सूचना का अधिकार
RIGHT TO INFORMATION

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

स्पीड पोस्ट

No. WII/RTI/CPIO/2020-21 (Qtr-III)/72

दिनाक: 16.12.2020

सेवा में,

श्री विनोद कुमार जैन
मकान न. एल -79, ऋषिलोक कॉलोनी
ऋषिकेश -249201

विषय: आरटीआई अधिनियम, 2005 के तहत सूचना।

संदर्भ: आपका आरटीआई पत्र संख्या: --- दिनांक 20.11.2020

महोदय,

कृपया आरटीआई अधिनियम, 2005 के तहत उल्लिखित अपने आवेदन को देखें। इस संदर्भ में, आपके द्वारा मांगी गई जानकारी संस्थान के संबंधित प्राधिकरण से एकत्र की गई है और आपको इस पत्र के साथ संलग्न **Appendix-I** (साथ में **Annexure-1-6** की प्रमाणित फोटोकॉपी) कर प्रेषित किया जा रहा है।

चूंकि संलग्न **Annexure-7, 8, 9** और **10** बड़ी रिपोर्ट्स में समाहित हैं जो कि आपको Compact Disk (CD) में पत्र के साथ भेजी जा रही हैं|

अगर आप उक्त जानकारी से संतुष्ट नहीं हैं तो **सूचना का अधिकार अधिनियम 2005,** के तहत अधोलिखित अपीलीय प्राधिकारी को एक माह के भीतर – **निदेशक एवं अपीलीय प्राधिकारी, भारतीय वन्यजीव संस्थान, पोस्ट बॉक्स 18, चन्द्रबनी, देहरादून – 248001, दूरभाष न० 0135-2640910, 2646102** को अपील कर सकते हैं |

धन्यवाद,

भवदीय,

केन्द्रीय लोक सूचना अधिकारी

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, फैक्स : 0135-2640117
EPABX : +91-135-2640100, 2640114, 2640115, फैक्स : 0135-2640117
ई-मेल/E-mail : wii@wii.gov.in, वेब/Website : www.wii.gov.in

Appendix - I

Sub: Response to RTI NO: WII/RTI/CPIO/2020-21 (Qtr-III)/72

The following are the responses to RTI filed on 24 November 2020.

1) The permission letters for field survey and radio-collaring are enclosed as Annexure 1-5.
2) The project budget and utilisation details are enclosed as Annexure 6.
3) All work was done by WII-Research team and no tender or quotation was placed.
4) A preliminary report on radio-collaring of swamp deer, titled "Capture, collaring and monitoring of swamp deer at Jhilmil Jheel Conservation Reserve" is enclosed as Annexure 7.
5) Two female swamp deer were radio-collared on 30th May and 22nd June 2018 respectively. The collar of 1st individual is active as of 10/12/2020. The collar from 2nd individual provided data till June 2019. However the animal died of unknown causes inside swamps of Jhilmil Jheel and the collar was retrieved by Forest Department in July 2019. WII has not condcted any research on this matter.
6) Submitted reports on the research work on swamp deer are enclosed as Annexure 8,9,10.

INFORMATION PROVIDED UNDER RTI

WILDLIFE INSTITUTE OF INDIA • CHANDRABANI, DEHRADUN •

Samrat Mondol, Ph.D.
Scientist
Animal Ecology & Conservation Biology
Wildlife Institute of India
Chandrabani, Dehradun

ATTESTED

CPIO, Wild Life Institute of India Dehradun

Annexure (1) (61)

OFFICE OF THE PRINCIPAL CHIEF CONSERVATOR OF FOREST WILDLIFE, UP, LUCKNOW
No. /23-2-12 (G) Lucknow dated May. 17 2016

Permisson to carry out swamp deer survey in Hastinapur Wildlife Sanctuary and adjoining stretches of River Ganga

Under the provisions of Sec. 12 (b) and Sec 28 of the Wildlife (Protection) Act, 1972, as amended 2003 and as per Guidelines of the Govt. of India, Ministry of Environment of Forests issued vide their letter F.No 6-1/2003 WL (PL), Government of India Ministry of Environment and Forest, permission is hereby granted to Sri V.B. Mathur, Director Wildlife Institute of India 18-Chandrabani, Dhehradun to carry out swamp deer survey in Hastinapur Wildlife Sanctuary and adjoining stretches of River Ganga.

This permission is subject to the following conditions:-

1. The permit holder will be well versed with the provisions of Wildlife (Protection) Act, 1972 and all subsequent amendments and rules there in and will ensure that no rules are transgressed in the conduction of their research work.
2. Permit holder will attach the list of bonafide person with this permission and will also informed concerned Dy. Conservator of Forest/ Divisional Forest Officer/Dy. Director.
3. The permit holders will not collect specimens indiscriminately or in manner not justified for a scientific survey of the classes and orders of animals specified in his request.
4. Before entering the area permit holder will inform to the concerned Dy. Conservator of Forest/ Divisional Forest Officer/Dy Director .
5. The permit holder will have to pay all charges as required as per rules.
6. A copy of any report, publication and literature originating from the above research will have to be supplied free of charge to this office.
7. The Forest Department will not be responsible for any loss of life or property or injury that may sustained by the researches while conducting their research.
8. The permit will be valid May 2016 to April 2017.

DWII OFFICE
DIARY NO.: 980
DATE: 01/06/2016

(Dr. Rupak De)
Principal Chief Conservator of Forest,
Wildlife U.P. Lucknow

No.2833/ of dated

Copy- to Sri V.B. Mathur, Director Wildlife Institute of India 18-Chandrabani, Dhehradun-248001 to in his Letter Deted 29-04-2016 for information and necessary action.

Copy- to Divisional Forest Officer, Meerut, Bijnore, Jyotibha Phule Nagar (Amroha), Muzaffarnagar and Hapur for information and necessary action.

(Dr. Rupak De) 16/5/16
Principal Chief Conservator of Forest
Wildlife U.P. Lucknow.

ATTESTED
CPIO, Wild Life Institute of India, Dehradun

6-Permission-14.docx

1/6/16 INFORMATION PROVIDED UNDER RTI

Annexure (2)
(56) (63)

कार्यालय प्रमुख वन संरक्षक (वन्य जीव) उत्तराखंड

85, राजपुर रोड, देहरादून (उत्तराखंड) फोन – 0135– 2742884 फैक्स नं० 2745691 email : cwlwua@yahoo.co.in

पत्र संख्या – 978 /6-32/16 देहरादून, दिनांक 29 सितम्बर, 2016

सेवा मे,

Dr. G. S. Rawat,
Dean, Faculty of Wildlife Science.
Wildlife Institute of India,
Dehradun.

विषयः– Permission tocarry out fieldwork in research project entitled 'Movement patterns and inbreeding status of Swamp deer (Rucervus duvaucelii duvaucelii) at Uttarakhand, India"

संदर्भः– आपकी पत्र संख्या WII/AECB/SM/2015/01 दिनांक 28 मार्च 2016

महोदय,

उपरोक्त संदर्भित पत्र द्वारा विषयगत प्रकरण पर प्रभागीय वनाधिकारी, हरिद्वार वन प्रभाग हरिद्वार के द्वारा की गयी संस्तुति के आधार पर बिन्दु संख्या 01, 02 व 04 पर अध्ययन एवं शोध हेतु अनुमति निम्न शर्तो के तहत प्रदान की जाती है। बिन्दु संख्या 03 पर इस कार्यालय के पत्र संख्या 2976/37–1/6–32 दिनांक 16 अप्रैल का अवलोकन करे, भारत सरकार से अनुमति प्राप्त होने पर ही अग्रेतर कार्यवाही की जायेगीः–

1. शोध/भ्रमण के दौरान किसी भी प्रकार से वन्य प्राणियों/वनस्पतियों को नुकसान नहीं पहुंचाया जायेगा और कोई पौधा या उसका अंश प्राणी नष्ट करने की अनुमति नहीं है।
2. भारतीय वन्य जीव (संरक्षण) अधिनियम, 1972 यथा संशोधित 2006 का कोई उल्लघंन नहीं किया जायेगा।
3. वन क्षेत्रों में शोध/भ्रमण कार्यक्रम आरम्भ करने से पूर्व आपको सम्बन्धित अधिकारी को सूचित कराना होगा। शोधार्थी द्वारा अपना प्रस्तावित कार्यक्रम प्रभाग कार्यालय को सूचित करना होगा।
4. शोध/भ्रमण के दौरान नियमानुसार समस्त शुल्कों का वहन करना होगा।
5. शोध/भ्रमण के दौरान किसी भी प्रकार का प्रतिकूल दृश्य/गतिविधि देखे जाने पर, जो ज्ञात न हो, की सूचना स्थानीय अधिकारी को देनी होगी।
6. शोध/भ्रमण कार्य हेतु संस्तुति इस शर्त के साथ दी जाती है कि उक्त शोध/भ्रमण कार्य के उपरान्त शोधार्थी द्वारा जो भी डाटा एकत्र किया जायेगा उसकी प्रति/रिपोर्ट इस कार्यालय को भी उपलब्ध करायेंगे।
7. शोध के दौरान वन्य जन्तुओं से या किसी अन्य प्रकार से जनधन की हानि के लिये वन विभाग जिम्मेदार नहीं होगा।

भवदीय,

29/9/16

(डी०वी०एस० खाती)
प्रमुख वन संरक्षक, वन्यजीव/
मुख्य वन्य जीव प्रतिपालक
उत्तराखण्ड, देहरादून।

DEAN FWS OFFICE
RECEIVED ON 30.9.16

Dr. S. Mondal
Dr. B. Pandav

INFORMATION PROVIDED
UNDER RTI

पत्रांक 978 / उक्तदिनांकित।

प्रतिलिपिः प्रभागीय वनाधिकारी, हरिद्वार वन प्रभाग हरिद्वार को उक्तानुसार सूचनार्थ एवं आवश्यक कार्यवाही हेतु प्रेषित।

ATTESTED
CPIO, Wild Life Institute of India, Dehradun

29/9/16

(डी०वी०एस० खाती)
प्रमुख वन संरक्षक, वन्यजीव/
मुख्य वन्य जीव प्रतिपालक

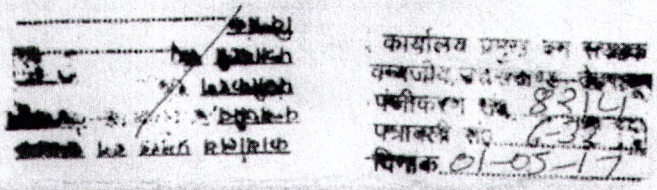
Annexure: (3)

Government of India
Ministry of Environment, Forests and Climate Change
Wildlife Division

6th Floor, Vayu Wing
Indira Paryavaran Bhawan,
Jor Bag Road, Aliganj,
New Delhi-110003

F. No. 1-76/2017 WL
Dated: 12th April 2017

The Chief Wildlife Warden
Government of Uttarakhand
Dehradun.



Sub: Permission for capture and radio-collaring Swamp Deer in Uttarakhand.

Sir,

Kindly refer to the letter of the Chief Wildlife Warden, Uttarakhand regarding capture and radio-collaring 4-6 Swamp Deer to understand the movement patterns across the Jhilmil Jheel Conservation Reserve and adjoining Ganga Basin, Uttarakhand.

In this context, the undersigned is directed to convey the approval under proviso (a) of Section 12 of the Wild Life (Protection) Act, 1972 for capture and radio-collaring of 4-6 Swamp Deer to understand the movement patterns across the Jhilmil Jheel Conservation Reserve and adjoining Ganga Basin, Uttarakhand, subject to the following conditions:

(i) The Chief Wildlife Warden shall ensure and satisfy himself that the entire operation is carried out in a safe manner to the animals.

(ii) The capture, radio-collaring and subsequent release of the animals shall be undertaken by qualified veterinarian and strictly under the supervision of the State Forest Department. Adequate veterinary care will also be ensured at all stages of capture, transportation and subsequent release of the animals.

(iii) It should be ensured that minimum trauma is caused to the animals during the entire operation.

(iv) There would be regular monitoring during and after process by the Chief Wildlife Warden/State Forest Department and regular periodic report will be submitted by the Chief Wildlife Warden to the Ministry.

APCCF
We can have a meeting with all concern in the project. We can ask WII to have a presentation. Forest department can appoint a nodal officer for this
01/5/17

(v) In case of any mis-happening during the process, that endangers or may endanger the safety of the Swamp Deer, the Ministry may review/revoke the permission given.

The Chief Wildlife Warden may take further action in the matter accordingly.

Yours faithfully,

(S.P. Vashishth)
Deputy Inspector General of Forests (WL)
Tel: 011-24695355

ATTESTED

CPIO, Wild Life Institute of India, Dehradun

INFORMATION PROVIDED
UNDER RTI

Annexure (4)

(81)

कार्यालय प्रमुख वन संरक्षक (वन्य जीव) उत्तराखंड

35, राजपुर रोड, देहरादून (उत्तराखंड) फोन : 0135- 2742884 फैक्स नं० 2745031 email : cwlwua@yahoo.co.in

पत्र संख्या – 1575/C-32 देहरादून दिनांक दिसम्बर, 2017

सेवा मे,

Dr. G. S. Rawat,
Dean, Faculty of Wildlife Science.
Wildlife Institute of India.
Dehradun.

विषयः– Permission to carry out fieldwork in research project entitled 'Movement patterns and inbreeding status of Swamp deer (Rucervus duvauceli duvauceli) at Uttarakhand, India"

संदर्भः– आपकी पत्र संख्या WII/AECB/SM/2015/01 दिनांक 28 मार्च 2016 एवं उप महा निरीक्षक, वन (वन्यजीव), भारत सरकार, पर्यावरण वन एवं जलवायु परिवर्तन मंत्रालय, नई दिल्ली का पत्रांक F.No. 1-76/2017 WL दिनांक 12.04.2017

महोदय,

उपरोक्त संदर्भित पत्र के कम में विषयगत प्रकरण पर बिन्दु संख्या 01, 02 व 04 पर अध्ययन एवं शोध हेतु अनुमति इस कार्यालय के पत्रांक 978/32–1 दिनांक 29.09.2016 के द्वारा प्रदान की जा चुकी है। बिन्दु संख्या 03 पर भारत सरकार के संदर्भित पत्र से प्राप्त अनुमति को संलग्न कर प्रेषित किया जा रहा है। भारत सरकार से प्राप्त अनुमति के कम में विषयक प्रकरण पर अविलम्ब आवश्यक कार्यवाही करने का कष्ट करे।

संलग्नक: यथोपरि।

DWII OFFICE
DIARY NO.: 3248
DATE: 29/01/2018

भवदीय,

(डी०वी०एस० खाती)
प्रमुख वन संरक्षक, वन्यजीव/
मुख्य वन्य जीव प्रतिपालक
उत्तराखण्ड, देहरादून।

पत्रांक 1575/ उक्तदिनांकित।

प्रतिलिपिः उप महा निरीक्षक, वन (वन्यजीव), भारत सरकार, पर्यावरण वन एवं जलवायु परिवर्तन मंत्रालय, नई दिल्ली को उक्तानुसार सूचनार्थ प्रेषित।

(डी०वी०एस० खाती)
प्रमुख वन संरक्षक, वन्यजीव/
मुख्य वन्य जीव प्रतिपालक
उत्तराखण्ड, देहरादून।

DIARY NO. 4847
DATE 29.1.18

पत्रांक 1575/ उक्तदिनांकित।

प्रतिलिपिः प्रभागीय वनाधिकारी, हरिद्वार वन प्रभाग हरिद्वार को उक्तानुसार सूचनार्थ एव आवश्यक कार्यवाही हेतु प्रेषित।

(डी०वी०एस० खाती)
प्रमुख वन संरक्षक, वन्यजीव/
मुख्य वन्य जीव प्रतिपालक
उत्तराखण्ड, देहरादून।

उ. म. मोसल / वि. पाण्डे

ATTESTED
CPIO, Wild Life Institute of India, Dehradun

INFORMATION PROVIDED
UNDER RTI

Annexure (5)
(67)

(8) (8)

OFFICE OF THE PRINCIPAL CHIEF CONSERVATOR OF FOREST WILDLIFE, UP, LUCKNOW

No. 3438 /23-2-12 (G) Lucknow dated April. 13 2018

Assessing fine scale distribution patterns, population status and genetic composition of Swamp deer (Rucervus duvauceli duvauceli) in Uttar Pradesh India.

Under the provisions of Sec. 12 (b) and Sec 28 of the Wildlife (Protection) Act, 1972, as amended 2003 and as per Guidelines of the Govt. of India, Ministry of Environment of Forests issued vide their letter F.No 6-1/2003 WL (PL), Government of India Ministry of Environment and Forest, permission is hereby granted to Shri Samrat Mondol, PhD. Scientist D, Wildlife Institute of India, P.O. Box-18, Chandrabani, Dehradun and Bivash Pandav, PhD., Scientist F, Wildlife Institute of India, P.O. Box-18, Chandrabani, Dehradun & Mukesh Kumar, Chief Conservator of Forests, Uttar Pradesh forest Department, Uttar Pradesh, Lucknow to survey all swamp deer habitats to assess swamp deer distribution along Ganga from Bijnor to Kanpur barrage.

This permission is subject to the following conditions:-

1. The permit holder will be well versed with the provisions of Wildlife (Protection) Act, 1972 and all subsequent amendments and rules there in and will ensure that no rules are transgressed in the conduction of their research work.
2. Permit holder will attach the list of bonafide person with this permission and will also informed concerned Divisional Forest Officer.
3. The permit holders will not collect specimens indiscriminately or in manner not justified for a scientific survey of the classes and orders of animals specified in his request.
4. Before entering the area permit holder will inform to the concerned Divisional Forest Officer.
5. The permit holder will have to pay all charges as required as per rules.
6. A copy of any report, publication and literature originating from the above research will have to be supplied free of charge to this office in hard as well as soft copy.
7. The Forest Department will not be responsible for any loss of life or property or injury that may sustained by the researches while conducting their research.
8. The permit will be valid 31.03.2021.

(S.K. Upadhyay)
Principal Chief Conservator of Forest,
Wildlife U.P., Lucknow

No. 3439 / of dated

Copy- to Mukesh Kumar, Chief Conservator of Forests, Uttar Pradesh forest Department, Uttar Pradesh, Lucknow reference to his letter dated 23.01.2018 for information and necessary action.

Copy- to Shri Samrat Mondol, PhD. Scientist D, Wildlife Institute of India, P.O. Box-18, Chandrabani, Dehradun for information and necessary action.

Copy- to Bivash Pandav, PhD., Scientist F, Wildlife Institute of India, P.O. Box-18, Chandrabani, Dehradun for information and necessary action.

Copy- to Divisional Forest Officer, Gautam Buddha Nagar, Bijnor, Hapur, Bulandshahar, Meerut, Mujaffar Nagar, Farrukkhabad, Kannauj, Etawah, Kanpur Nagar & Kanpur Dehat for information and necessary action.

(S.K. Upadhyay)
Principal Chief Conservator of Forest,
Wildlife U.P., Lucknow

Annexure: 6

Swamp Deer Funded By Uttarakhand Forest Department
Budget Position As on 30.11.2018
FINANCIAL YEAR 2018-19

S. No.	Head	Year 1 Grant Received FY (16-17)	Year 2 Grant Received FY (17-18)	Total Grant Received	Expenses FY (16-17)	Expenditure 2017-18	Expenditure 2018-19	Committed Expenditure	Total Expenditure	Balance as per Grant
1	Radio Collars	10,00,000.00	2,00,000.00	12,00,000.00	-	9,68,825.00	1,07,647.00	-	10,76,472.00	1,23,528.00
2	Field Assistant	96,000.00	96,000.00	1,92,000.00	24,000.00		2,14,860.00	-	2,38,860.00	(46,860.00)
3	Laboratory Reagents and Chemicals	4,00,000.00	4,00,000.00	8,00,000.00	1,76,592.00	5,70,556.00	25,763.00	-	7,72,911.00	27,089.00
4	Travel and field work Expenses	75,000.00	75,000.00	1,50,000.00	27,554.00	88,851.00	58,866.00	-	1,75,271.00	(25,271.00)
5	Satellite data cost/Drugs and other essentials	75,000.00	75,000.00	1,50,000.00	-	1,01,609.00	50,035.00	-	1,51,644.00	(1,644.00)
6	Contingency	-	-	-			32,307.00		32,307.00	(32,307.00)
7	Institutional Charges	2,46,900.00	96,900.00	3,43,800.00	2,46,900.00	1,41,435.00		-	3,88,335.00	(44,535.00)
	Grand Total	18,92,900.00	9,42,900.00	28,35,800.00	4,75,046.00	18,71,276.00	4,89,478.00	-	28,35,800.00	-

ATTESTED
CPIO, Wild Life Institute of India, Dehradun

INFORMATION PROVIDED
UNDER RTI

Capture, collaring and monitoring of swamp deer at Jhilmil Jheel Conservation Reserve

by

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

June 2019

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Introduction

The Jhilmil Jheel swamp deer population in Uttarakhand has been observed to move out of the reserve during monsoons (June-July). Observations from January 2016 to July 2018 revealed that the numbers start building up post December and peak around May. Once the monsoon arrives, the animals start moving out of the area and the numbers of swamp deer begin to diminish (Figure.1). This leads to speculations about probable presence of swamp deer and their habitat outside Jhilmil. The initial survey and later genetic analysis have revealed that small fragmented grassland patches along Ganges still harbour swamp deer (Paul et al., 2018) with genetic connectivity between them. Relatedness analysis indicates recent movement between the fragmented grassland patches. So, to know the movement routes and the usage of grassland patches along Ganges, the study necessitated capture, collaring and monitoring of swamp deer. Field capture and collaring operation was initiated from May 2017 onwards and this section is an attempt to document the procedures followed for successful operation and insights into movement ecology along with habitat use of swamp deer.

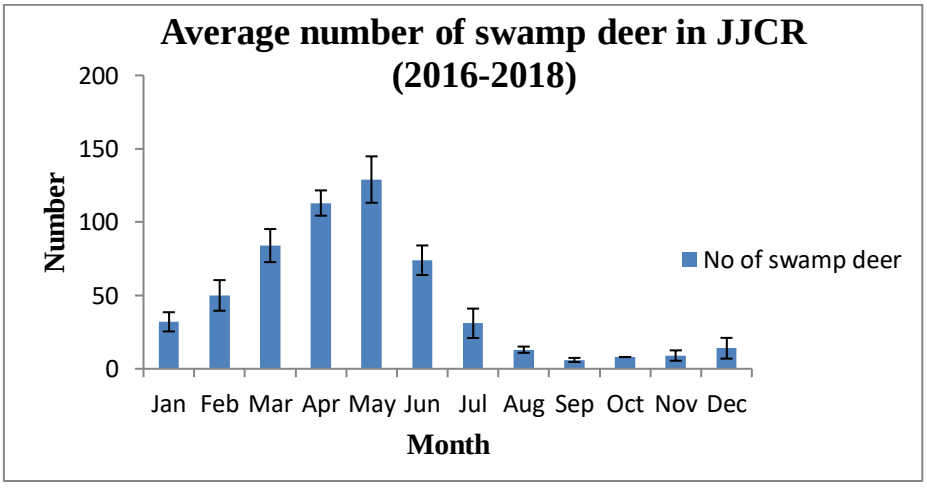

Figure.1: The average number of swamp deer in JJCR (2016-2018)

Study area

Jhilmil Jheel Conservation Reserve (JJCR) is a saucer shaped wetland located between Haridwar–Najibabad along the Ganges River, in Rasiabad range of Haridwar Division, Uttarakhand (Area of 37.83 km^2 of Reserve Forest with elevation ranging from 200 to 250 m above Mean Sea Level (Tewari et al., 2013a) (Figure.2 & 3).

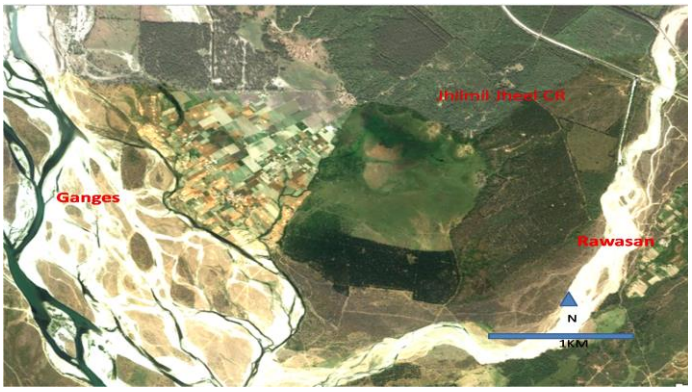

Figure.2: Google Earth Im agery of JJCR

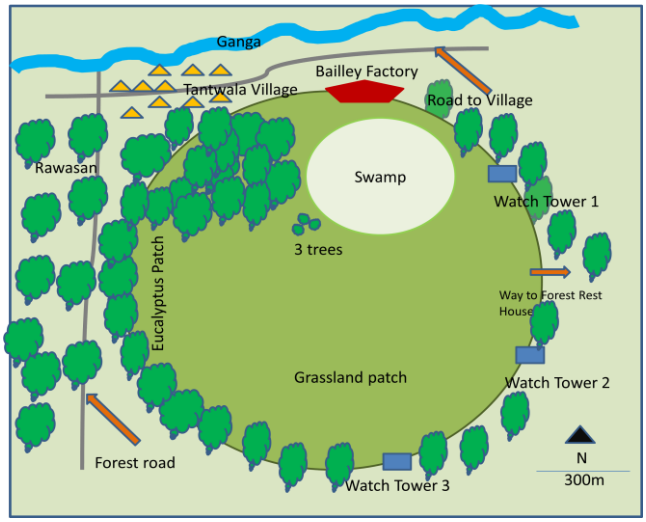

Figure.3: Schematic representation of Jhilmil

The landscape of the study area is a mosaic of short and tall grasslands, tropical mixed moist deciduous forests, and secondary scrub. The area experiences sub-tropical climate with annual rainfall averaging 1300 mm (recorded between 1997 and 2007) and peaking during June-September (monsoon). Temperature ranges from 44°C during May to 2°C during January. The soil quality varies from fine sand to clayey loam. The area is rich in faunal diversity including spotted deer, elephant, nilgai, wild boar, monkey, langur, mongoose, hare, common leopard and occasionally tiger, jungle cat, otter, porcupine, sambar, barking deer and hog deer. Avifauna includes a large number of resident and winter migratory birds. Out of the total area of JJCR only 1.2 km^2 of core habitat is available for swamp deer.

Methods

Capture

The options chosen for capturing included following methods

- Chemical capture through remote darting
- Employing physical restraint procedure viz. Drive-netting

a) Efforts towards chemical capture

Chemical capture involves use of immobilization drugs delivered remotely through long range syringe projectors though essentially require closer approach (Morris, 2001). Habituating the animals to use specified areas close to darting area forms basis for effective darting. It requires placing of the darting team in a hide and luring the animals to use the area using lures, salt, mineral mixture blocks etc.

Habituation effort

The field effort carried out during the reporting period included construction of multiple hides in the swampy patches inhabited by swamp deer with the deer lure placed at distances of 10 m, 20 m and 30 m (Figure.4) from the hide with pair of camera traps deployed to monitor animal activity. This effort was continued for almost 90 days starting from February 2018. Since swamp deer is an extremely shy species and sensitive to human presence and smell, the animals avoided an unnatural structure in their natural environment though the lure was sporadically visited. Based on the camera trap images, we found that the buffaloes mostly fed on the lures (Figure.5). The hides were destroyed by elephants and buffaloes many a times.

Figure.4 & 5: Construction of hide and buffalo feeding on the lure

Efforts to capture swamp deer in the adjacent crop fields

Based on questionnaire survey administered to local community, it was speculated that the swamp deer capture could be attempted in the crop fields adjacent to Jhilmil Jheel on the northern border. These agricultural fields had single access route and had indirect evidences of animal use. Three camera traps were deployed at the entry points to the crop fields from 17th March 2018 to 31st March 2018 (Figure.6) and the night surveys were conducted between 2200h to 0400h for potential swamp deer sighting.

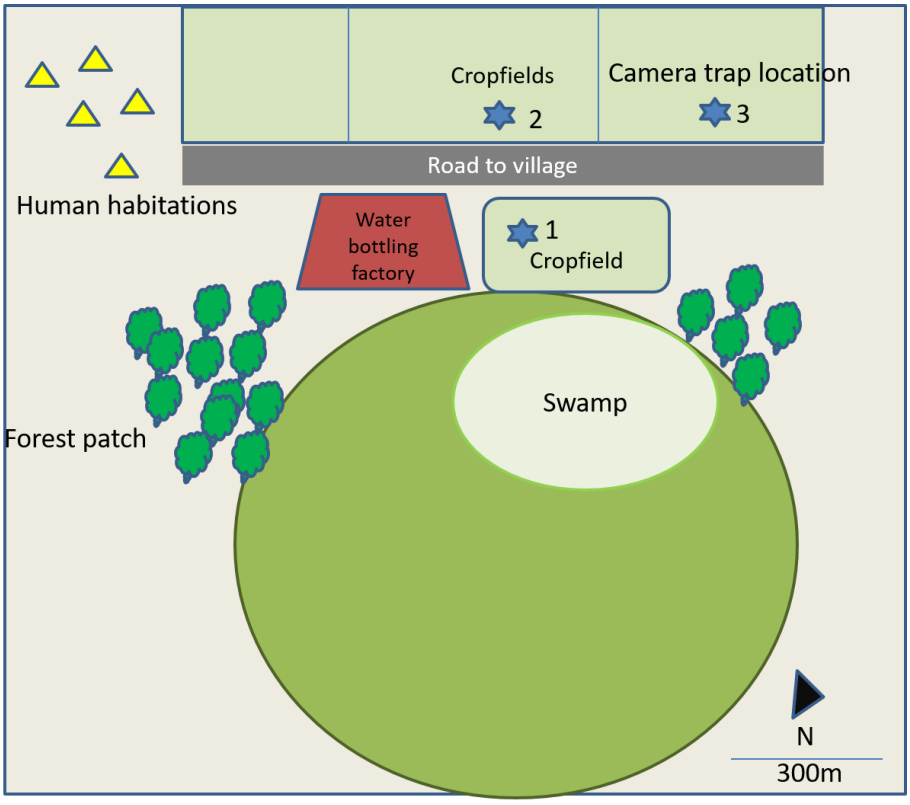

Figure.6: Camera trap locations to monitor swamp deer movement

Swamp deer visited the crop fields but the number and frequency were low as obtained from camera trap images (Figure.7). The capture rate per trap night (Cr/Tn) for swamp deer was 0.04 while that of sambar was 0.55. This conclusively proved that people mistakenly identified sambar as swamp deer. The capture rate per trap night for leopard and buffaloes was (0.04Cr/Tn) and (0.33Cr/Tn) respectively.

Figure.7: Animals captured by camera trapping (17.03.2018 to 31.03.2018)

Gentle drive for darting

As the animal habituation efforts did not bear positive results, a plan was put in place to drive the animals gently towards the hide where the darting team was positioned. This exercise was carried out on 5th April 2018. The schematic representation of the drive effort is presented at Figure.8.

