam". You may be kindly aware that this study was for a duration of eight months and was initiated in mid-December 2020 following the selection and appointment of a research personnel. In this context, we had also submitted a progress report of the study to your office in February 2021. The lockdown restrictions due to the COVID pandemic did affect our field activities though however, we have now successfully completed the six-months field work in May 2021. The data collected has been analyzed and the final project report is currently under preparation and will be submitted to your office in mid of August 2021. As per originally proposed the study report was to be submitted in June 2021 however this has been delayed due to the late start of our field work. I request you to kindly consider the delay in submission, considering delays owing to Covid-19.

Thanking you.

Yours faithfully,

INFORMATION PROVIDED
UNDER RTI


(Dr. Dhananjai Mohan, IFS)
Director

Copy: Conservator of Forests, Wildlife, Assam, Guwahati – 37.

6



GOVERNMENT OF ASSAM
OFFICE OF THE PRINCIPAL CHIEF CONSERVATOR OF FORESTS WILDLIFE
& CHIEF WILDLIFE WARDEN, ASSAM, ARANYA BHAWAN::GUWAHATI-37.
Email ID: pccf.wl.assam@gmail.com

No. WL/FG.35/Deepor Beel Conservation & Development Society/2019.

Date: 08/07/2021

To,

The Director,
Wildlife Institute of India,
Chanrabani, Dehradun-248001
Uttarakhand, India.

Sub: Final report on the "Study to access impact of power lines on avian species in and around Deepor Beel Ramsar Site, Assam"- reg.

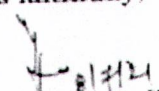
Ref: 1. Your email dtd. 17/02/2021
2. This office letter No. WL/FG.35/Deepor Beel Conservation & Development Society/2019, dtd. 22/01/2021.

Sir,

In continuation to this office letter dtd. 22/01/2021 and your email dtd. 17/02/2021, I am directed to request you kindly to furnish the final report on the "Study to access impact of power lines on avian species in and around Deepor Beel Ramsar Site, Assam" at an early date.

This is for favour of your information and necessary action.

Yours faithfully,


Conservator of Forests, Wildlife,
Assam, Guwahati- 37

O/e
8/7/2021
ISSUED ON

INFORMATION PROVIDED
UNDER RTI

7

Subject: Progress report on the "Study to assess impact of power lines on avian species in and around Deepor Beel Ramsar Site, Assam"

From: "Dr. R Suresh Kumar" <suresh@wii.gov.in>

Date: 17-02-2021, 13:03

To: pccf.wl.assam@gmail.com, "Director, WII" <dwii@wii.gov.in>

Dear sir

In response to your letter No. WL/FG.35/Deepor Beel Conservation & Development Society/2019 dated 22.01.2021 I am directed to send you a progress report of the ongoing study "To assess impact of power lines on avian species in and around Deepor Beel Ramsar Site, Assam". Please find attached the report required by your kind self.

with kind regards

R. Suresh Kumar
Scientist - E
Department of Endangered Species Management
Wildlife Institute of India

— Attachments: —

Progress Report 15022021.pdf

1.1 MB

INFORMATION PROVIDED
UNDER RTI

8

GOVERNMENT OF ASSAM
OFFICE OF THE PRINCIPAL CHIEF CONSERVATOR OF FORESTS, WILDLIFE & CHIEF WILDLIFE WARDEN,
ASSAM:::ARANYA BHAWAN:::PANJABARI:::GUWAHATI-37.

E-mail: pccf.wl.assam@gmail.com

No.WL/FG.35/Deepor Beel Conservation & Development Society/2019

dtd: 22 /01/2021

To,

✓ The Director,
Wildlife Institute of India,
Chanrabani, Dehradun – 248001
Uttarakhand, India.

Sub: Status report regarding “Study to ascertain the impact of the power line passing through the Deepor Beel to the Avi Fauna”.

Ref: Your letter No. WII/ESMD/RSK/2020/Deepor Beel, dtd: 01-10-2020.

Sir,

With reference to the subject cited above, I am directed to request you kindly to furnish a status report regarding “Study to ascertain the impact of the power line passing through the Deepor Beel to the Avi Fauna” at early date.

This is for favour of your information and necessary action.

Yours faithfully,

(K.K Deori, AFS)

Deputy Conservator of Forests (P).

O/o the Principal Chief Conservator of Forests, Wildlife &
Chief Wildlife Warden, Panjabari, Assam

Copy to the Principal Chief Conservator of Forest (Wetlands) O/o Principal Chief
Conservator of Forest & Head of Forests Force, Assam Panjabari, Guwahati-37 for information.

| |
|----------------|
| DWII OFFICE |
| DIARY NO. 2078 |
| DATE 8/2/21 |

Deputy Conservator of Forests (P).

O/o the Principal Chief Conservator of Forests, Wildlife &
Chief Wildlife Warden, Panjabari, Assam

Dr. Suresh
[Signature]



GOVERNMENT OF ASSAM
OFFICE OF THE PRINCIPAL CHIEF CONSERVATOR OF FORESTS, WILDLIFE & CHIEF WILDLIFE
WARDEN, PANJABARI, GUWAHATI-37

37

No. WL/FA/CORPUS FUND/2020

dt. 22-10-2020

To,

The Branch Manager, Corporation Bank,
21. M.L. Nehru Road
Pan Bazaar, Guwahati-1.

Sub: Request for electronic transfer of money.

Sir,

Please find herewith the cheque No. 664424 dt. 22-10-2020 issued in favour of Director, Wildlife Institute of India, amounting Rs. 6,84,250/- (Rupees six lakhs eighty four thousand two hundred fifty) only. The amount kindly be electronically transferred in below mention details.

- 1 Name of the account holder: Director, Wildlife Institute of India.
2. Account No.: 518502010000008
3. Name of the Bank: Union Bank of India
4. Branch: Wildlife Institute of India
5. IFS Code: UBIN0551856

Encl: Cheque mentioned above

Sincerely yours

| |
|------------------|
| DWII OFFICE |
| DIARY NO.: 1675 |
| DATE: 23/11/2020 |

INFORMATION PROVIDED
UNDER RTI

Addl. Principal Chief Conservator of Forests, Wildlife
& Chief Wildlife Warden, Assam, Panjabari, Guwahati-37

Copy to the

1. Principal Chief Conservator of Forests & Head of Forests Force, Assam, Panjabari, Guwahati-37 for favour of his kind information.

2. Director, Wildlife Institute of India, Post Box No. 18, Chandrabani Dehradun, 248001 for information and necessary action, with reference to his letter No. WII/ESMD/RSK/2020/Deepor Beel dt. 01-10-2020.

Registrar / Dr. R. Shresh Kumar

Addl. Principal Chief Conservator of Forests, Wildlife
& Chief Wildlife Warden, Assam, Panjabari, Guwahati-37



भारतीय वन्यजीव संस्थान
Wildlife Institute of India

No: WII/ESMD/RSK/2020/Deepor Beel

To,
The Principal Chief Conservator of Forests (WL) &
Chief Wildlife Warden
Government of Assam
Panjabari, Guwahati – 37
Email: pccf.wl.assam@gmail.com

Dated: 01-10-2020

Sub: Study to ascertain the impact of the power line passing through Deepor Beel to the avifauna – reg.

Ref No: Your letter No. WL/FG.35/Deepor Beel Conservation & Development Society/2019 dated 16.09.2020

Kind Attn: Sh. Bankim Sarma, IFS Conservator of Forest (Wildlife) O/o the PCCF, WL & CWLW, Assam

Dear Sir,

This is with regard to your acceptance of the project proposal developed by WII relating to the study to ascertain the impact of the power line passing through Deepor Beel to the avifauna (Your letter No. WL/FG.35/Deepor Beel Conservation & Development Society/2019 dated 16.09.2020). Further to this I request you to kindly transfer the project amount of Rs. 6,84,250/- to WII so as to enable us to initiate the appointment of project biologist and start with other preparations. The bank account details of WII is enclosed.

Thanking you,

Yours Sincerely

INFORMATION PROVIDED
UNDER RTI

(Dr. Dhananjai Mohan)
Director

Encl. As above



GOVERNMENT OF ASSAM
OFFICE OF THE PRINCIPAL CHIEF CONSERVATOR OF FORESTS (WILDLIFE) AND
CHIEF WILDLIFE WARDEN, ASSAM::PANJABARI::GUWAHATI-37

Email ID: pcwf.wl.assam@gmail.com

No.WI/FG.35 Deepor Beel Conservation & Development Society/2019

Dated: 6th Sept., 2020

To,

Director,
Wildlife Institute of India,
Chandrabani, Dehradun-248001,
Uttarakhand, India.

For kind attention of Dr. R.Suresh Kumar, Scientist- E.

Sub: Study to ascertain the impact of the power line passing through Deepor-Beel to the Avifauna-reg.

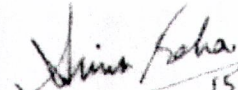
Ref: Your letter no. WII/ESMD/RSK/2020/Deeporbeel, dtd. 31/08/2020.

Sir,

In inviting a reference to your letter cited under reference, it is requested to carry out the short term study to ascertain the impact of power line passing through Deepor Beel Wetland. In this regard, the proposal submitted by you vide your letter dtd. 31/08/2020 is hereby approved and necessary fund amounting to Rs. 6.84,250/- (Rupees six lakhs eighty four thousand two hundred and fifty) only will be provided from this office.

This is for your kind information and necessary action.

Yours faithfully,


15/9/2020
Principal Chief Conservator of Forests
(Wildlife), Assam

**INFORMATION PROVIDED
UNDER RTI**

12



भारतीय वन्यजीव संस्थान
Wildlife Institute of India

17

No: WH/ESMD/RSK/2020/Deepor Beel

Dated: 31-08-2020

To,

The Principal Chief Conservator of Forests (WL) &
Chief Wildlife Warden
Government of Assam
Panjabari, Guwahati – 37
Email: pccf.wl.assam@gmail.com

Sub: Study to ascertain the impact of the power line passing through Deepor Beel to the avifauna – reg.

Ref: Your letter No. WL/FG.35/Deepor Beel Conservation & Development Society/2019 dated 11.12.2019

Kind Attn: Sh. Bankim Sarma, IFS Conservator of Forest (Wildlife) O/o the PCCF, WL & CWLW, Assam


Dear Sir,

This is with regard to your email communication dated 28 August 2020 regarding the request for a project proposal to ascertain the impact of the power line passing through Deepor Beel to the avifauna. A short-term study for a duration of eight months that includes six-month fieldwork from November 2020 to April 2021 with financial requirement of Rs. 6,84,250/- has been developed. The proposed study will determine the spatial distribution of select avian species of conservation significance and assess the impact due to the existing power lines in and around Deepor Beel Wetland. This will also involve mapping all power lines in and around Deepor Beel Wetland and identification of problematic structures. We thank you once again for inviting WH to undertake this important activity and we look forward to further directions from you.

Thanking you.

Yours faithfully,

INFORMATION PROVIDED
UNDER RTI


(Dr. Dhananjai Mohan)
Director

Encl.: As above

13

7



GOVERNMENT OF ASSAM
OFFICE OF THE PRINCIPAL CHIEF CONSERVATOR OF FORESTS (WILDLIFE) AND
CHIEF WILDLIFE WARDEN, ASSAM::PANJABARI::GUWAHATI-37

Email ID: pccf.wl.assam@gmail.com

No. WL/FG.35/ Deepor Beel Conservation & Development Society/2019 Dated: 16th, June, 2020

To, ✓
The Director,
Wildlife Institute of India
Chandrabani, Dehradun-248001
Uttarakhand, India.

Sub: Study to ascertain the impact of the Power line passing through Deepor Beel take avifauna-reg.

Ref: 1. Your letter No.WII/ESMD/RSK/2019/Misc. Deepor Beel, dated 10/01/2020.
2. This office letter WL/FG.35/ Deepor Beel Conservation & Development Society/2019, dated 30/01/2020.
3. This office letter WL/FG.35/ Deepor Beel Conservation & Development Society/2019, dated 24/02/2020.

Sir,

In continuation to this office letter cited under reference, I would like to request you to develop a proposal showing the financial requirement for undertaking the study by Dr. R. Suresh Kumar, as proposed by you.

As the matter is an urgent nature, an early action in this regard will be highly appreciated.

Thanking you.

Yours faithfully,

(T.V. Reddy, IFS)

Principal Chief Conservator of Forests, Wildlife
& Chief Wildlife Warden, Assam.

Copy to the Principal Chief Conservator of Forests, (Wet land) O/o the PCCF & HoFF, Assam, Panjabari, Guwahati-37 for favour of kind information.

Dr. R. Suresh Kumar

Principal Chief Conservator of Forests, Wildlife
& Chief Wildlife Warden, Assam.

| |
|------------------|
| DWII OFFICE |
| DIARY NO.: 1235 |
| DATE: 06/08/2020 |

INFORMATION PROVIDED
UNDER RTI

05/08

14

3

GOVERNMENT OF ASSAM
OFFICE OF THE PRINCIPAL CHIEF CONSERVATOR OF FORESTS (WILDLIFE) AND
CHIEF WILDLIFE WARDEN, ASSAM :: PANJABARI :: GUWAHATI-37

Email ID: pccf.wl.assam@gmail.com

No. WL/FG.35/Deepar Beel Conservation & Development Society/2019, Dated: 24/2/2020

To,

The Director,
Wildlife Institute of India,
Chandrabani, Dehradun-248001.
Uttarakhand, India.

Sub: Study to ascertain the impact of the Power line passing through Deepor Beel take avifauna -
reg.

Ref: (1) Your letter No. WII/ESMD/RSK/2019/Misc. Deepor Beel, dated 10.01.2020.
(2) This office letter No. WL/FG.35/Deepar Beel Conservation & Development
Society/2019, dated 30.01.2020.

Sir,

In continuation to this office letter cited under reference, I am directed to once again request
you to submit the proposal for undertaking the study by Dr. R. Suresh Kumar, as proposed by you.

An earlier action/response from your end will be highly appreciated.

This is for your kind information and necessary action.

Yours faithfully,

INFORMATION PROVIDED
UNDER RTI

V. Thyagi
24/2/2020
(Thenmozhi V, IFS)

Deputy Conservator of Forests (Enf.)
O/o the PCCF, WL & CWLW, Assam
Panjabari, Guwahati-37.

Copy to the Principal Chief Conservator of Forests (Wetland) O/o the PCCF & HoFF, Assam,
Panjabari, Guwahati-37 for favour of kind information.

V. Thyagi
24/2/2020
Deputy Conservator of Forests (Enf.)
O/o the PCCF, WL & CWLW, Assam
Panjabari, Guwahati-37.

24.02.2020
ISSUED ON

15

2

GOVERNMENT OF ASSAM
OFFICE OF THE PRINCIPAL CHIEF CONSERVATOR OF FORESTS (WILDLIFE) AND
CHIEF WILDLIFE WARDEN, ASSAM :: PANJABARI :: GUWAHATI-37

Email ID: pccf_wl.assam@gmail.com

No. WL/FG.35/Deepor Beel Conservation & Development Society/2019. Dated: 30/01/2020

To,

The Director,
Wildlife Institute of India,
Chandrabani, Dehradun-248001,
Uttarakhand, India

Sub: Study to ascertain the impact of the Power line passing through Deepor Beel ^{To the} ~~lake~~ avifauna -
reg.

Ref: Your letter No. WII/ESMD/RSK/2019/Misc. Deepor Beel, dated 10.01.2020.


Sir,

With reference to the above, I am directed to inform you that you may develop a proposal to undertake the study and submit the same for onward necessary action.

o/e
INFORMATION PROVIDED
UNDER RTI

30-01-2020
ISSUED ON

Yours faithfully,


20-01-2020

(Bankim Sarma, IFS)

Conservator of Forests (WL)
O/o the PCCF, WL & CWLW, Assam.

16

4



भारतीय वन्यजीव संस्थान
Wildlife Institute of India

No: WII/ESMD/RSK/2019/Misc. Deepor Beel

To,
The Principal Chief Conservator of Forests (WL) &
Chief Wildlife Warden
Government of Assam
Panjabari, Guwahati - 37

Dated: 01-01-2020
10-01-2020

Sub: Study to ascertain the impact of the power line passing through Deepor Beel to the avifauna
- reg.

Ref No: Your letter No. WL/FG.35/Deepor Beel Conservation & Development Society/2019
dated 11.12.2019

Kind Attn: Ms. V. Thenmozhi, DCF, O/o the PCCF, WL & CWLW, Assam

Dear Sir,

We received your communication (No. WL/FG.35/Deepor Beel Conservation & Development Society/2019 dated 11.12.2019) regarding the request to undertake a Study to ascertain the impact of the power line passing through Deepor Beel to the avifauna. Dr. R. Suresh Kumar, Scientist - E in the Department of Endangered Species Management of WII is nominated to take up this matter. The study will require a series of visits to the Deepor Beel wetland to ascertain the impact of the power line passing through on the avifauna. And, for an in depth understanding of the issue the study will need to consider seasonality and therefore it is proposed to be undertaken as a short-term project for a period of six to eight months. If this is agreeable to you, WII can develop a proposal with funding requirement to undertake the study. We thank you for inviting WII to undertake this important activity and will look forward to a response from you.