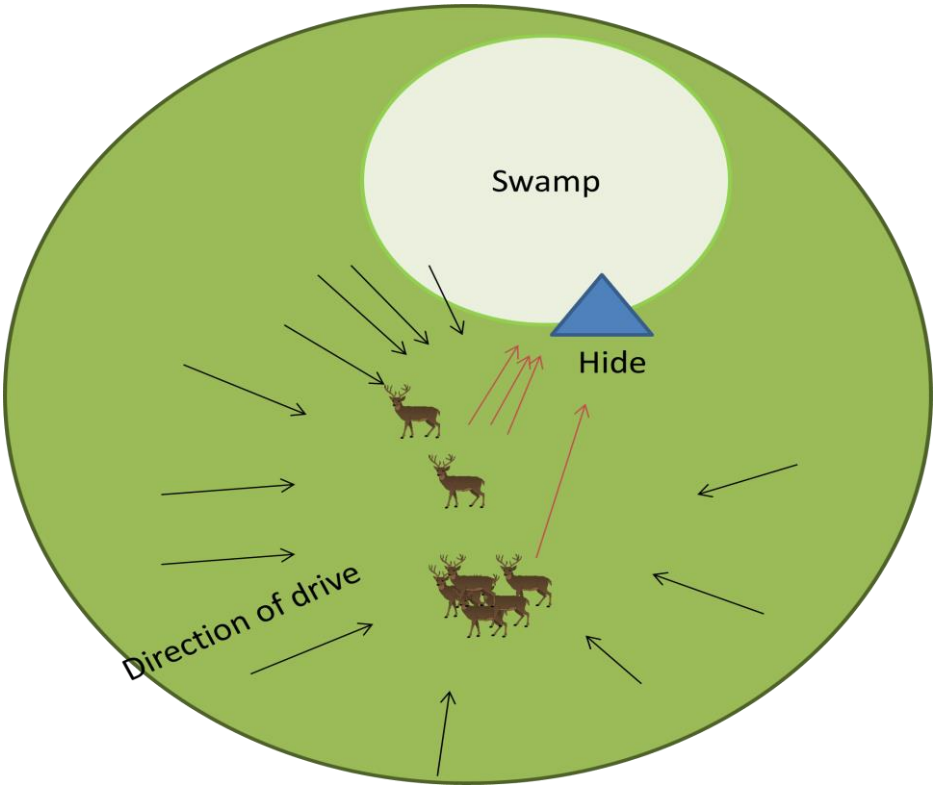

Figure.8: Representation of technique for driving animals towards the hide

Though the drive team was successful in cornering and pushing the animals gently towards the darting team, the swamp deer maintained a distance of about 80-90 m from the hide and did not provide opportunity for darting. The animals managed to escape into the nearby Phragmites/ Typha swamp patch.

b) Efforts towards physical capture (Drive-net Method):

As the efforts towards capturing the animals using above mentioned techniques did not bear positive results, the second option of physically capturing the animal was attempted. The project team discussed various methods for physical capture (Drop-netting, Drive-netting, Pop-up netting, Cannon-nets, Box traps, Clover traps etc.) (Schemnitz et al., 2009) and its associated procedures and risks. Capture methods that are conspicuous (e.g., Drop-nets, Box traps, Clover traps) are susceptible to vandalism, specifically in disturbed areas. Other problems with some of these established capture techniques include difficulty in setting or moving traps in swamps (e.g., Drop-nets, Box traps), potential for the trap to damage multiple animals (e.g., Drop-nets, Net guns, Cannon-nets, Rocket-nets) and high risk of capture myopathy (e.g., Clover traps, Box traps) (Haulton et al., 2001; Peterson et al., 2003).

Finally, some of these capture methods can be expensive (e.g., Cannon-nets, Net guns, Clover traps) and lack the selectivity in animal capture.

> **Drive-net method:** Drive-net method is a technique for capturing and restraining free-ranging herding ungulates. In this method, camouflaged nets are put up at strategic positions covering a considerable distance. Then the animals are cornered and driven towards the net by drive team. A restraining team remains hidden in the vegetation near the nets who starts restraining the animal once it hits the nets and gets entangled. Drive-net has been reported to be a safe and efficient method to capture wild ungulate animals with good success rates.

The efficacy of each method was discussed and drive-net method was selected based on its versatility, ease of deployment, manageable logistical requirements. Drive-net method for capturing of swamp deer was narrowed down based on its successful and effective use in similar species elsewhere. Drive-nets had been effectively used in capturing swamp deer in Nepal (Youtube, 2016, *https://***www.youtube.com/***watch?v=gXwjemTw-Ng*), Saiga antelope in Mongolia (Berger et al., 2010), urban white tailed deer in Florida (Locke et al., 2004) and mountain sheep (Kock et al., 1987). The previous attempts of drive-netting in India used for black bucks and nilgai were not successful (personal communication). The shortcomings of these operations were discussed and necessary preparedness to deal with emergencies and possible failures were deliberated.

Drive-netting was chosen, as the nets could be effectively hoisted in the swamp, would keep the animals away from swamp thereby limiting associated emergencies and provide opportunity for the team to reach and react quickly. It was however decided to keep the procedures as short as possible to subject the animals to minimal stress. The concern with drive-nets for a herding animal is the probability of multiple animals getting trapped and injured. From field observation it was found that once an individual takes the lead, the others follow. It was speculated that once the first animal collides with the net, the other animals can leap over the dropped net.

Necessary components of a physical capture operation (Drive-nets, physical deterrents, drugs and other equipment)

Drive-nets

Three drive-nets of 30 m length each with mesh size of 4 inch by 4 inch and height of 10 ft were setup in the Phragmites patch used by the swamp deer. The nets were hoisted on bamboo poles (Figure.9 & 10) that were positioned at 6 m distance. Around 3 ft of the net length was kept lying on the ground and remaining 7 ft of net was hoisted on the poles. The nets were anchored on nail head on top of the pole. The efficacy of net to drop on impact was tested again and again. Five poles were used to hoist a single net (Figure.12).

Figure.9: Drive-net

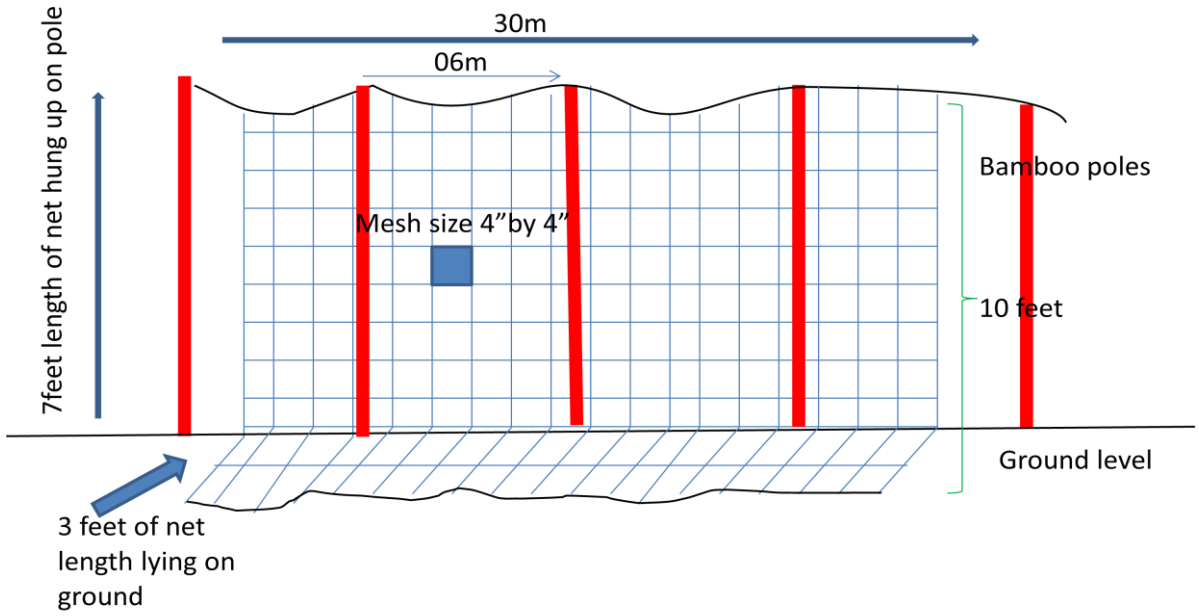

Figure.10: Graphical representation of drive-net system

Cost-effective physical deterrents

As a physical deterrent to stop animals running haywire, a cost-effective locally made barrier was setup. The periphery of the entire ground (length 3.2 km) starting from the two sides of the nets was covered using the cost-effective barriers. The barriers were comprised of torn pieces of gunny bags (700) attached to the rope of length 3.2 km (Figure.11).

Figure.11: Cost-effective barriers to act as physical deterrent

Emergency preparedness

During the entire operation, the safety of the animal would be given priority over other procedures. If the animal was in stress condition during capture, the operation would be aborted. Clippers would be used to free the animals cut the net open if multiple animals get entangled. Selected people were trained for a week who would deal with the emergency situation. Oxygen canisters were kept for emergency. Processing of tranquilizers, sedatives and supplementary drugs was ensured to manage any veterinary emergencies.

Preparatory phase

i) Observations

The preparatory phase of the field operation for capturing swamp deer using drive-net was initiated on 16th May 2018. The procedure involved initial observation of animal activity and assessment of area use. To understand the use of area by the animals and for selecting the time for capture, the animals were monitored throughout the day for initial period. Subsequently the monitoring was limited to observations from 0600-1000h and 1500-1900h with a break during mid-day. The mid-day breaks were given, as the ambient temperatures and humidity were high. The capturing attempts during these times would have subjected the animals to additional stress. Ungulates in general are prone to hyperthermia during physical capture (Sawicka, 2015) and this was one of the important concerns prior to capture attempts.

ii) Net setup and trials

The nets were setup and dislodged numerable times to ensure its stability under all circumstances (Figure.12)

Figure.12: Erecting a net

Prior to collaring exercise, dry drives using human and goats were attempted in the nearby village to see the efficacy of the nets (Figure.13).

Figure.13: Drive trials on goat

Collars

a) Radio-tracking and its role in wildlife research

Wildlife radio-telemetry may be defined as the transmission of information from a transmitter on a free-ranging wild animal to a receiver. Wildlife related telemetry is also known as radio-tagging, radio-tracking or simply 'tagging' or 'tracking'. Studying the behavior of wild animal has supplied important information to wildlife management and conservation (Habib

et al., 2014). For many years, the only way researchers were using to track wildlife was to simply follow and observe the movement and habits of an animal. Advances in the field of wildlife telemetry have made it possible to acquire detailed data on many aspects of wildlife biology, including habitat use, home range size, mortality and survivorship, migration timing and routes (Cochran & Lord, 1963; Kernohan et al., 2001; Murray, 2006; Borkowski & Pudelko, 2007; Martin et al., 2010). Since many wildlife species are secretive and difficult to observe, radio-telemetry has provided a valuable tool to learn more about their respective life histories. As a result, radio-telemetry studies are very common throughout the current wildlife literature. For instance; the study by Miller (2005) identified critical stopover sites for the northern pintails, which are the most important sites for conservation and the authors used this information to urge for protection of these sites to ensure the continuation of pintail migration. In addition, wildlife radio-telemetry can be of great use when studying the migration of land mammals. Scientists fitted mountain elk (*Cervus elaphus nelsoni*) with GPS collars and monitored elk's ability to cross roads to assess direct and indirect impacts of highways. Highways are among the most common forces altering ecosystems in the United States, killing an estimated 500,000–700,000 deer on U.S. highways annually. The study showed that using GPS telemetry can provide solutions to physical barriers to elk migration, as data generated were used to develop fencing and re-routing strategies to promote barrier permeability and reduce fatal collisions with vehicles (Dodd et al., 2007)

b) Brief description of Vertex collars used in this study

The Vertex Plus collars have been widely used in wildlife telemetry in the past. It is highly flexible, comes with customisable options and the ultimate tool for wildlife scientists. The basic setup consists of a standard GPS with various communications, sensor and drop-off options. It can also be coupled with External Sensors and UHF ID Tags. The Vertex Plus can be used as a simple 'Store Onboard' version with limited features and abilites (www.vetronicaerospace.com). All GPS, activity, temperature, proximity and external sensor data measured by the collar are stored in the non-volatile on-board memory. Even after the battery is exhausted, the data is always preserved. One can choose from several wireless communication interfaces to communicate with the collar depending on the structure of study area, field work and budget. These collars have an option of Iridium two-way communication through which activity, mortality and temperature data are stored with every GPS fix.

c) Types of collars and their uses

Features	**VHF Collars**	**GPS / GSM Collars**	**GPS Satellite Collars**
Method of locating the collar	VHF transmitters attached to a study animal emit a pulsed radio signal allowing a person to physically locate and observe the animal by homing into the signal using a receiver and directional antenna. More time consuming in field work.	Collar sends GPS locations to researcher via GSM mobile phone signal. Data can be downloaded with a handheld UHF device when the collar is within a certain distance from the researcher. Visual mapping data, available via Google Earth.	Collar sends its location data to researcher through e-mail. Visual mapping data available via Google Earth. Less field time required.
Added features	Only ground tracking possible	Activity, temperature, mortality and ground tracking possible.	Activity, temperature, mortality and ground tracking possible.
Data Acquired	As a visual sighting, data is collected on home range, habitat usage, animal behaviour, population demographics and diet.	Position of animal is recorded at certain intervals to determine home range and fine-scale habitat use. However no behavioural data is recorded, unless it has VHF attachment.	Position of animal is recorded to determine home range and habitat use. Ideal to use in inaccessible areas.
Battery life	Good	Moderate/poor	Poor

Age of Technology	Over 20 years	Over 10 years	Less than 3 years
Cost	Low	Moderate	High

Field operation

a) Episode I: First capture attempt and subsequent learnings

First attempt of driving animals was carried out on 18th May 2018 between 0400h to 1000h. A team of 12 people was used to drive the swamp deer towards the nets. The plan of driving the animals towards the net was successful in the first attempt itself.

Two of the swamp deer from the herd of around nine individuals jumped onto the net but escaped within 10 seconds before the animal restraint team could reach. The animals escaped from the lower end of the net into the Phragmites patch while other individuals of the herd jumped over the half fallen net. Subsequent efforts to again drive the animals did not bear desired results. The procedure was repeated on 19th May 2018 again between 0400h to 1000h but the animals did not come out of the Phragmites patch making capture attempts not possible.

Slight modifications in hoisting of the nets on the bamboo poles for easy and complete dropping were made for subsequent capture attempts. In this regard, the nets were hoisted on the pointed side of the nails instead on the head side.

b) Episode II

The capture operation on 22nd May was initiated at 0400h. The swamp deer finally came out of the swamp by 1600h. A team of 12 people was used to drive the swamp deer towards the nets. The animals responded to the push but were quite alert. Swamp deer escaped and further attempts were not made due to paucity of time and to avoid stress to the animals.

The respective teams again positioned in the morning at 0700h on 23rd May 2018 and waited for the animals to come out. A group of 20 individuals was located in the open patch in front of the nets. As the driving team failed to reach the spot on time, the animals could not be driven towards the net. The animal drive exercise was stopped for the coming days to let the

animals settle and exhibit normal behaviour. Additionally, efforts were made to increase the netting area by adding three more nets that were provisioned from Wildlife Institute of India. The effective netting length was 160 m.

Lessons learnt from the first round of unsuccessful collaring attempts

1) The exit routes of swamp deer require sealing off before the drive is conducted.
2) Need for proper communication among the drive and net deploying teams.
3) Adequate length of the net has to be lying on ground to ensure that the animal is entangled completely within the net.
4) The length of the nail attached to the bamboo pole need to be adjusted so that the net only slides off when the animal hits and not by itself.
5) After one unsuccessful attempt, sufficient time has to be given to the swamp deer for exhibiting normal activities.
6) The physical deterrent has to be lifted only after the nets have been hoisted.

c) Episode III: Successful capture on 30th May 2018 (1400 to 1800h)

A herd of around 50 animals was seen grazing in open in the evening along with a chital herd, near the swamp on 30th May 2018 and provided opportunity for capture. A team of 51 people was used to successfully drive the swamp deer towards the net. When the drive started, the chital started moving towards the forest patch while the swamp deer moved towards the swamp. Four motorbikes were stationed strategically to block off the exit routes of swamp deer. One adult female got into the net while the other animals of the herd reverted back. The animal was immediately approached and restrained. The physiological parameters were monitored and found within normal limits. The individual was blindfolded and administered mild doses of tranquilizer to minimise the stress. The animal was immediately collared with Vectronics GPS satellite collar (Figure.14a-b). Biological samples (blood and hair) were collected and stored for further analysis. The animal was released from the entanglements of the net and administered with reversal drugs. The animal was left undisturbed and sprayed water from distance to support cooling and recovery. The animal got up and rushed back into the thicket. The radio-signals of the deployed collar were checked which indicated proper functioning.

Figure.14a-b: Collaring of swamp deer

d) Episode IV: Subsequent capture attempts

Captures were attempted again on 6th and 21st June but were unsuccessful. The animal numbers in the meadow were low on 6th June and the animals escaped even before the nets

could be set. On 21st June, the animals escaped even prior to initiation of exercise, due to disturbances caused by dogs.

Another attempt was made on 22nd June between 0800h to 1100h. About fifteen individuals were seen in the meadow. As the team was already prepared and positioned, same technique used for driving the animal into the nets. The team was successful in capturing and collaring another adult hind.

Post collaring data analysis

a) Home range estimation

The Brownian Bridge Movement Model (BBMM) is based on the properties of a conditional random walk between successive pairs of locations dependent on the time between locations, the distance between locations and the Brownian motion variance that is related to the animal's mobility (Horne, 2007). A BBMM assumes that locations are not independent, whereas the 'classical' Kernel Density Estimator (KDE) assumes they are. Using the BBMM, we estimated home ranges of two collared swamp deer during the entire period of GPS data records (June 2018-June 2019). The BBMM requires (1) sequential location data (2) estimated error associated with location data and (3) grid cell size assigned for the output utilization distribution. We selected a grid cell size of 30 m for the analysis. Using the BBMM package (http://cran.opensourceresources.org), we calculated BBMM in the R language for statistical computing (R Foundation for Statistical Computing, Vienna, Austria). We prepared 50% BBMM and 95% BBMM to represent the core area of use and the standard home range size, respectively (Fischer et al., 2013).

b) Group dynamics study

There was difficulty in sighting swamp deer inside the tall wet grasslands as accessibility to these areas during monsoon was limited. Based on the core area usage of the two collared swamp deer (Figure.25- only Jhilmil's core area shown), five cameras were deployed in each of the two locations and activity and group dynamics were monitored for 10 days (100 trap nights). We placed the camera traps in certain trails in the grasslands for clear visibility. We calculated the temporal activity overlap analysis with CamTrap package implemented in R software (Niedballa et al., 2016). The time activity of humans and swamp deer was analysed by Oriana software 2.0 (Kovach Computing Services).

Results

Radio-tracking of animals post collaring

The 1st collared swamp deer was named as 'Jhilmil' (Figure.15) and the individual stayed in JJCR from 30th May to 6th June. Detailed movement path of Jhilmil is given in Figure 19. On 6th evening it left Jhilmil Jheel and moved along Ganges and reached Nangal grasslands. Constant data was generated at an interval of 2 hours via satellite tracking and adequate ground tracking was also done (Figure.16). On 9th June it moved further south and settled in a river island grassland patch four km upstream of Balawali Rail Bridge (Figure.17 right panel). Detailed movement path (May 2018-May 2019) from Jhilmil Jheel to Balawali river island with stopover sites is given in Figure 18(a-f). Ground tracking revealed that the habitat in the river island where it spent considerable time is mainly comprised of *Saccharum* spp. It was also accompanied by two more individuals at the time of sighting. During the course of one year monitoring, it had mainly resided within the grassland of Nangal and associated river islands.

Figure.15: Collared swamp deer grazing with the herd on 5th June 2018 at Jhilmil Jheel

The 2nd collared swamp deer was named as 'Gori'. The detailed movement path of the individual is given in Figure 21. Gori stayed in Jhilmil Jheel till 25th June 2018. On 26th June, Gori crossed Ganges and ventured into a cropfield / grassland complex for one day. The

animal moved further south and remained in Ranjeetpur Jheel in Laksar Range, Haridwar Forest Division till it moved downstream on 30th June, crossed the river and reached a small wetland near Sukhapur village in Uttar Pradesh (Figure.17 left panel). Detailed movement path (June 2018-May 2019) from Jhilmil Jheel to Sukhapur and back to Jhilmil with stopover sites is given in Figure.20 (a-f). The habitat is mainly comprised of Typha and Phragmites and it has been sighted twice but alone. It left Sukhapur on 15th January 2019 and stayed near the Balawali bridge area till 14th February 2019. On 15th February, Gori changed bank and moved upstream to Ranjeetpur Jheel where it stayed for about a month. On 15th March it again crossed Ganges and stopped at Nangal grassland for six days before finally reaching Jhilmil on 21st March. Till May 2019, Gori stayed in Jhilmil.

Figure.16: Radio-tracking of collared swamp deer

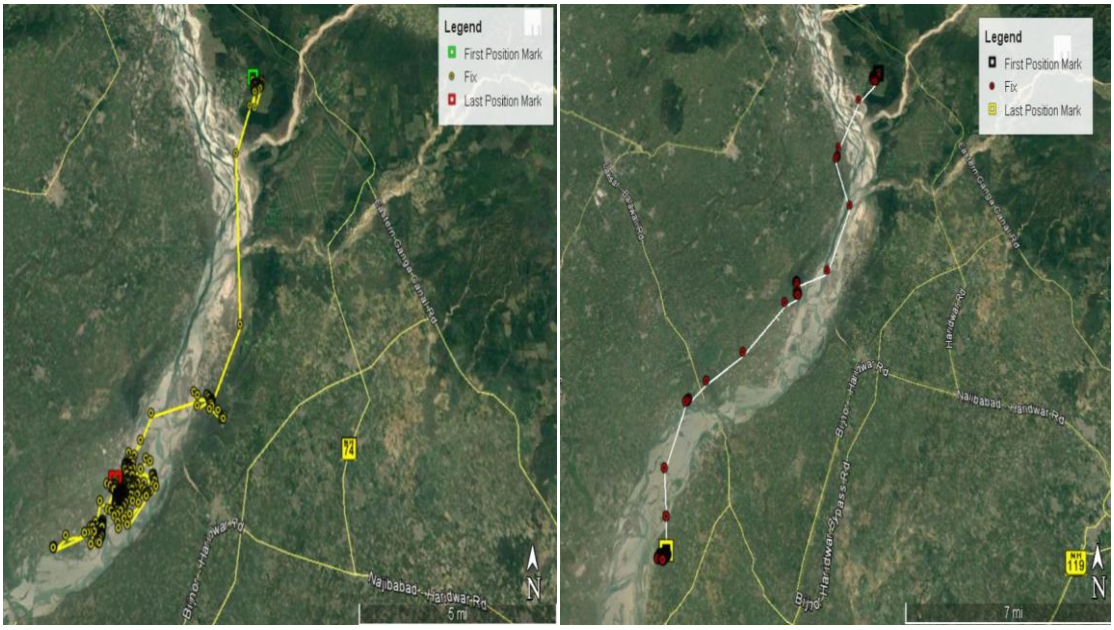

Figure.17: Movement pattern of Jhilmil (Right panel 30-5-18 to 12-7-18) and Gori (Left panel 22-6-18 to 12-7-18) (green/black squares= start point, red/yellow squares= end point)

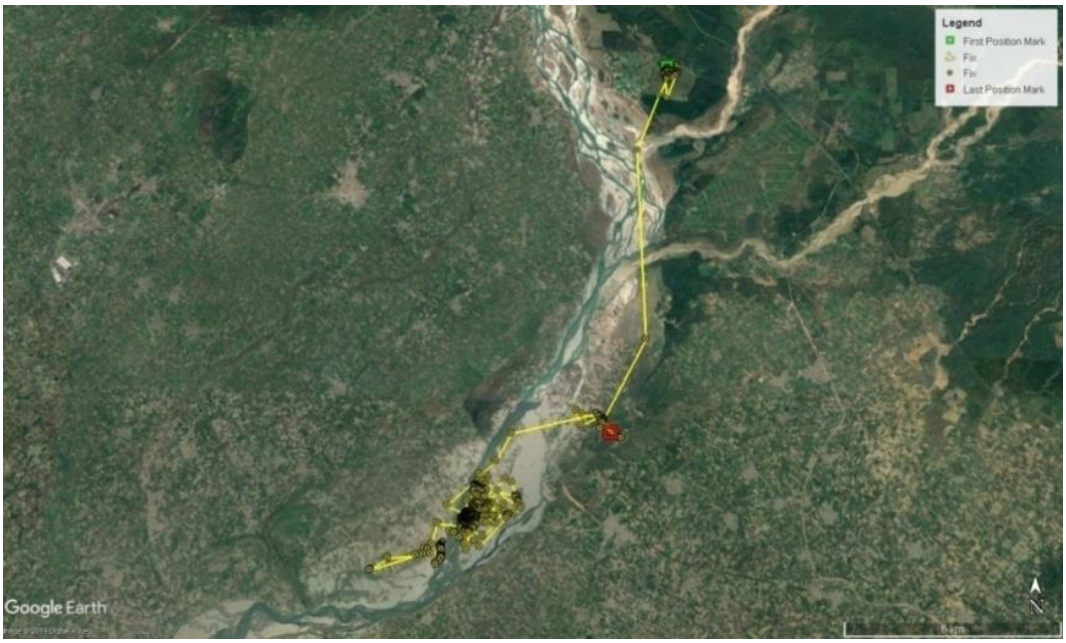

Figure.18a: Tracklog of Jhilmil; 30-5-18 to 22-7-18

Figure.18b: Tracklog of Jhilmil; 22-7-18 to 19-9-18

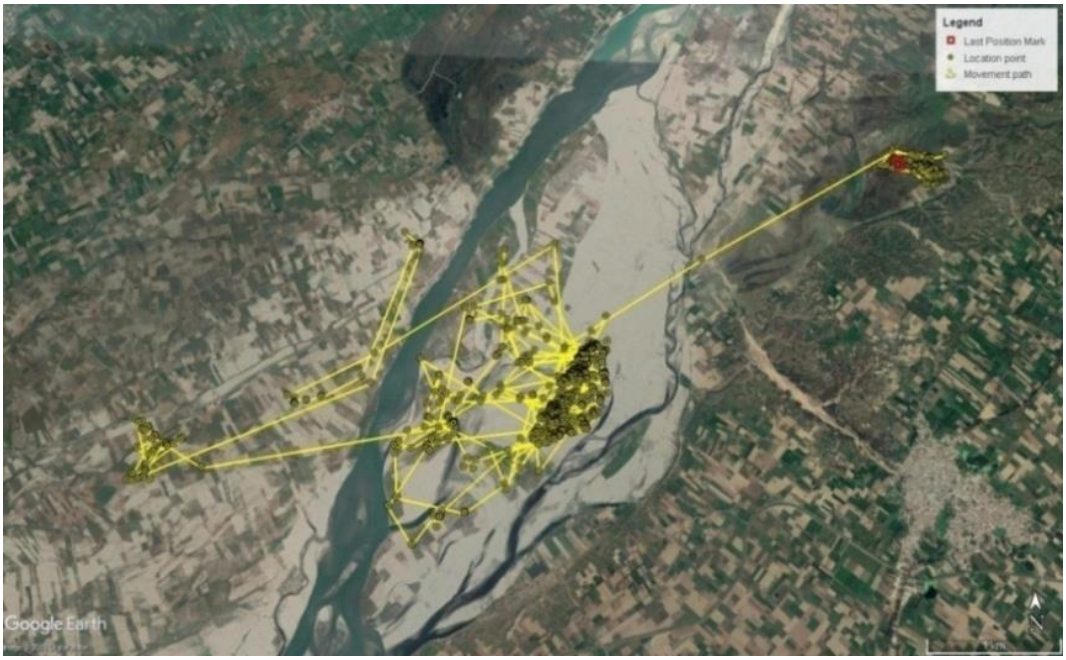

Figure.18c: Tracklog of Jhilmil; 19-9-18 to 17-11-18

Figure.18d: Tracklog of Jhilmil; 17-11-18 to 18-1-19

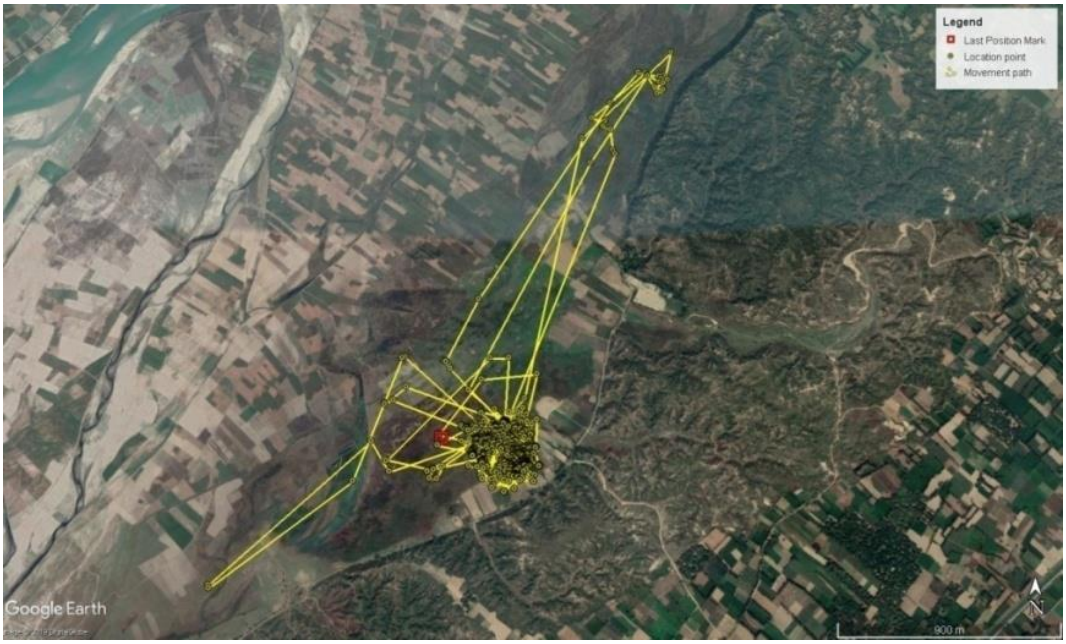

Figure.18e: Tracklog of Jhilmil; 18-1-19 to 17-3-19

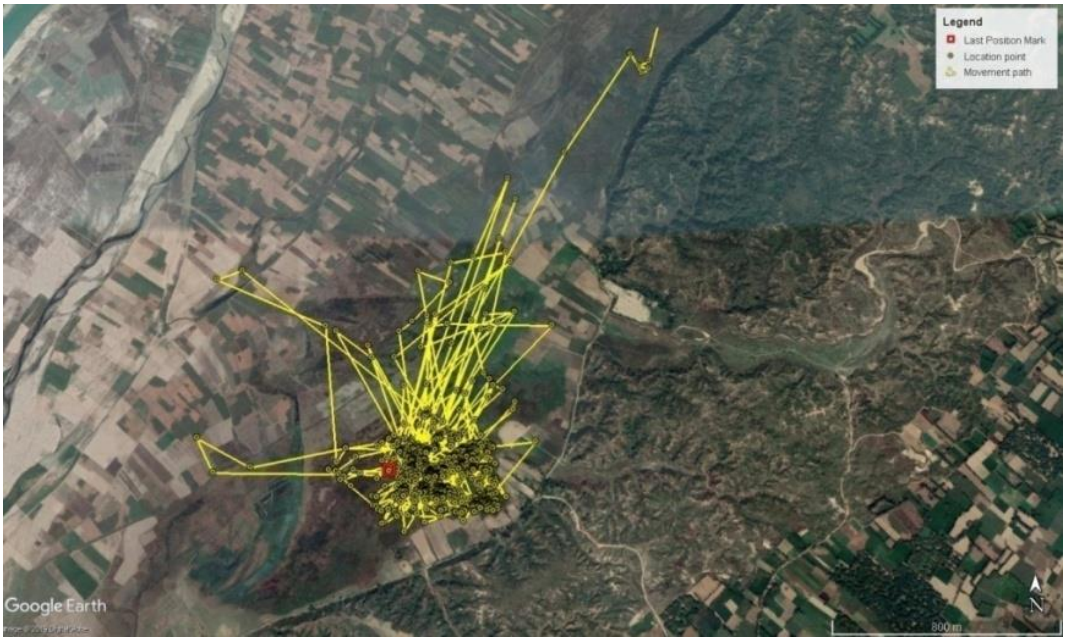

Figure.18f: Tracklog of Jhilmil; 17-3-19 to 28-5-19

Figure.18 (a-f): Swamp deer (Jhilmil) movement from Jhilmil Jheel to Balawali river island with stopovers

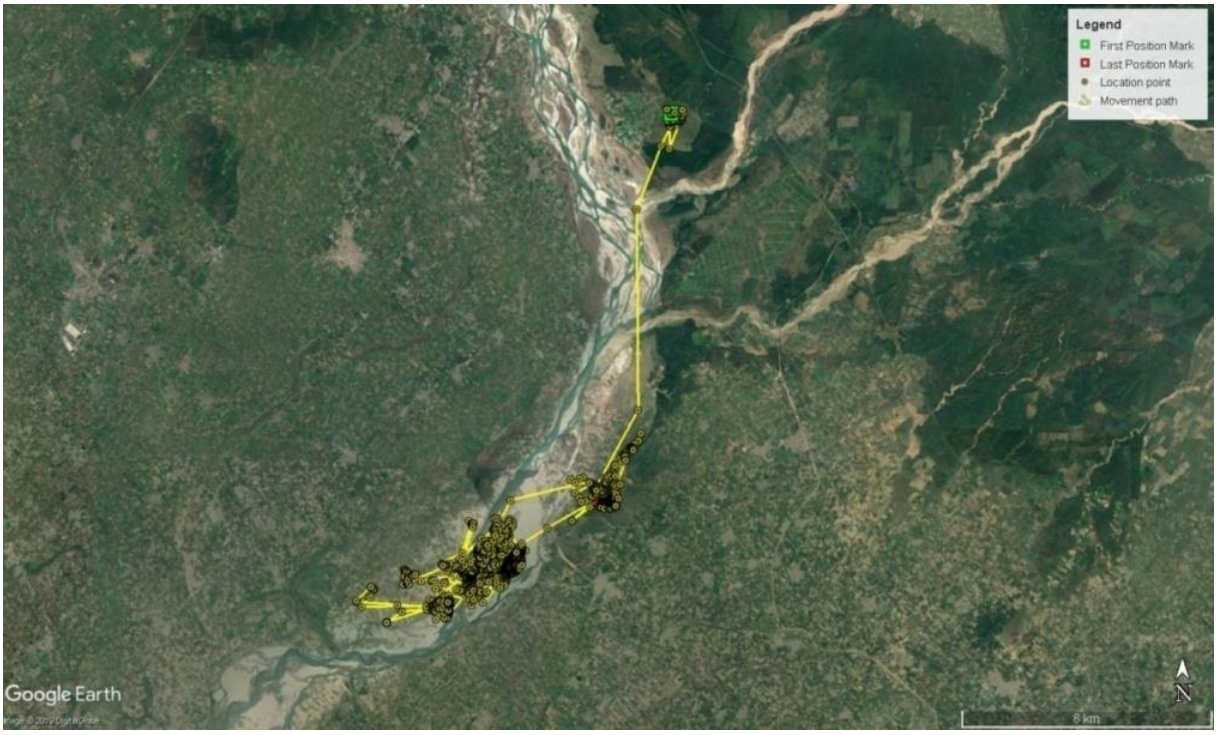

Figure.19: Overall tracklog of Jhilmil; 30-5-2018 to 28-5-2019

Figure.20a: Tracklog of Gori; 28-6-18 to 27-7-18

Figure.20b: Tracklog of Gori; 27-7-18 to 12-9-18

Figure.20c: Tracklog of Gori; 12-9-18 to 18-11-18

Figure.20d: Tracklog of Gori; 18-11-18 to 19-1-19

Figure.20e: Tracklog of Gori; 19-1-19 to 12-3-19

Figure.20f: Tracklog of Gori; 12-3-19 to 28-5-19

Figure.20 (a-f): Swamp deer (Gori) movement from Jhilmil Jheel to Sukhapur and back to Jhilmil with stopovers

Figure.21: Overall tracklog of Gori; 28-6-18 to 28-5-2019

Home range estimation

For the 1st collared swamp deer (Jhilmil), BBMM analysis revealed a 95% usage area of 8.22 km^2 and 50% usage area of 0.58 km^2 (Figure.22). The overall displacement was 224 km and the linear distance between initial and final points was 17 km. The 2nd collared swamp deer showed a 95% and 50% usage area of 11.97 and 1.47 km^2 respectively (Figure.23). Overall it moved 81 km and a maximum of 26 km linearly along Ganges from its initial location. The results suggest that very minimal habitat is available for the swamp deer outside the realms of protected areas.

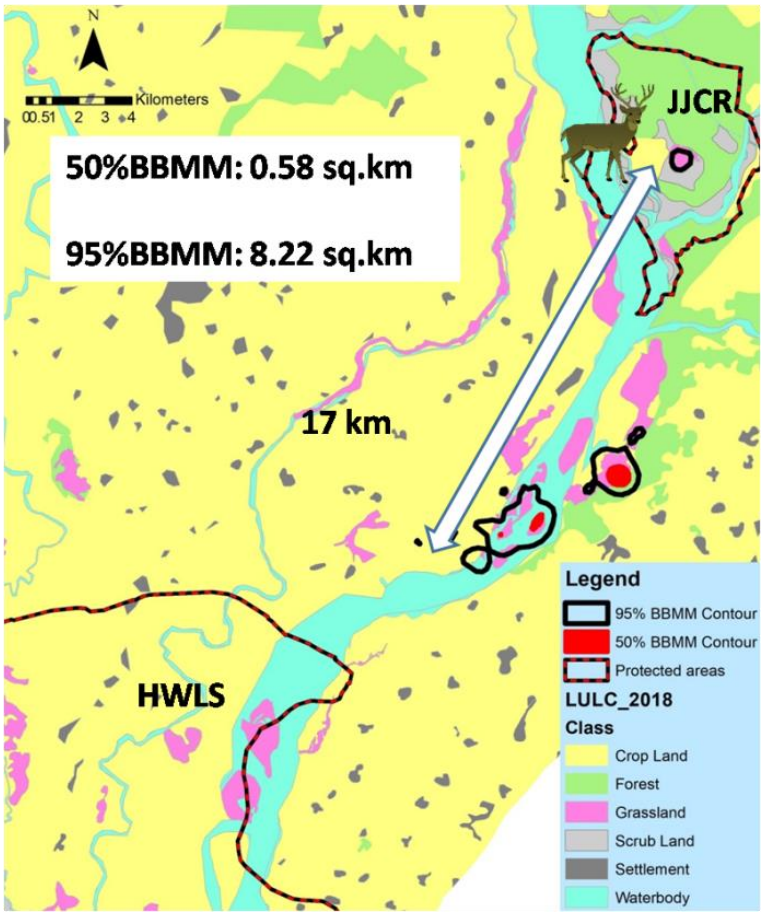

Figure.22: BBMM Home range of 1st collared individual (Jhilmil)

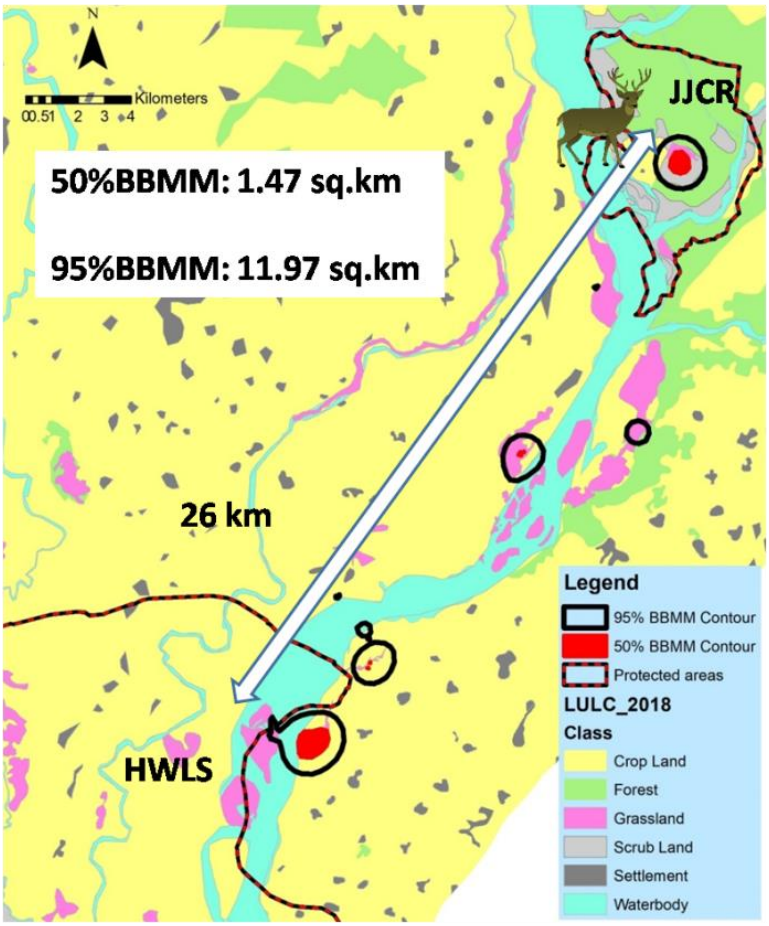

Figure.23: BBMM Home range of 2nd collared individual (Gori)

To see the habitat selection by the two individual swamp deer, we collated all the GPS points and plotted it on the different classes, categorized in Land Use and Land Cover map 2018. We observed that 80% of the GPS points fell on grasslands (Figure.24).

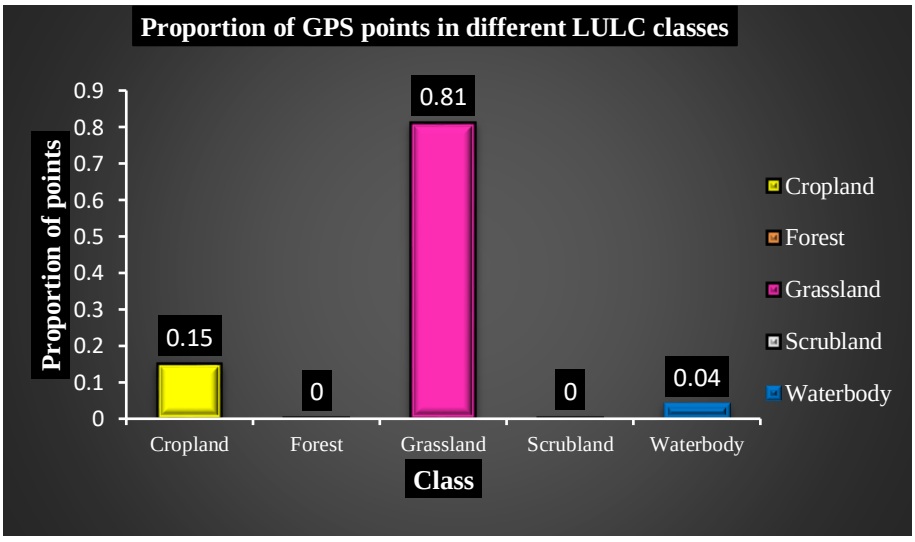

Figure.24: Proportion of GPS points in different LULC classes

Camera trapping to study group dynamics and activity pattern

Based on the core area usage of the two collared swamp deer (Figure.25- only Jhilmil's core area shown), we deployed five cameras in each of the two locations which revealed amazing data on swamp deer group dynamics and temporal segregation with humans.

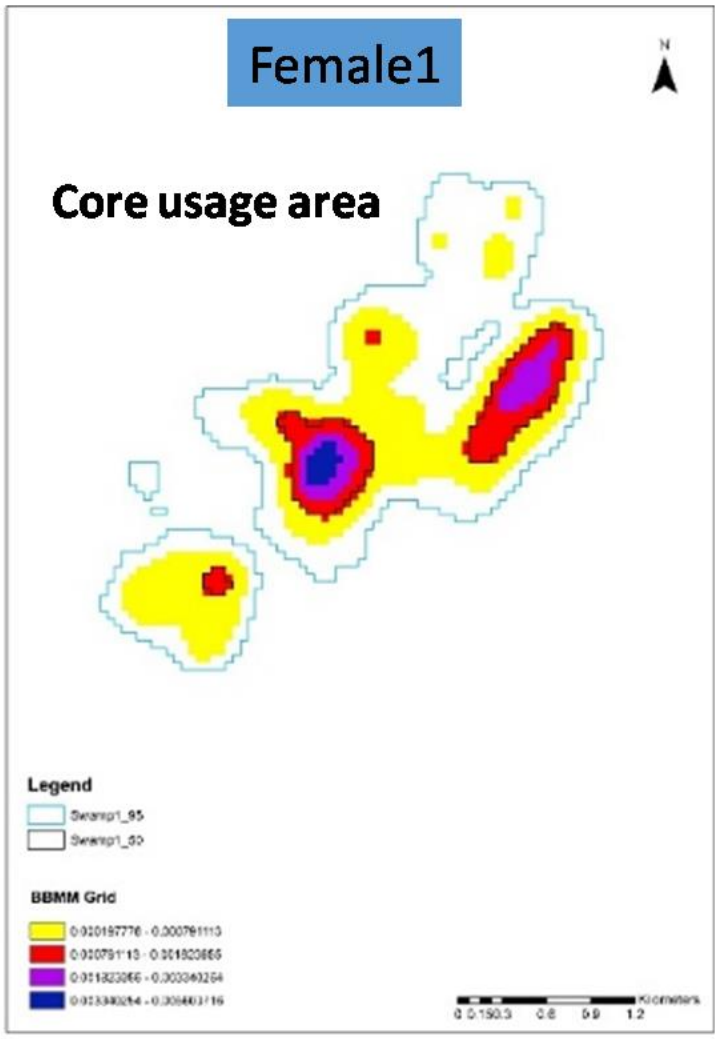

Figure.25: Camera traps deployed based on core area usage (only Jhilmil shown)

Camera trap data suggests that the swamp deer are operating in small groups (Figure.26) with presence of stags (Figure.27) and other hinds (Figure.28) besides collared females (Figure.29). From the camera trap images, it was understood that these fragmented grasslands are critical fawning and rutting grounds (Figure.30 & 31). Most of the captures of swamp deer were during the night between 6:00pm to 6:00am (Figure.34). During day, human activities are rampant, especially between 7:00am and 4:00pm (Figure.32, 33 & 35). An

activity overlap analysis shows only a mere 16% overlap between the activities of swamp deer and human (Figure.36) ($U2= 4.69$ $p<0.001$).

Figure.26: A group of swamp deer in Sukhapur

Figure.27: A stag in Sukhapur

Figure.28: A hind and a stag near Balawali river island

Figure.29: 2nd collared individual (Gori) in Sukhapur

Figure.30: Swamp deer stag in rut

Figure.31: Swamp deer hind with fawn

Figure.32: Human activity in Sukhapur

Figure.33: Human activity in Balawali river island

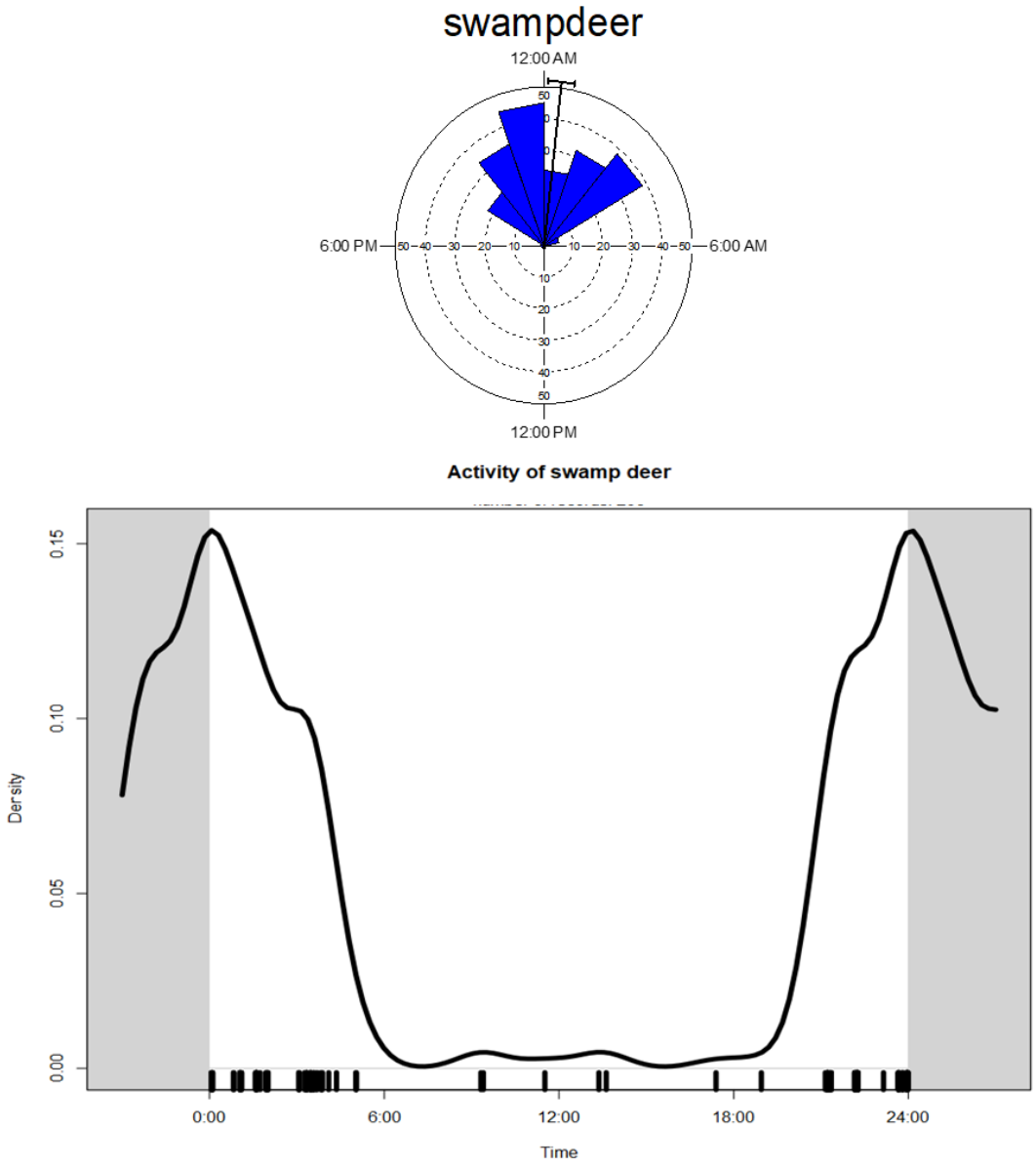

Figure.34: Temporal activity pattern of swamp deer (Trapnight=100)

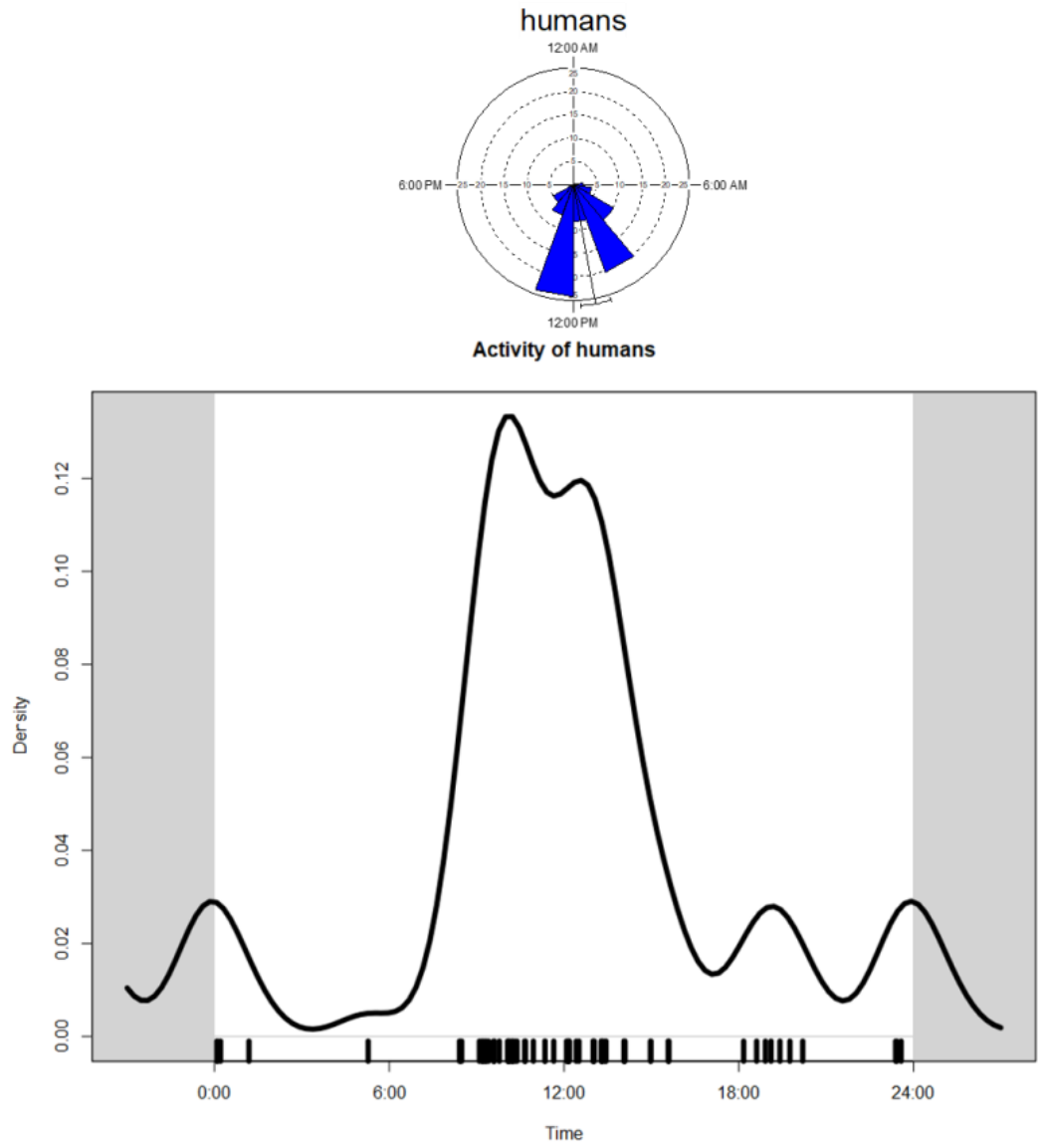

Figure.35: Temporal activity pattern of human (Trapnight=100)

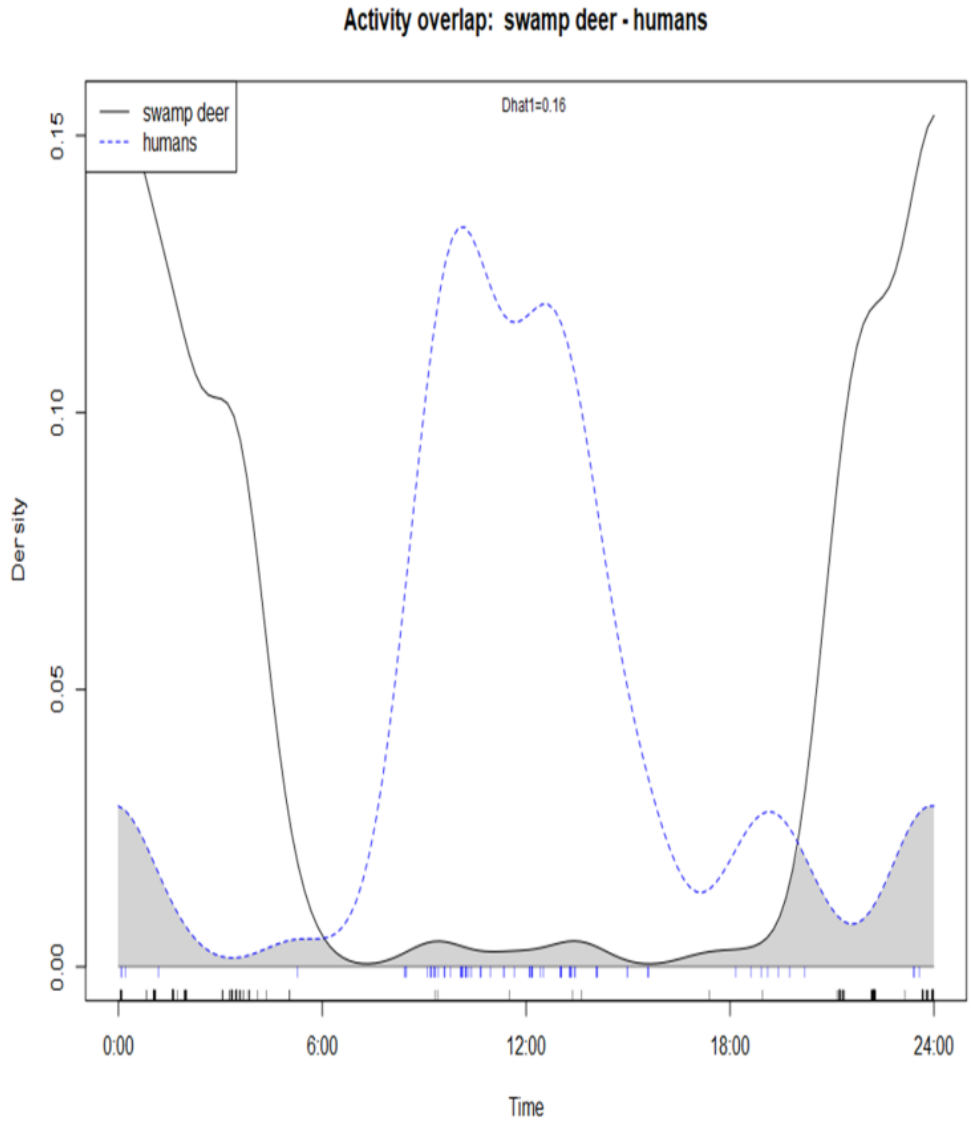

Figure.36 : Activity overlap pattern between human and swamp deer (Trapnight=100)

Discussion

The collaring of swamp deer is a critical step in the conservation of this species in this fragmented non-protected landscape. Fluctuating swamp deer numbers throughout the year raised questions about their unknown whereabouts. Surveys revealed presence of grassland patches outside Jhilmil Jheel which could be used by swamp deer moving from Jhilmil Jheel Conservation Reserve. Drive-net technique was successfully implemented to collar two swamp deer. The movement pattern displayed by the two collared individuals validated the previously generated genetic data which showed connectivity between different swamp deer harbouring areas. The movement data identified critical stopover sites (Nangal grassland, Ranjeetpur Jheel, river islands) between Jhilmil and Bijnor which both swamp deer actively

used. Some of the habitats are still suitable for swamp deer (Nangal grassland) while Sukhapur is highly degraded and requires immediate attention. If the intermediate habitats perish, it can have catastrophic effect on swamp deer population. Also we found that the core area usage for swamp deer was limited (0.58 and 1.47 km^2) which indicates minimal habitat left for swamp deer in this human-dominated landscape. The swamp deer are operating in small groups in these non-protected grasslands and they showed an overlap coefficient of 0.16 with humans. Presence of fawns and rutting males in the fragmented grassland patches indicate that these grasslands are integral part of their life-cycle. Some croplands were also used by the collared swamp deer but the croplands were in close vicinity of the grasslands. In our current study we have been able to radio-collar only two females from 2016-2018. Further efforts with radiocollaring some stags would shed some light on the sex-specific movement and habitat usage pattern in this landscape. A long-term radiocollaring study with significant number of animals would help us priortize conservation measures for swamp deer of the Gangetic plains in future. As of now, all analysis and findings indicate that these grassland patches continue to be critical in supporting a viable population of swamp deer. It is essential to devise management plans involving local communites around Ganges for these fragmented patches to support swamp deer conservation.

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Movement pattern and inbreeding status of swamp deer (*Rucervus duvaucelii duvaucelii*) at Uttarakhand, India

Project Report

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Funding agencies

Uttarakhand Forest Department
Department of Science and Technology

Distribution and status of swamp deer along the Ganga river and its tributaries in North India

Introduction

The Swamp deer (*Rucervus duvaucelii*) or *Barasingha* is a large 5-6 tined cervid of tall, swampy grasslands and is endemic to the India and Nepal (Qureshi *et al*. 2004). Currently they are found to occupy isolated pockets in north and central India and south-western Nepal, covering less than 2000 km^2 area where about 10 known viable populations survive (Qureshi et al. 2004). They are currently positioned as vulnerable according to IUCN Red List and Schedule I according to WPA with the populations showing a decline throughout its range (Duckworth et al 2013). The northern subspecies of swamp deer *Rucervus duvaucelii duvaucelii* is currently known to be restricted to only certain areas in the states of Uttar Pradesh (Hastinapur sanctuary, Bijnor forest division, Pilibhit forest division, Kishanpur Wildlife Sanctuary, Dudhwa National Park and Katerniaghat Wildlife Sanctuary) and Uttarakhand (Jhilmil Jheel Conservation Reserve) in Northern India (Qureshi et al 2004). While much work has been done on the populations of Dudhwa National Park, Kishanpur and Katerniaghat wildlife sanctuaries which are situated to the north of Uttar Pradesh, the status of swamp deer along the Ganges which is situated further south remain unknown.

Back ground study

Jhilmil Jheel Conservation Reserve (JJCR) is the only protected area of Uttarakhand that harbors swamp deer. There are about 150 individuals who start congregating on the meadow of JJCR from the month of January but they do not stay there for whole of the year. On the onset of monsoon the population starts migrating and they again return back in December. The swamp deer move out of the protected area and where they go is unknown. Anecdotal reports suggest that swamp deer has been sighted moving towards the Ganga River during monsoons. The other known place along the Ganga from where swamp deer is reported is Hastinapur Wildlife Sanctuary (HWLS) which is situated approximately 53kms from JJCR. So are these areas connected? What are the places between these two areas that are capable of harboring swamp deer?