Thanking you,

Yours Sincerely

(Dr. Dhananjai Mohan)
Director

SP/182
13/1/2020
INFORMATION PROVIDED
UNDER RTI

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GOVERNMENT OF ASSAM
OFFICE OF THE PRINCIPAL CHIEF CONSERVATOR OF FORESTS (WILDLIFE) AND
CHIEF WILDLIFE WARDEN, ASSAM :: PANJABARI :: GUWAHATI-37

Email ID: pccf.wl.assam@gmail.com

No. WL/FG.35/Deepor Beel Conservation & Development Society/2019

Dated: 18th July, 2019

From,

Dr. Ranjana Gupta, IFS
PCCF (WL) & Chief Wildlife Warden, Assam
Aranya Bhawan, Panjabari, Guwahati.

To,

The Director,
Wildlife Institute of India,
Post Box #18, Chandrabani
Dehradun - 248001
Uttarakhand, India

Sub: Study to ascertain the Impact of the Power line passing through Deepor Beel to the Avifauna.

Sir,

With reference to the above, this is to bring to your kind notice that the Government of Assam has constituted a "Deepor Beel Conservation & Development Society". The Governing Body of this Society is headed by the Hon'ble Chief Minister, Assam. The first meeting of the Governing Body of the Society was held on 16th May, 2019 and one of the issues discussed was **Shifting of Power Line passing through the Deepor Beel**. The decision taken on the matter was that 'A detailed study will be carried out to ascertain the impact of the power line passing through Deepor Beel to the avifauna'.

In this regard, it is requested to kindly consider deputing a team from your Institute to study the impact of the power line passing through Deepor Beel to the avifauna. As you may be aware Deepor Beel is a Ramsar Site in Assam and a Wildlife Sanctuary.

An early response is solicited.

Yours faithfully

Ranjana Gupta
(Ranjana Gupta, IFS)

Principal Chief Conservator of Forests, Wildlife &
Chief Wildlife Warden, Assam.

Copy for information and necessary action to:

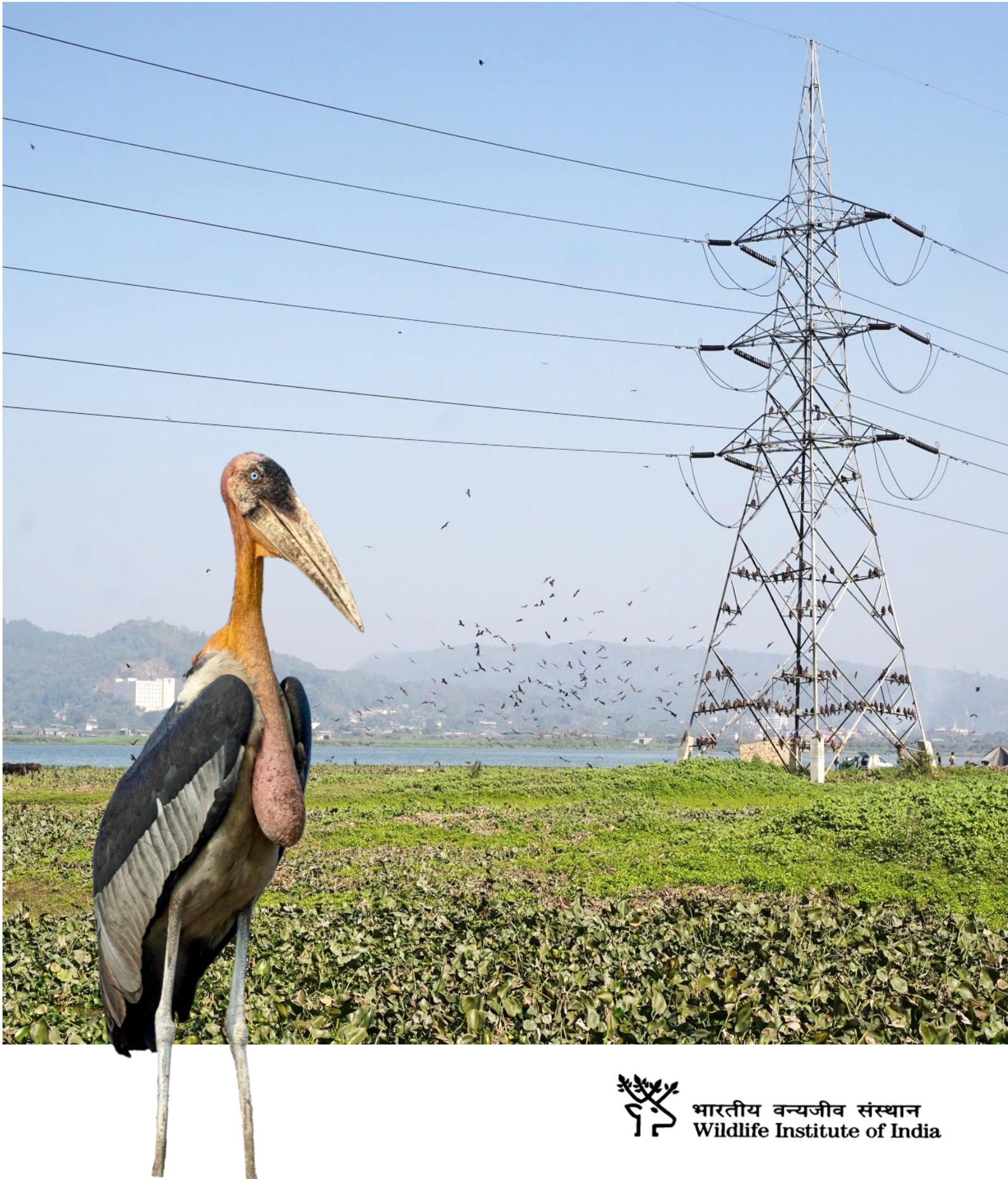
1. The Addl. Chief Secretary to the Govt. of Assam, Environment & Forest Department, Guwahati.
2. The Principal Chief Conservator of Forests & Head of Forest Force, Assam, Panjabari, Guwahati-37
3. The Addl. Principal Chief Conservator of Forests (Wetlands) cum Chief Executive Officer, Deepor Beel Conservation and Development Society, O/o. PCCF & HoFF, Assam

Principal Chief Conservator of Forests, Wildlife &
Chief Wildlife Warden, Assam.

INFORMATION PROVIDED
UNDER RTI

Study to assess the impact of Power lines on Avian Species in and around Deepor Beel Ramsar Site, Assam

TR No. 2021/12



भारतीय वन्यजीव संस्थान
Wildlife Institute of India

Front Cover Image: Greater Adjutant © Kartik Patel
Transmission line at Deepor Beel © Dipanjali Gohain

Back Cover Image: Falcated Duck © Harindra Baraiya

***Study to assess the impact of Power lines on Avian Species
in and around Deepor Beel Ramsar Site, Assam***

Technical Report

submitted to the
Assam State Forest Department

September 2021



भारतीय वन्यजीव संस्थान
Wildlife Institute of India

Project Brief and Project Personnel

| | |
|--|---|
| Project Title | Study to assess the impact of power lines on avian species in and around the Deepor Beel Ramsar Site, Assam |
| Name and Address of the Reporting Institute | Wildlife Institute of India P.O. Box # 18, Chandrabani Dehradun- 248001 (Uttarakhand), India |
| Project Start Date | 15 December 2020 |
| Project Duration | 8 Months |
| Name of the Investigator | Dr. R. Suresh Kumar, Scientist – E Dr. Dhananjai Mohan, IFS, Director |
| Research Personnel | Ms. Dipanjali Gohain |
| Inputs From | Mr. Dhiraj Das Mr. Gaurav Sirola Mr. Harindra Baraiya |
| Funding Agency | Assam State Forest Department |

Citation

Gohain, D., Das, D., Sirola, G., Baraiya, H., Kumar, R.S. and Mohan, D. 2021. Study to assess the impact of power lines on avian species in and around the Deepor Beel Ramsar Site, Assam. Wildlife Institute of India, Dehradun. Technical Report No. 2021/12. Pp. 57

Acknowledgment

This study was supported by the Assam State Forest Department and we thank Sh. Bankim Sharma, IFS for providing us support during the planning of the study. We would like to thank the Range Forest Officers and other forest personnel of Deepor Beel for their support during the study. We particularly like to thank Sh. Guddu Thapa (Forest Guard) and Sh. Dijen Das (Local Boatman) for regularly accompanying us during boat surveys in the Beel. Thank Ms. Ankita Kaushik, Mr. Bitupan Kalita and Mr. Rishi for providing technical support during fieldwork, and Mr. Praveen Krishna for help during report writing.

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Summary

This report details the findings of the study on an assessment of the impact of power lines on birds in and around the Deepor Beel Ramsar site. This is the first such study at this site and was taken up following a request from the Assam State Forest Department. The study determined areas in the Beel with high diversity and abundance of select avian species groups, specifically those that are known to be impacted by power lines. Additionally, the power lines both transmission and distribution lines in the area were mapped and characterized, and also assessed for their collision and electrocution risk to birds. Only one 220 kV transmission line spanning a length of 11 km was in the area that passed all along the southern fringe of the Beel, while 30 distribution lines spanning a total length of 55 km were located in and around the Beel that included 28 lines of 11 kV and 2 lines of 33 kV capacities. The distribution line power poles (1000 of 11 kV and 333 of 33 kV) based on their structural design were assessed in terms of their potential electrocution risk as from very high to low or no risk.

A total of 120 bird species were recorded during the study that included 67 species potentially impacted by power lines. Of these, 40 species were those prone to collision risk, 21 to electrocution risk and six to both. The eastern parts of the Beel had maximum number of waterbirds, a majority of which were migratory ducks and geese, while water associate species like storks, herons, ibis, egrets and others were found maximum in the western parts of the Beel. Waterbirds in the area appeared to potentially face a lesser risk of collision with the transmission line as the areas where they primarily occurred were quite distant, on an average 2 km away. The water associates on the other hand particularly the threatened Greater and Lesser Adjutant likely face either collision and or electrocution risk as they were recorded from across the Beel, and also that they particularly congregated in very large numbers in and around the Boragaon disposal site.

Collision risk assessment based on observations of birds in flight crossing the transmission line in the area identified select spans, specifically one passing over a water expanse to pose relatively higher risk to birds. It was also here that maximum number of dangerous flights by birds while attempting to cross the transmission line span was observed. The extensive mortality surveys to assess electrocution risk by distribution line power poles in the area lead to finding a single case of Greater Adjutant *Leptoptilos dubius* electrocution. The Adjutant stork was electrocuted on a 33 kV power pole located in a forested tract of the Rani-Garbhangra Reserve Forest along the southern fringe of the Beel. The distribution line section there appears to pose serious risks to Adjutant storks as the birds were observed to shuttle between their day roost in the Reserve Forest to the Beel or to the disposal site. The 33 kV pole design having longer cross arms (2 to 3 meter), placed horizontally at the top of the pole provided ideal platform for large birds to perch, and poles like these with exposed phase and jumper wires were found to pose very high electrocution risk to birds.

To summarize, this study as required identified high use areas by avian species groups, identified high-risk transmission line stretches and problematic distribution power poles posing collision, and electrocution risk to birds in the area specifically of the Adjutant storks in and around the Beel. And, lastly measures to mitigate or minimize the risks posed by the power lines to birds in the area is provided.

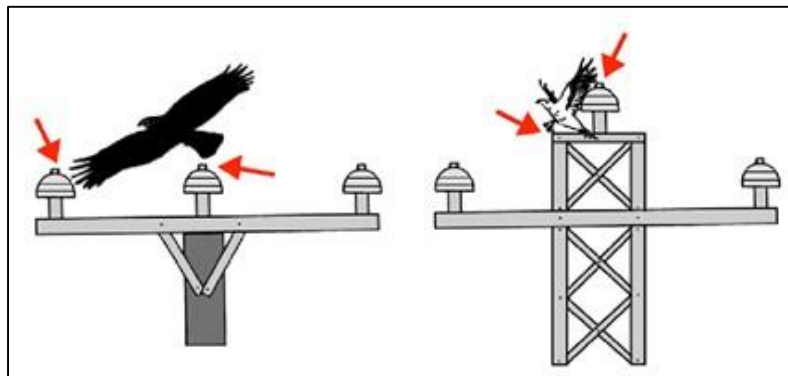


Introduction

Globally collisions with power lines and electrocutions are said to cause more than one billion annual bird mortalities (Hunting, 2002). This extent of mortality would rank power lines along with wind turbines and communication towers to be a major threat to birds (Longcore et al. 2012; Smallwood, 2013). Furthermore, mortality at power lines may contribute to population declines for some species, as evidenced by studies documenting that power line-caused mortality can cause a large percentage of total mortality for species from several avian orders (Bevanger, 1995; Sergio, 2004; Sundar & Choudhury, 2005; Harness et al. 2013; Hernández-Matías et al. 2015; Shobrak et al. 2021; Uddin et al. 2021).

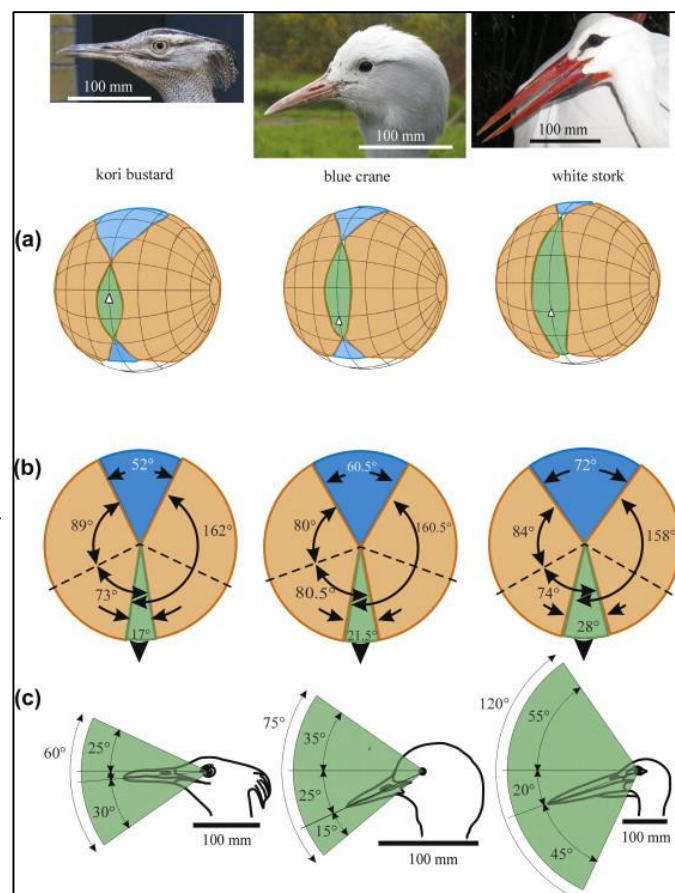
Birds can safely sit on energized equipment on a power line as long as all points of contact are at the same electric potential. Death (electrocution) or injury (shock) occurs only when birds create a circuit through which electric current flows from a higher potential (or voltage) to a lower potential (often a path to ground). This can occur if a bird simultaneously contacts two differently energized wires (phase wires) or simultaneously contacts an energized wire and any grounded, conductive material. On the other hand, transmission lines are primarily

associated with collision of birds and most often with the overhead static wire (earth wire), which has a smaller diameter as compared to the energized conductors making it less visible, and affects selected group of large birds like storks, cranes and bustards whose field of vision is narrow towards the front due to their sidewise eye placement, thereby lacking the ability to quickly negotiate obstacles, making them more vulnerable to power line collisions (Martin and Shaw, 2010).



Structural design of the power poles in distribution lines such as separation distances between conducting surfaces as show in the image dictates electrocution risks to birds. (Source: Tinto et al. 2005)

Large birds such as storks, cranes and bustards are prone to collision risk with power lines when in flight due to their lateral position of eyes resulting in a narrow frontal visual field and differ in the extent of the blind areas which project above and below their binocular fields (Source: Martin and Shaw 2010)



Electrocution and collision of birds due to power lines is a topic of conservation priority and a matter of serious economic and financial cost due to disruption to power supplies, consequently becoming a cause of concern to electricity-producing and distribution companies. Though, appropriate routing and structural design of power-lines is said to reduce the risks posed to birds by 50% or more (Jenkins et al. 2010; Prinsen et al. 2012). A large number of studies world over have focused on this issue and guidelines or measures to mitigate or reduce the risks posed by power lines have been developed and implemented at both the local level as well as globally. Few of these guidance documents include those developed by the Avian Power Line Interaction Committee (APLIC) (2006, 2012, 2015), Prinsen et al. (2012), Raptor Protection of Slovakia (2019), and WII (2016) for the Indian region.

Electricity generated at power stations is transmitted by high voltage long distance transmission lines to the distribution centers and these lines traverse through landscapes across the country that are generally rich in wildlife. Power lines are also aligned through ecologically sensitive areas and through forests, National Parks and Wildlife Sanctuaries that often require diversion of forest land. Current and future patterns of electric power transmission and distribution lines across the country will increase the potential for interference with the daily, seasonal movements of both resident and migratory birds. Habitats and flight pathways of birds are unavoidably altered by the presence of overhead power-lines and associated structures. Migration and distribution patterns are also affected if the birds avoid areas adjacent to these structures. However, the overall impact of power-lines on bird movements is not fully understood, although it has been the subject of an increasing amount of research in recent years.