Objectives

1. So based on this background study the objectives of this study were formulated which is primarily to investigate the movement patterns of swamp deer in Uttarakhand and Uttar Pradesh along the main rivers.
2. As a part of our long term goals we also plan to estimate the abundance, sex ratio, connectivity and inbreeding status of swamp deer in this area.
3. In the initial phase we plan to carry out survey along the grasslands and wetlands along Ganga to find potential swamp deer presence and identify the threats and status of these populations along Ganga.
4. Finally using all these information we plan to develop long term conservation plans for this species in this region.

Study area

We plan to survey the whole stretch of Ganga from JJCR to HWLS which is a linear distance of 53 kms (Fig.1). The whole stretch between these two areas is unprotected. JJCR is predominantly made up of *Typha sp*, *Phragmites sp* and *Imperata sp* which are typical characteristics of a swamp deer habitat. HWLS, declared a sanctuary in1986 encompassing an area of 2073sq km likewise is also comprised of mainly *Typha sp* patches.

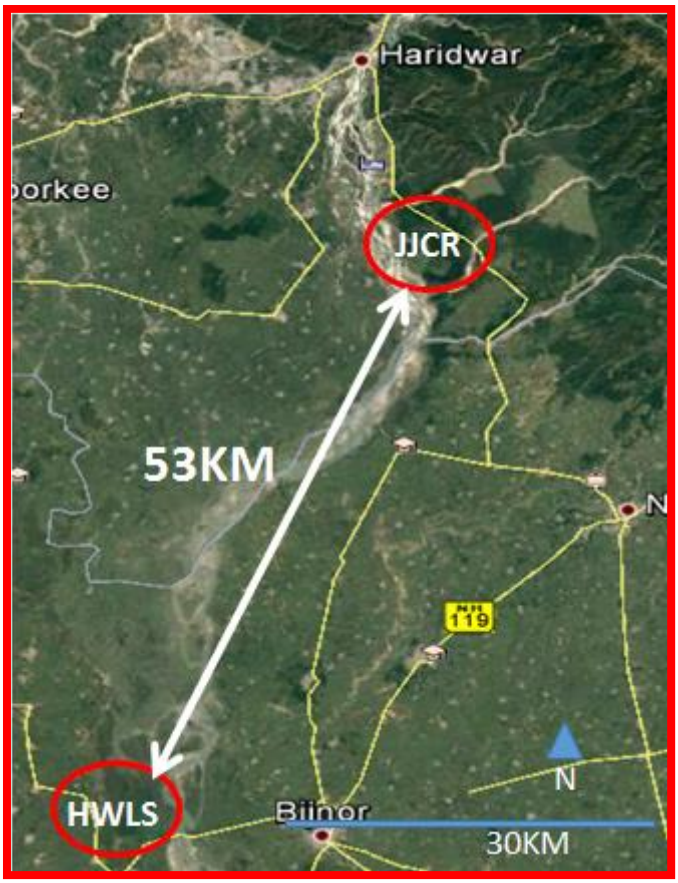

Fig. 1: Initial field study area

Methodology

1. We will be using a combination of ecological survey, radio collaring and molecular tools to answer our questions.
2. In the initial phase we carried out pilot survey along the Ganga by conducting unstructured questionnaire surveys with locals followed by intensive survey in the suggested places.
3. Direct sighting, hoofmarks, antlers and pellets were all considered as evidence of presence.
4. We also collected biological samples in the form of antlers, pellets and opportunistic tissue samples from dead animals and brought them back to WII.
5. Using those samples we have standardized a PCR assay for exclusive swamp deer identification in the laboratory.

The survey

Before we began our survey we wanted to look at whether any information is present about the current status of swamp deer along Ganges. Schaller in 1965 reported the presence of around 120 odd swamp deer along Ganges from Bijnor to Haridwar. But the most recent report of 1995 does not provide any conclusive information about the current status of swamp deer along the Ganga. So we embarked upon the arduous task of covering both the banks of Ganga on foot, boat and tractor. The track log of the survey is shown in Fig.2. This initial survey began in the month of March 2016 and concluded in August 2016. We also carried out our survey in some of the other areas of Uttar Pradesh based on newspaper articles and local information.

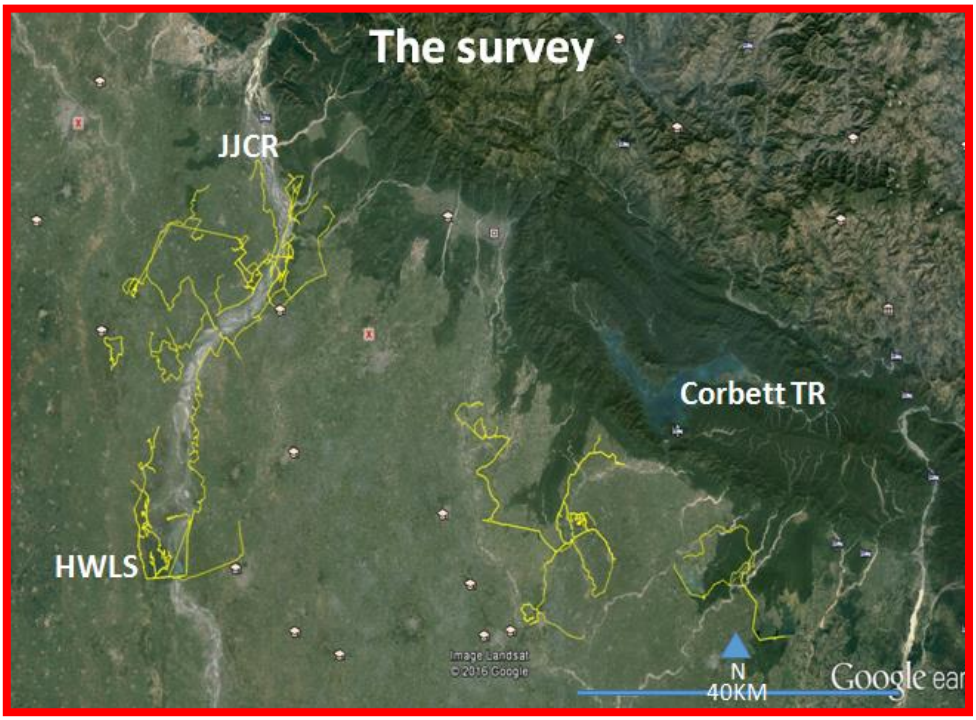

Fig.2: Track log of entire initial survey

Results

The initial survey yielded exciting results (Fig.3) as we found evidence of swamp deer presence in fragmented patches along Ganga on both banks from JJCR to HWLS.

1. Our survey started from the Jhilmil Jheel Conservation reserve where swamp deer was sighted regularly till May. From this area we also collected antlers and pellets from the month of March to June. JJCR is located along the left bank of Ganga and our search primarily concentrated on the left bank of the Ganga up to Hastinapur Wildlife Sanctuary.
2. Next we came across a grassland on the left bank of Ganga situated at a distance of 15km from JJCR The area is unprotected and is locally known as Amichand, Nangal and Bhoriasood. The grassland is dominated by plants like *Sacchurumsp, Typha sp* and we found evidence of swamp deer presence here Further south on the left bank upto Hastinapur Wildlife Sanctuary gave way to cropfields and huge anthropogenic disturbance with no suitable habitats present. No signs of swamp deer presence were found in this area.
3. We then turned our attention to the right bank starting right from the opposite side of JJCR. Our survey lead us to a huge Jheel in a place called Ranjitpur which comes under Laksar Range of Haridwar Forest Division, situated exactly opposite to Amichand . It proved to be an ideal habitat of swamp deer with presence of *Typha sp, Phragmites sp*. This area is surrounded by villages on all sides and Ganga on the other side. We found antlers and fresh pellets of swamp deer in this area.
4. Moving further inland, about 10 to 15 km from Ganga we found a grassland called Dharampur (Laksar Range, Haridwar Forest Division) situated on the bank of Saloni River, a tributary of Ganga. Here also we found evidence of swamp deer presence.
5. Further south along Ganga another Jheel/Tal was found which is locally known as Jogga Jheel where locals report presence of swamp deer. Though we did not find pellets or antlers we saw hoofmarks which closely resembled that of swamp deer. We also collected few pellets from a place called Balia Khaddar near Ganga on the right bank.
6. Finally we surveyed HWLS, the last known protected place along Ganga to harbor swamp deer. We sighted swamp deer and recovered fresh pellets, antlers from this area. On the course of Ganga from JJCR to HWLS, some river islands are formed in between which we surveyed for swamp deer presence. We found evidence of swamp deer presence in a place locally called Raulighat which harbors a big Tal dominated by *Typha sp*. We saw hoofmarks and we recovered pellets, antlers and a whole skeleton of a swamp deer.

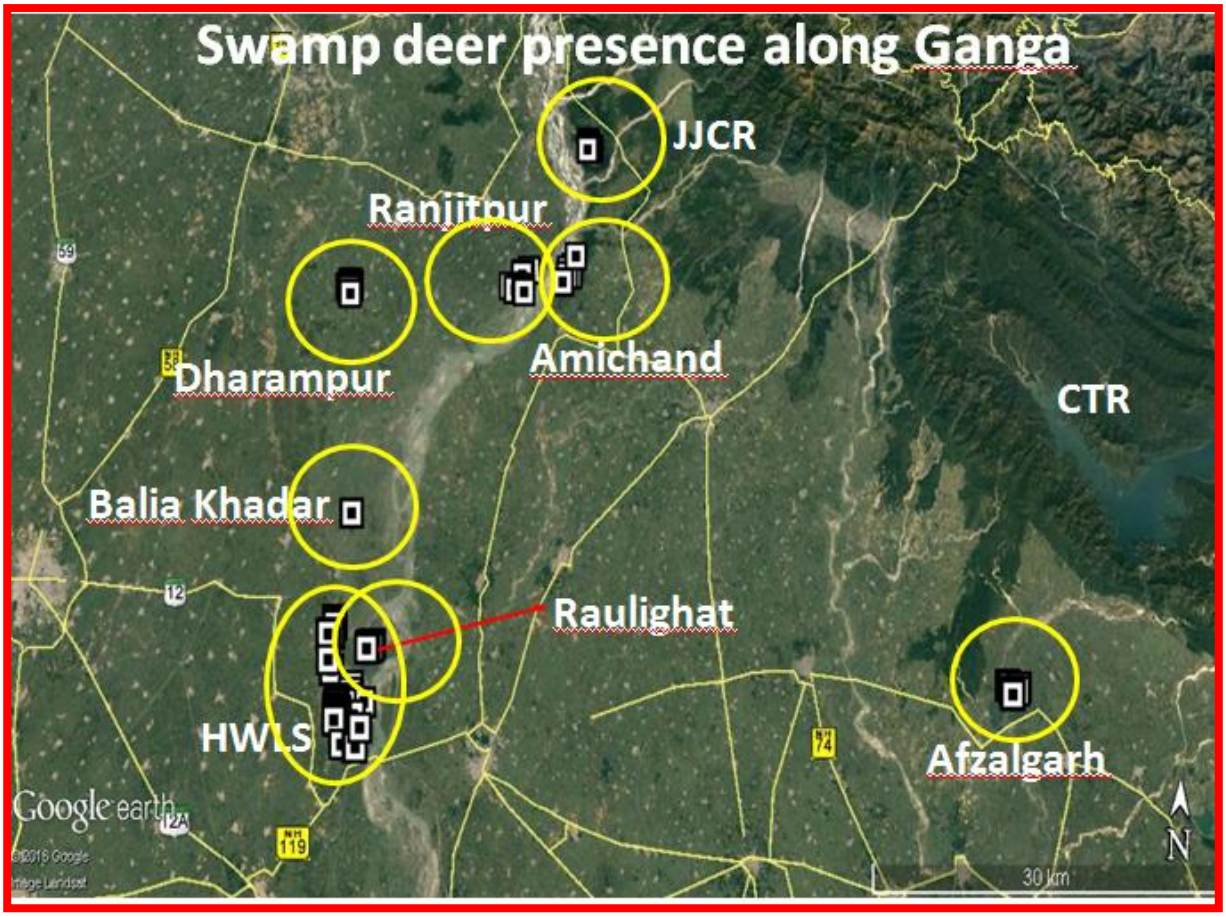

Fig.3: Findings of survey

The population found at Jamanpur, Afzalgarh

A newspaper breakthrough led us to stumble upon a unreported population till date. We heard about a poacher getting caught in Barhapur area of Uttar Pradesh and we went to survey the area. After interviews with locals, we went to search a huge Tal in a place called Jamanpur near Afzalgarh in the Barhapur district. The place is dominated by *Typha sp, Phragmites sp*. There we sighted around 11 swamp deer and we recovered 26 pellets and 9 antlers. This place is situated quite far from Ganga and on the banks of Ramganga River. We surveyed the area along the Ramganga bank up to a place where this river meets Kho River and we heard locals saying swamp deer coming there. Beyond this point all suitable habitats have been converted to croplands and we found no evidence of swamp deer presence. Genetic data obtained from the samples collected from this area will reveal whether this population is isolated from Ganga or not.

Other findings

Apart from presence, we also recorded GPS locations of some other important parameters like disturbances, suitable habitats, kills etc. Some of the pictorial representatives (Fig.4 to Fig.9) of those parameters are provided below:

Fig.4: Poached carcass of swamp deer found at Amichand

Fig.5: Encroachment by livestock at Amichand

Fig.6: New population at Jamanpur, Afzalgarh

Fig.7: Sand mining on bank of Ganga, Amichand

Fig.8: Skull of swamp deer found at Raulighat, a river island

Fig.9: Typical swamp deer habitat at Ranjitpur

Conclusions

The initial survey revealed that the whole stretch of Ganga from Jhilmil Jheel to Hastinapur Wildlife Sanctuary has multiple areas of swamp deer presence with possible swamp deer movement going on. A new unreported population has been found out at Jamanpur, Afzalgarh on the bank of Ramganga River. The presence of swamp deer at multiple areas adds hope for this species but these populations are suffering from habitat loss, encroachment and poaching which appears to be a major threat to the survival of swamp deer in this area. The initial findings are now in a manuscript preparation stage which will be communicated to a peer reviewed journal within the next two months.

Future Plans

1. Intensive survey of other swamp deer habitats in Uttarakhand and Uttar Pradesh.
2. Radio collaring of 4-6 individuals to track their movement.
3. Determining the genetic status of swamp deer along Ganga.
4. Plan for long term conservation of swamp deer along Ganga based on the data generated.

Significance of the study

1. Importance of wetlands and grasslands along Ganga has to be realized. Wetlands are known as Nature's kidney and also home to many a flora and fauna. So, protecting wetlands will automatically protect the swamp deer.
2. Swamp deer can be represented as an umbrella species of wetlands. It is a mega herbivore, the largest mammal found in these wetlands. If one gives protection to swamp deer, then under its umbrella one can protect hog deer, fishing cat, otters, wetland birds and many herpetofauna.
3. Swamp deer in this region is in threat of local extermination and our study can help prevent it. It is extremely essential that some conservation steps should immediately be deployed to save the last resort of swamp deer along the Ganges.

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Current distribution and status of swamp deer (*Rucervus duvaucelii duvaucelii*) along upper Gangetic plains in North India

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Department

Movement pattern and inbreeding status of swamp deer (*Rucervus duvaucelii duvaucelii*) at Uttarakhand, India

Project Report

Submitted to

Uttarakhand Forest Department

by

Wildlife Institute of India

Report Summary

The swamp deer (*Rucervus duvauceilii*) is the largest grassland-dwelling endemic cervid species in India and Nepal. With a declining population trend across their range, this species is found in fragmented habitats of northern, north-eastern and central India as well as south western Nepal. Distributed within a number of small wetland patches across the states of Uttarakhand and Uttar Pradesh in India, the northern swamp deer subspecies (*Rucervus duvaucelii duvaucelii*) has lost most of its' habitat in recent time. In the upper Gangetic plains, information about swamp deer distribution is very limited except two protected areas, Jhilmil Jheel Conservation Reserve (JJCR) in Uttarakhand and Hastinapur Wildlife Sanctuary (HWLS) in Uttar Pradesh. We surveyed the entire stretch of upper Gangetic plains between JJCR to HWLS and adjoining areas, including some tributaries of Ganges to assess current swamp deer distribution, the threats and status of these habitats. Our survey revealed a much extended swamp deer distribution with presence of multiple populations in non-protected swamps along the whole stretch of upper Ganges and an unknown population in Uttar Pradesh. We documented major threats in the forms of habitat conversion, livestock grazing, poaching, conflict and other types of anthropogenic disturbances. We suggest local community driven conservation and management of *Rucervus duvaucelii duvaucelii* populations in this fragmented, non-protected landscape to ensure future survival of this species and other endangered fauna inhabiting these wetlands.

Introduction

The Swamp deer (*Rucervus duvauceilii*) or 'Barasingha' is an obligate 5-6 tined swampy grassland dwelling large cervid currently endemic to India and Nepal (Qureshi et al., 2004). Historically swamp deer was widely distributed throughout Indo-Gangetic plain and the lowlands flanking the southern Himalayas from Pakistan to Bangladesh through India (Schaller, 1967; Groves, 1982; Sankaran, 1989). With current population size of less than 5000 individuals globally (Qureshi et al., 2004; Tewari & Rawat, 2013a) and a declining trend across its' range (Duckworth et al., 2015), they are restricted to isolated pockets of northern and central India and south western Nepal (Qureshi et al., 2004) (Fig. 1). Now considered as vulnerable by IUCN Red List (Duckworth et al., 2015), the species is listed in Appendix I in CITES and Schedule I of Wildlife Protection Act of India (1972, *i.e.* highest level of protection). Three subspecies of swamp deer (based on morphological characteristics) are described across their range. The northern subspecies *Rucervus duvaucelii duvaucelii* is found in the north Indian states of Uttar Pradesh and Uttarakhand along with Nepal. The hard ground barasingha *Rucervus duvaucelii branderi* (Pocock 1943; Ellerman and Morrison-Scott 1951) is found as a single population in Central India and the eastern subspecies *Rucervus duvaucelii ranjitsinhii* is found in the state of Assam (Groves 1982; Qureshi et al., 2004). All swamp deer populations in India have declined in recent time due to increased human pressure and changing land use practices (Qureshi et al., 2004). The long-term viability of the remaining populations is under serious threat from habitat loss and degradation leading to isolated populations, disturbance from heavy livestock grazing and poaching (Qureshi et al., 2004).

Fig .1: Current distribution of swamp deer in India

Rucervus duvaucelii duvaucelii is the most abundant of all subspecies and retains about 80% of the global swamp deer population (Qureshi et al., 1995, 2004). Currently, they are found in small, fragmented populations across the states of Uttar Pradesh (Hastinapur Wildlife Sanctuary, Bijnor forest division, Pilibhit forest division, Kishanpur Wildlife Sanctuary, Dudhwa National Park and Katerniaghat Wildlife Sanctuary) and Uttarakhand (Jhilmil Jheel Conservation Reserve) (Qureshi et al., 2004). This subspecies has lost most of its' grassland habitat in recent time and was thought to be extinct in the state of Uttarakhand. Swamp deer population was rediscovered in 2005 at Jhilmil Jheel Conservation Reserve (JJCR), Uttarakhand (Sinha & Chandola, 2006). Subsequently, another small population was located in Banganga wetland region (Tewari & Rawat 2013a). The ecology of *Rucervus duvaucelii duvaucelii*, specifically habitat use, feeding habits, diet, herd size and threats are fairly well studied in JJCR (Tewari & Rawat, 2013a,b,c,d,e) and other parts of their distribution (Qureshi

et al., 1995, 2004). Their regular congregation in JJCR during summer and subsequent migration with the onset of monsoon leads to questions about their unresolved seasonal whereabouts. Anecdotal reports suggest their movement towards the Ganges river through human modified landscapes. The closest protected swamp deer habitat from JJCR along the Ganges is at 53 kms downstream area of Hastinapur Wildlife Sanctuary (HWLS) (Khan & Khan 1999). The entire stretch of habitat between these two areas are non-protected. A number of smaller patches of swamp habitats are present between these two areas, but information on swamp deer status outside the protected areas (JJCR and HWLS) is meagre. Last swamp deer status report based on survey conducted along Ganges in 1995 showed no conclusive evidence of its' presence between these two regions (Qureshi et al., 2004), but there are many anecdotal sighting reports of swamp deer movement toward the Ganges by local communities. As neither of the existing populations in Uttarakhand have large number of individuals to support viable swamp deer populations, their conservation will strongly depend on how they are managed as one intermixing management unit with populations in the neighbouring state of Uttar Pradesh. In this study, we assessed the current population status of *Rucervus duvaucelii duvaucelii* along both banks of the Ganges and its' tributaries. We surveyed the entire stretch of Ganges from JJCR to HWLS and adjoining areas, including some tributaries of Ganges looking for current swamp deer presence/absence, potential species habitats and assessed the threats and status of these habitats.

Study area

Swamp deer is a highly specialised species that prefers wetlands (also called 'Swamps' or 'Tals' locally) and flooded grasslands (Tewari & Rawat, 2013). Thus, our survey mostly focused on the swampy grasslands found along the whole stretch of Ganges and adjoining areas (both left and right banks) between JJCR and HWLS (Fig. 2). Along with survey we also monitore the fluctuations of swamp deer numbers in JJCR from March to Decemeber.First, we

conducted unstructured questionnaire surveys with the local communities to get information on swamp deer location records outside JJCR and HWLS. Based on swamp deer sighting information gathered from local communities, we subsequently divided the left and right banks of Ganges between JJCR and HWLS into specific survey blocks. The left bank of the Ganges was divided into three major survey zones: (i) the first zone (Survey Zone 1) comprises JJCR, which is a saucer-shaped swampy grassland and surrounding areas in Uttarakhand. This region is dominated by vegetation of *Typha sp.* and *Phragmites sp.* (Tewari & Rawat 2013) (Fig. 2); (ii) the second zone (Survey Zone 2) is a grassland situated 15 km downstream from JJCR along Ganges stretching to a distance of 26 km, locally called as Amichand, Nangal and Bhuria Sot (Fig. 2) spread across Uttarakhand and Uttar Pradesh. This area is non-protected, dominated by vegetations of *Sacchurum sp., Typha sp.* and interspersed with croplands; and (iii) the third zone (Survey Zone 3) is further south, downstream of Amichand extending upto HWLS in Uttar Pradesh. This region is filled with human settlements and crop fields, and devoid of any swampy areas (Fig. 2).

Similarly, the right bank of Ganges was divided into five survey zones: (i) the first area (Survey Zone 4) comprises the area opposite to JJCR, which is non-protected, mostly human dominated and interspersed with few grassland and wetland patches (Fig. 2) in Uttarakhand; (ii) the second area (Survey Zone 5) is an non-protected wetland downstream of the first area, adjacent to Ganges and locally known as Ranjitpur in Uttarakhand. This area harbours a huge swamp dominated with *Typha sp.* vegetations (Fig. 2); (iii) the third area (Survey Zone 6) is further downstream along the Ganges, non-protected and mostly dominated by human settlements, croplands, extremely fragmented grassland and wetland patches (Fig. 2) stretching across Uttarakhand and Uttar Pradesh; (iv) the fourth area (Survey Zone 7) along the right bank comprises parts of HWLS and adjoining regions (Fig. 2) in Uttar Pradesh. This wildlife sanctuary possibly harbours a large number of swamp deer along Ganges. The sanctuary also

has some human settlements and croplands; and (v) the fifth survey zone (Survey Zone 8) is a number of river islands found in the riverbed close to HWLS in Uttar Pradesh. These river islands are dominated with patches of *Saccharum sp.* and *Typha sp.* vegetations.

Based on the information on potential swamp deer sighting provided by local communities, we also surveyed the grasslands along some of the tributaries of Ganges. First, about 10 km inland on the right bank of Ganges we found a grassland and a big swamp near river Saloni (Survey Zone 9) (Fig. 2) across Uttarakhand and Uttar Pradesh. This area is surrounded by human habitations, with potentially some connectivity with another *Typha*-dominated swamp locally known as Jogga Jheel downstream south of this region. Next we focused on the left bank of Ganges along its' tributary river Ramganga (Survey Zone 10) in Uttar Pradesh. This survey was motivated by a local newspaper report on swamp deer poaching in that region. Following interviews with the local community, we conducted an extensive survey and found a sizeable swamp in an area called Jamanpur. This swamp is present on both banks of Ramganga river (Fig. 2) and dominated with *Typha sp.* And *Phragmites sp.* vegetation. This swamp is completely surrounded by human habitations from all sides and possibly isolated from other swamp deer harbouring areas.

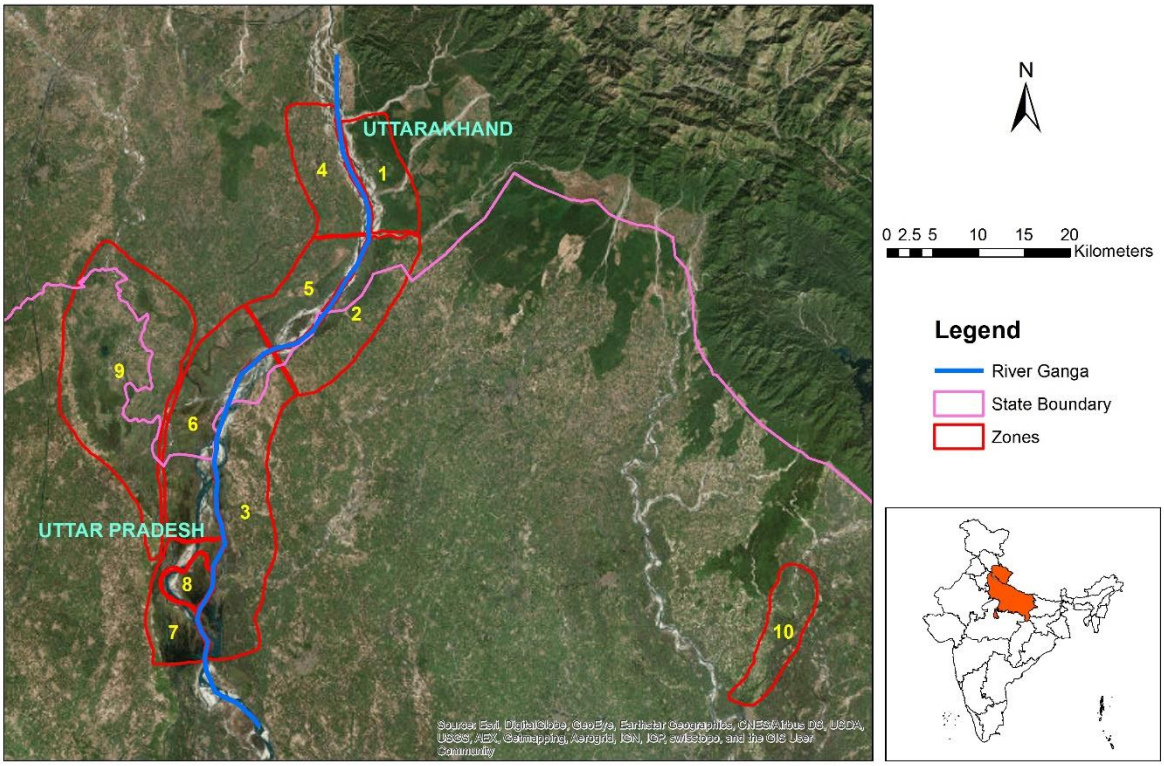

Fig .2: Current study area

Methods

Research permissions

All required permissions for our surveys and biological sample collections were provided by the Forest Department of Uttarakhand (Letter no: 978/6-32/56) and Department of Uttar Pradesh (Letter no: 2233/23-2-12 (G)).

Survey methods

After gathering information on potential swamp deer sightings, we surveyed the above-mentioned target regions extensively on foot, vehicle or boat, depending on the study area characteristics. The entire survey was conducted between December 2015 to November 2016, barring the monsoon season between July- October. The tracklog of the survey is given in fig .3. During our survey, we considered direct sighting, swamp deer specific signs (characteristic

splayed hoof marks, dung pellets, antlers etc.) and dead animals as evidence of swamp deer presence. We recorded GPS locations of all swamp deer presence evidence and collected biological samples (dung pellets, antlers, opportunistic tissue etc.) from all surveyed areas. Along with presence/absence data, we have also gathered geo-referenced information on other important ecological and habitat parameters (suitable habitats, disturbances, poaching incidences etc.).

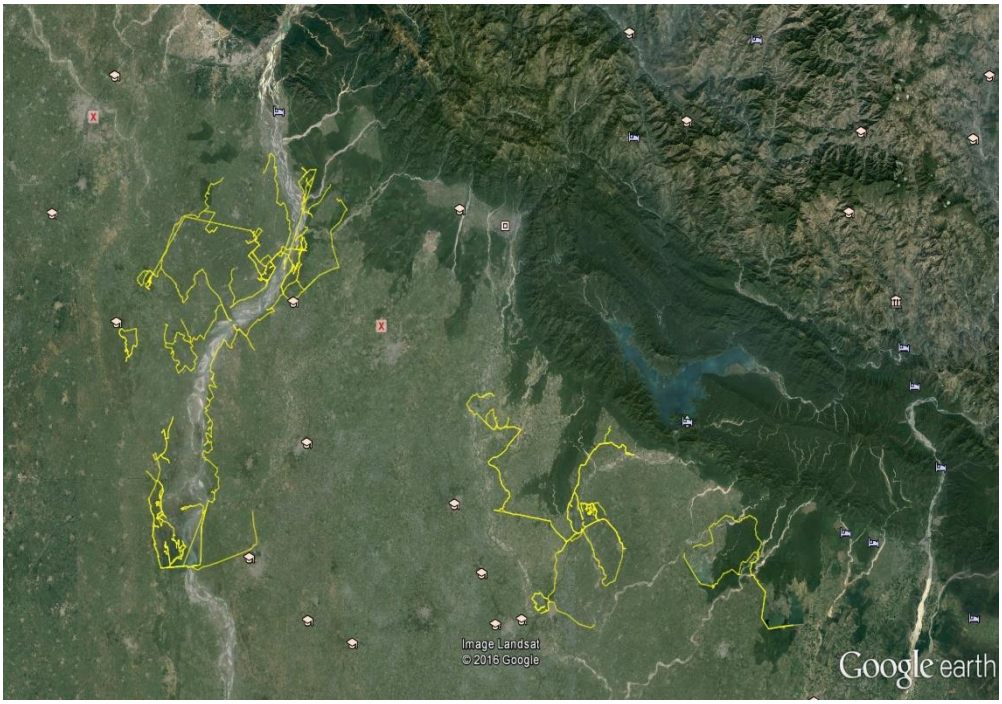

Fig .3: Tracklog of survey

Counting methods

In JJCR, swamp deer are counted from watch towers from March to December , twice in fifteen days by multiple observers simultaneously. Only direct observations were considered. Sex and age of each swamp deer are visually assigned based on their body size and antler characteristics (for males only). The swamp deer are grouped into three age-sex classes such as adult males, adult females and fawns. GPS and binoculars are used during the exercise to locate and record the deer in different parts of the Conservation Reserve.

Results

Swamp deer survey:

While reporting our survey results, we will present swamp deer distribution patterns in each survey zone described in the 'Methods' section. We had three such survey zones along the left bank of Ganges, five along the right bank and two along different tributaries of Ganges.

(i) The 'Survey Zone 1' comprising of JJCR and surrounding areas has probably the highest number of swamp deer individuals in the state of Uttarakhand. Despite anthropogenic pressures in the form of proximity to a village, swamp deer is still common in this area as proven by frequent direct sightings. We counted up to 162 swamp deer individuals in the month of May 2016 in JJCR. Apart from sighting, a large number of biological materials in form of antlers and pellets were collected from this area (Table 1, Fig. 4).

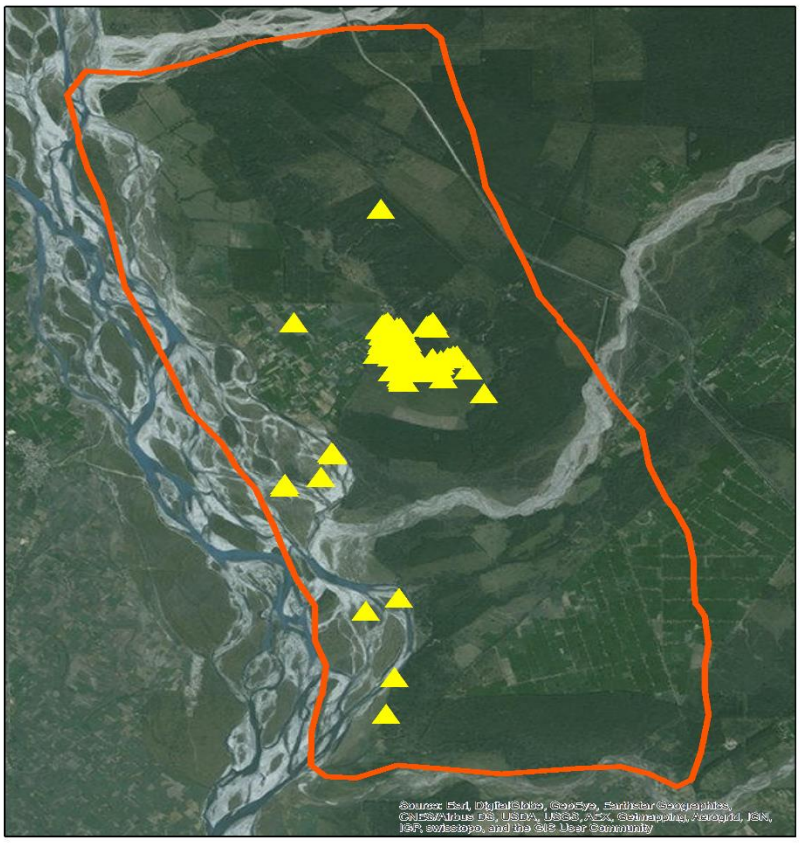

Fig .4: Swamp deer evidence in Zone 1

(ii) Our surveys in the 'Survey Zone 2' along the left bank of Ganges known as Amichand, Nangal and Bhuria Sot showed both direct as well as indirect evidences of swamp deer presence. Our questionnaire surveys with local communities revealed regular presence of swamp deer in this area. We found swamp deer specific signs (characteristic splayed hoof marks) in different areas in this zone and two carcasses as direct evidence. In addition,

we also recovered swamp deer antlers and fresh pellets as biological samples (Table 1, Fig. 5).

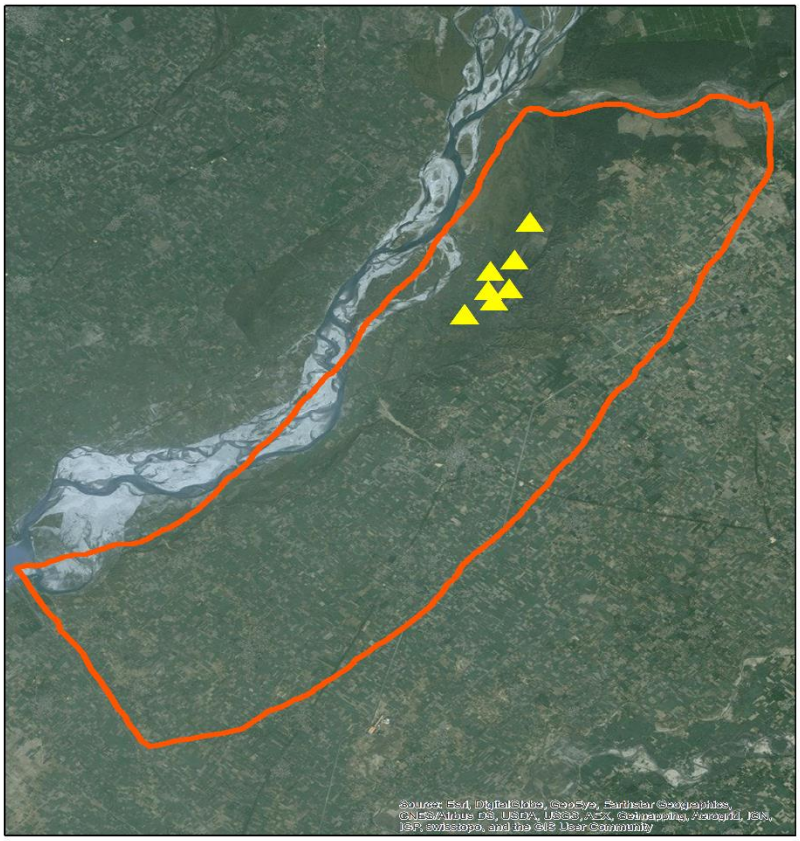

Fig .5: Swamp deer evidence in Zone 2

(iii) The 'Survey Zone 3' is devoid of any typical swamp deer habitat. During our survey we did not find any suitable habitat or indirect/direct signs of swamp deer in this zone.

(iv) The 'Survey Zone 4' in the right bank of Ganges did not provide us with any direct or indirect evidences of swamp deer presence. Our questionnaire surveys with local communities revealed historical presence of swamp deer in this area, but currently no swamp deer is found here.

(v) The ‘Survey Zone 5’ covers an non-protected wetland situated adjacent to Ganga river and directly opposite to Amichand grassland (Survey Zone 2). During our survey we collected swamp deer antlers and fresh pellets from this area as evidences (Table 1, Fig. 6).

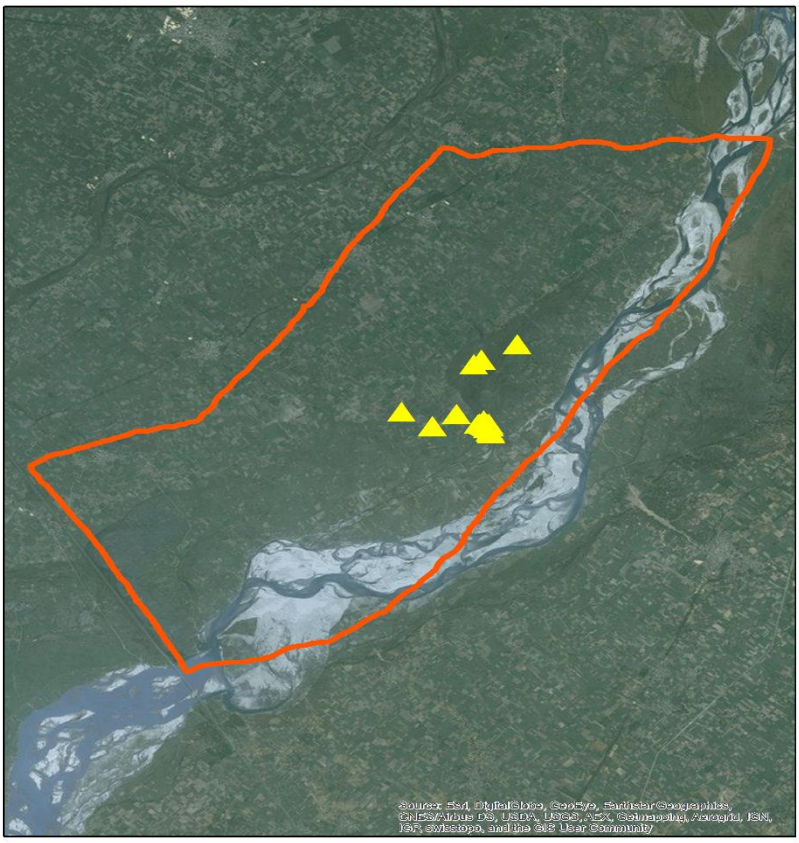

Fig .6: Swamp deer evidence in Zone 5

(vi) Despite historical records of existence, the ‘Survey Zone 6’ showed scanty evidences of swamp deer presence during our survey. Local communities reported occasional sighting

of swamp deer in this area and we collected few samples and found swamp deer signs (Table 1, Fig .7).

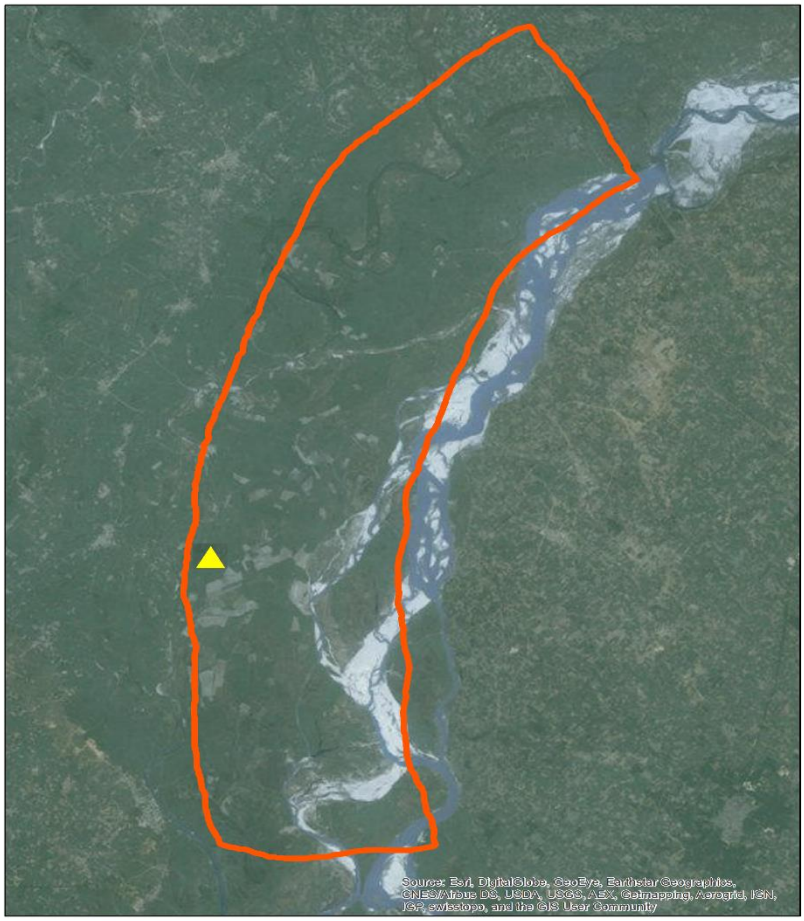

Fig .7: Swamp deer evidence in Zone 6

(vii) The 'Survey Zone 7' in the right bank comprising HWLS and adjoining regions possibly harbours a large population of swamp deer. During our survey of this large area we sighted swamp deer, and collected large numbers of biological materials in the form of antlers and pellets (Table 1, Fig. 8).

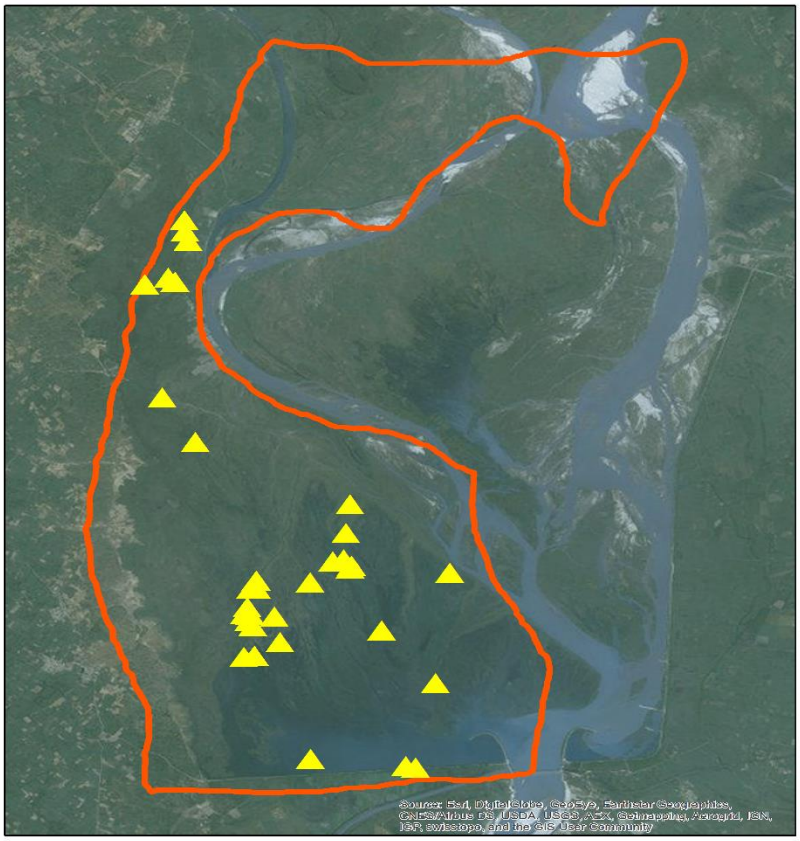

Fig .8: Swamp deer evidence in Zone 7

(viii) The final block of ‘Survey Zone 8’ in the right bank of Ganges consists of a number of small grassland-dominated river islands. We recovered a carcass and collected fresh pellets and antlers as evidences of swamp deer presence in these river islands (Table 1, Fig. 9).

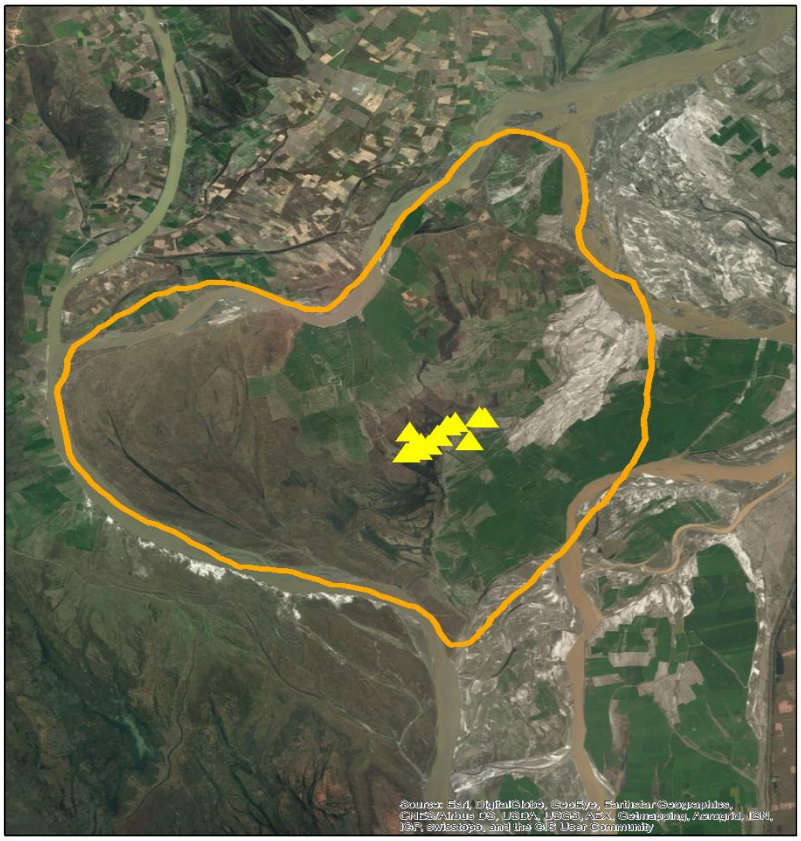

Fig .9: Swamp deer evidence in Zone 8

(ix) Among the two tributaries of Ganges we first surveyed the ‘Survey Zone 9’ on the right bank along river Saloni. The grassland and wetland patches along this river showed direct and indirect evidences of swamp deer presence. We recovered a carcass, antlers and pellets from this area (Table 1, Fig. 10).

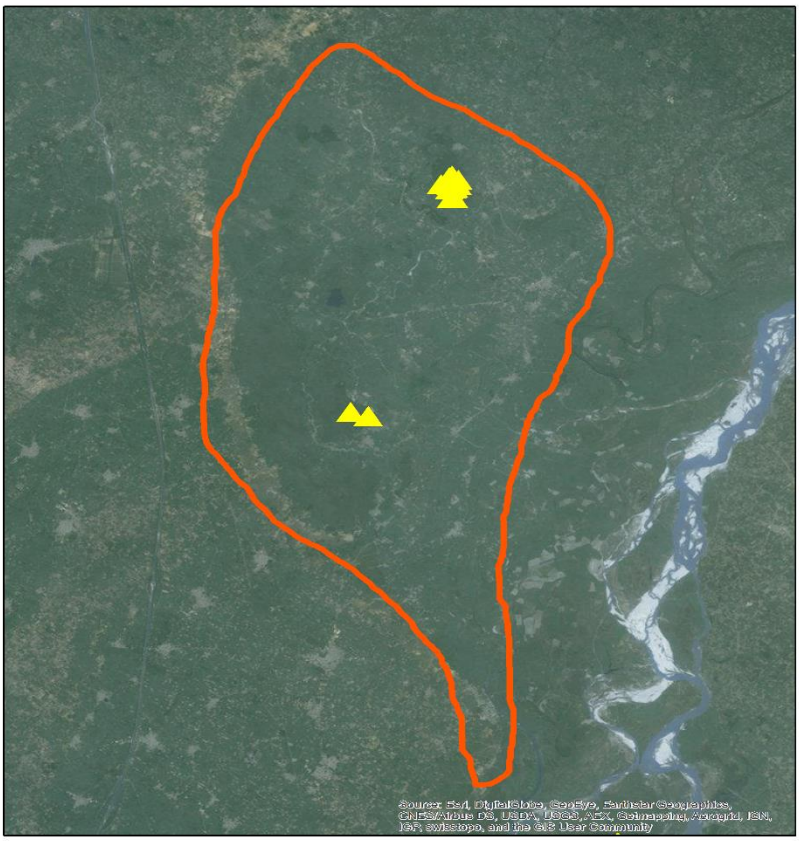

Fig .10: Swamp deer evidence in Zone 9

(x) Our last survey area ‘Survey Zone 10’ along the Ramganga river revealed an unknown swamp deer population about 58 km away from JJCR on the left bank of Ganges. We have direct sighting evidences of swamp deer along with antler and pellet samples from this area (Table 1, Fig. 3). During our surveys we did not find any further evidences of swamp deer presence beyond this area.

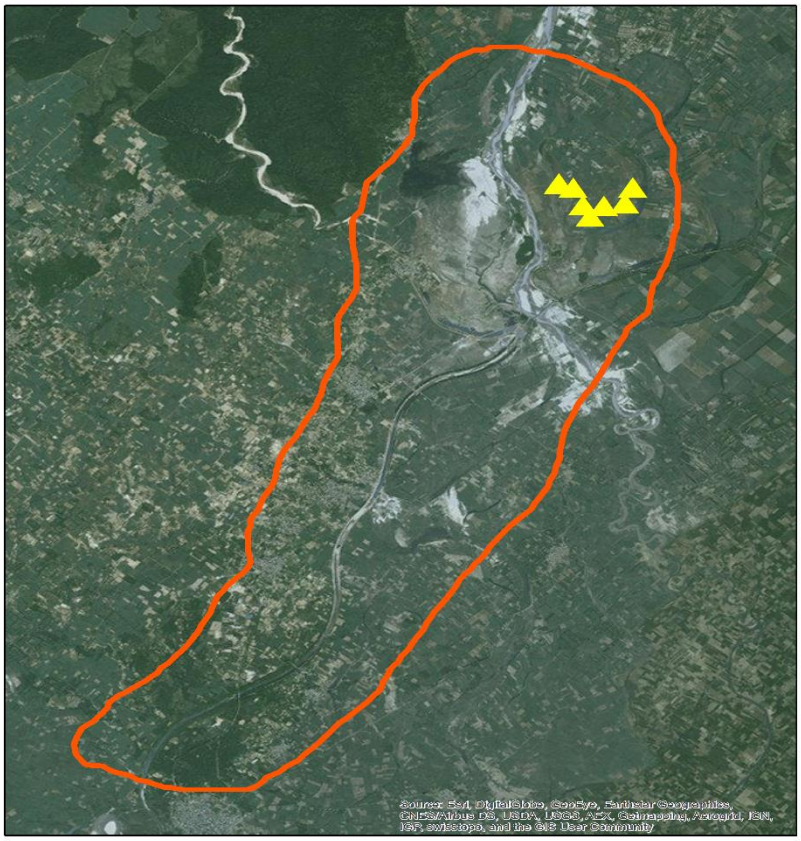

Fig .11: Swamp deer evidence in Zone 10

Area	Survey Zones	Direct sighting	Carcass	Antlers	Pellets	Hoofmark
Left bank of Ganges	Survey Zone 1	Yes (n=162)	1	61	1301	Yes
	Survey Zone 2	No	3	3	43	Yes
	Survey Zone 3	No	0	0	0	No
Right bank of Ganges	Survey Zone 4	No	0	0	0	No
	Survey Zone 5	No	0	4	52	Yes
	Survey Zone 6	No	0	0	4	Yes
	Survey Zone 7	Yes (n=12)	1	120	272	Yes
	Survey Zone 8	No	1	11	8	Yes
Tributary (Saloni rivar)	Survey Zone 9	Yes (n=1)	0	7	28	Yes
Tributary (Ramganga river)	Survey Zone 10	Yes (n=9)	0	9	26	Yes

Table .1: Details of swamp deer evidence recorded during surveys

Swamp deer numbers in JJCR

The numbers in JJCR started increasing from March to May and during July the numbers started decreasing considerably (Fig. 12). It remained that way till November and it again increased in December.

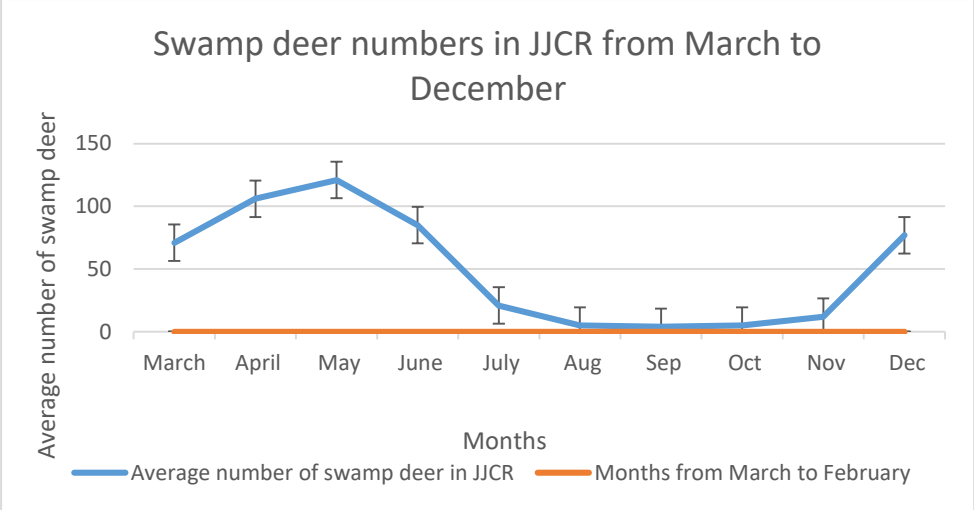

Fig .12 : Average swamp deer numbers during the study period

Habitat status:

Majority of our survey areas (Survey Zones 2, 3, 4, 6, 8, 9, 10) in the northern Indian swamp deer distribution range are non-protected and face different types of disturbances. As expected, the best population of swamp deer are present in Survey Zone 1 (JJCR and surrounding areas) and 7 (HWLS and surrounding areas) covering mostly protected areas. Despite having a protected area status, our survey showed signs of anthropogenic pressures in the form of livestock grazing (both areas) and habitat conversions (particularly in the HWLS area). In the remaining non-protected survey zones major problems are poaching, crop depredation related conflict and other forms of disturbances (Fig .13,14,15). For example, the 'Survey Zone 2' grassland patches are heavily disturbed by heavy vehicles from sand mining activities. Similarly, in 'Survey Zone 3' all small grassland patches have been converted to croplands, leading to no suitable habitats for the species now. Along the right bank of Ganges, we found that 'Survey zones 4 and 6' have minimal suitable habitats left for swamp deer but Survey zone 5 has some habitat left (Fig 16). All remaining areas in this bank (zones 5 and 8) have hunting/poaching pressures from the local communities. The river island of zone 5 provided swamp deer evidence (Fig .17) but disturbances are prevalent here. In survey zone 5 we also

had reports of conflict from crop-raiding by swamp deer. Finally, our survey areas along the tributaries of Ganges revealed potentially isolated populations of swamp deer (Fig 18). The grassland and wetland patches along Saloni river are completely surrounded by human habitations and the status of swamp deer connectivity with the other population cannot be ascertained. The survey area along the Ramganga river revealed occasional poaching pressure and potentially poor connectivity with other populations.

Fig. 13: Poached carcass of swamp deer found at Amichand

Fig.14: Encroachment by livestock at Amichand

Fig .15 : Sandmining on the bank of Ganga, Amichand

Fig. 16: Typical swamp deer habitat at Ranjitpur

Fig.17: Skull of swamp deer found at Raulighat, a river island

Fig .18 : New population of swamp deer at Jamanpur, Afzalgarh, Uttar Pradesh

Discussion

Our survey of northern swamp deer subspecies' *Rucervus duvaucelii duvaucelii* range in the upper Gangetic plain revealed presence of multiple populations along the whole stretch of Ganges, starting from Jhilmil Jheel Conservation Reserve (Uttarakhand) to Hastinapur Wildlife Sanctuary (Uttar Pradesh). We have also found swamp deer populations along Saloni and Ramganga rivers (tributaries of Ganges), with a previously unreported population at Jamanpur, Uttar Pradesh. These new populations greatly extend swamp deer occurance when compared to the earlier survey reports in this region (Qureshi et al., 2004), and adds hope for future survival of this species. Intensive search around other tributaries of Ganges and grassland habitats of Uttarakhand and Uttar Pradesh may reveal some additional areas of swamp deer distribution. However, most of these new populations are present in non-protected areas and are facing severe threats of habitat loss from conversion of wetlands to agricultural fields,

livestock grazing and occational poaching. The conservation and management of these populations outside protected areas brings new challenges and require particular attention towards involving local communities for their future survival.

Our results suggest very patchy distribution of this subspecies in relatively small areas across the states of Uttar Pradesh and Uttarakhand. Though we have not conducted any population estimation in this study, our surveys indicate small population size of swamp deer in this region. Seasonal migration of swamp deer from JJCR population indicate their capability of movement to other areas. Such seasonal and flood-driven movement patterns were observed in central Indian and northern swamp deer populations, respectively (Martin & Gopal, 2015). However, detailed information on exact movement routes and gene flow rate among these small populations, if any, is not available. Future efforts with radio collaring of few individuals and genetic data from already collected biological samples (antlers, pellet, tissue) can help in getting valuable ecological information on these parameters. Currently all these non-protected areas along the upper Gangetic plains have small populations, and their future survival will depend on their management as one metapopulation with stable demographic and genetic parameters. Conservation and management of *Rucervus duvaucelii duvaucelii* as an 'umbrella species' in the non-protected areas will definitely have a long lasting impact on conservation of swamp habitats in upper Gangetic plains. Some focus within government initiated large-scale programs like 'National Mission for Clean Ganga (NMCG)' on reviving and protecting the swampy grassland patches along Ganges would greatly help future swamp deer recovery. These swampy grasslands or wetlands are home to variety of endangered fauna like hog deer, otter, fishing cat, herpetofauna, and a number of resident and migratory birds. Swamp deer is the largest herbivore present in the wetlands along Ganges and its conservation and management is immediately required to save these critical habitats for the subspecies and other endangered fauna in this landscape.

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Assessment of wildlife habitats with special focus on swamp deer in Hastinapur Wildlife Sanctuary, Uttar Pradesh, India

भारतीय वन्यजीव संस्थान
Wildlife Institute of India

Assessment of wildlife habitats with special focus on swamp deer in Hastinapur Wildlife Sanctuary, Uttar Pradesh, India

Project Investigators

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Wildlife Institute of India

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Shrutarshi Paul, Wildlife Institute of India

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The Hastinapur Wildlife Sanctuary is situated between 29.5799º and 28.7538ºN latitude and 77.9009º and 78.1372ºE longitude in Uttar Pradesh state of India (Figure 1). As per the original Government of India gazette notification, the sanctuary encompasses an area of 2073 km^2 along the banks of Ganga covering five districts of Uttar Pradesh, namely Muzaffarnagar, Bijnor, Meerut, Hapur and Amroha (see Annexure 1 for the first notification). The altitude of the area ranges between 130 and 150 m above the sea level (Khan and Khan 1999). The sanctuary is one of the most important protected areas in north India with a focus on conserving the endangered swamp deer and other Gangetic grassland biome.