In a similar context, the Assam State Forest Department requested Wildlife Institute of India (WII) to undertake a study to ascertain the impact of power lines passing through Deepor Beel to avifauna (Letter No. WL/FG. 35/Deepor Beel Conservation & Development Society/2019 dated 18th July 2019). Deepor Beel is a large freshwater lake and an important riverine wetland in the Brahmaputra valley of lower Assam. The wetland was declared as a Ramsar site in 2002

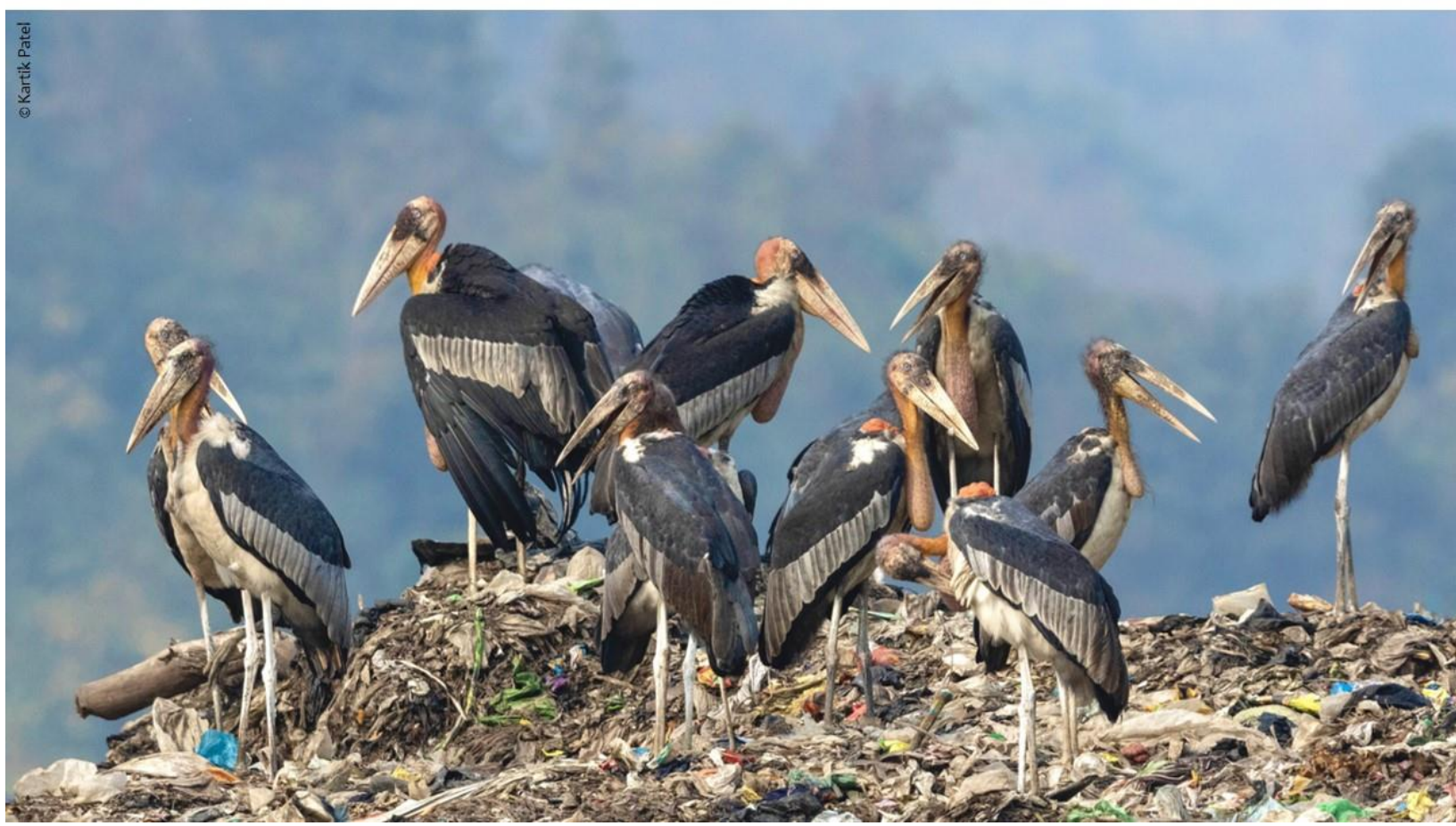
since it is known to harbor large congregations of resident and migratory Waterbirds, and also that it supports high floral and faunal diversity. Located close to the Guwahati city, this site is reported to face a number of threats specifically due to over-fishing, hunting of waterbirds, pollution from pesticides and fertilizers, release of sewage into the lake, dumping of solid waste, invasion of water hyacinth *Eichhornia crassipes*, and human encroachment (RIS, 2002, Anonymous, 2008). Added to this is the increase in power line network around the wetland. Therefore, to ascertain the impact of power lines on birds at the Deepor Beel Ramsar site a short-term study from December 2020 to May 2021 was taken up. The study aimed at determining the spatial distribution of select avian species of conservation significance in the wetland, and monitor and assess the impact on avifauna due to the existing power lines in and around the wetland.



Deepor Beel Ramsar Site

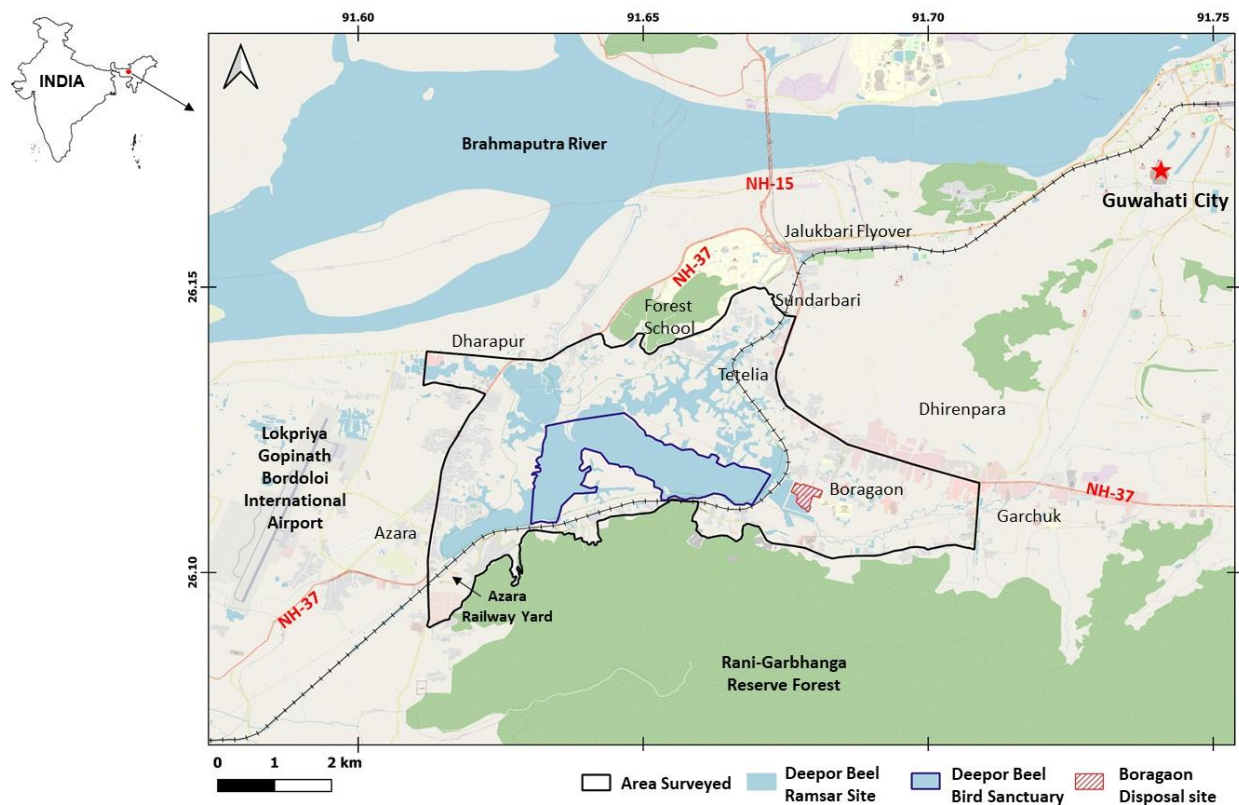
Deepor Beel declared as a Ramsar site in 2002 is located south-west of the Guwahati city and is the largest riverine wetland in the Brahmaputra valley in the Assam State. Spanning over an area of 40 sq. km this wetland is fed by the rivers Basistha and Kalamani, and from local monsoon runoff; and drains out from the north to the Brahmaputra river through a channel. The wetland is characterized by both deep open water, and shallow marshy and grassland patches. During the monsoon the water level in the wetland is known to rise to about 4 meters, while during winter the drier phase it drops to one meter resulting in large parts of the wetland drying up (RIS, 2002). The Beel is bounded by the hills of the Rani-Garbhanga Reserve Forests along the southern fringe, while on other sides is surrounded by several villages, urban clusters and industrial establishments including a railway yard located at the south-western corner. Located within this wetland is the Deepor Beel Wildlife Sanctuary (4.14 sq.km) that was declared in 1989 though the final notification is still to be issued.

Detailed information on the floral and faunal elements recorded in the wetland are given in RIS (2002). However, specifically to state the floral diversity of this wetland is primarily water hyacinth, aquatic grasses, water lilies and other submerged, emergent and floating vegetation. A number of threatened mammalian fauna are recorded from the hills and include the Asian Elephant *Elephas maximus*, populations of which regularly move down from the hills to the wetland during the dry period to forage on the aquatic plants. The wetland is very famous for its avifauna, particularly known for the large congregations of resident and migratory Waterbirds, and has been identified as an Important Bird Area (BirdLife International, 2021). A number of globally threatened bird species are recorded here including the Critically Endangered Baer's Pochard *Aythya baeri*, White-rumped Vulture *Gyps bengalensis* and Slender-billed Vulture *Gyps tenuirostris*. The other notable species of conservation concern recorded in and around the wetland is the Endangered Greater Adjutant. Relatively large numbers of these birds are recorded in the area, specifically concentrating at the Boragaon solid waste disposal site on the eastern side of the wetland where they scavenge through the year.



A number of roads passes around the wetland including the National Highway 37, and a railway line passes along the southern and eastern fringe of the Beel (Figure 1), that has potentially lead to encroachment of the wetland with the establishment of warehouses, industries and habitations. This has also led to increase in power line network to meet the energy demands, increase in flow of sewage into the lake, and establishment of a municipal garbage dumping yard in the vicinity. Also, due to the proximity to Guwahati city high number of picnickers especially at weekends visit the wetland, and large gatherings for recreation occur during the holiday season in the winter months causing disturbance to birds. Several actions to mitigate and manage these threats have been proposed however remains to be effectively implemented.

Figure 1. Map of the Deepor Beel Ramsar Site located south of the Brahmaputra River



Note: The boundary of the Deepor Beel Bird Sanctuary shown in the map here was provided by the GIS Department of the Assam Forest Department, though this is not officially authenticated



Methodology

Mapping and characterization of power lines

For assessing the impacts of power line on birds, a combination of on-ground field surveys (January to May 2021) and lab-based GIS approaches were carried out to achieve the project objectives. Mapping and characterization of the distribution and transmission lines in the area surveyed around Deepor Beel was first carried out. The GPS location of each power pole (pylons) of the transmission line along with information on voltage type (kV), height of the pylon, number of conductor and earth wires, separation distance between conductor wires, and the distance of the lowest conductor wire to ground were recorded. Similarly, in the case of distribution lines, the voltage (kV) type, the height of the pole, cross-arm length, separation distance between phase wires were recorded. These power poles were categorized into different types based on their structural design and further classified in terms of their potential risk of electrocution to birds as very high risk, high risk, medium, low and no risk.

Collision & Electrocution Risk Assessment

For assessing collision risk that is primarily associated with transmission lines observations of birds crossing different line stretch (Spans) were made from a designated spot or vantage point at each, and during March and April month during the study. Observations were made for a two-hour duration and at each span on different days, and only during the morning hours between 07:00 to 11:00 am when birds are most active. When a bird or flock of birds in flight approached the power line the species and their number were recorded. The flight observation was then characterized as: change in flight height (either gained height to fly above the earth wire, or lowered height to fly below the lowest conductor wire, and or fly through the wires), splitting of flocks while attempting to cross the line, and change of course to either return and reattempt. In those observations of birds crossing the line, information on whether the crossing was made above or below the earth wire, and whether it was high risk crossing where birds crossed either between the earth wire and conductor wire, or between conductor wires was recorded. Lastly, dangerous interactions such as flaring, near-collision and collision of birds while crossing the line were recorded. Where accessible we undertook regular walks below the transmission line to locate bird carcasses that may have resulted from a collision. The information collected on the above were summarized to identify the transmission line span posing high collision risk, and the select bird species that faced maximum risk.

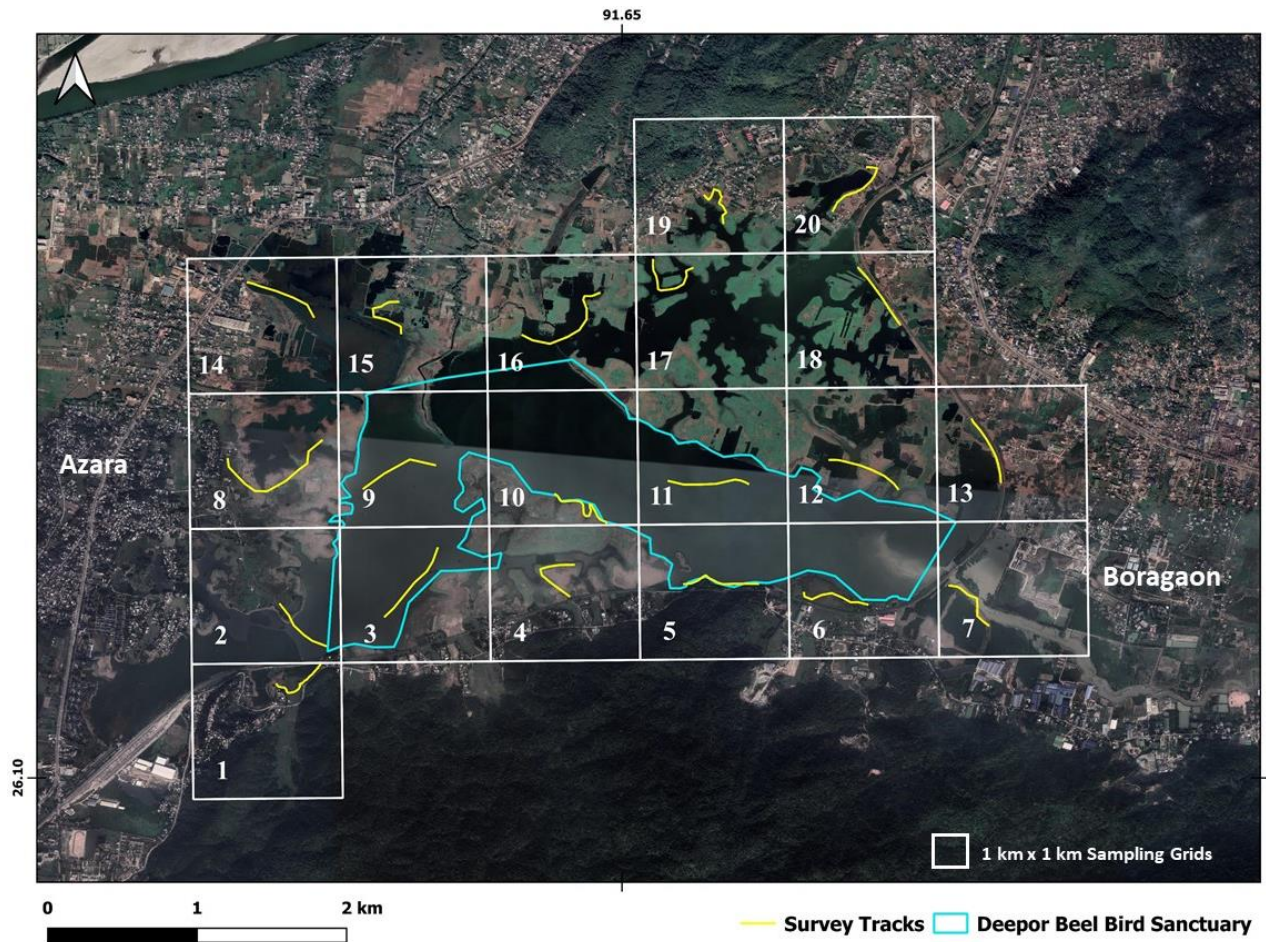
To assess the electrocution risks posed by distribution lines we carried out vehicular and foot surveys of the lines to document mortality of birds. The vehicular surveys were made on a two-wheeler driven at a speed of 10-20 km/h with frequent stops at power poles to search for bird carcasses or remains. The distribution lines in the area were segregated into northern, eastern, southern and western section, and dedicated surveys of each were made throughout the study period. The cross arms of the distribution line poles were also scanned for remains of feathers that may have resulted from an electrocution. In the case of an electrocution mortality information on the bird species, distribution pole type including the line characteristics were recorded.

Distribution mapping of bird species associated with Deepor Beel

In order to document the spatial distribution of bird species associated with the Beel, a grid-based systematic sampling approach was adopted. For this, the wetland was divided into 20 grids (1 x 1 km) and within each a sampling trail approximately 500 m in length was identified and surveyed by foot (Figure 2). Additionally, few grids being primarily open water expanse were surveyed from a non-motorized boat. The grids were surveyed once every fortnight and in all nine visits were made in each grid between January to first week of May. This period coincided with the wintering and return migration of a number of waterbirds and few water associate species. The grid survey was conducted in the morning between 08:00 to 10:00 am and during the survey information on the bird species along with their abundance were recorded. From the survey data heatmaps of species richness, overall average abundance, and an average Simpson's Evenness Index for each grid was generated to depict areas of high importance for birds within the Beel. The heatmaps were generated in QGIS (Version 3.4.9-Madeira) and were then overlaid with the power lines mapped in the area to assess the collision and electrocution risks posed to birds.



Figure 2. Map of the Deepor Beel wetland showing the 20 grids that were sampled from the survey trails (yellow tracks) to document and map select waterbirds and wetland associated species.



Findings of the study

Power lines of the Deepor Beel Wetland

A single high voltage power line of 220 kV capacity of the Assam Electricity Grid Corporation Limited (AEGCL) connecting the Kukurmara and Sarusajai substations was the only transmission line observed in the vicinity of the Deepor Beel wetland. Part of this line spanning a length of approx. 11 km falls on the southern fringe of the wetland and along the Rani-Garbhangha Reserve Forest (Figure 1). On the eastern side of the area surveyed approx. 4 km of this line stretch passes through the Pamohi village. It is also here where the Kalamani river flows and opens into the beel, and the habitat is predominantly agriculture with few industrial setups, and the Boragaon disposal site (garbage dump) is located here. The 11 km transmission line section consists a total of 36 pylons (steel lattice) each measuring approx. 25 meters in height and carries six conductor wires (3 on each side), and with a single earth wire. The distance between two pylons ranged from the shortest being 130 meter to the longest being 420 meter. The longest is also the line span that cuts across a water stretch in the wetland and is relatively saggy making it closer to the water surface. And, during high water level in the wetland this distance is further reduced and falls in the flight path of birds using the area posing collision risk.





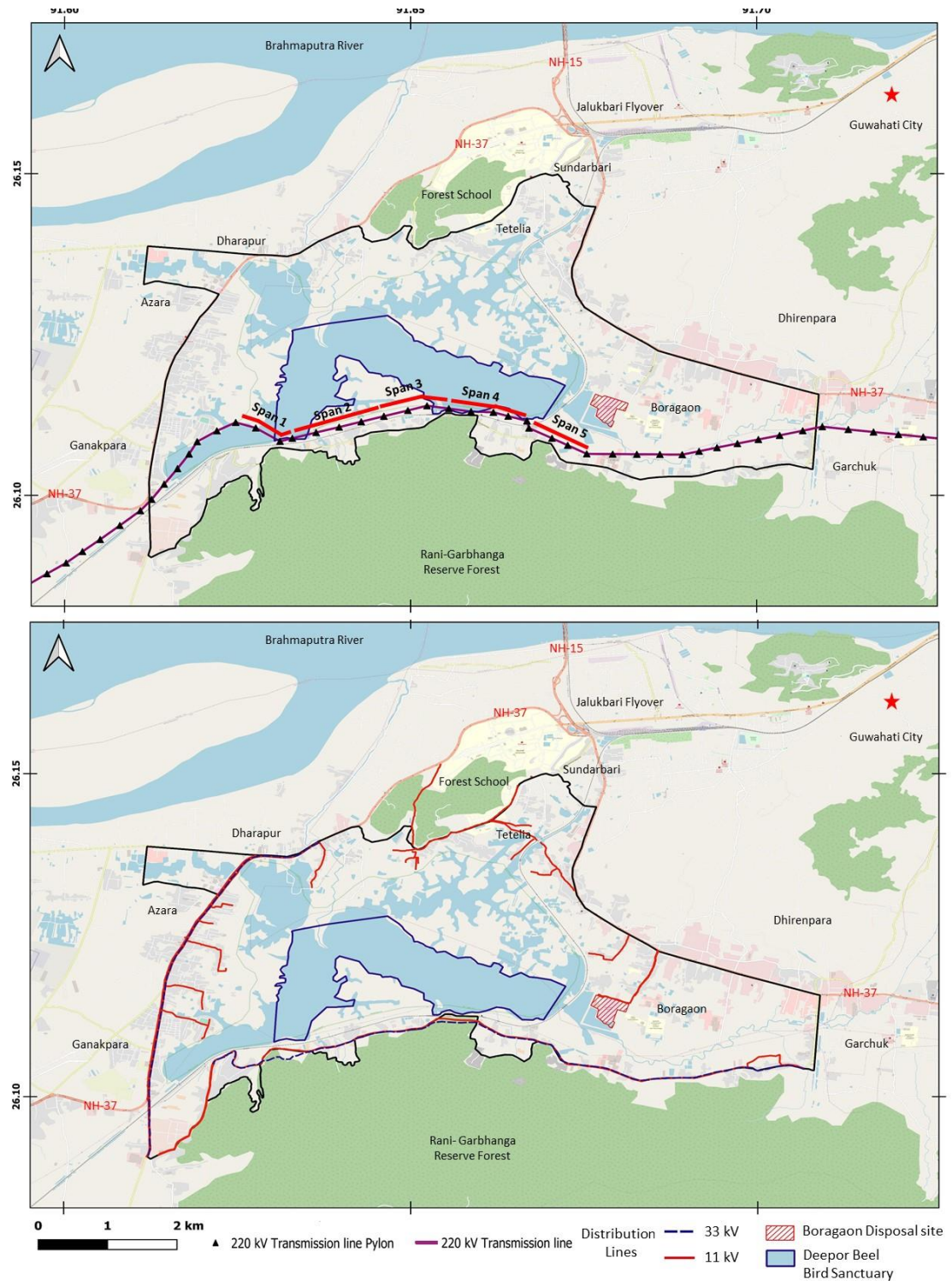
The 220 kV transmission line in the area has three phase wires on either side of the pylon and was well separated and as a result do not pose electrocution risk, while pose the risk of collision to birds in flight

For assessing collision risk to birds, the transmission line stretch from near to Azara railway station to the point near Boragaon disposal site spanning a length of 5.15 km was selected. This line stretch had 19 pylons and was demarcated into five spans with varying length (Figure 3). The line span 1 (900 m) and 3 (970 m) had three line sections, while span 2 (1380 m), span 4 (1160 m) and Span 5 (1070 m) had four line sections. The longest line span section was 420 m and this was over water and is part of span 1. The transmission line stretch beyond these spans were not included for the collision risk observations since during preliminary surveys very low bird activity was observed there, which was likely a result of presence of habitations and construction works.

The distribution lines as expected were relatively more in number and in all 30 lines spanning a total length of 41.19 km (11 kV) and 14.01 km (33 kV) in and around Deepor Beel was mapped and surveyed (Figure 3; Table 1). The distribution lines were primarily all along the roadside except for one 33 kV line (8.86 km) located along the southern fringe of the Beel that cut through forested tracts of the Rani-Garbhangra Reserve Forest in certain parts. The distribution lines in the area were predominantly with three phase wires held atop a single utility pole that was mostly metal, and the poles were on average 10 m in height. At line junctions, the number of utility poles were variable and ranged from 2 to 4. The three phase wires were held on pin insulators atop a metal cross arm, and in few cases from suspended insulators. On few poles, additional phase wires were observed below the main cross arm.



Figure 3. A map of the Deepor Beel Ramsar Site showing the existing power line network in the area that includes one 220 kV transmission line located along the southern boundary and a network of 30 distribution lines of both 11 kV and 33 kV.



The line characteristics in terms of the cross arm length and pole structure were highly variable, and 17 and 23 different types were recorded in the area for the 11 kV and 33 kV respectively (Annexure 1). In cases where there were only two-phase wires the cross arm length was 50 cm, while with three phase wires the length ranged from 100 to 150 cm. The distance between conducting surfaces on these lines was on average 50 cm, and this poses potential electrocution risk to birds in the area. Also, at line junctions the jumper wires connecting the phase wires were not insulated, and are held invariably above the cross arm posing yet again significant electrocution risk.

Table 1. Details of the 11 kV and 33 kV distribution lines surveyed in and around Deepor Beel for this study

| Region | Capacity of line (kV) | No. of Lines | Length (km) | No. of Poles | Pole Types |
|----------|-----------------------|--------------|-------------|--------------|------------|
| Northern | 11 | 10 | 6.2 | 198 | 10 |
| Eastern | 11 | 5 | 4.7 | 184 | 13 |
| Southern | 11 | 3 | 14.9 | 310 | 12 |
| | 33 | 1 | 9.5 | 192 | 22 |
| Western | 11 | 10 | 16.7 | 308 | 17 |
| | 33 | 1 | 6.5 | 141 | 8 |
| Total | 11 | 28 | 42.5 | 1000 | 17 |
| | 33 | 2 | 16.0 | 333 | 23 |

Diversity and distribution mapping of birds species associated with Deepor Beel

A total of 120 species of birds were recorded in and around the Deepor Beel during the study off which 80 are resident, 37 are winter migrants and 3 are summer visitors (Annexure 1). Of the 120, 67 species based on their morphology, behavior and habitat use were identified to be those likely impacted by power lines, and included those that are prone to collision risk (40 species), electrocution risk (21 species), and to both risks (6 species). Eight of these species recorded are globally threatened and included the Falcated Duck *Mareca falcata*, Common Pochard *Aythya ferina*, Ferruginous Duck *Aythya nyroca*, Greater Adjutant, Lesser Adjutant *Leptoptilos javanicus*, Oriental Darter *Anhinga melanogaster*, Northern Lapwing *Vanellus vanellus* and Slender-billed Vulture (Table 2). The Baer's Pochard a Critically Endangered species that has been previously reported at the Beel was not recorded during this study. It is possible that this duck may have gone unnoticed given its rarity. One other Critically Endangered species and reported from the Beel previously the White-rumped Vulture was also not recorded during this study. The Lesser Whistling Duck *Dendrocygna javanica* and Fulvous Whistling Duck *Dendrocygna bicolor* both resident species were commonly recorded across the Beel and the former was the most abundant duck species in the area.

Species that faced risk of collision were further observed to fall under two groups: Waterbirds (23 species) that included the Ducks, Geese, Coot, Gull, Tern, Cormorant; and Water Associate species (23 species) that included the Storks, Herons, Ibis, Egrets, Lapwings, Jacana. The diversity and distribution of these birds were therefore examined separately. Based only on the number of species recorded in a grid the Dharapur area in the northern part of the Beel (Grid # 15) had the highest of 35 species of both waterbirds (17 species) and water associates (18 species). This grid being a mosaic of shallow open water and marsh habitat resulted in the high species richness of the two species groups. This grid also had the highest overall average abundance of water associates and in the case of waterbirds it was second to the eastern parts (Grid #12) that had the highest. The Pat Gaon area (Grid # 1) with only five species had the lowest diversity, and only water associates were recorded there. This is because only a small part of this grid sampled is wetland, and the rest is habitations and forested tracts.

Table 2. List of select bird species recorded in Deepor Beel that are prone to power line related collision risk (40 species both waterbirds and water associates), electrocution risk (21 species) and to both (6 species).

| S. No | English Name | Scientific Name | Risk | Group* | IUCN Status |
|-------|-------------------------|---------------------------------------|-----------|--------|-------------|
| 1 | Fulvous Whistling Duck | <i>Dendrocygna bicolor</i> | Collision | W | LC |
| 2 | Lesser Whistling Duck | <i>Dendrocygna javanica</i> | Collision | W | LC |
| 3 | Bar-headed Goose | <i>Anser indicus</i> | Collision | W | LC |
| 4 | Greylag Goose | <i>Anser anser</i> | Collision | W | LC |
| 5 | Ruddy Shelduck | <i>Tadorna ferruginea</i> | Collision | W | LC |
| 6 | Cotton Pygmy Goose | <i>Nettapus coromandelianus</i> | Collision | W | LC |
| 7 | Garganey | <i>Spatula querquedula</i> | Collision | W | LC |
| 8 | Northern Shoveler | <i>Spatula clypeata</i> | Collision | W | LC |
| 9 | Gadwall | <i>Mareca strepera</i> | Collision | W | LC |
| 10 | Falcated Duck | <i>Mareca falcata</i> | Collision | W | NT |
| 11 | Eurasian Wigeon | <i>Mareca penelope</i> | Collision | W | LC |
| 12 | Indian Spot-billed Duck | <i>Anas poecilorhyncha</i> | Collision | W | LC |
| 13 | Mallard | <i>Anas platyrhynchos</i> | Collision | W | LC |
| 14 | Northern Pintail | <i>Anas acuta</i> | Collision | W | LC |
| 15 | Red-crested Pochard | <i>Netta rufina</i> | Collision | W | LC |
| 16 | Common Pochard | <i>Aythya ferina</i> | Collision | W | VU |
| 17 | Ferruginous duck | <i>Aythya nyroca</i> | Collision | W | NT |
| 18 | Great Crested Grebe | <i>Podiceps cristatus</i> | Collision | W | LC |
| 19 | Eurasian Coot | <i>Fulica atra</i> | Collision | W | LC |
| 20 | Brown-headed Gull | <i>Chroicocephalus brunnicephalus</i> | Collision | W | LC |
| 21 | Whiskered Tern | <i>Chlidonias hybrida</i> | Collision | W | LC |
| 22 | Oriental Darter | <i>Anhinga melanogaster</i> | Collision | W | NT |
| 23 | Little Cormorant | <i>Microcarbo niger</i> | Collision | W | LC |
| 24 | Common Moorhen | <i>Gallinula chloropus</i> | Collision | WA | LC |
| 25 | Grey-headed Swampphen | <i>Porphyrio poliocephalus</i> | Collision | WA | LC |
| 26 | Black-winged Stilt | <i>Himantopus himantopus</i> | Collision | WA | LC |
| 27 | Pied Avocet | <i>Recurvirostra avosetta</i> | Collision | WA | LC |
| 28 | Northern Lapwing | <i>Vanellus vanellus</i> | Collision | WA | NT |
| 29 | Grey-headed Lapwing | <i>Vanellus cinereus</i> | Collision | WA | LC |
| 30 | Red-wattled Lapwing | <i>Vanellus indicus</i> | Collision | WA | LC |
| 31 | Greater Painted-snipe | <i>Rostratula benghalensis</i> | Collision | WA | LC |
| 32 | Pheasant-tailed Jacana | <i>Hydrophasianus chirurgus</i> | Collision | WA | LC |
| 33 | Bronze-winged Jacana | <i>Metopidius indicus</i> | Collision | WA | LC |

| S. No | English Name | Scientific Name | Risk | Group* | IUCN Status |
|-------|----------------------------|-------------------------------|---------------|--------|-------------|
| 34 | Asian Openbill | <i>Anastomus oscitans</i> | Collision | WA | LC |
| 35 | Cinnamon Bittern | <i>Ixobrychus cinnamomeus</i> | Collision | WA | LC |
| 36 | Great Egret | <i>Ardea alba</i> | Collision | WA | LC |
| 37 | Intermediate Egret | <i>Ardea intermedia</i> | Collision | WA | LC |
| 38 | Little Egret | <i>Egretta garzetta</i> | Collision | WA | LC |
| 39 | Black-crowned Night Heron | <i>Nycticorax nycticorax</i> | Collision | WA | LC |
| 40 | Glossy Ibis | <i>Plegadis falcinellus</i> | Collision | WA | LC |
| 41 | Lesser Adjutant | <i>Leptoptilos javanicus</i> | Both | WA | VU |
| 42 | Greater Adjutant | <i>Leptoptilos dubius</i> | Both | WA | EN |
| 43 | Grey Heron | <i>Ardea cinerea</i> | Both | WA | LC |
| 44 | Purple Heron | <i>Ardea purpurea</i> | Both | WA | LC |
| 45 | Cattle Egret | <i>Bubulcus ibis</i> | Both | WA | LC |
| 46 | Indian Pond Heron | <i>Ardeola grayii</i> | Both | WA | LC |
| 47 | Eurasian Collared Dove | <i>Streptopelia decaocto</i> | Electrocution | - | LC |
| 48 | Spotted Dove | <i>Streptopelia chinensis</i> | Electrocution | - | LC |
| 49 | Yellow-footed Green Pigeon | <i>Treron phoenicopterus</i> | Electrocution | - | LC |
| 50 | Asian Koel | <i>Eudynamis scolopaceus</i> | Electrocution | - | LC |
| 51 | Osprey | <i>Pandion haliaetus</i> | Electrocution | - | LC |
| 52 | Oriental Honey Buzzard | <i>Pernis ptilorhynchus</i> | Electrocution | - | LC |
| 53 | Slender-billed Vulture | <i>Gyps tenuirostris</i> | Electrocution | - | CR |
| 54 | Crested Serpent Eagle | <i>Spilornis cheela</i> | Electrocution | - | LC |
| 55 | Pied Harrier | <i>Circus melanoleucos</i> | Electrocution | - | LC |
| 56 | Shikra | <i>Accipiter badius</i> | Electrocution | - | LC |
| 57 | Black Kite | <i>Milvus migrans</i> | Electrocution | - | LC |
| 58 | Spotted Owlet | <i>Athene brama</i> | Electrocution | - | LC |
| 59 | Short-eared Owl | <i>Asio flammeus</i> | Electrocution | - | LC |
| 60 | Indochinese Roller | <i>Coracias affinis</i> | Electrocution | - | LC |
| 61 | Peregrine Falcon | <i>Falco peregrinus</i> | Electrocution | - | LC |
| 62 | Rufous Treepie | <i>Dendrocitta vagabunda</i> | Electrocution | - | LC |
| 63 | House Crow | <i>Corvus splendens</i> | Electrocution | - | LC |
| 64 | Large-billed Crow | <i>Corvus macrorhynchos</i> | Electrocution | - | LC |
| 65 | Asian Pied Starling | <i>Gracupica contra</i> | Electrocution | - | LC |
| 66 | Common Myna | <i>Acridotheres tristis</i> | Electrocution | - | LC |
| 67 | Jungle Myna | <i>Acridotheres fuscus</i> | Electrocution | - | LC |

* W - Waterbirds, WA - Water Associates



The eastern parts of the Beel, the Grid # 11, 12, 13 together had the maximum number of waterbirds with 18 of 22 species. Most of the waterbird encountered here are the migratory ducks and geese (13 species). The Beel here was primarily open water and is bounded by the embankment of a railway line resulting in the area being relatively deeper (on average one meter). It is also here where the River Kalamani that is polluted opens into the Beel and it appears that a high nutrient load may have resulted in higher availability of food to the birds, influencing their presence and abundance. The maximum number of water associate species on the other hand were found in the western parts of the Beel, the Grid # 9 & 15 together had 19 of 23 species. Similarly, the eastern parts of the Beel, the Grid # 7 & 13 together had a high number of these species, with 17 of 23 recorded there.