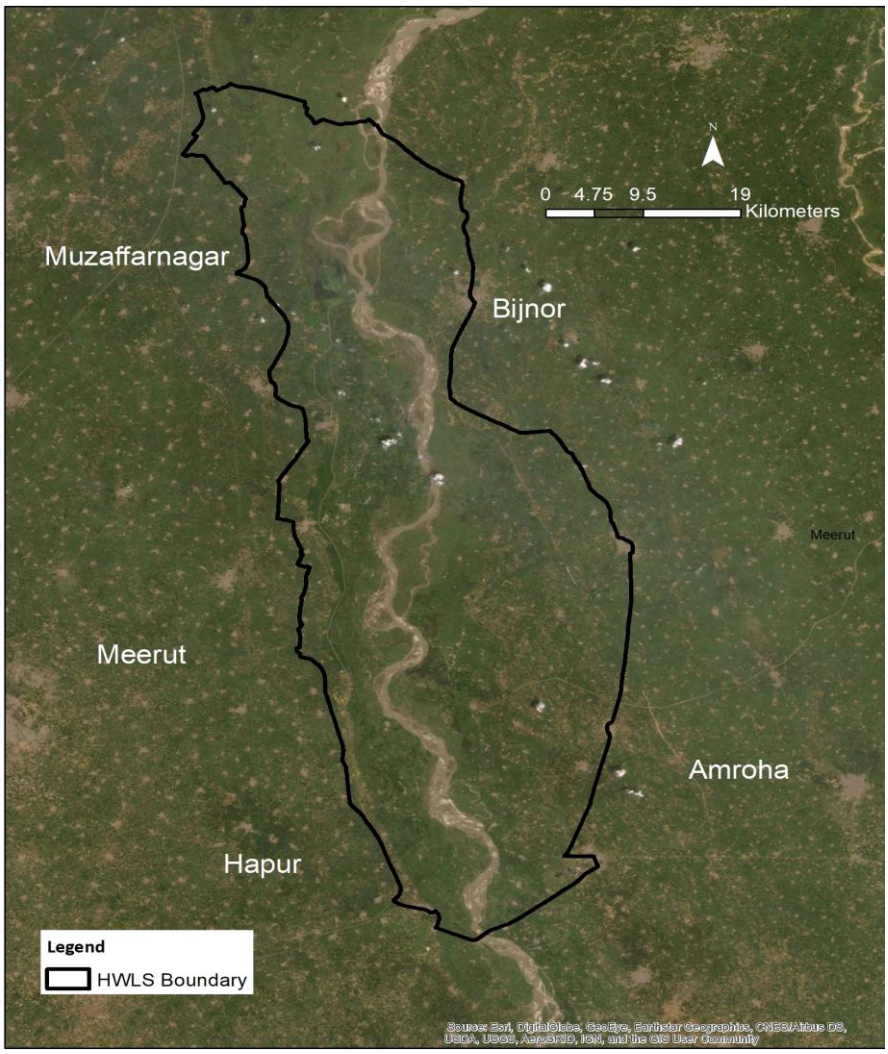

Figure 1: Hastinapur Wildlife Sanctuary

The vegetation of the sanctuary can be classified into three main types namely,

i) **Tall wet grasslands:** These are found across the low laying areas. These grasslands remain inundated for most part of the year and are dominated by grass species like *Saccharum spotaneum*, *Eriathus revennae* and *Phragmites* sp. along with dicot species *Nymphoides cristatum* and *Vicoa vestila.*

ii) **Short wet grasslands:** These remain dry from mid-winters till the onset of monsoon. Major grass species found inshort wet grasslands are *Imperata cylindrica, Paspalidium* and *Typha sp.* and their dicot associates are *Bacopa monieri, Rananculus cantonensis* and *Polygonum lanigerum*.

iii) **Dry scrub grasslands or 'Khola':**These regions are found on raised grounds amidst the Ganga and on highlands. Major species growing in dry scrub grasslands are *Tamarix sp.*, *Veteveria ziznoides* and *Dichanthium annulatum* while commonly occurring tree species are *Accacia spp., Dalbergia sissoo* and *Bombax cieba.* At few places on the highlands, the forest department hasraised *Eucalyptus, Accacia, Syzygium* and *Dalbergia Ailanthes* and *Heterophragma* plantations as part of Social Forestry Scheme.

The grasslands and plantation occupy only about 17% of the total area of the sanctuary (Tall wet grasslands-6%, short wet grasslands-4%, dry scrub grasslands-5% and plantation-2%, respectively). The rest of the Sanctuary is human dominated (mostly agriculture and human habitations).

The need for strategizing protection of Hastinapur Wildlife Sanctuary

This sanctuary represents some of the last standing grasslands along Ganga that require immediate protection. These grasslands are home to a number of endangered species like the swamp deer and hog deer. The sanctuary also has reserve forests that are home to large mammalian species like leopard, fishing cat, otter, jackal, nilgai etc. along with a range of small carnivore species. The sanctuary encompasses around 745 villages including human habitations, townships, business areas and industries. Over the years, conversion of grasslands into sugarcane fields as part of changing cropping patterns, use of Gangetic sand bed areas for seasonal vegetable cultivation and increased human interference has complicated the management practices of the sanctuary. Currently the sanctuary is under tremendous burgeoning human pressures that are detrimental for sustenance of wildlife. High grazing pressure, repeated fire and extraction of plants, cutting of trees etc. are some of the factors responsible for high disturbances in this area. The grasslands found here are severely fragmented with human presence throughout the year. The continuous pressures from existing built-up areas (human habitations, townships, business areas and industries) create severe management challenges for the authorities. Hence, critical analysis and mapping of remaining wildlife habitats are required to realign the conservation-priority areas and strategize protection of endangered species in the sanctuary.

Wildlife habitat assessment

Swamp deer is the state animal of Uttar Pradesh. The state of currently retains the largest population of swamp deer in the country, which is distributed across the protected areas of Dudhwa National Park, Hastinapur Wildlife Sanctuary, Bijnor forest division, Pilibhit Tiger Reserve, Kishanpur Wildlife Sanctuary and Katerniaghat Wildlife Sanctuary (Qureshi et al., 2004, Paul et al., 2018). Two swamp deer habitat blocks are currently found in Uttar Pradesh: the upper block restricted within the Sharda river basin, and the lower block along the upper Gangetic plains (Figure 2). The upper block habitat is connected to the southern Nepal population, another stronghold of the subspecies. The Sharda basin swamp deer populations mostly reside inside protected area of Dudhwa and Pilibhit Tiger Reserve, and receive good protection. Much ecological information on swamp deer is also available from this region. However, swamp deer information from the lower habitat block around upper Gangetic plains of Uttar Pradesh and Uttarakhand is limited. There are reports of swamp deer presence in the Jhilmil Jheel Conservation Reserve (JJCR), Uttarakhand (population rediscovered in 2005) and Bijnor barrage area of Hastinapur Wildlife Sanctuary (HWLS), Uttar Pradesh (Duckworth et al., 2015). The area between these two regions are human dominated and receive limited protection measures.

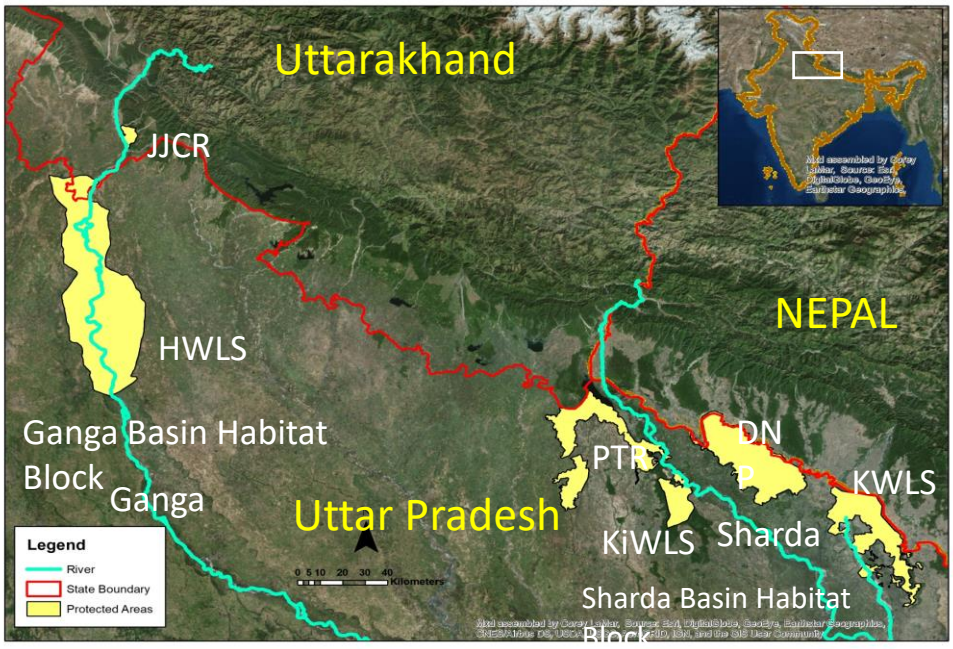

Figure 2: Swamp deer habitat blocks across the states of Uttar Pradesh and Uttarakhand

The Uttar Pradesh Forest Department has identified the management challenges related to the rights of settlement of the sanctuary and requested Wildlife Institute of India (WII) to conduct a review of management effectiveness (ME) of HWLS vide letter no 1951/26-11 dated 12/12/2017 (Annexure 2). This review was requested with a focus to assess the biological and ecological value and rationalization

of the sanctuary boundary to map potential wildlife habitats for their conservation and facilitate management. The institute has submitted a report titled '**Identification of critical wildlife habitats with specific reference to swamp deer in Hastinapur Wildlife Sanctuary, Uttar Pradesh**' vide letter no WII/AECB/SM/2015/01 dated 01/05/2018. Area-wise details of critical wildlife habitats on right and left bank of Ganges within HWLS was found to be as provided in Table 1 below:

#	Name of the area	Forest Division	Habitat Characteristics	Wildlife evidences	Disturbances recorded
1	Almawala, Joggawala Jheel	Muzaffarnagar Forest Division (MuFD)	Wetlands comprising of Typha sp and Phragmites sp.	Swamp deer/Hog deer	Encroachment, wetland interspersed with crop fields
2	Balia khaddar complex	MuFD	Fragmented grasslands dominated by Saccharum sp.	Hog deer	Encroachment
3	Rauli Ghat	MuFD	Wetland comprising of Typha sp and Phragmites sp.	Swamp deer	Less disturbance area
4	Bijnor barrage area	MuFD	Good habitat comprising of Phragmites and Typha in wet parts and Saccharum in dry parts	Swamp deer/Hog deer	Best swamp deer habitat but disturbance from human activities
5	Shivpuri area	MuFD	Reserve forest	Nilgai, no swamp deer	Human activities
6	Ramraj	MuFD	Boodiganga Jheel	Hog deer	Extremely fragmented with lots of disturbance
7	Dharampur	MuFD	Grassland dominated by Saccharum sp	Swamp deer mainly	Live stock grazing
8	Majahidpur	MuFD/ Meerut FD	Grassland dominated by Saccharum sp	Hog deer	Lot of human activities
9	Mahamudpur-Hastinapur-Nangla Gusai	MuFD/ Meerut FD	Long stretches of reserve forest	Nilgai but no swamp deer	Encroachment
10	Hadipur Gaori	Meerut FD	Small grassland dominated by Saccharum sp	Hog deer	Surrounded by crop fields on all sides
11	Jalalpur/ Hatoopora Khadar	Meerut FD	Grassland dominated by Saccharum sp	Swamp deer	Good habitat but human presence is prevalent
12	Tarbiyatpur	MeerutFD	Grassland dominated by Saccharum sp	Hog deer mainly	Extremely fragmented grasslands
13	Kutubpur	Meerut FD/ Hapur FD	Small grassland patch	None	Severe disturbances

#	Name of the area	Forest Division	Habitat Characteristics	Wildlife evidences	Disturbances recorded
14	Kotla Jheel	Hapur FD	Jheel dominated by Typha sp and Phragmites sp.	Swamp deer	Swamp deer habitat but livestock present
15	Gadawali	Hapur FD	Forest patch	None	Surrounded by crop fields on all sides
16	Area adjacent to Bijnor Barrage area across Ganga	Bijnor FD	Grassland dominated by Saccharum sp	None	Human presence, Crop fields, Gujjar huts
17	Jeevanpuri Khadar	Bijnor FD	Grassland dominated by Saccharum sp with Eucalyptus plantations present	Swamp deer/ Hog deer	Encroachment, Gujjar huts in swamp deer habitat
18	River island opposite to Jeevanpuri Khadar	Bijnor FD	Grassland dominated by Saccharum sp but moist areas also present	Swamp deer/ Hog deer	Relatively less disturbed
19	Daranagarganj Khadar	Bijnor FD	Grassland comprising of Saccharum sp and Typha sp	None	Highly disturbed
20	Jahanabad Khadar	Bijnor FD	Grassland dominated by Saccharum sp	Hog deer	Human activities
21	Jheel	Bijnor FD	Wetlands comprising of Phragmites sp	Swamp deer but genetic confirmation needed	Extremely fragmented with lots of disturbances
22	Kalyanpur Khadar	Bijnor FD	Grassland mainly dominated by Saccharum sp but trees also present in some areas	Swamp/ Hog deer	Live stock grazing, roads passing through grasslands
23	Faizipur Khadar	Bijnor FD	Reserve forest but grass cover underneath	Hog deer, Nilgai	Lot of human activities
24	Sujatpur Khadar	Bijnor FD	Grassland dominated by Saccharum sp	Hog deer	Encroachment, Crop fields present
25	Rahmanpur Khadar	Bijnor FD	Grassland and reserve forest complex	None	Surrounded by crop fields on all sides
26	Dattiana Forest	Bijnor FD	Grassland and reserve forest complex	Hog deer	Livestock grazing
27	Rusulpur	Amroha FD	Reserve forest	None	Less disturbed
28	Kali dhab, Bastora rani Khadar	Amroha FD	Big Grassland dominated by Saccharum sp	Swamp deer / Hog deer	Very big grassland patch but livestock grazing present

Table 1: Critical wildlife habitats along Ganges in HWLS

For better understanding of wildlife use of these habitats in HWLS, Uttar Pradesh Forest Department has also provided funding support to undertake a project titled '**Assessment of wildlife habitats with**

special focus on swamp deer in Hastinapur Wildlife Sanctuary, Uttar Pradesh, India' to WII. This project was conceptualized as a collaborative study based on suggestions by the Uttar Pradesh State Wildlife Board vide letter no 2913/23-9-1 dated February 28, 2019 from the department. This report summarizes all the information gathered based on our research at HWLS. The results also includes earlier work conducted by WII to assess fine-scale swamp deer distribution, habitat assessment, inbreeding status and movement patterns in Jhilmil Jheel Conservation Reserve (JJCR), Uttarakhand and surrounding areas. The final phase of the work will be focused on in-depth assessment of swamp deer habitats and species status from Hastinapur Wildlife Sanctuary to Kanpur Barrage, Uttar Pradesh.

Survey strategies along Ganga between JJCR and HWLS

As last survey report between Jhilmil Jheel Conservation Reserve and Hastinapur Wildlife Sanctuary showed no conclusive evidence of swamp deer presence (Qureshi et al., 2004) and no information on current status of swamp deer habitat is available, we decided to first gather information on evidences of swamp deer and their habitat from local communities living close to Ganges across the study area. The local communities included mostly villagers, cattle herders, farmers, boatmen and fishermen. Overall, information regarding swamp deer habitat and presence was opportunistically collected from a total of 42 people (11 villagers, 16 cattle herders, 8 farmers, 3 boatmen and 4 fishermen, respectively). Each of these interactions spanned about 10-20 minutes duration, where following information was enquired: (a) Residential status; (b) Occupation; (c) General mammalian diversity around their respective area; (d) Location of swamps or grasslands in the area, if any; (e) Information of swamp deer presence and specific identifying characteristics used in identification; (f) Approximate time and day of the sightings; (g) Presence of antler/s in the area; (h) Willingness to locate the antler/s, if they are found in the area; (i) Crop raiding related conflict in the area; and (j) Any hunting/poaching incidences known from that area. We also used Google Earth imageries to identify grassland patches to corroborate with the information on swamp deer habitat provided by the local residents along the Ganges and its' tributaries within our study area.

These information revealed that most of the grassland areas are currently restricted to 2-3 km on both sides of Ganges and its' tributaries, and are extremely fragmented along both banks of the entire 51 km stretch of Ganges between Jhilmil Jheel Conservation Reserve and Hastinapur Wildlife Sanctuary. Subsequently, we decided to conduct focused survey covering maximum of 5 km distance on both banks of Ganges and its' tributaries along the entire stretch (Paul et al., 2018). We divided the entire study area into 10 survey zones taking account of the grasslands present, road network, tributary network, distribution of croplands and human habitations, and surveyed each of these zones extensively on foot, vehicle or boat depending on the habitat characteristics for swamp deer presence.

Survey effort ranged from 210.26 - 765.14 kms in different survey zones. Each zone was surveyed three independent times over a period of 15-18 days between 6.00 a.m. and 6.00 p.m. with occasional night surveys for potential swamp deer sighting.

The left bank of the Ganges was divided into three major survey zones: (i) Survey Zone 1 comprising Jhilmil Jheel Conservation Reserve, a saucer-shaped swampy grassland and surrounding areas in Uttarakhand; (ii) Survey Zone 2 covering a grassland situated 15 km downstream from Jhilmil Jheel Conservation Reserve along Ganges stretching to a distance of 26 km, locally called as Amichand, Nangal and Bhuria Sot spread across Uttarakhand and Uttar Pradesh; and (iii) Survey Zone 3 extending further south, downstream of Amichand up to Hastinapur Wildlife Sanctuary in Uttar Pradesh.

Similarly, the right bank of Ganges was divided into five survey zones: (i) Survey Zone 4 comprising the area opposite to Jhilmil Jheel Conservation Reserve in Uttarakhand, which is non-protected, mostly human dominated and interspersed with few grassland and wetland patches; (ii) Survey Zone 5 covering a non-protected wetland downstream south of Zone 4, adjacent to Ganges and locally known as Ranjitpur in Uttarakhand (iii) Survey Zone 6 covering further downstream human dominated areas along the Ganges, partly within the boundary of Hastinapur Wildlife sanctuary, stretching across Uttarakhand and Uttar Pradesh; (iv) Survey Zone 7 including the Bijnor Barrage area of Hastinapur Wildlife Sanctuary and adjoining regions in Uttar Pradesh. (v) Survey Zone 8 incorporating a number of river islands found in the riverbed close to Survey Zone 7 within Hastinapur Wildlife Sanctuary in Uttar Pradesh.

In addition, we surveyed the grasslands along three of the tributaries of Ganges- Solani and Banganga on the right bank and Ramganga on the left bank. Survey zone 9 comprised swampy grasslands along Solani, about 10km from Ganges covering the states of Uttarakhand and Uttar Pradesh. The grasslands along river Banganga were covered by surveying both ‘Survey zone 6’ and ‘Survey zone 9’. The survey zone 10 included the swampy areas present on both banks of river Ramganga near town Afzalgarh. This survey was motivated by a local newspaper report of swamp deer poaching in that region. Following interviews with the local communities, we conducted extensive surveys for swamp deer habitats and presence in this area.

During the survey, we considered direct sighting, presence of carcass, and swamp deer specific signs (antlers, hoof marks, dung pellets etc.) as evidences of swamp deer presence in any area. Direct sighting and carcass was considered the best evidence of swamp deer existence, followed by presence of antler, hoof marks and faecal pellets in the field. Swamp deer antlers are very distinct from other cervid species found in the landscape. An adult swamp deer antler is mostly 5-6 tined and branches in

a dichotomous manner in the upper half of the beam, whereas sambar, spotted deer and hog deer antlers are mostly three tined. Similarly, swamp deer hoof marks can be easily identified in the field from their distinctive splayed pattern due to evolutionary adaptation of living in swampy areas. Swamp deer faecal pellets are generally bigger in size than other sympatric cervids (hog deer) or domestic animals (sheep, goat etc.) found in this area, but this was not explicitly used as presence evidence alone. In the field, swamp deer presence was considered when at least two of the three signs (antler, hoof marks and faecal pellets) were found in a given area. Subsequently, we also conducted DNA-based species identification in the laboratory from different survey zones to further confirm swamp deer presence.

During our surveys, we recorded GPS locations of all swamp deer presence evidences and collected biological samples (dung pellets, antlers, opportunistic tissue etc.) from all surveyed areas. Along with occurrence data, we have also opportunistically collected information on other important ecological and habitat parameters (disturbances, poaching evidences etc.). Presence of undisturbed *Typha sp.* and *Phragmites sp.* patches was an indicator of potential swamp deer habitat, while presence of livestock and humans in grassland was considered signatures of disturbance. Poaching related information was either provided by local residents or opportunistic evidences (skinned hide) were collected during surveys in our study area.

Survey along Sharda river basin

We adopted a combined approach of opportunistic unstructured questionnaire surveys and Google earth imageries to locate possible swamp deer habitats in this region. As majority of the areas in the Sharda block is protected, the questionnaire surveys were conducted mainly with forest department staff and occasionally with cattle herders, boatmen and fishermen. The interactions and Google Earth imageries revealed that the grassland areas are currently restricted to <10 km on both sides of Mala (Pilibhit Tiger Reserve), Sharda (Pilibhit Tiger Reserve and Kishanpur Wildlife Sanctuary), Suheli (Dudwa National Park) and Ghagra (Katerniaghat Wildlife sanctuary) rivers. Subsequently, we conducted surveys on stretches of the above-mentioned rivers flowing within the boundaries of the protected areas covering a maximum distance of 6km on either side. We also conducted the surveys along the stretches of the above-mentioned rivers flowing through some of the adjoining non-protected areas.

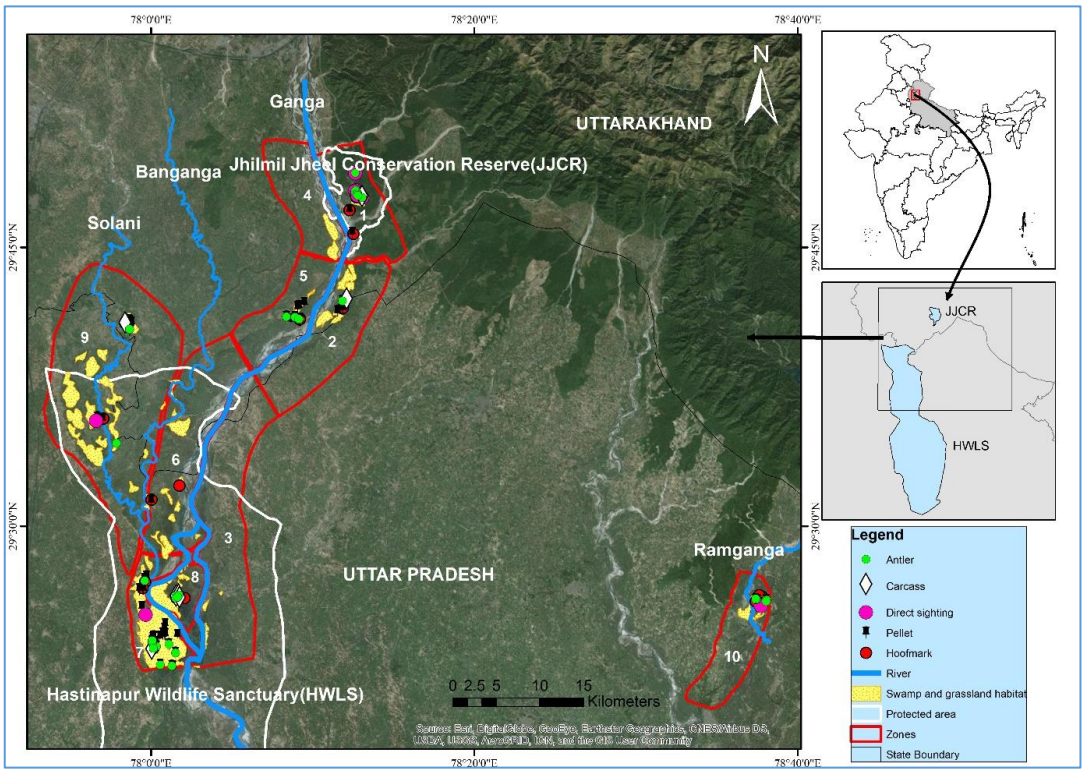

Figure 3: Results of surveys between JJCR and HWLS conducted in 2016-2017

DNA-based swamp deer identification

Although swamp deer pellets are larger than other grassland cervids (hog deer), domestic ungulates (sheep, goat) and distinctive from bovids (nilgai) found in this region, there are often uncertainties associated with pellet morphology-based species identification for similar body-sized animals. Identifying swamp deer pellets collected from marshy areas is easy as these areas are inaccessible to most other species. However, because swamp deer co-occur with other ungulates in many areas, we used DNA-based species identification to confirm species' presence. We used swamp deer specific primers described in (Paul et al., 2019). Any gel product showing swamp deer specific amplification pattern was considered as a sample belonging to swamp deer.

Predictive modeling of potential swamp deer habitat

We collected a total 308 confirmed swamp deer locations from the entire survey. To reduce spatial clusters of localities we have used single records in each 1km² area (equivalent to a viable swamp deer habitat patch) using Spatially Rarefy Tool of SDM tool Box (Brown, 2014) in Arc GIS 10.2.2. Finally, we used 90 records for modeling the species distribution in the Gangetic plains of Uttarakhand and Uttar Pradesh (Figure 4). We used MaxEnt (Maximum Entropy species distribution) algorithm to model the potential distribution of swamp deer in the Gangetic plains of Uttar Pradesh and Uttarakhand (Phillips et

al., 2006). We established the models with MaxEnt modelling version3.3.3k (Elith et al., 2006). The result of the modeling is presented in Figure 5.

Validating surveys for swamp deer based on Maxent prediction

The Maxent prediction gave a probability distribution map of swamp deer in the upper Gangetic plains of North India. Based on Maxent predicted distribution we surveyed the entire stretch of Ganga (100 kms approx.) downstream of Bijnor Barrage lying within the limits of Hastinapur Wildlife Sanctuary, covering a distance of 5 km. maximum on either side of the river. Presence of swamp deer or habitats was collected from the survey (Figure 6). Again antlers, direct sighting, and genetically identified pellets were considered as presence of swamp deer. Swamp deer evidences (both direct as well as indirect) were found in parts of Muzaffarnagar, Meerut and Hapur Forest Divisions (accuracy=86%) (Figure 6).

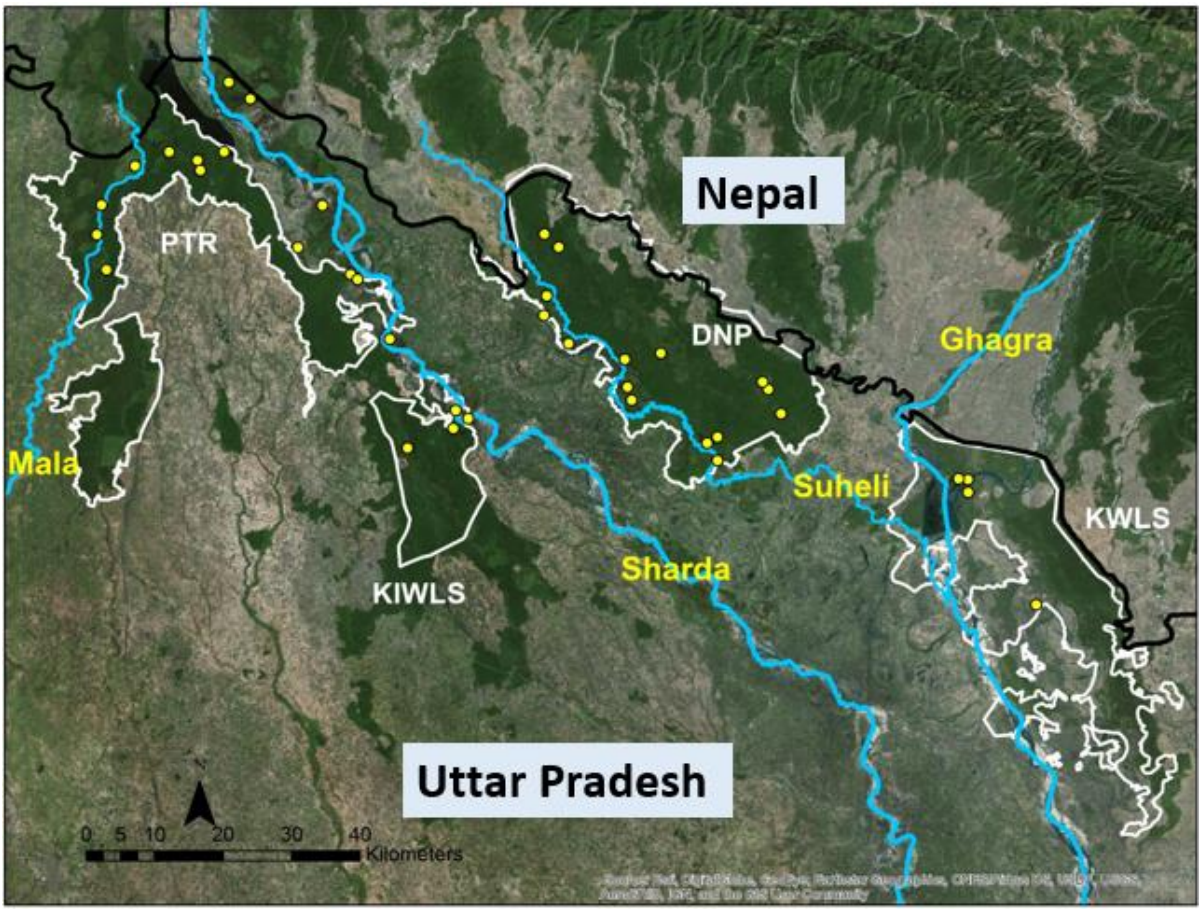

Figure 4: Results of surveys in Sharda river habitats conducted in 2017-2018. The yellow marks represent confirmed swap deer locations.

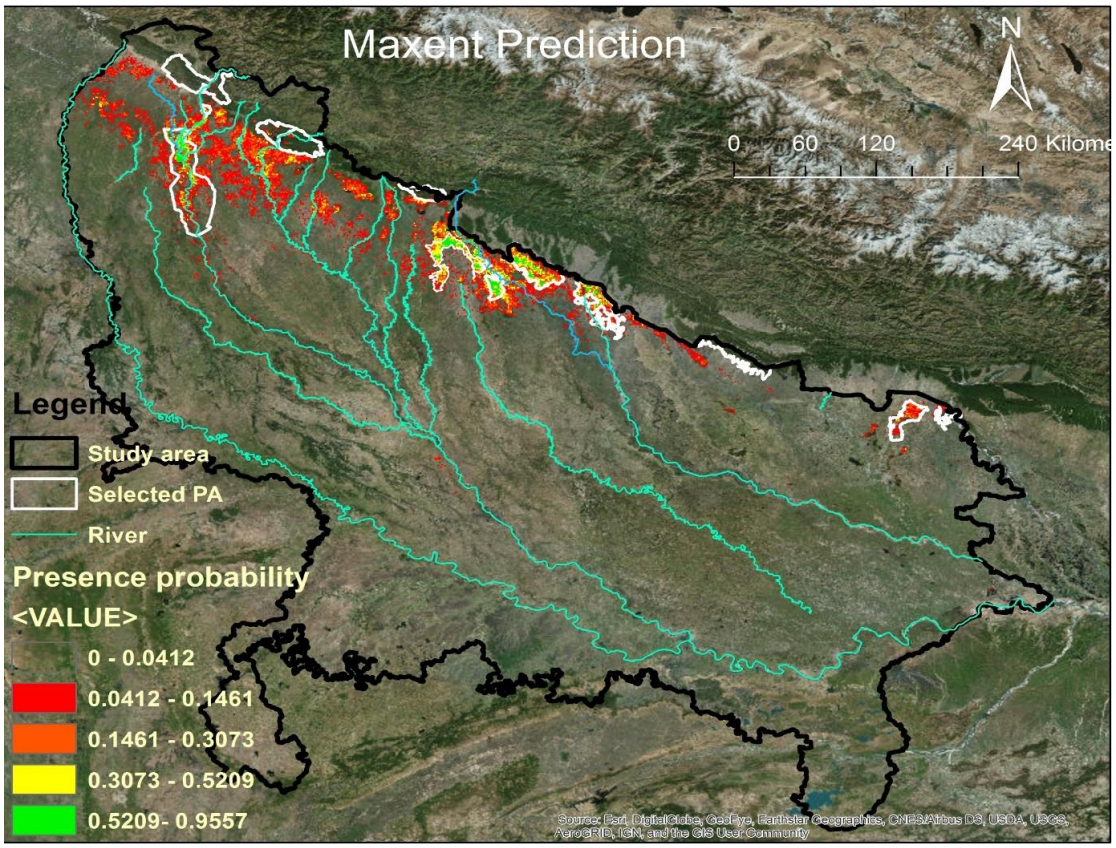

Figure 5: Probable swamp deer distribution from MaxEnt modeling

Role of the grasslands in governing movement pattern and genetic connectivity

It is important to know if the fragmented grassland patches with fine scale presence of swamp deer are connected or not. To get a detailed idea on this we used genetic techniques on biological samples (antler, fecal pellets and tissue) collected from different areas of this landscape. We standardized a panel of 13 microsatellites from an initial set of 48 red deer markers. Finally, these 13 loci were used to generate data from 231 antlers and 18 pellets collected in the field. Overall the average amplification success was 96% over all the samples. None of the 13 loci showed presence of null alleles and signatures of large-scale allelic dropouts. None of the loci were found to deviate from the Hardy-Weinberg equilibrium and there were no evidences for strong linkage disequilibrium between any pair of loci. All the loci were moderately polymorphic with a mean of 6.25 alleles (ranging from 2 to 12 alleles), expected heterozygosity (H_E) of 0.582 and observed heterozygosity (Ho) of 0.532.