The Endangered Greater Adjutant and the Vulnerable Lesser Adjutant storks were seen in 13 and 14 of the 20 grids respectively, and were regularly seen in Grid # 7 & 13 specifically. The Boragaon disposal site falling in the Grid # 7 is where the Adjutant storks congregated in large

numbers to forage on the garbage. On one sampling session, 40 and 75 Greater Adjutants were recorded in the Grid # 7 & 13 respectively. Sighting records of over 500 Greater Adjutant storks at one time have been reported at this disposal site (Don Roberson, www.ebird.org/india). Elsewhere across the Beel, the Lesser Adjutant was mostly observed in pairs or solitary, while the Greater Adjutant were seen in small flocks of three to nine individuals and in large flocks as mentioned above. On the whole, Lesser Adjutant were observed to be relatively less common in Deepor Beel than Greater Adjutant storks.

The six other threatened species recorded during the study: the Vulnerable Common Pochard was recorded in 8 of the 20 grids and a highest of 100 individuals was seen in Grid # 19; the Near-Threatened Ferruginous Duck occurred in 13 grids and a highest of 88 individuals was recorded in Grid # 13; the Near-Threatened Oriental Darter was recorded in 8 grids and a highest of 25 individuals was seen in Grid # 11 & 15; and lastly the Near-Threatened Northern Lapwing was seen in four grids and a highest of 15 individuals were recorded in Grid # 4 & 11. The Near-Threatened Falcated Duck, a lone male individual was sighted once in the company of other ducks at Grid # 19. Similarly, a Slender-billed Vulture in flight was sighted only once beyond the Azara railway yard during the study.



An average Simpson's Evenness Index (SEI) of the grids sampled showed waterbirds and water associate species together with their populations to be variable, further signifying certain areas across the Beel to be more important than others (Figure 4 & 5). The interquartile range in the case of waterbirds was widest in the Grid # 4, 5 & 8 as on many of the sampling sessions either only few or no birds were recorded there. In Grid # 4 & 5 relatively high human disturbance due to the presence of the Azara-Garchuk road and habitations, along with tourism activity likely influenced waterbirds there. In Grid # 8 much of the area is dry land with shrub cover and the rest was covered with water hyacinth, not a suitable habitat of waterbirds. Similarly, in the case of water associates, Grid # 8, 17 & 19 with 8, 12 & 14 species respectively had wide inter-quartile range. Many of the species recorded there were only seen on few occasions and in relatively low numbers. The Grid # 8 again appeared unsuitable for these birds and the few species that occurred there were only recorded sporadically. In Grid # 19 and 17 fishing activity by local people appears to have influenced water associate species presence.

From the above, the waterbirds in the area appeared to potentially face a lesser risk of collision with the existing transmission line located along the southern fringe of the Beel as the areas they primarily occurred were quite distant, on an average 2 km away. The water associates on the other hand particularly the threatened Greater and Lesser Adjutant were recorded across the Beel and as a result likely face a higher risk of collision or electrocution due to power lines. Around the Boragaon disposal site particularly, the two species congregated in very large numbers and the presence of two 11 kV distribution lines in the immediate vicinity likely pose serious risk of electrocution to the birds.

Figure 4. The species richness, overall average abundance of both waterbirds and water associate species across the Deepor Beel wetland along with the Simpson's Evenness Index were found to be markedly different between and among the two species groups indicating differences in their use of the area.

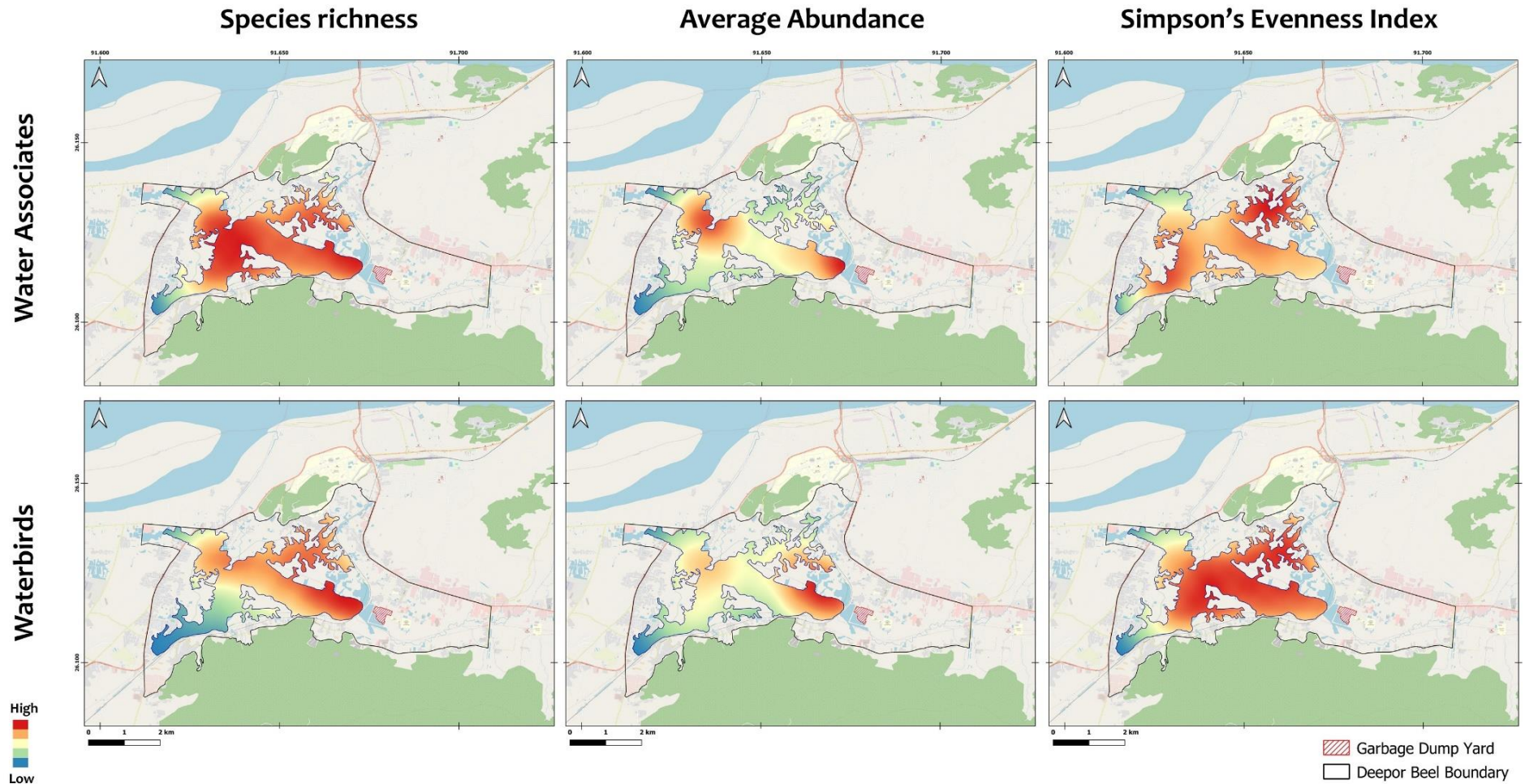
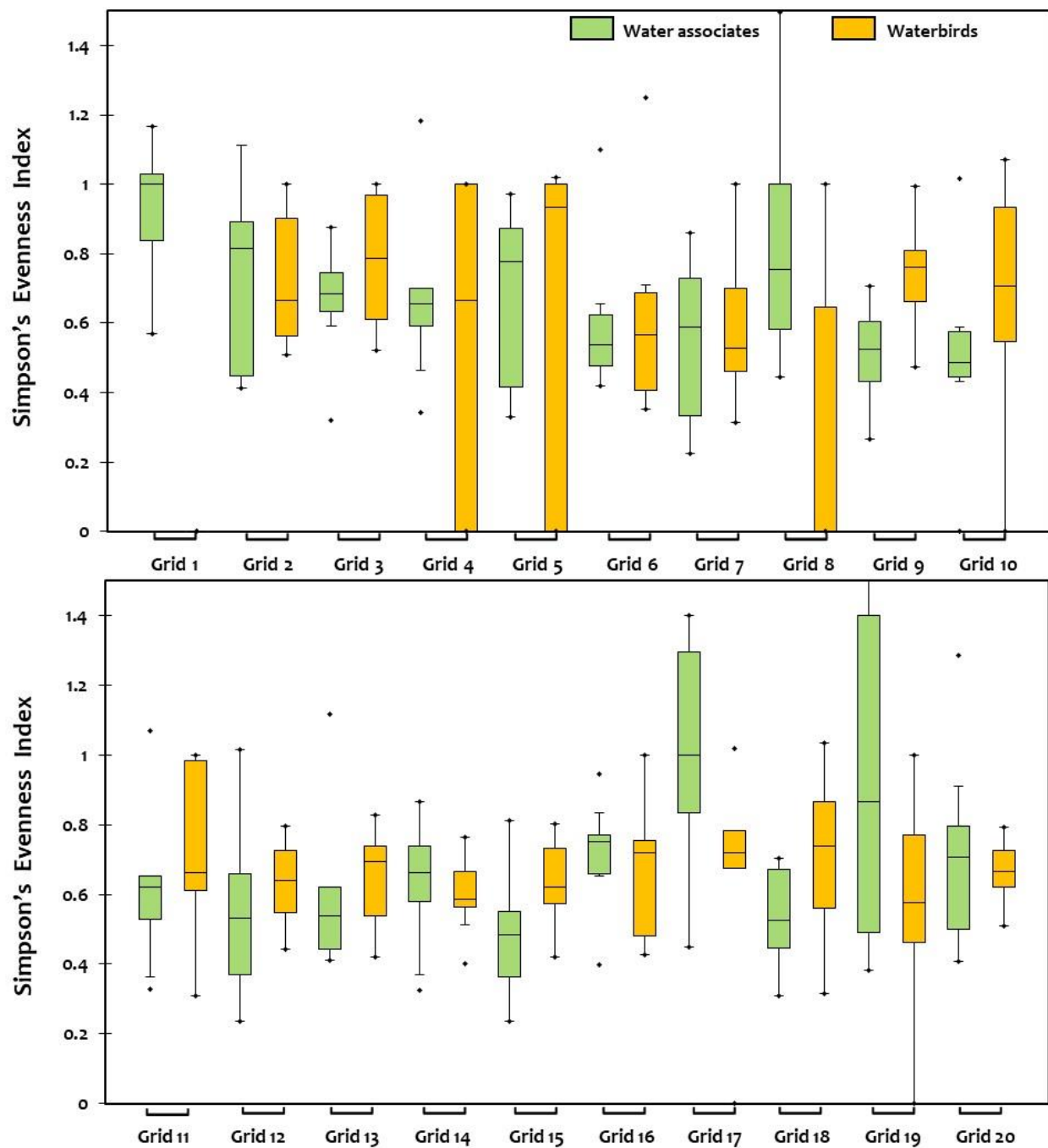


Figure 5. Box plots showing the Simpson's Evenness Index of waterbirds and water associates across the 20 grids surveyed during the study period. Diversity of waterbirds was found to be fluctuating across the grids whereas water associated birds are evenly distributed across the whole area.



Transmission lines and collision risk

A total of 60 hours were spent observing birds crossing the five transmission line spans during the study. This involved 12 hours of observations across different days in each line span, and during this 232 crossings of individual birds/bird flocks totaling 833 individuals of 20 species prone to collisions with power lines were recorded (Table 3). Apart from this, 106 other observations of line crossings by birds (258 individuals) were recorded and these were of the commonly occurring House crow and Black Kite that face no or low risk of collision with power lines, and their observations were not included in the analysis here.

The 20 species recorded crossing the line spans included only four waterbirds, while the rest were water associates. This was expected as during the distribution surveys most waterbirds including the migratory ducks that occurred in large flocks primarily used the Beel well away from the transmission line. It is to be highlighted here that most of these birds were not observed flying towards the southern fringe of the wetland and instead flew out in the direction of the river Brahmaputra to the north. Further, as the southern side of the wetland is bounded by the hill section of the Rani-Garbhangra Reserve Forest that extends into Meghalaya, and this being not a suitable habitat for waterbirds is likely the reason for few observations of these birds crossing the transmission line.

Three of the 20 species: Cattle Egret with the highest of 61 sightings, Lesser Whistling Duck with 39 sightings and Indian Pond Heron with 34 sightings together contributed 58% of the observations of bird flocks or individuals crossing the transmission line (Table 3). The Lesser Whistling Duck being the most commonly seen duck species in the area and occurring in small to large flocks crossed the line spans the most, with 438 individuals recorded crossing. Across the line spans, the span 1 had the highest number of observations ($n = 88$), and also the highest of 14 species out of 20 crossing the line. This is because this line span passes over a water expanse cutting across the Beel and birds were observed using the area on either side.

Table 3. The list of bird species prone to collision with power lines observed crossing the five different spans of the 220 kV transmission line at Deepor Beel during the study. The numbers given here refer to the total line crossing observations or sightings and those given in parenthesis refer to total individual birds observed.

| S. No | Species | Transmission Line Span | | | | | All |
|---------------------------|---------------------------|------------------------|----------------|----------------|----------------|----------------|------------------|
| | | 1 | 2 | 3 | 4 | 5 | |
| 1 | Cattle Egret | 9 (13) | 12 (15) | 11 (20) | 18 (27) | 11 (14) | 61 (89) |
| 2 | Lesser Whistling Duck | 36 (425) | - | - | 3 (13) | - | 39 (438) |
| 3 | Indian Pond Heron | 5 (9) | 7 (9) | 6 (7) | 12 (15) | 4 (5) | 34 (45) |
| 4 | Greater Adjutant | - | - | - | - | 16 (24) | 16 (24) |
| 5 | Asian Openbill | 4 (5) | 3 (3) | 3 (3) | 3 (3) | - | 13 (14) |
| 6 | Fulvous Whistling Duck | 11 (88) | - | 2 (11) | - | - | 13 (99) |
| 7 | Little Egret | - | 3 (4) | 2 (2) | 6 (7) | - | 11 (13) |
| 8 | Red-wattled Lapwing | 6 (12) | - | 1 (2) | 2 (4) | - | 9 (18) |
| 9 | Intermediate Egret | 2 (3) | 3 (4) | - | 1 (1) | 2 (2) | 8 (10) |
| 10 | Lesser Adjutant | 1 (1) | - | - | - | 4 (4) | 5 (5) |
| 11 | Purple Heron | 4 (5) | - | 1 (1) | - | - | 5 (6) |
| 12 | Grey-headed Swampphen | 4 (6) | - | - | - | - | 4 (6) |
| 13 | Grey-headed Lapwing | - | - | 2 (8) | 1 (7) | - | 3 (15) |
| 14 | Little Cormorant | - | - | 1 (2) | 2 (2) | - | 3 (4) |
| 15 | Great Egret | 2 (3) | - | - | - | - | 2 (3) |
| 16 | Whiskered Tern | 2 (32) | - | - | - | - | 2 (32) |
| 17 | Black-crowned Night Heron | - | 1 (2) | - | - | - | 1 (2) |
| 18 | Bronze-winged Jacana | 1 (1) | - | - | - | - | 1 (1) |
| 19 | Cinnamon Bittern | - | 1 (1) | - | - | - | 1 (1) |
| 20 | Glossy Ibis | 1 (8) | - | - | - | - | 1 (8) |
| Total Observations | | 88 (611) | 30 (38) | 29 (56) | 48 (79) | 37 (49) | 232 (833) |

It was also at this line span where the Lesser Whistling Duck was recorded most frequently crossing, 425 individuals of its total 438 crossed here. The line span 3 & 2 with 29 and 30 observations respectively had the lowest number of bird crossings relatively. And, this is because these two line spans pass close to the hills along the southern fringe of the wetland and also this part of the Beel (Grid # 4 & 5) is relatively less used by birds. At span 5 only five species were observed crossing the line and it was only here that the Greater Adjutant (24 individuals) was recorded. The Lesser Adjutant (4 out of 5 individuals) was again primarily recorded crossing the line here. This is likely as a result of the proximity to the Boragaon disposal site where these two Adjutant storks primarily foraged. The birds that crossed the adjoining line span 4 were also those that are attracted to garbage dumps as was observed from the relatively higher number of Cattle Egret (18 observations of 27 individuals) and Indian Pond Heron (12 observations of 15 individuals) crossing there.

On closer examination of the 232 observations of line crossings by birds, a total of 589 individuals of 130 observations (56%) responded to the line (Table 4). There were 16 species out of the 20 that showed visible response to the line spans. The four species with no response observed were the Grey-headed Swamphen, Whiskered Tern, Bronze-winged Jacana and Cinnamon Bittern. The visible response recorded was either gaining or lowering their flight height, or changed their course, and in many others the birds flying in flocks split up when attempting to cross the line and then few changed course while others flew through the line, or above or below. Here again, as expected line span 1 had the highest observation of 56 involving 466 individual birds showing visible response to the line while crossing. Further, 64% of these responses were of the Lesser Whistling Duck alone (374 individuals).

In those observations (n = 102) where no response could be discerned, it was not visible whether the birds were aware of the presence of the line or that they made a conscious attempt to avoid the line. In 22 of these cases, birds flew just above the earth wire clearing the line safely, while in 80 other cases, the birds crossed the line below the lowest conductor wire. Further, in the latter case, a highest of 31 observations were at span 1 which was over water and it is likely that birds using that area avoided the line obstructing their flight path by flying below it. The Lesser and Fulvous Whistling Duck, Purple Heron,

Grey-headed Swamphen and few others observed crossing here are also those birds that used areas with aquatic vegetation and when in such habitat they generally fly low over the surface moving between patches. The Span 4 with 23 observations of birds crossing from below were primarily Cattle Egret and Indian Pond Heron and these birds foraged in the open meadows around the line and likely moved in and out of the Boragaon disposal site nearby to the forest tract across the line.

Table 4. Sixteen of the 20 bird species that showed a response in the form of change in flight behavior while crossing the five spans of the transmission line during the study. The numbers given here refer to the total line crossing observations or sightings and those given in parenthesis refer to total individual birds observed.

| S. No | Species | Transmission Line Span | | | | | All |
|---------------------------|---------------------------|------------------------|----------------|----------------|----------------|----------------|------------------|
| | | 1 | 2 | 3 | 4 | 5 | |
| 1 | Cattle Egret | 6 (8) | 6 (8) | 6 (12) | 9 (14) | 6 (8) | 33 (50) |
| 2 | Lesser Whistling Duck | 30 (374) | | | 2 (7) | | 32 (381) |
| 3 | Indian Pond Heron | 2 (5) | 4 (6) | 3 (3) | 4 (6) | 3 (4) | 16 (24) |
| 4 | Greater Adjutant | | | | | 3 (3) | 3 (3) |
| 5 | Asian Openbill | 3 (4) | 2 (2) | 3 (3) | 2 (2) | | 10 (11) |
| 6 | Fulvous Whistling Duck | 6 (54) | | 2 (11) | | | 8 (65) |
| 7 | Little Egret | | 2 (3) | 2 (2) | 2 (3) | | 6 (8) |
| 8 | Red-wattled Lapwing | 4 (8) | 2 (3) | | 2 (4) | | 8 (15) |
| 9 | Intermediate Egret | 2 (3) | | | 1 (1) | 2 (2) | 5 (6) |
| 10 | Lesser Adjutant | | | | | 1 (1) | 1 (1) |
| 11 | Purple Heron | 1 (1) | | 1 (1) | | | 2 (2) |
| 12 | Grey-headed Lapwing | | | 1 (4) | 1 (7) | | 2 (11) |
| 13 | Little Cormorant | | | | 1 (1) | | 1 (1) |
| 14 | Great Egret | 1 (1) | | | | | 1 (1) |
| 15 | Black-crowned Night Heron | | 1 (2) | | | | 1 (2) |
| 16 | Glossy Ibis | 1 (8) | | | | | 1 (8) |
| Total Observations | | 56 (466) | 17 (24) | 18 (36) | 24 (45) | 15 (18) | 130 (589) |

High Risk Crossings

A total of 71 observations of the 130 (55%) were classified as high risk crossings involved birds flying through the transmission line either between the earth wire and conductor wire (27 observations of 86 individuals), or between conductor wires (44 observations of 105 individuals) (Table 5). These high risk crossings by birds were observed in all five spans though most were recorded in Span 1 & 4, with 21 (117 individuals) and 18 (31 individuals) respectively. The maximum number of high risk crossings were made by two common species in the area: Cattle Egret of 27 observations (39 individuals) and Lesser Whistling Duck of 12 observations (86 individuals). The Greater Adjutant was observed making the high risk crossing only on two occasions, while Lesser Adjutant only once and all of these were at the line Span 5. No other threatened species in the area was observed attempting these high-risk crossings. Further, apart from the 71 high risk crossings, 23 other observations wherein flocks splitting up on approaching the line and attempting to cross the line were observed. These involved a total of 264 individual birds with many crossing through the wires, while other crossing above the earth wire or below the conductor wire though these could not be clearly segregated.

No collisions of birds with the line spans were observed during the study, though the Deepor Beel Forest Department personnel informed of two separate cases of collision with the transmission line at Span 3 & 4 of Asian Openbill during April-May 2020. During this study, however dangerous interactions of birds with the lines in the form of near collision (23 observations) and flaring behavior (four observations) were observed. Most of these dangerous interactions were again observed at line Span 1 (20 observations involving 268 individuals), followed by Span 3 & 4 with 4 (13 individuals) and 3 (9 individuals) observations respectively. There were a total of eight species that were involved in these dangerous interactions and they were the Lesser Whistling Duck, Fulvous Whistling Duck, Indian Pond Heron, Asian Openbill, Intermediate Egret, Little Egret, Cattle Egret and Red-wattled Lapwing.

From the above, the Span 1 of the transmission line passing along the southern fringe of the Beel was found to pose relatively higher collision risk to both waterbirds and water

associate species. The other line section that is of concern is Span 5, which section had the highest number of line crossings by the two globally threatened adjutant stork species. The proximity of line Span 5 to the Boragaon disposal site further increases the probability of collision risk of adjutant storks at this span.

Table 5. The change in flight behavior and associated high risk crossings by birds while crossing the 220 kV transmission line spans observed during the study at Deepor Beel.

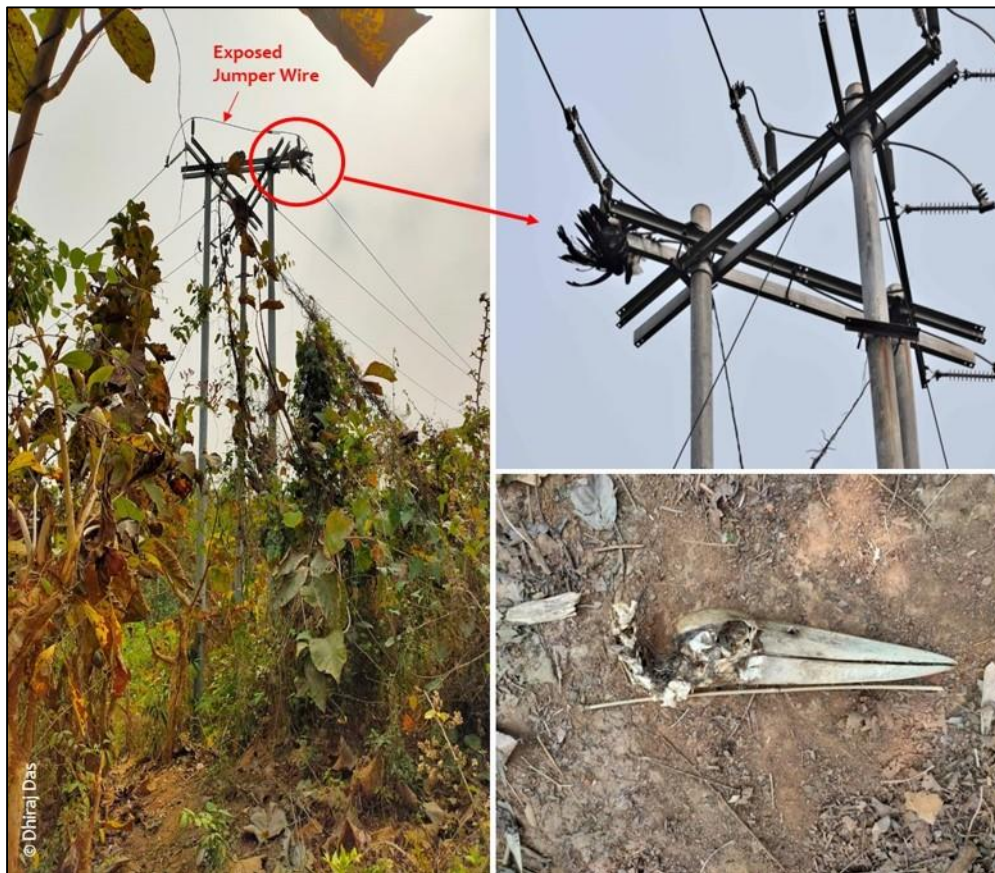
| Crossing Type | Over Earth wire | High Risk Crossings | | Below conductor wire | Overall |
|-----------------------|---|--------------------------------|---|----------------------|------------------|
| | | Between Earth & conductor wire | Between conductor wire | | |
| Gained/Lowered Height | 6 (20) | 27 (86) | 35 (78) (2 flared, 4 Near collision) | 18 (63) | 86 (247) |
| Changed Course | 2 (2) | - | 9 (27) (4 Near Collision) | 10 (49) | 21 (78) |
| Flock Splitting | 23 (264) (2 flared, 15 Near Collision) | | | | 23 (264) |
| Total | 8 | 27 | 44 | 28 | 130 (589) |





Distribution lines and electrocution risk

To record electrocution related mortality of birds in and around the Beel a total of 350 hours were spent surveying the 11 kV (28 lines) and 33 kV (2 lines) distribution lines, and the lines were surveyed once every 10 days from January through May. Only one case of a Greater Adjutant mortality due to electrocution on a 33 kV line was recorded during the study. This electrocution was on a 3-pole type power pole, which is part of the 33 kV line passing along the southern boundary of the Beel. This specific power pole was part of a span passing through a forested tract of the Rani-Gharbanga Reserve Forest, and was located on a hilly slope, 200 m straight-line distance to the Beel. The structural design of the power pole with 3-meter-long cross arm provided an ideal perching site for large birds like the adjutant storks, and with exposed jumper wires as seen on this pole (See image below) it proved fatal to the bird. The Deepor Beel Forest Department personnel informed of two similar such incidences of electrocution having occurred earlier in the same area.



The remains of a Greater adjutant stork that was observed at the base of the 33 kV power pole that resulted from electrocution

An electrocution risk assessment of the 333 and 1000 power poles of the two 33 kV and twenty-eight 11 kV distribution lines in the area respectively it was found that the poles were highly variable in their structural design and posed differential risks to birds. There were 23 different pole types in 33 kV and 17 types in 11 kV lines (Table 6; Annexure 3). These were assigned to five different risk type classes and was based on the design (number of poles that ranged from 1 to 4, cross arm length, exposed jumper wires present, insulated or not), and what bird species potentially used those poles for perching. The larger or complex pole structures with 2 or more poles at each point and with longer cross arm were classed under Very High and High risk types, and were found to pose serious electrocution risk to birds, specifically to large bodied birds. Together these two types accounted for 34 % and 22% of all the 33 kV and 11 kV poles in the area respectively. On the other hand, the only section that posed no risk to birds was a short stretch of 11 kV line (500 meter) along the perimeter of the Boragaon disposal site. This line stretch with 16 poles and including jumper wires was insulated and so posed no electrocution risk to birds. However, this 11 kV line from one corner of the disposal site and for its remaining length of one km was not insulated and posed electrocution risk.



Table 6. The details of the different power pole types of the 33 kV and 11 kV lines observed in the area and assigned to the five different risk type classes

| S. No | Risk Type | 33 kV | | | 11 kV | | |
|-------|-----------|------------|------------|-------------------------------------|-------------|------------|-------------------------|
| | | # of poles | # of types | Type ID | # of poles | # of types | Type ID |
| 1 | Very High | 39 | 3 | 3A, 4A, T33 | 45 | 3 | 3A, 4A, T11 |
| 2 | High | 75 | 6 | 2A, 2B, 2C, 2D, 2E, 2F | 171 | 6 | 2A, 2B, 2C, 2D, 2E, 1 G |
| 3 | Medium | 180 | 9 | 1B, 1C, 1F, 1G, 1H, 1J, 1K, 1L, 1M, | 31 | 3 | 1E, 1F, 1H |
| 4 | Low | 39 | 5 | 1A, 1D, 1E, 1I, 1N | 737 | 5 | 1A, 1B, 1C, 1D, 1I |
| 5 | No Risk* | - | - | - | 16 | | 1B, 1C, 2A, 2B |
| | | 333 | 23 | | 1000 | 17 | |

* 16 poles of four different types seen in one distribution line located adjoining the Boragaon disposal site were categorized as “No Risk” poles since they were insulated and posed no risk of electrocution to birds

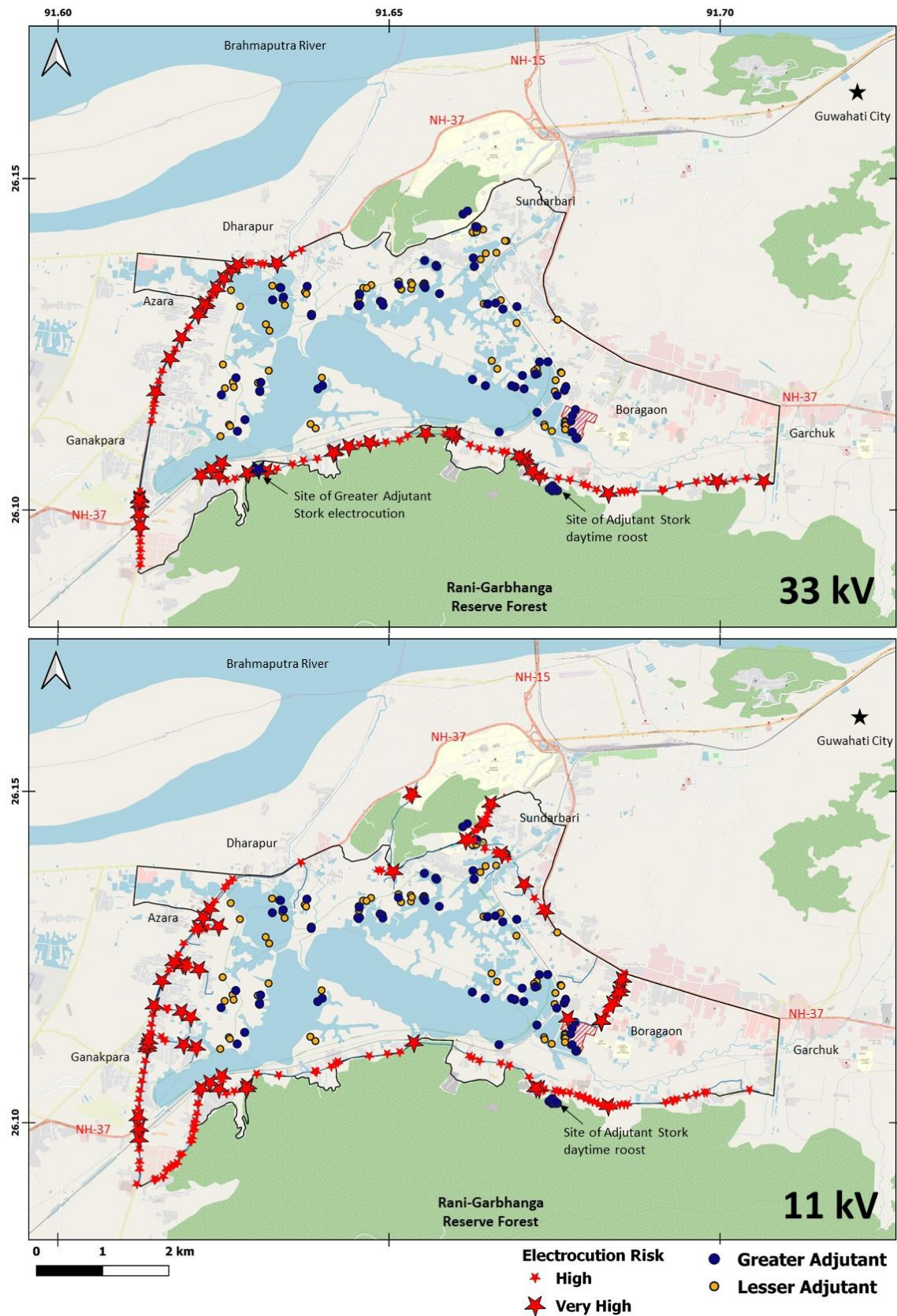
Large birds particularly adjutant storks and vultures were found to face higher electrocution risk in the area at power poles that were either with three or two pole design, and those that had transformers. These pole types had relatively longer cross arm (2 to 3 meter), placed horizontally at the top and with multiple cross arms on the same pole providing ideal platform for large birds to perch. While the separation distance between phase wires in these pole types were more and are likely safe for smaller body size birds, this was not the case for larger bodied birds. Added to this, is the presence of exposed jumper wires present on many of these poles increasing the risk of contact between conducting surfaces by the birds simultaneously and resulting in electrocution. These high risk pole types were present on all distribution lines

mapped and across the area. This is of concern as both Greater and Lesser Adjutant stork also occurred across the wetland, though were seen in higher numbers in and around the Boragaon disposal site (Figure 6).

The distribution lines along the southern boundary particularly appears to pose serious risk to the Adjutant storks as the storks appeared to use the forested tracts in the Rani-Garbhangra Reserve Forest as day roost. The storks appeared to shuttle between the forest to the Beel or to the disposal site. With power poles located within the forested tract the Adjutants may readily take to perching atop it, and in the process become prone to electrocution.



Figure 6. The sighting locations of the two Adjutant stork species recorded in and around Deepor Beel during the study along with the locations of 11 kV and 33 kV distribution line power poles that pose Very High/High electrocution risk to the species.