We identified a total of 192 unique swamp deer individuals from the field-collected samples. The microsatellite panel produced a $P_{ID(sibs)}$ value of $1.5*10^{-4}$ indicating a misidentification probability of 1 in every 6666 swamp deer siblings, a statistically strong result for individual identification. Exploratory analysis with programme STRUCTURE indicated the presence of two distinct genetic clusters (K=2,

based on ten independent runs) in this landscape (Figure 7). Our data reveal that swamp deer populations from Jhilmil Jheel Conservation Reserve and Bijnor have two distinct lineages but they are not spatially segregated, suggesting genetic connectivity across the study landscape. Overall, we found low average relatedness value (0.083) and very few related individuals in the dataset. When related individuals were plotted on the map, it was seen that some related individuals are spread across the landscape, further supporting recent movement in this landscape.

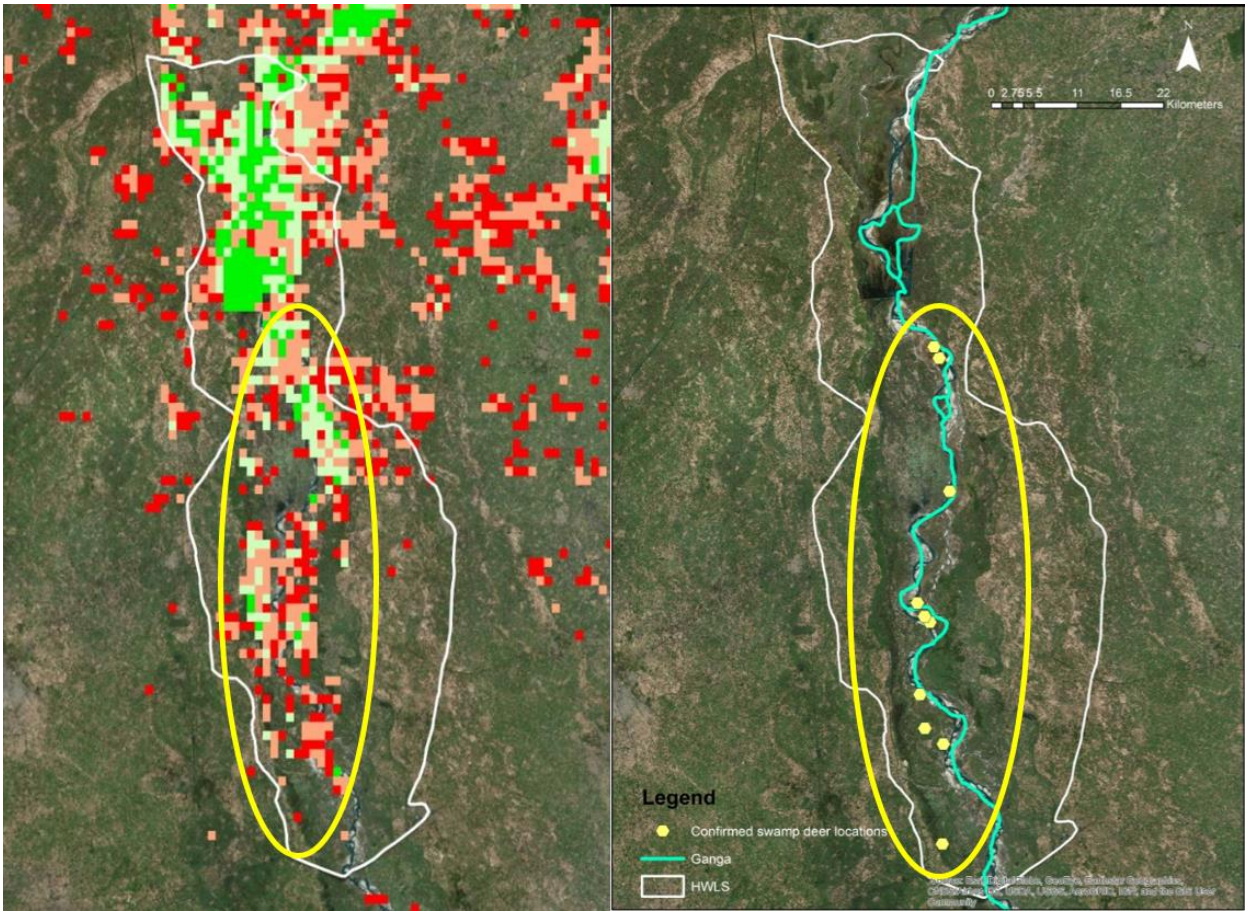

Figure 6: Swamp deer evidences between Bijnor barrage and Garhmukteshwar (yellow circle). We surveyed the circled area (right bank of Ganga) based on predictive species distribution model and yellow points in the right pane of the figure shows area with confirmed swamp deer presence.

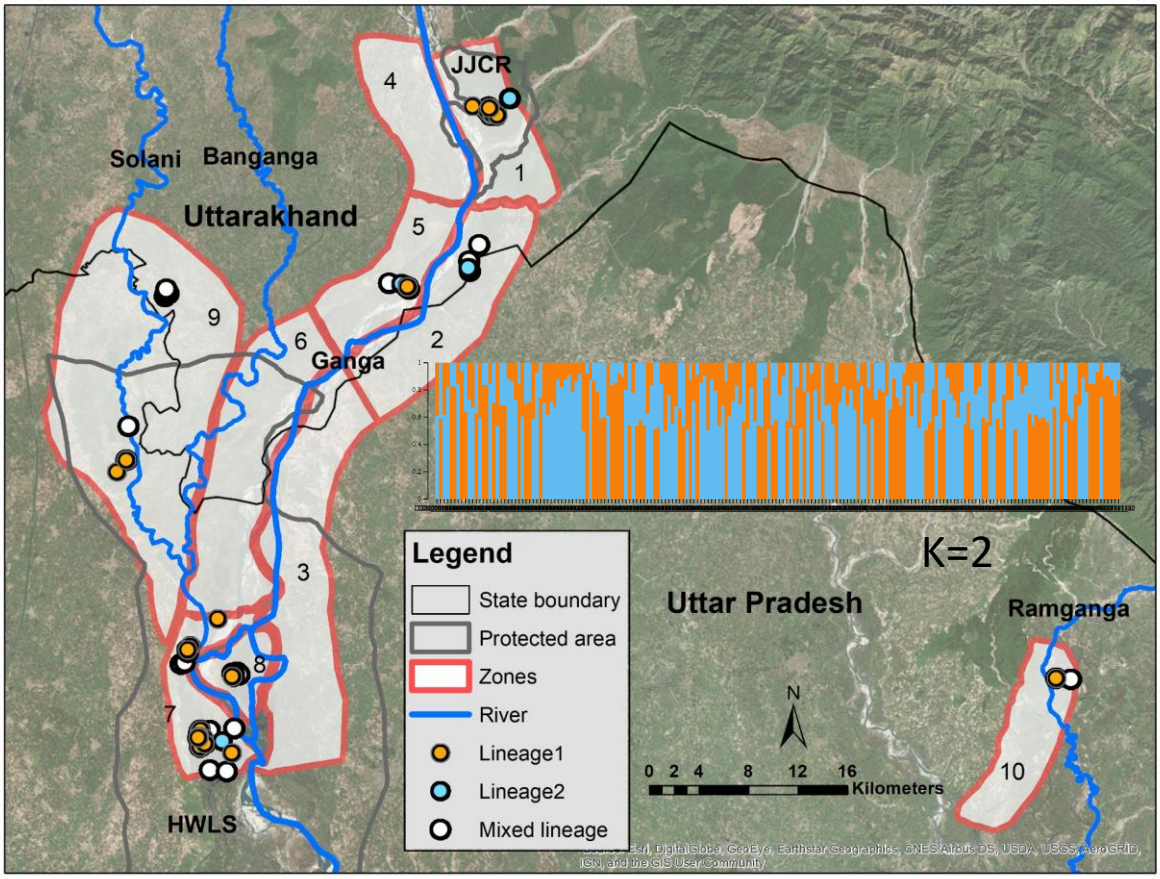

Figure 7: STRUCTURE data suggests an intermixing population of swamp deer from Jhilmil to Bijnor

Radio collaring and tracking

Two female swamp deer were fitted with GPS radiocollared in Jhilmil Jheel using drive net technique and their movement was intensively monitored. Both the animals showed downwards movement from Jhilmil Jheel Conservation Reserve towards HWLS using the fragmented grasslands between them. The first female showed an overall displacement of 224 km, with a linear distance between initial and final points of 17 km (Figure 8 left panel). The second female showed an overall displacement of 81 km, with a final position 26 km downstream of JJCR (Figure 8 right panel). We used Brownian Bridge Movement model (BBMM) to analyze the local habitat use patterns by both animals (Horne et al., 2007). The analyses revealed use of multiple core patches within their overall habitat, corresponding to the fragmented grassland patches available for the species. For the first animal, BBMM analysis during May to December revealed a 95% usage area of 5.48 km^2 and 50% usage area of 0.68km^2. Similarly, for the second animal, 95% and 50% usage area was found to be of 1.08 and 0.12 km^2, respectively. These results suggest high use of the fragmented habitats found in this landscape.

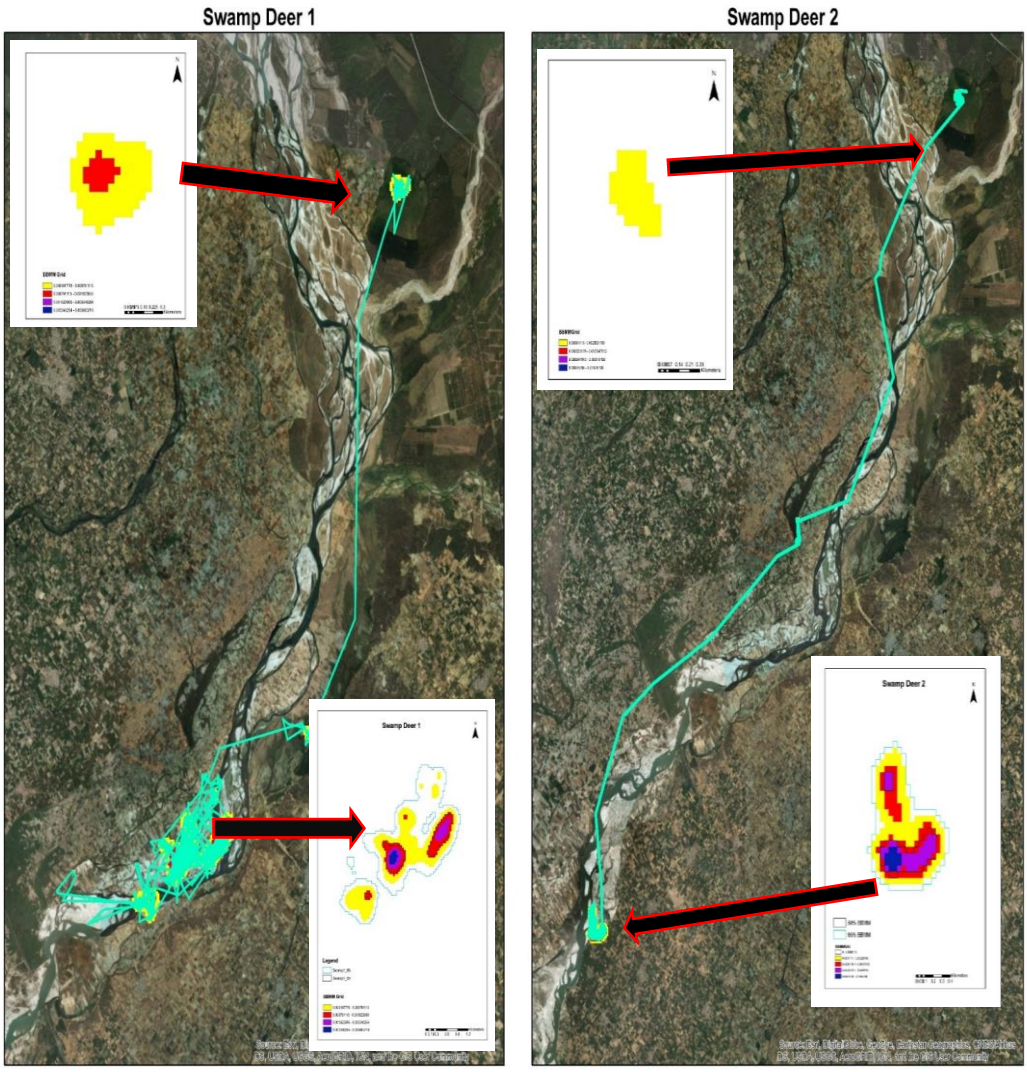

Figure 8: Movement paths and Activity centres derived from BBMM for the two collared swamp deer individuals (May-December, 2018)

Identifying critical wildlife use habitat patches within HWLS

We have generated all required information on grassland habitat, swamp deer presence, their habitat use and movement patterns from Hastinapur Wildlife Sanctuary. It is essential to identify the critical patch of habitats for conservation and management in this sanctuary. We used the above-described information to assess HWLS wildlife habitats. The entire process was conducted keeping swamp deer as a focal species (along with other wildlife and habitat in the sanctuary) in a step-wise manner as given below:

i) The entire park has been divided by 1*1 km grid, making a total of about 1895 such grids. This grid size was decided based on our field data on grassland patch size (standard patch size is of around 1 km^2). The grids against the entire study area can be visualized in Figure 9.

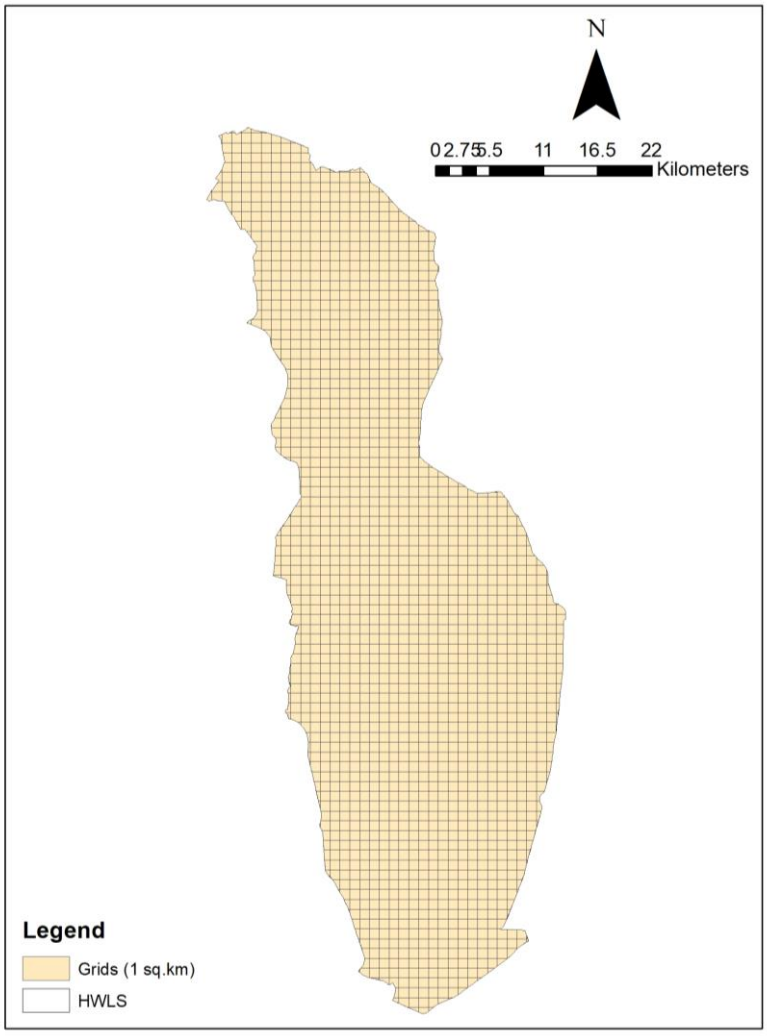

Figure 9: HWLS with 1 sq. km grids plotted

ii) Subsequently, we identified the important grids in terms of presence of river Ganga, grassland habitats, swamp deer presence etc. The importance of each grid in the sanctuary was derived from a combination of swamp deer presence points, river Ganga, grassland and forest patch distribution, connectivity path between two habitat patches and human-dominated areas within the sanctuary. The information was used from primary data generated during our completed survey and swamp deer monitoring, as well as from the Forest Department of Uttar Pradesh (forest habitat layer). In addition, we have also digitized the course of River Ganga, using a polygon function in Google earth. This was important as majority of the grassland habitats are along Ganga and it's tributaries. Finally, we have identified grids those are critical for swamp deer habitat connectivity. This was defined based on our radio collaring information from two female swamp deers collared in JJCR, Uttarakhand. These connectivity grids are extremely critical to maintain a meta-population framework for long-term viability of swamp deer population. The proximity of these connectivity grids to river Ganga further facilitates wildlife movement along riverbanks. Different layers are presented in Figures 10- 14.

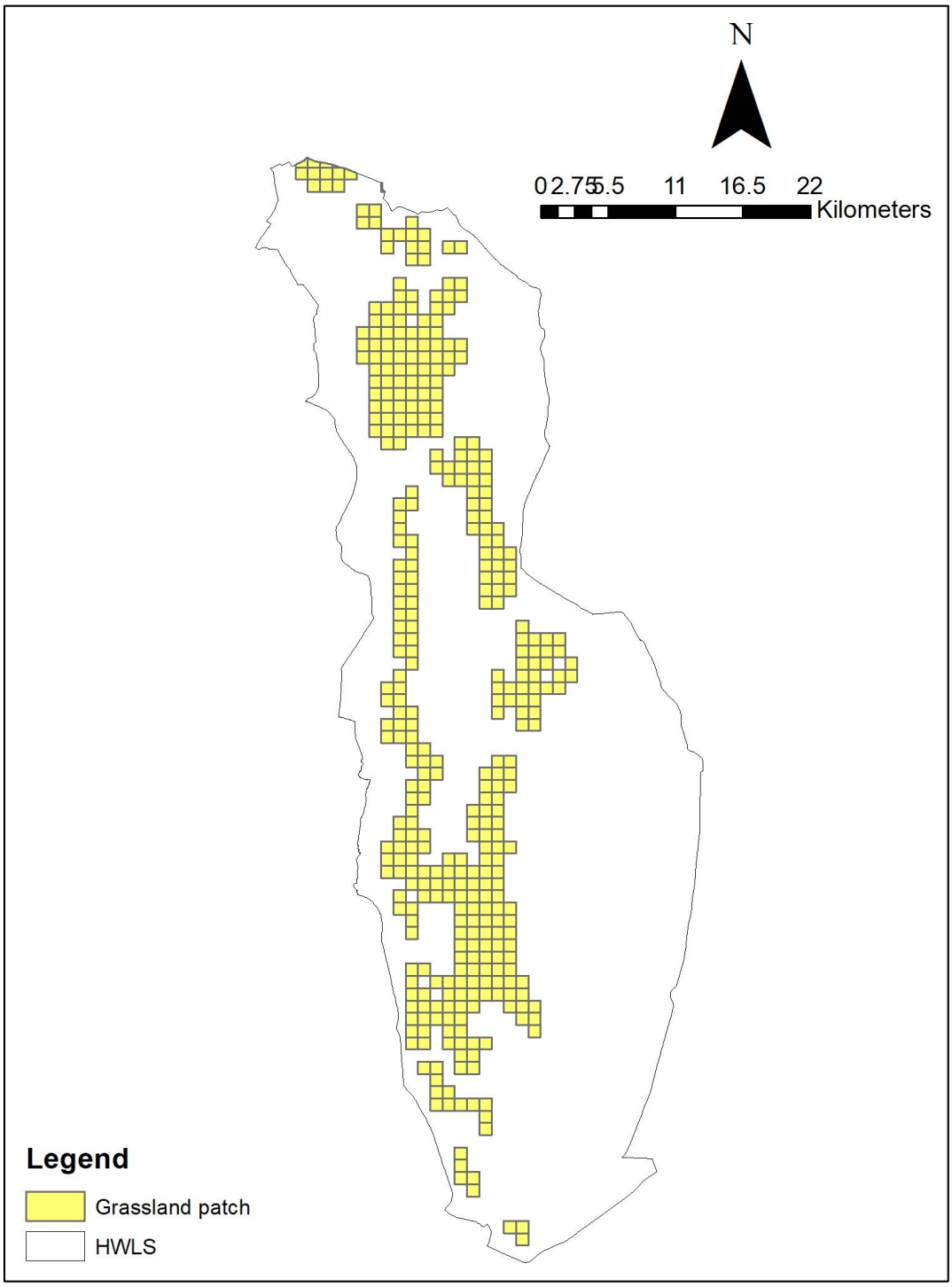

Figure 10: Grids with grassland patches within HWLS.

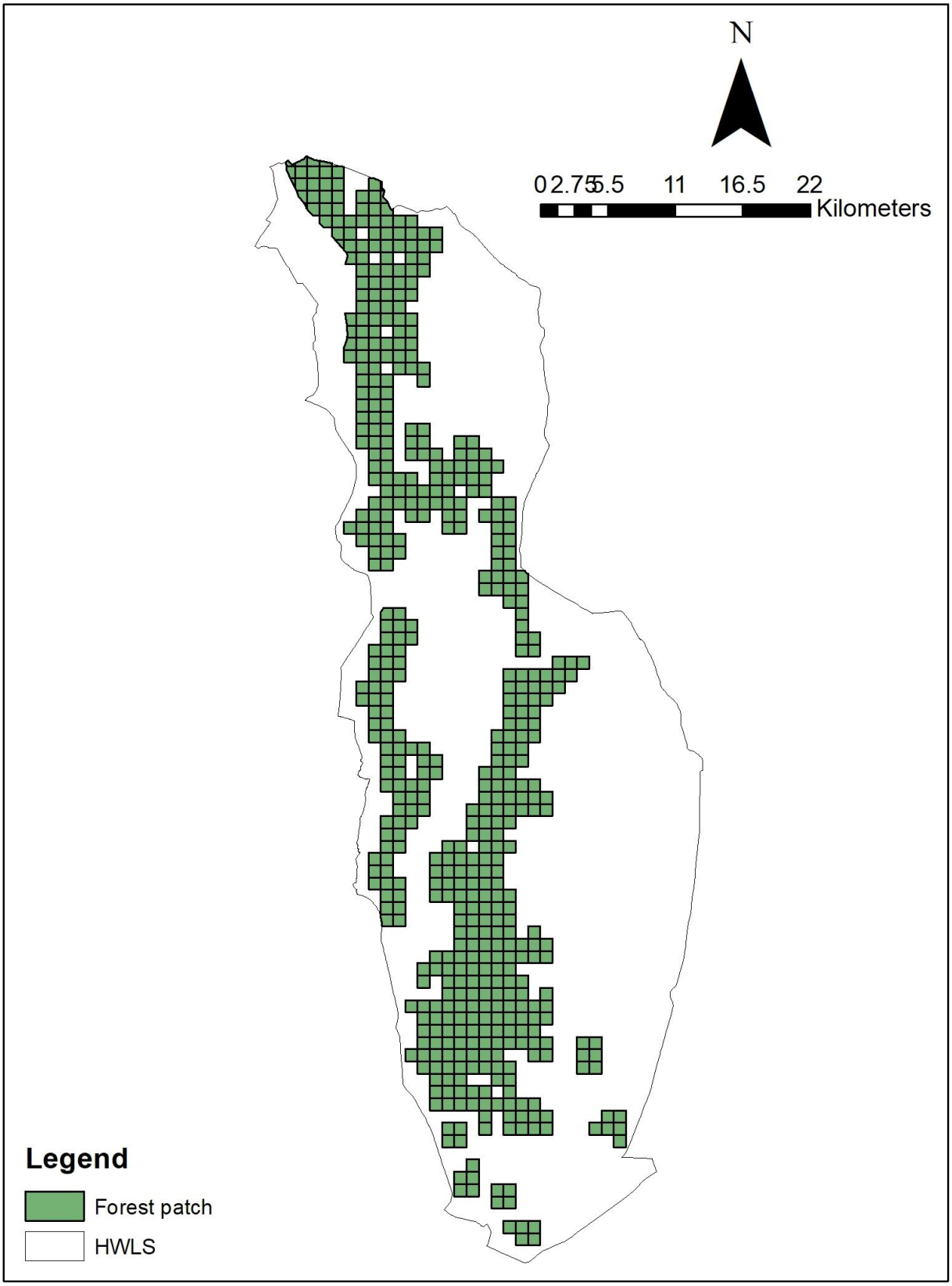

Figure 11: Grids with forest/plantation patches within HWLS.

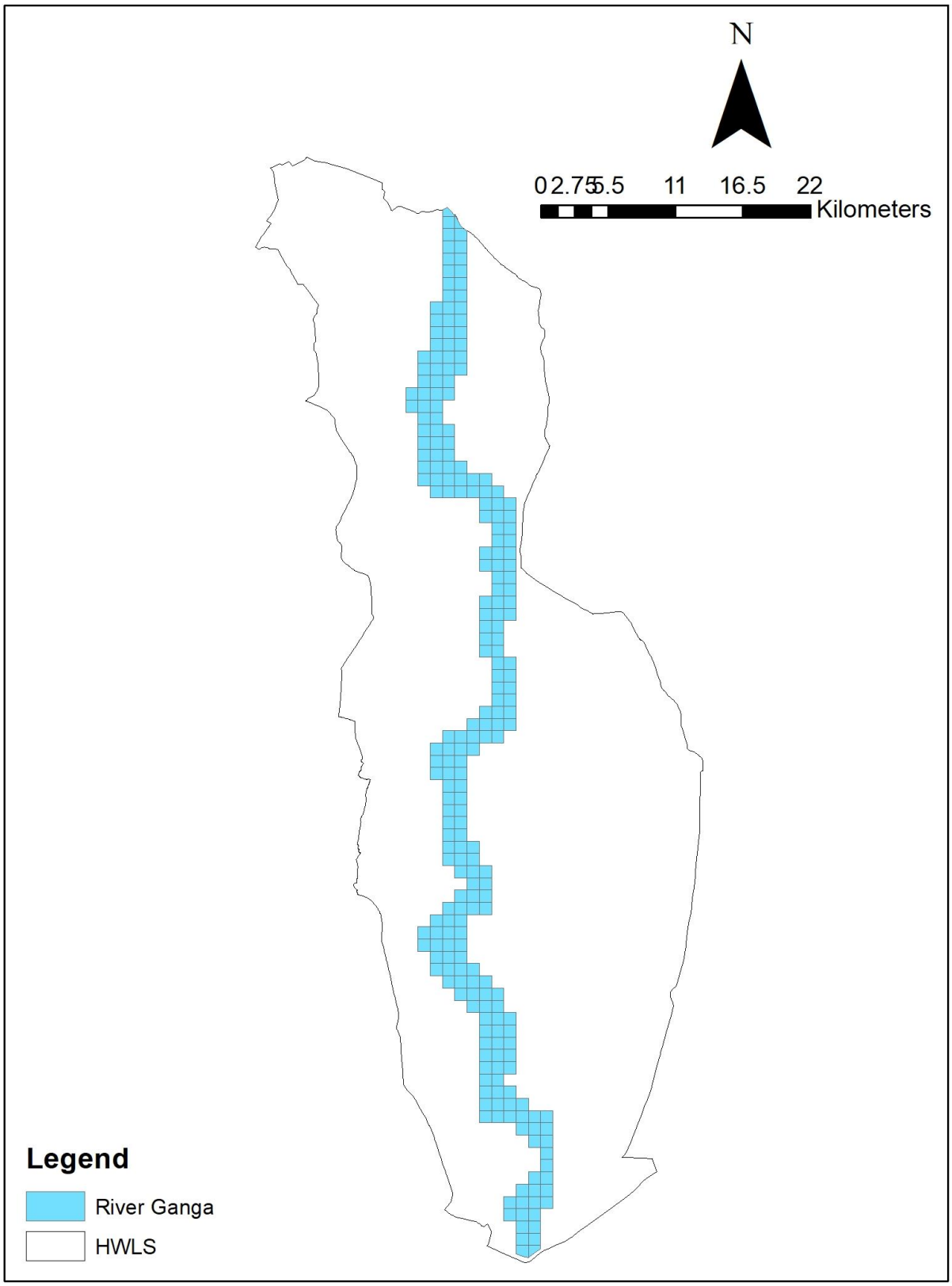

Figure 12: Grids with river Ganga within HWLS.