The other relatively large bird species prone to electrocution risk and often observed on power lines in the area was the Black Kite *Milvus migrans*. The kites were recorded in all the 20 grids of this study, though they occurred in large flocks numbering more than 200 individuals in few select grids during January and February, and thereafter their numbers declined. Two such large congregations of kites were observed particularly in Grid # 2 & 6 where they communally roosted on trees at night, and during the day were found resting on transmission line pylons there and on the ground next to it. A highest of 300 kites congregating together was counted once during the grid survey.

The kites were observed to leave the roost tree every morning and shuttle between the transmission line pylons where they roosted during the day and the Boragaon disposal site where they foraged. A large population of kites remained through the day in Grid # 6 as here they appeared to scavenge for food remains left by large number of picnickers visiting the area throughout January on a daily basis. The Black Kites in the area appear to be composed of populations of the migratory subspecies *Milvus migrans lineatus*, which subspecies is a winter visitor to the Indian Subcontinent and likely arrive from Mongolia, China and Russia. The decline in number of kites during the study from early March onwards suggests the populations to may have returned on their spring migration to their breeding grounds.



The spatial distribution and use of pylons for day roost by Black Kites during this study was quite predictable, and it appears the kites may not be using the distribution line power poles in the area that often. The kites are however likely to be at risk of electrocution particularly around the disposal site even though no mortalities were recorded during this study. The transmission line pylons where the kites congregated in large numbers posed no electrocution risk as the high voltage phase wires are well separated from conducting surfaces. Further, the kites while in flight were observed to clearly negotiate the transmission line conductor and earth wires, and appeared to escape the risk of collision.

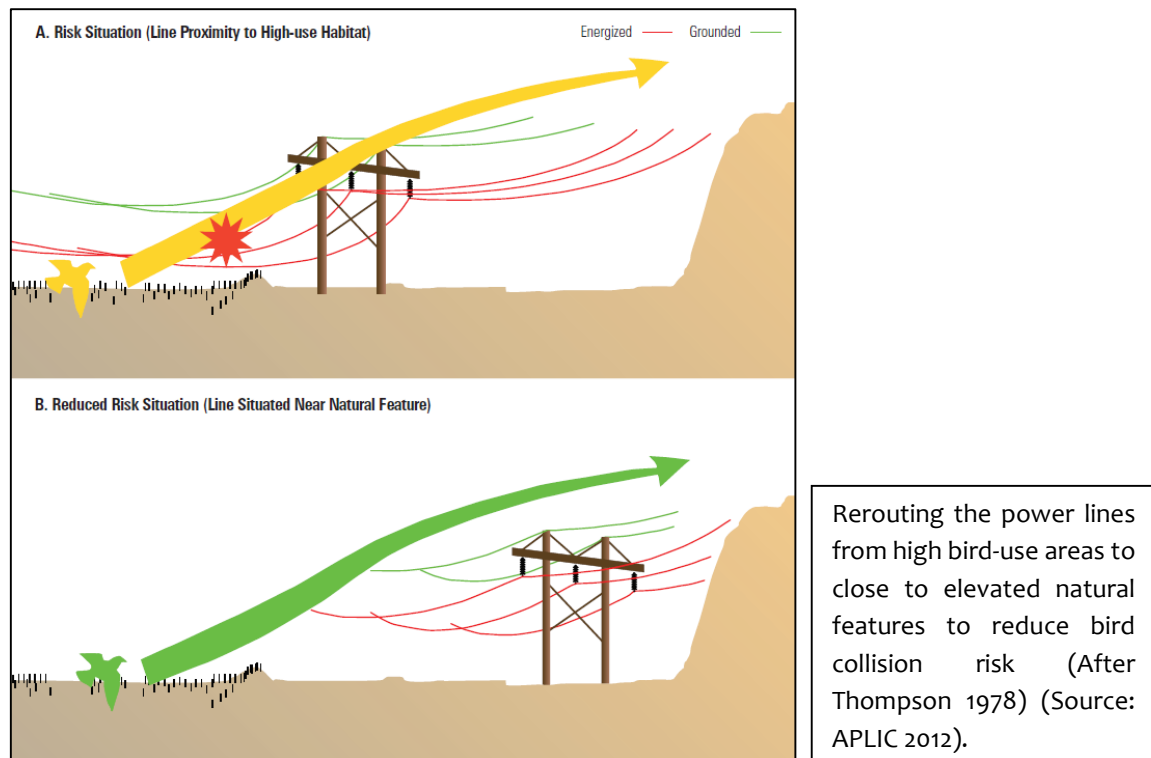
From the above, the structural design of the distribution line power poles dictates electrocution risk of birds in the area, and the pole types affects bird species differently. The power poles located along the southern boundary on the 33 kV and 11 kV line particularly pose serious risk of electrocution to threatened birds like Adjutant storks and Vultures, and to other large bodied birds like Crested Serpent Eagle and Oriental Honey Buzzard associated with the forested habitat there. A number of smaller bird species commonly occurring in the area also readily use distribution line power poles as perch, and a number of these poles in the area pose risk of electrocution. Further, garbage being a major attractant to a number of birds and the presence of power lines nearby increases the probability of electrocution.



Measures to mitigate or minimize power line risks to birds in and around Deepor Beel Ramsar Site

Collision and electrocution risk posed by power lines to birds is influenced by multiple factors that includes structural design of power lines, topography or physical features of the landscape, seasonality, weather conditions and biological traits of bird species. In line with this, the magnitude of the power line risks to birds was observed to vary across the Deepor Beel site, and across time and species. The measures suggested here to mitigate or minimize the impact of power lines on birds follows the guidance document “Eco-friendly measures to mitigate impacts of linear infrastructure on wildlife” (WII, 2016), and others such as APLIC (2006, 2012) and Prinsen et al. (2012). Many of these suggested measures or actions are widely adopted world over.

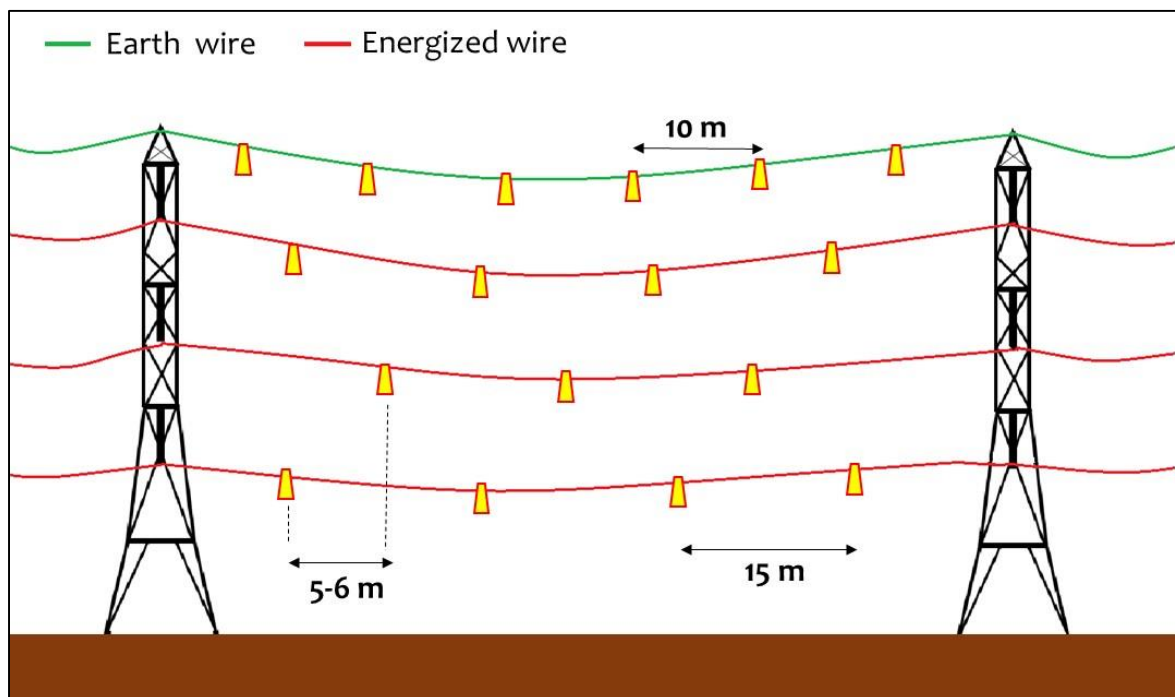
- **Routing:** The foremost mitigation measure specifically with regard to collision risk to birds is to consider the placement or routing of power lines in the landscape. It is recommended that power lines should be avoided or routed through or near to high bird-use areas as birds will likely encounter the lines more often while landing and taking off increasing the risk of collision. Also, it is recommended that the lines be placed closer to elevated natural features like hill slopes. At Deepor Beel, most parts of the single 220 kV transmission line does adhere to the above in being placed close to the elevated natural feature of the Rani-Gharbanga Reserve Forest. However, few spans of this line in particular the Span # 1 identified in this study passes over a water expanse, which area was observed used by birds. It was also here that the maximum number of dangerous crossings of the line by birds was recorded during the study. To mitigate the potential risk posed by this line span it is suggested that the section of this transmission line starting from Azara station to the line Span # 2 identified in this study (spanning approx. 2.5 km) be rerouted from its current route cutting through the wetland to south of the Azara Railway Yard along the Garchuk road.



- **Undergrounding Power line:** In cases where rerouting is not possible it is recommended to place the problematic stretch of the power line underground. This may be considered for the case at Deepor Beel, though this again comes with its limitations specifically that the line span in question passes over water and placing the line underwater may be challenging.
- **Wire Marking:** In a situation where the power line cannot be rerouted or placed underground then to mitigate the risk of collision a suspended wire marking device or Bird Diverter is used. This is not a permanent mitigation measure as the diverters require to be monitored and maintained periodically. Bird collisions with power lines are reported to frequently occur with the earth wires, and it is this wire that is generally marked with line marking devices. This is particularly the case in western countries and in terrestrial habitats where few species of large birds occur and in low densities. This is unlike the case in tropical regions like in Deepor Beel where there are number of large-bodied species that encounter transmission lines and become vulnerable to both earth and conductor wires. Therefore, it is suggested to mark all wires in the transmission line

spans. The Central Electricity Authority (CEA) in India had produced a technical specification on the use of bird diverters (Anonymous, 2021). It specified the installation of line marking devices on all conductors and earth wire in identified stretches as per requirement to avoid the chances of collision of birds. Based on the above, it is suggested that line marking of the problematic transmission line sections at Deepor Beel specifically, span # 1 and Span # 5 be taken up so as to mitigate collision risks.

- The CEA suggests that one BFD should be installed at every 10 m on the earth wire and again one BFD should be installed at every 15 m on conductor wires in a staggered pattern such that as a whole, the power line will have effectively one diverter at every 5 m to 6 m.



(Schematic diagram showing the positioning of BFDs on earth wires or energized wires of the transmission line)

- **Bird Flight Diverter (BFD):** The BFDs of the suspended type are generally preferred as they readily spin and this increases visibility of the marked line to birds in flight passing through the area. Also, the recommended BFDs should have reflectors on it so as to refract sunlight that can be visible to birds from far. The BFDs should also have

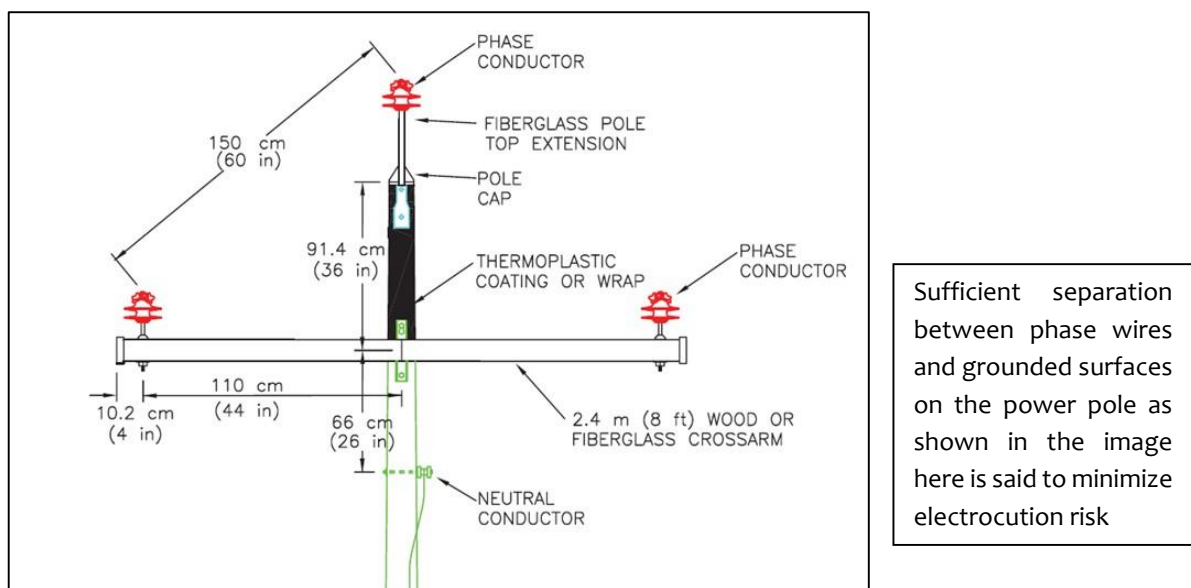
luminescent material so as to glow in the dark and stay lit for long hours after dusk, and also be visible in low light or fog conditions, when birds are most vulnerable. The installation of BFDs on an existing line is simple and fast, and can be installed either by hand or through drones.



The glow in the dark suspended bird flight diverters are widely used around the world to mitigate the risk of bird collision

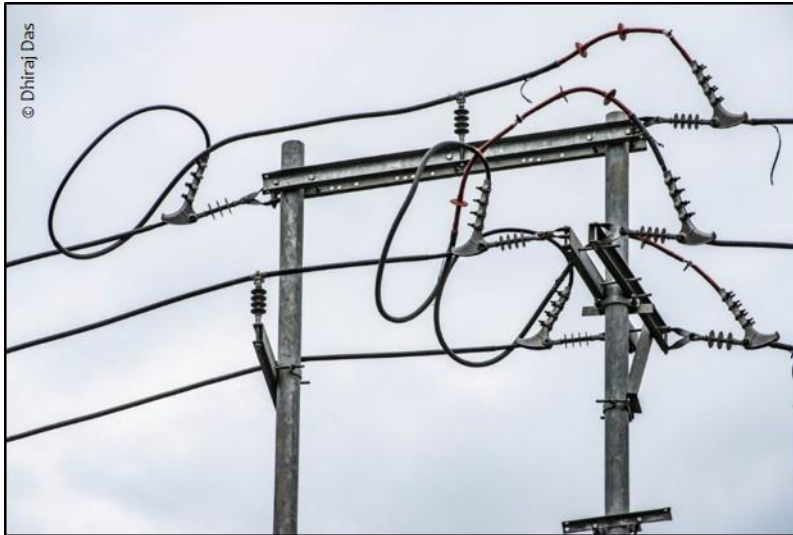
- In a situation where the transmission line at Deepor Beel is marked with BFDs a study to assess its **efficacy in mitigating collision risk** to birds will require to be taken up. This study should be for a minimum period of one year so as to cover different seasons and involve systematic observations to record behavior of birds in flight while crossing the marked lines.
- Measures suggested to **mitigate electrocution risks** to birds, which is associated with distribution lines is generally again rerouting or undergrounding of problematic sections. This is a long-term measure however, given the innumerable number of distribution lines in and around Deepor Beel and that birds vulnerable to electrocution risk occur across the area rerouting may not be effective, while undergrounding the lines in the area is likely to be an expensive proposition. In situations where these two mitigation measures are not possible retrofitting existing power lines specifically the configuration of the power pole design is recommended to be taken up.

- The **pole design** should primarily consider providing sufficient separation between energized conductors or phases and grounded hardware. The separation distances can be increased by increasing cross-arm length, lowering the position of cross-arm on pole, or installing fibreglass pole extension to elevate the top conductor. Installation of phase wires below the cross arms, using suspension insulators is said to reduce electrocution risk. A 33 kV line section in the area had phase wires installed using suspended insulators (Pole type 1E).



Source: APLIC 2006

- **Insulation:** At Deepor Beel the pole design observed were highly variable making it complex in arriving at a solution. This study however identified power poles that pose serious risk to threatened species such as Adjutant Storks. To prevent electrocutions at these power poles it is suggested that the energized conductor wires, jumper wires and other conducting surfaces be covered by a non-conductor insulation material. Additionally, use fuse cut-out covers, arrester caps and insulation riser termination where necessary. These will require periodic monitoring and maintenance as the insulation material do weather over time and the line may once again pose electrocution risks.



The conductor and jumper wires of this distribution line near Boragaon disposal site were fully insulated. Insulation of high and very high risk poles in the area in a similar way can mitigate the risk of electrocution.

- As a short-term measure discouraging birds from perching on distribution line power poles can be adopted. For this, **perch discouragers** such as brush, spikes and pointed deterrents can be mounted on the cross-arms. However, the installation of perch discouragers may displace birds to other poles where there are no perch discouragers, and therefore should only be used where there are natural perches available in the area. This again will require regular monitoring and maintenance.
- Lastly, **new power lines** that may be proposed to be placed in and around Deepor Beel should avoid placement and routing through high-use areas of birds identified in this study. Further, optimization of the existing transmission line pylon by increasing the voltage capacity and or number of conductors should be considered. This is to avoid placement of any additional transmission line in the area that may increase the collision risk to birds. New distribution lines planned should consider a single pole design standard with sufficient separation between conducting surfaces to avoid electrocution risks.

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Annexure 1

The list of birds recorded in and around Deepor Beel during the study. (R: Resident, WM: Winter Migrant, SM: Summer Migrant, LC: Least Concern, NT: Near Threatened, VU: Vulnerable, EN: Endangered)

| S. No. | Common Name | Scientific Name | Resident / Migratory | IUCN Status |
|---|----------------------------|---------------------------------|----------------------|-------------|
| Order: Anseriformes Family: Anatidae | | | | |
| 1 | Fulvous Whistling Duck | <i>Dendrocygna bicolor</i> | R | LC |
| 2 | Lesser Whistling Duck | <i>Dendrocygna javanica</i> | R | LC |
| 3 | Bar-headed Goose | <i>Anser indicus</i> | WM | LC |
| 4 | Greylag Goose | <i>Anser anser</i> | WM | LC |
| 5 | Ruddy Shelduck | <i>Tadorna ferruginea</i> | WM | LC |
| 6 | Cotton Pygmy Goose | <i>Nettapus coromandelianus</i> | WM | LC |
| 7 | Garganey | <i>Spatula querquedula</i> | WM | LC |
| 8 | Northern Shoveler | <i>Spatula clypeata</i> | WM | LC |
| 9 | Gadwall | <i>Mareca strepera</i> | WM | LC |
| 10 | Falcated Duck | <i>Mareca falcata</i> | WM | NT |
| 11 | Eurasian Wigeon | <i>Mareca penelope</i> | WM | LC |
| 12 | Indian Spot-billed Duck | <i>Anas poecilorhyncha</i> | R | LC |
| 13 | Mallard | <i>Anas platyrhynchos</i> | WM | LC |
| 14 | Northern Pintail | <i>Anas acuta</i> | WM | LC |
| 15 | Red-crested Pochard | <i>Netta rufina</i> | WM | LC |
| 16 | Common Pochard | <i>Aythya ferina</i> | WM | VU |
| 17 | Ferruginous Duck | <i>Aythya nyroca</i> | WM | NT |
| Order: Podicipediformes Family: Podicipedidae | | | | |
| 18 | Little Grebe | <i>Tachybaptus ruficollis</i> | R | LC |
| 19 | Great Crested Grebe | <i>Podiceps cristatus</i> | WM | LC |
| Order: Columbiformes Family: Columbidae | | | | |
| 20 | Eurasian Collared Dove | <i>Streptopelia decaocto</i> | R | LC |
| 21 | Spotted Dove | <i>Streptopelia chinensis</i> | R | LC |
| 22 | Yellow-footed Green Pigeon | <i>Treron phoenicopterus</i> | R | LC |

| S. No. | Common Name | Scientific Name | Resident / Migratory | IUCN Status |
|--------------------------------|-------------------------|---------------------------------|----------------------|-------------|
| Order: Cuculiformes | | | | |
| Family: Cuculidae | | | | |
| 23 | Asian Koel | <i>Eudynamys scolopaceus</i> | R | LC |
| 24 | Common hawk Cuckoo | <i>Hierococcyx varius</i> | R | LC |
| 25 | Indian Cuckoo | <i>Cuculus micropterus</i> | R | LC |
| Order: Caprimulgiformes | | | | |
| Family: Apodidae | | | | |
| 26 | Asian Palm Swift | <i>Cypsiurus balasiensis</i> | R | LC |
| Order: Gruiformes | | | | |
| Family: Rallidae | | | | |
| 27 | Common Moorhen | <i>Gallinula chloropus</i> | R | LC |
| 28 | Eurasian Coot | <i>Fulica atra</i> | R | LC |
| 29 | Grey-headed Swamphen | <i>Porphyrio porphyrio</i> | R | LC |
| 30 | White-breasted Waterhen | <i>Amauornis phoenicurus</i> | R | LC |
| Order: Charadriiformes | | | | |
| Family: Recurvirostridae | | | | |
| 31 | Black-winged Stilt | <i>Himantopus himantopus</i> | R | LC |
| 32 | Pied Avocet | <i>Recurvirostra avosetta</i> | WM | LC |
| Family: Charadriidae | | | | |
| 33 | Northern Lapwing | <i>Vanellus vanellus</i> | WM | NT |
| 34 | Grey-headed Lapwing | <i>Vanellus cinereus</i> | WM | LC |
| 35 | Red-wattled Lapwing | <i>Vanellus indicus</i> | R | LC |
| 36 | Little Ringed Plover | <i>Charadrius dubius</i> | R | LC |
| Family: Rostratulidae | | | | |
| 37 | Greater painted-snipe | <i>Rostratula benghalensis</i> | R | LC |
| Family: Jacanidae | | | | |
| 38 | Pheasant -tailed Jacana | <i>Hydrophasianus chirurgus</i> | R | LC |
| 39 | Bronze -winged Jacana | <i>Metopidius indicus</i> | R | LC |
| Family: Scolopacidae | | | | |
| 40 | Common Sandpiper | <i>Actitis hypoleucos</i> | WM | LC |
| 41 | Wood Sandpiper | <i>Tringa glareola</i> | WM | LC |

| S. No. | Common Name | Scientific Name | Resident / Migratory | IUCN Status |
|-------------------------------|---------------------------|---------------------------------------|----------------------|-------------|
| Family: Glareolidae | | | | |
| 42 | Oriental Pratincole | <i>Glareola maldivarum</i> | R | LC |
| Family: Laridae | | | | |
| 43 | Brown-headed Gull | <i>Chroicocephalus brunnicephalus</i> | WM | LC |
| 44 | Whiskered Tern | <i>Chlidonias hybrida</i> | SM | LC |
| Order: Ciconiiformes | | | | |
| Family: Ciconiidae | | | | |
| 45 | Asian Openbill | <i>Anastomus oscitans</i> | R | LC |
| 46 | Lesser Adjutant | <i>Leptoptilos javanicus</i> | R | VU |
| 47 | Greater Adjutant | <i>Leptoptilos dubius</i> | R | EN |
| Order: Suliformes | | | | |
| Family: Anhingidae | | | | |
| 48 | Oriental Darter | <i>Anhinga melanogaster</i> | R | NT |
| Family: Phalacrocoracidae | | | | |
| 49 | Little Cormorant | <i>Microcarbo niger</i> | R | LC |
| Order: Pelecaniformes | | | | |
| Family: Threskiornithidae | | | | |
| 50 | Glossy Ibis | <i>Plegadis falcinellus</i> | WM | LC |
| Family: Ardeidae | | | | |
| 51 | Cinnamon Bittern | <i>Ixobrychus cinnamomeus</i> | R | LC |
| 52 | Grey Heron | <i>Ardea cinerea</i> | R | LC |
| 53 | Purple Heron | <i>Ardea purpurea</i> | R | LC |
| 54 | Great Egret | <i>Ardea alba</i> | R | LC |
| 55 | Intermediate Egret | <i>Ardea intermedia</i> | R | LC |
| 56 | Little Egret | <i>Egretta garzetta</i> | R | LC |
| 57 | Cattle Egret | <i>Bubulcus ibis</i> | R | LC |
| 58 | Indian Pond Heron | <i>Ardeola grayii</i> | R | LC |
| 59 | Black-crowned night heron | <i>Nycticorax nycticorax</i> | SM | LC |
| Order: Accipitriformes | | | | |
| Family: Pandionidae | | | | |
| 60 | Osprey | <i>Pandion haliaetus</i> | WM | LC |

| S. No. | Common Name | Scientific Name | Resident / Migratory | IUCN Status |
|------------------------------|-----------------------------|---------------------------------|----------------------|-------------|
| Family: Accipitridae | | | | |
| 61 | Oriental Honey Buzzard | <i>Pernis ptilorhynchus</i> | R | LC |
| 62 | Slender-billed Vulture | <i>Gyps tenuirostris</i> | R | CR |
| 63 | Pied Harrier | <i>Circus melanoleucos</i> | WM | LC |
| 64 | Crested Serpent Eagle | <i>Spilornis cheela</i> | R | LC |
| 65 | Shikra | <i>Accipiter badius</i> | R | LC |
| 66 | Black Kite | <i>Milvus migrans</i> | R | LC |
| Order: Strigiformes | | | | |
| Family: Strigidae | | | | |
| 67 | Short-eared owl | <i>Asio flammeus</i> | WM | LC |
| 68 | Asian Barred Owlet | <i>Glaucidium cuculoides</i> | R | LC |
| 69 | Spotted Owlet | <i>Athene brama</i> | R | LC |
| Order: Bucerotiformes | | | | |
| Family: Upupidae | | | | |
| 70 | Eurasian Hoopoe | <i>Upupa epops</i> | R | LC |
| Order: Coraciiformes | | | | |
| Family: Alcedinidae | | | | |
| 71 | Common Kingfisher | <i>Alcedo atthis</i> | R | LC |
| 72 | Stork-billed Kingfisher | <i>Pelargopsis capensis</i> | R | LC |
| 73 | White-throated Kingfisher | <i>Halcyon smyrnensis</i> | R | LC |
| 74 | Pied Kingfisher | <i>Ceryle rudis</i> | R | LC |
| Family: Meropidae | | | | |
| 75 | Green Bee-eater | <i>Merops orientalis</i> | R | LC |
| 76 | Blue-tailed Bee-eater | <i>Merops philipiinus</i> | R | LC |
| Family: Coraciidae | | | | |
| 77 | Indochinese Roller | <i>Coracias affinis</i> | R | LC |
| Order: Piciformes | | | | |
| Family: Megalaimidae | | | | |
| 78 | Coppersmith barbet | <i>Psilopogon haemacephalus</i> | R | LC |
| 79 | Blue-throated barbet | <i>Psilopogon asiaticus</i> | R | LC |
| Family: Picidae | | | | |
| 80 | Fulvous breasted Woodpecker | <i>Dendrocopos macei</i> | R | LC |
| Order: Falconiformes | | | | |
| Family: Falconidae | | | | |
| S. No. | Common Name | Scientific Name | Resident / Migratory | IUCN Status |
| 81 | Peregrine Falcon | <i>Falco peregrinus</i> | WM | LC |

| | | | | |
|------------------------------|-----------------------|------------------------------|----|----|
| Order: Psittaciformes | | | | |
| Family: Psittaculidae | | | | |
| 82 | Rose-ringed Parakeet | <i>Psittacula krameri</i> | R | LC |
| Order: Passeriformes | | | | |
| Family: Oriolidae | | | | |
| 83 | Black-hooded Oriole | <i>Oriolus xanthornus</i> | R | LC |
| Family: Artamidae | | | | |
| 84 | Ashy Woodswallow | <i>Artamus fuscus</i> | R | LC |
| Family: Dicruridae | | | | |
| 85 | Black Drongo | <i>Dicrurus macrocercus</i> | R | LC |
| Family: Laniidae | | | | |
| 86 | Grey- backed Shrike | <i>Lanius tephronotus</i> | WM | LC |
| 87 | Brown shrike | <i>Lanius cristatus</i> | WM | LC |
| 88 | Long-tailed Shrike | <i>Lanius schach</i> | WM | LC |
| Family: Corvidae | | | | |
| 89 | Rufous Treepie | <i>Dendrocitta vagabunda</i> | R | LC |
| 90 | House Crow | <i>Corvus splendens</i> | R | LC |
| 91 | Eastern jungle crow | <i>Corvus levaillantii</i> | R | LC |
| Family: Paridae | | | | |
| 92 | Cinereous Tit | <i>Parus cinereus</i> | R | LC |
| Family: Alaudidae | | | | |
| 93 | Bengal bush-lark | <i>Mirafra assamica</i> | R | LC |
| Family: Cisticolidae | | | | |
| 94 | Common Tailorbird | <i>Orthotomus sutorius</i> | R | LC |
| 95 | Yellow-bellied prinia | <i>Prinia flaviventris</i> | R | LC |
| Family: Locustellidae | | | | |
| 96 | Striated Grassbird | <i>Megalurus palustris</i> | R | LC |
| Family: Hirundinidae | | | | |
| 97 | Sand Martin | <i>Riparia riparia</i> | WM | LC |
| 98 | Barn Swallow | <i>Hirundo rustica</i> | WM | LC |

| S. No. | Common Name | Scientific Name | Resident / Migratory | IUCN Status |
|------------------------|---------------------------|-----------------------------|----------------------|-------------|
| Family: Pycnontidae | | | | |
| 99 | Red-vented Bulbul | <i>Pycnonotus cafer</i> | R | LC |
| 100 | Red-whiskered Bulbul | <i>Pycnonotus jocosus</i> | R | LC |
| Family: Leiothrichidae | | | | |
| 101 | Jungle Babbler | <i>Argya striata</i> | R | LC |
| Family: Sturnidae | | | | |
| 102 | Common Hill Myna | <i>Gracula religiosa</i> | R | LC |
| 103 | Asian Pied Starling | <i>Gracupica contra</i> | R | LC |
| 104 | Chestnut- tailed starling | <i>Sturnia malabarica</i> | R | LC |
| 105 | Common Starling | <i>Sturnus vulgaris*</i> | WM | LC |
| 106 | Common Myna | <i>Acridotheres tristis</i> | R | LC |
| 107 | Jungle Myna | <i>Acridotheres fuscus</i> | R | LC |
| 108 | Great Myna | <i>Acridotheres grandis</i> | R | LC |
| Family: Muscicapidae | | | | |
| 109 | Oriental Magpie-Robin | <i>Copsychus saularis</i> | R | LC |
| 110 | Siberian Stonechat | <i>Saxicola maurus</i> | WM | LC |
| Family: Nectariniidae | | | | |
| 111 | Purple Sunbird | <i>Cinnyris asiaticus</i> | R | LC |
| Family: Ploceidae | | | | |
| 112 | Baya Weaver | <i>Ploceus philippinus</i> | R | LC |
| Family: Estrildidae | | | | |
| 113 | Scaly-breasted Munia | <i>Lonchura punctulata</i> | R | LC |
| Family: Passeridae | | | | |
| 114 | House sparrow | <i>Passer domesticus</i> | R | LC |
| 115 | Eurasian Tree Sparrow | <i>Passer montanus</i> | R | LC |
| Family: Motacillidae | | | | |
| 116 | Grey Wagtail | <i>Motacilla cinerea</i> | WM | LC |
| 117 | Citrine Wagtail | <i>Motacilla citreola</i> | WM | LC |
| 118 | White Wagtail | <i>Motacilla alba</i> | WM | LC |
| 119 | Paddyfield Pipit | <i>Anthus rufulus</i> | R | LC |
| 120 | Rosy Pipit | <i>Anthus roseatus</i> | WM | LC |

*a flock of five Common Starlings was seen on 05.03.2021 in Grid # 15 in the northern part of the Beel and were foraging near a herd of domestic buffaloes grazing there, and is the first sighting of the species for Deepor Beel.

Annexure - 2

The Species richness, Overall average abundance and the Simpson's Evenness Index of waterbirds and water associate species recorded during the study in each of the 20 grids at Deepor Beel

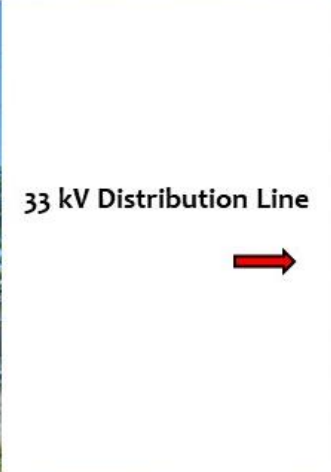
| Grid # | Waterbirds | | | Water Associate species | | |
|--------|------------------|---------------------------|--------------------------|-------------------------|---------------------------|--------------------------|
| | Species Richness | Overall Average Abundance | Simpson's Evenness Index | Species Richness | Overall Average Abundance | Simpson's Evenness Index |
| 1 | 0 | 0 | 0 | 5 | 11 | 0.91 |
| 2 | 2 | 135 | 0.72 | 14 | 47 | 1.00 |
| 3 | 2 | 82 | 0.78 | 17 | 34 | 0.67 |
| 4 | 6 | 37 | 0.56 | 13 | 37 | 0.68 |
| 5 | 4 | 11 | 0.61 | 11 | 23 | 0.69 |
| 6 | 12 | 162 | 0.60 | 14 | 75 | 0.60 |
| 7 | 13 | 105 | 0.58 | 17 | 138 | 0.55 |
| 8 | 4 | 39 | 0.26 | 10 | 22 | 0.88 |
| 9 | 4 | 135 | 0.74 | 15 | 56 | 0.51 |
| 10 | 7 | 43 | 0.65 | 13 | 40 | 0.50 |
| 11 | 14 | 178 | 0.70 | 14 | 82 | 0.62 |
| 12 | 14 | 270 | 0.62 | 15 | 66 | 0.54 |
| 13 | 11 | 191 | 0.65 | 16 | 111 | 0.64 |
| 14 | 11 | 120 | 0.60 | 14 | 59 | 0.63 |
| 15 | 17 | 191 | 0.63 | 18 | 174 | 0.49 |
| 16 | 11 | 90 | 0.67 | 12 | 28 | 0.71 |
| 17 | 9 | 95 | 0.66 | 12 | 17 | 1.00 |
| 18 | 6 | 104 | 0.70 | 15 | 49 | 0.53 |
| 19 | 13 | 88 | 0.59 | 14 | 25 | 1.11 |
| 20 | 12 | 54 | 0.66 | 4 | 47 | 0.71 |

Annexure - 3

Distribution line pole characteristics - The images below depict the structural differences in the poles of 11 kV and 33 kV distribution lines surveyed in and around Deepor Beel. The alpha-numeric codes on the image refers to whether it is single (1), double (2), triple (3) or quadra (4) pole type and the alphabet refers to individual types. In all 17 and 23 different pole types were seen in the 11 kV and 33 kV respectively.

11 kV Distribution Line









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