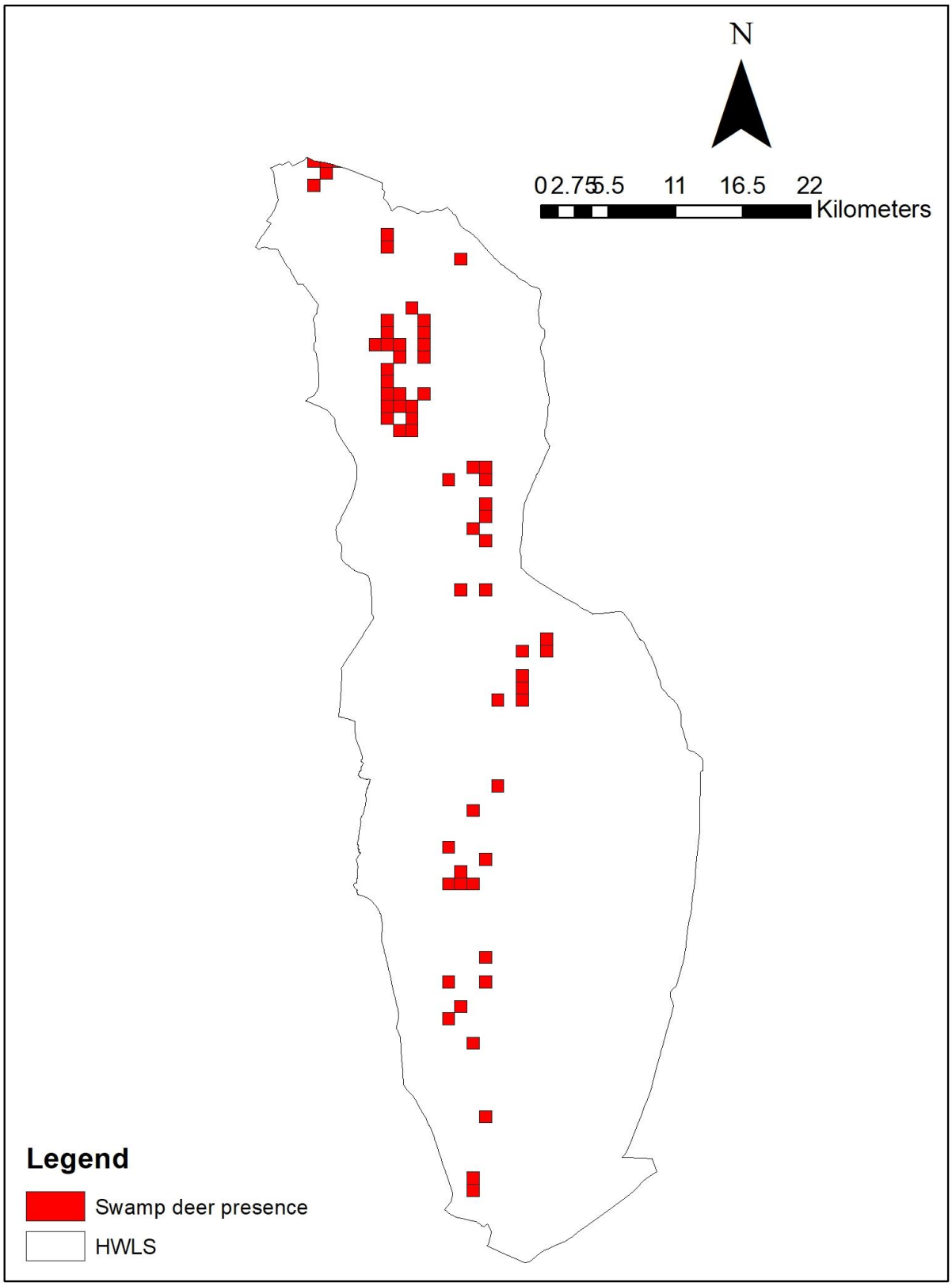

Figure 13: Grids with swamp deer evidences within HWLS.

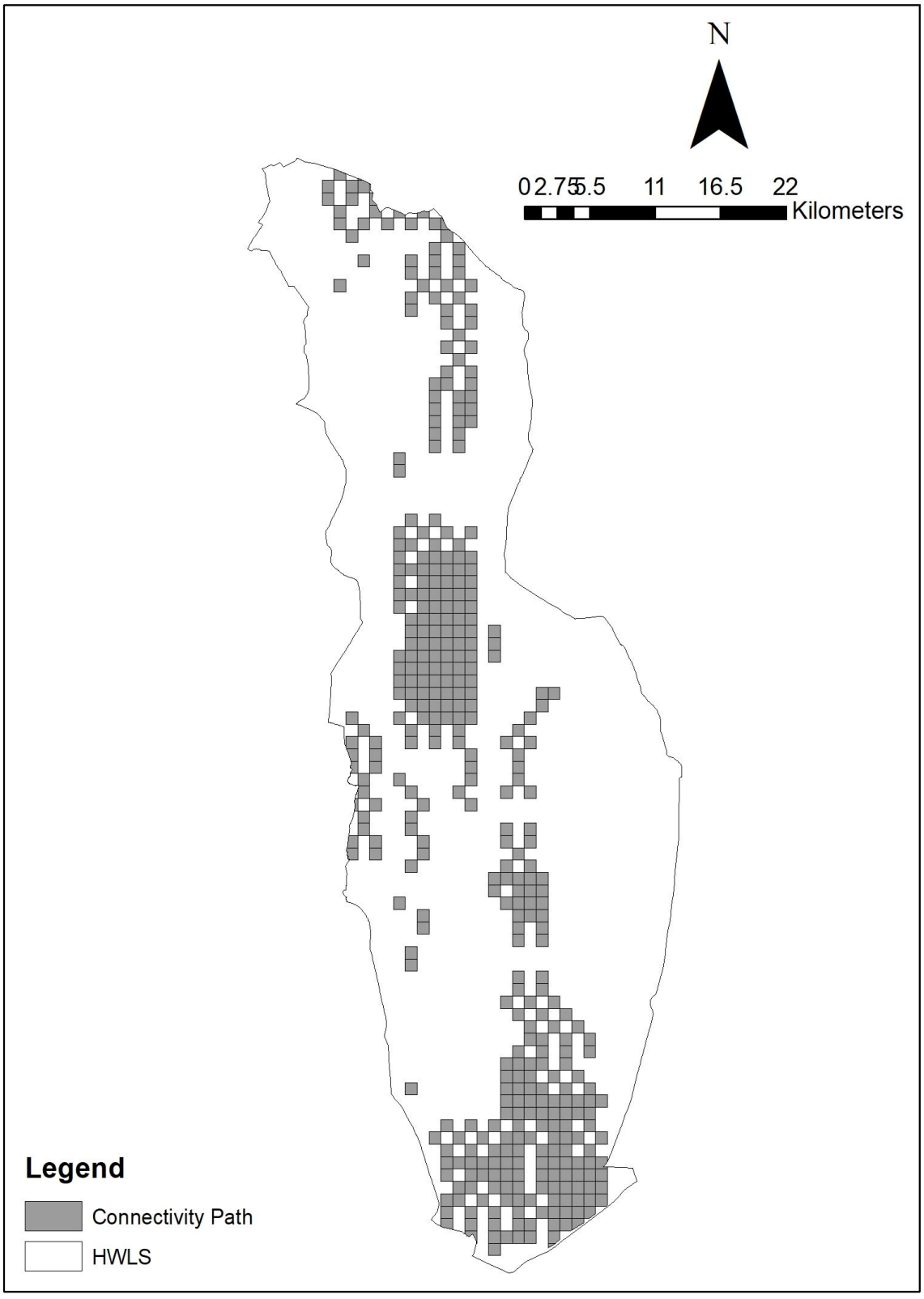

Figure 14: Grids that are critical in terms of swamp deer habitat connectivity within HWLS.

After identifying the important grids for these above-mentioned factors, we counted the number of grids covered under each factor. We found the following results:

a) Grassland patch- 404 grids
b) Forest/plantation habitat- 569 grids
c) Swamp deer presence- 65 grids
d) River Ganga- 247 grids
e) Critical grids for habitat connectivity- 403 grids

Given that some of these grids are overlapping, it was clear that the extensive wildlife use grids are centered around river Ganga. A total of about 207 grids were purely human dominated (see Figure 15).

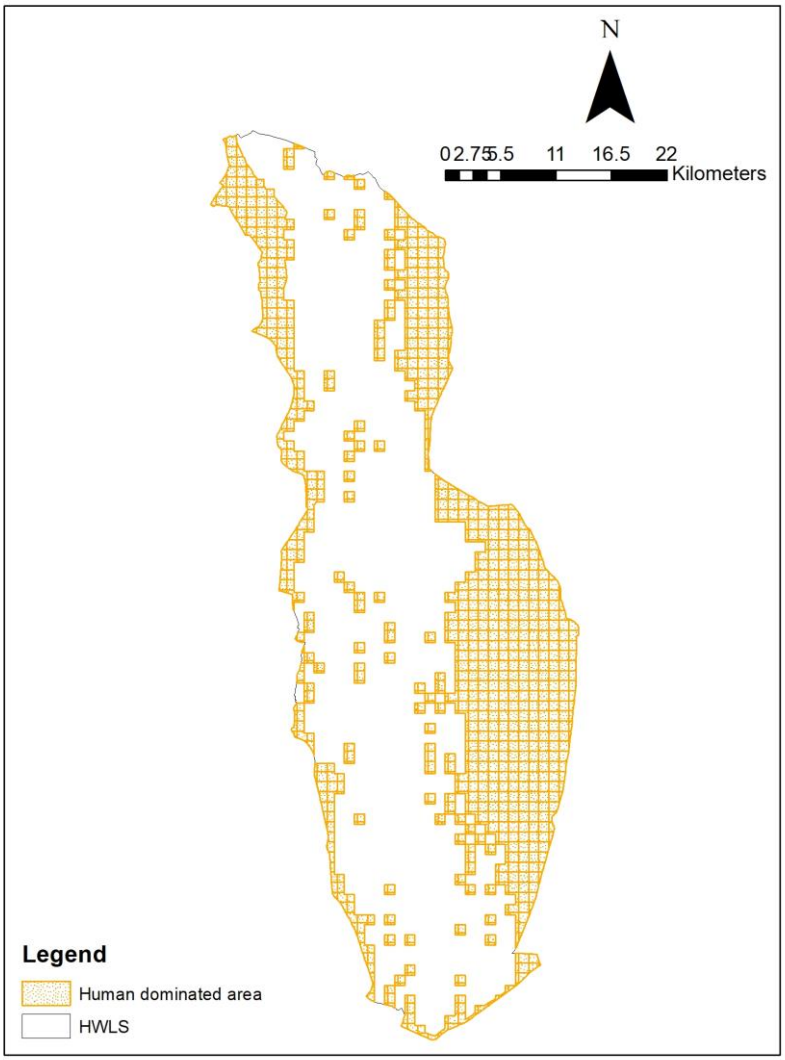

Figure 15: Grids that are human dominated within HWLS.

Figure 16 represents the clear picture of the composite layers within HWLS.

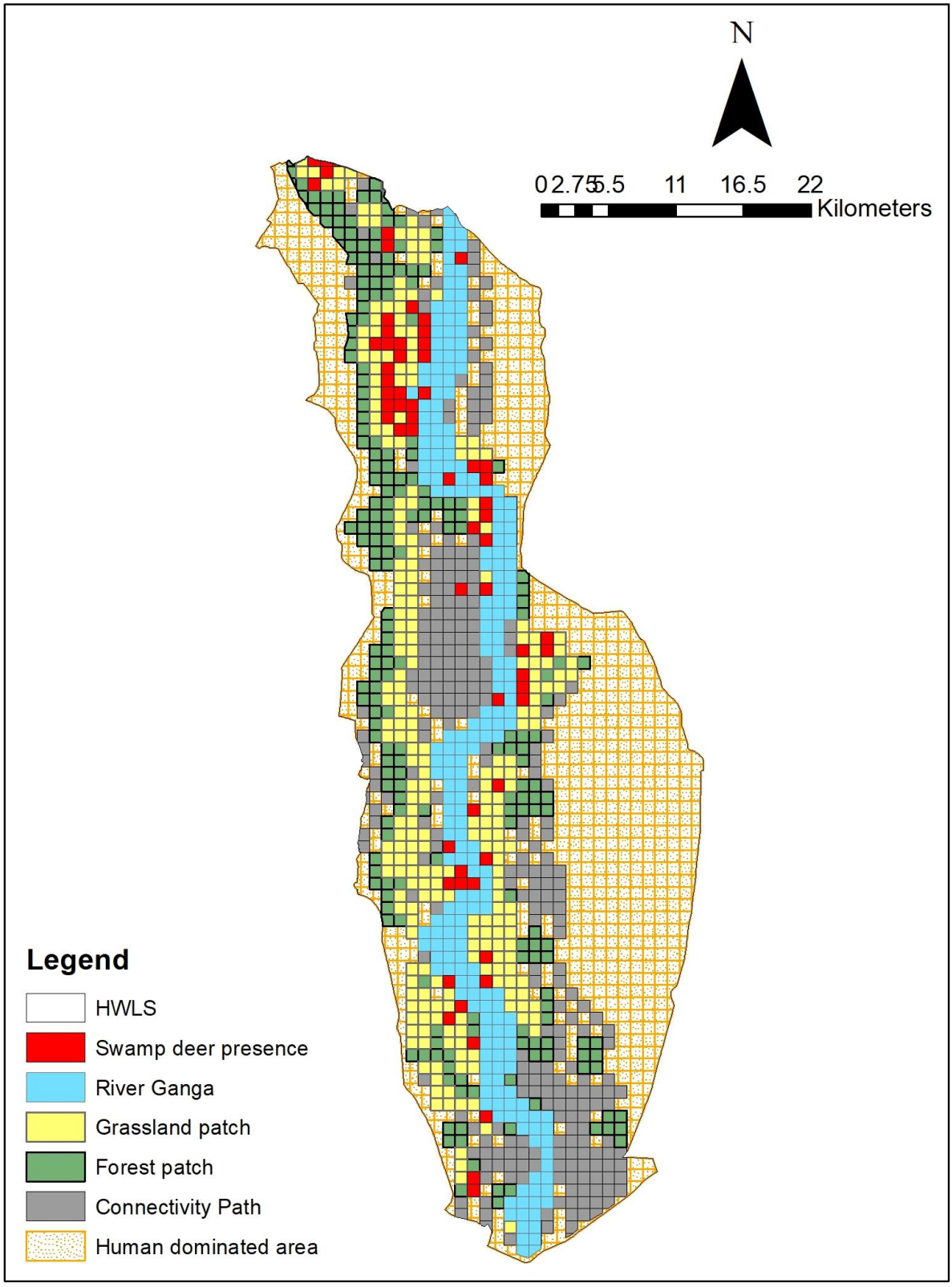

Figure 16: HWLS with all willdlife habitats within HWLS. It is important to point out that all critical wildlife habitats are associate with river Ganga and tributaries.

Discussion and recommendations

Our surveys clearly indicate patchy distribution of swamp deer within the limits of Hastinapur WLS. Swamp deer is not widely distributed throughout the designated boundaries of Hastinapur WLS and are restricted only to suitable grassland and wetland habitats along river Ganga that are currently subjected to severe anthropogenic disturbances. The genetic data indicate that animals present in these fragmented areas are genetically connected and overall inbreeding status is low. The radio collaring exercise clearly showed the use of fragmented grasslands by the animals to move downwards towards HWLS from JJCR. The analyses also confirmed the use of these small patches by the animals, making these grassland patches extremely critical for the species to survive. All the information also showed that the habitat outside HWLS boundary, particularly north of HWLS retains excellent grassland habitats with swamp deer, and they should be protected for the survival of the species. In addition, it may be useful to develop a joint management plan with Uttarakhand Forest Department to protect the habitats along the border between both states.

These findings were discussed with the Uttar Pradesh Forest Department officials over two meetings held on 14th January 2019 and 4th June 2019, convened by the Chief Wildlife Warden, Uttar Pradesh Forest Department at Lucknow. In the meeting it was discussed to use the help and expertise of the Department to generate a realigned boundary after considering different GIS layers (district, beat, village etc.) along with fine-scale swamp deer presence data and grassland patch layer developed during our surveys. All the information together will provide scientific evidence-based boundary realignment for the sanctuary.

The Wildlife Institute of India worked with the Uttar Pradesh Forest Department and proposed a revised boundary based on all collated information (see Figures 17-19). All these information were provided to the Uttar Pradesh Forest Department for further discussions regarding potential administrative issues towards implementation of the proposed new boundary. One of the major concerns was to resolve the uncertainties where the proposed boundary passed through part of the village boundary, as it can have long-term problems for proper management.

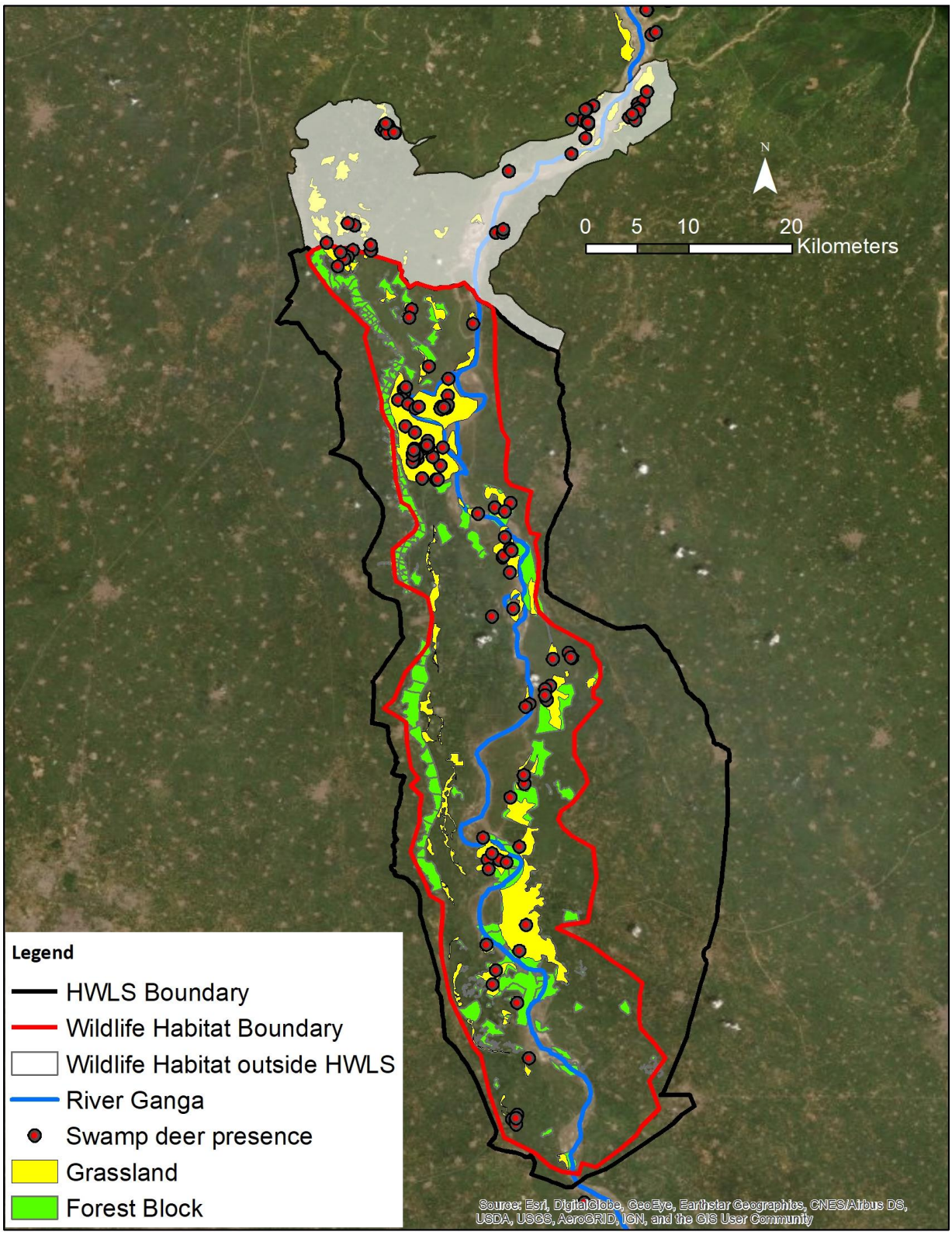

Figure 17: Existing (black) and critical wildlife use boundary (red) for HWLS considering digitized forest blocks and grassland patches. We also point that outside HWLS northern boundary critical grassland patches and swamp deer habitats are also present that need management attention.

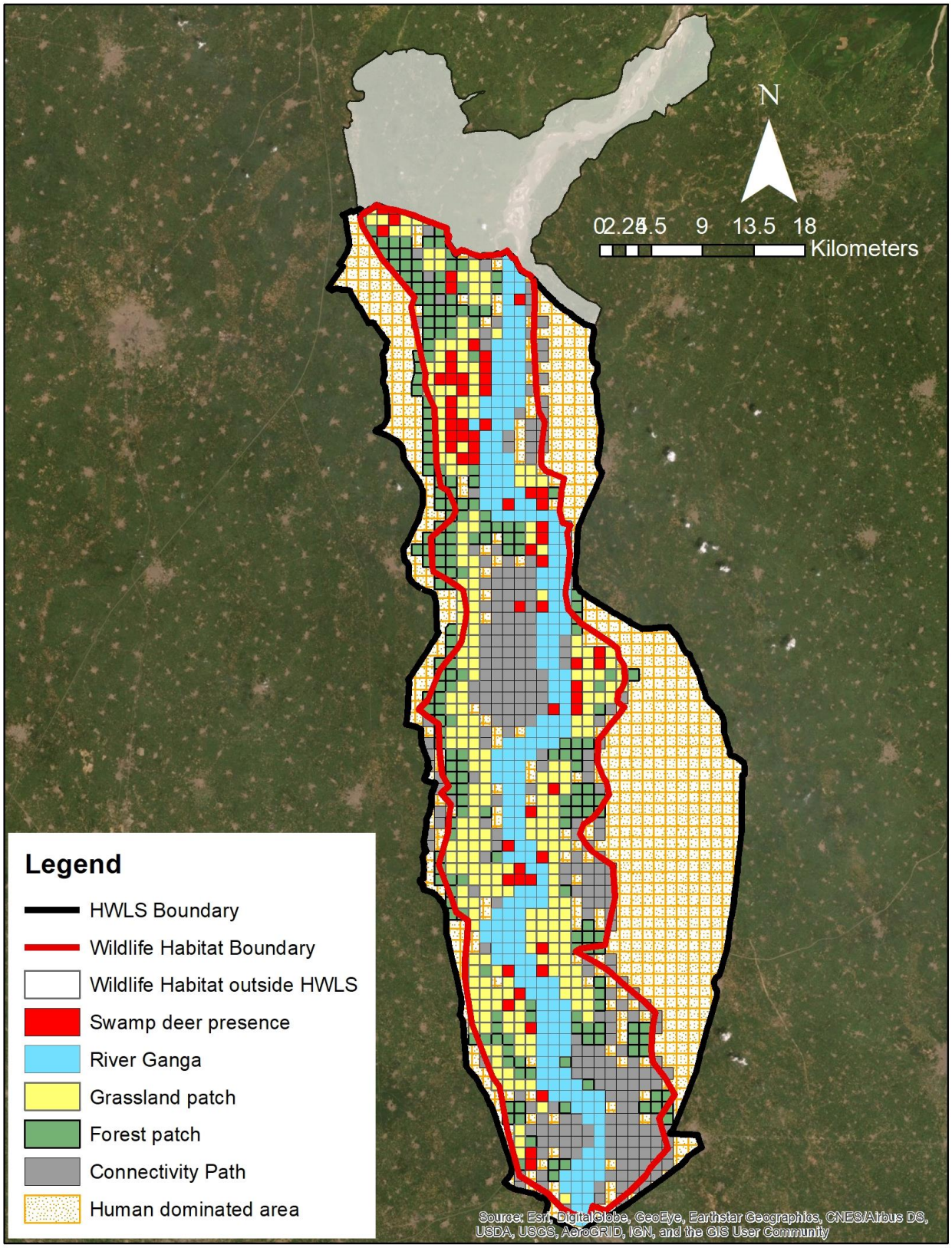

Figure 18: Existing (black) and critical wildlife use boundary (red) for HWLS considering habitat use grids found during our study.

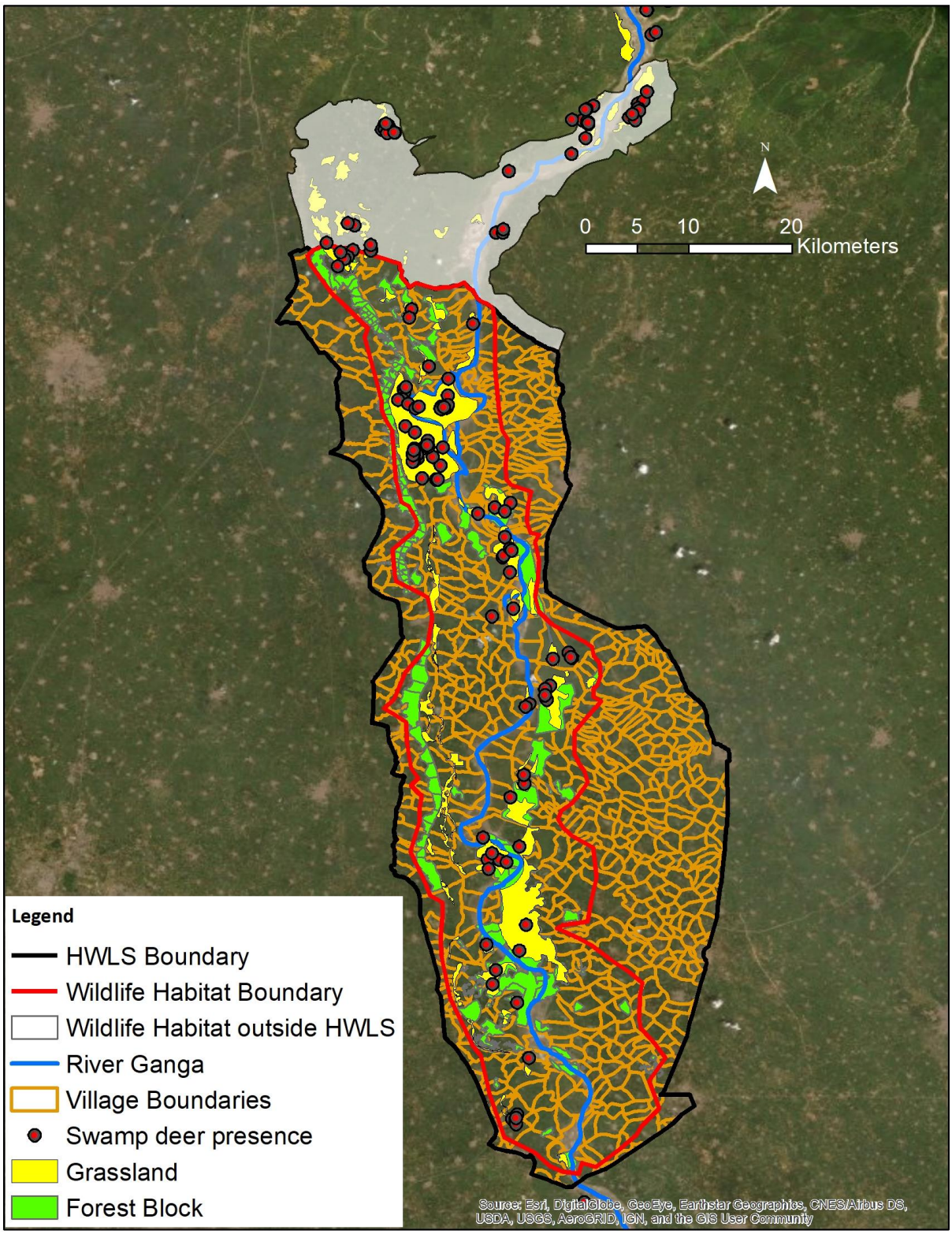

Figure 19: Existing (black) and critical wildlife use boundary (red) for HWLS considering digitized forest blocks, grassland patches, swamp deer presence points and digitized village layer.

After careful examination of the proposed boundary of critical wildlife use areas it was further realized that a large number of villages had the proposed boundary passing through them. Such situations can possibly create a range of complex management challenges and thus it would be better to either

include or exclude these villages in a revised proposed area boundary. The Uttar Pradesh Forest Department has prepared a revised area boundary based on the considerations of available grassland and forest patches, swamp deer presence points and the village boundaries. The final proposed area boundary along with the relevant collated information is provided in Figures 20- 21.

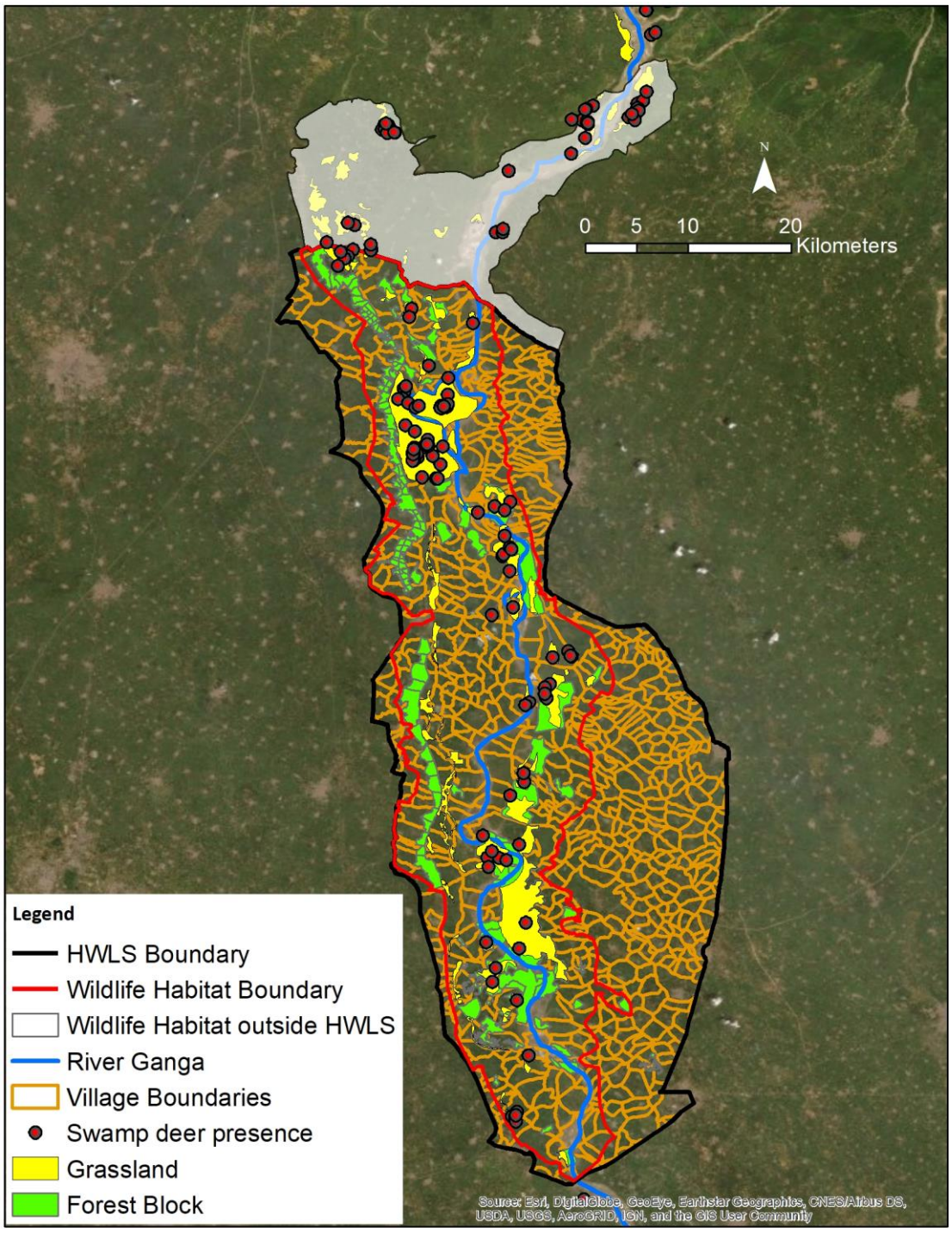

Figure 20: Existing (black) and proposed revised critical wildlife use boundary (red) for HWLS considering digitized forest blocks, grassland patches, swamp deer presence points and digitized village layer. The shaded area in the north is very critical for swamp deer that require immediate attention.

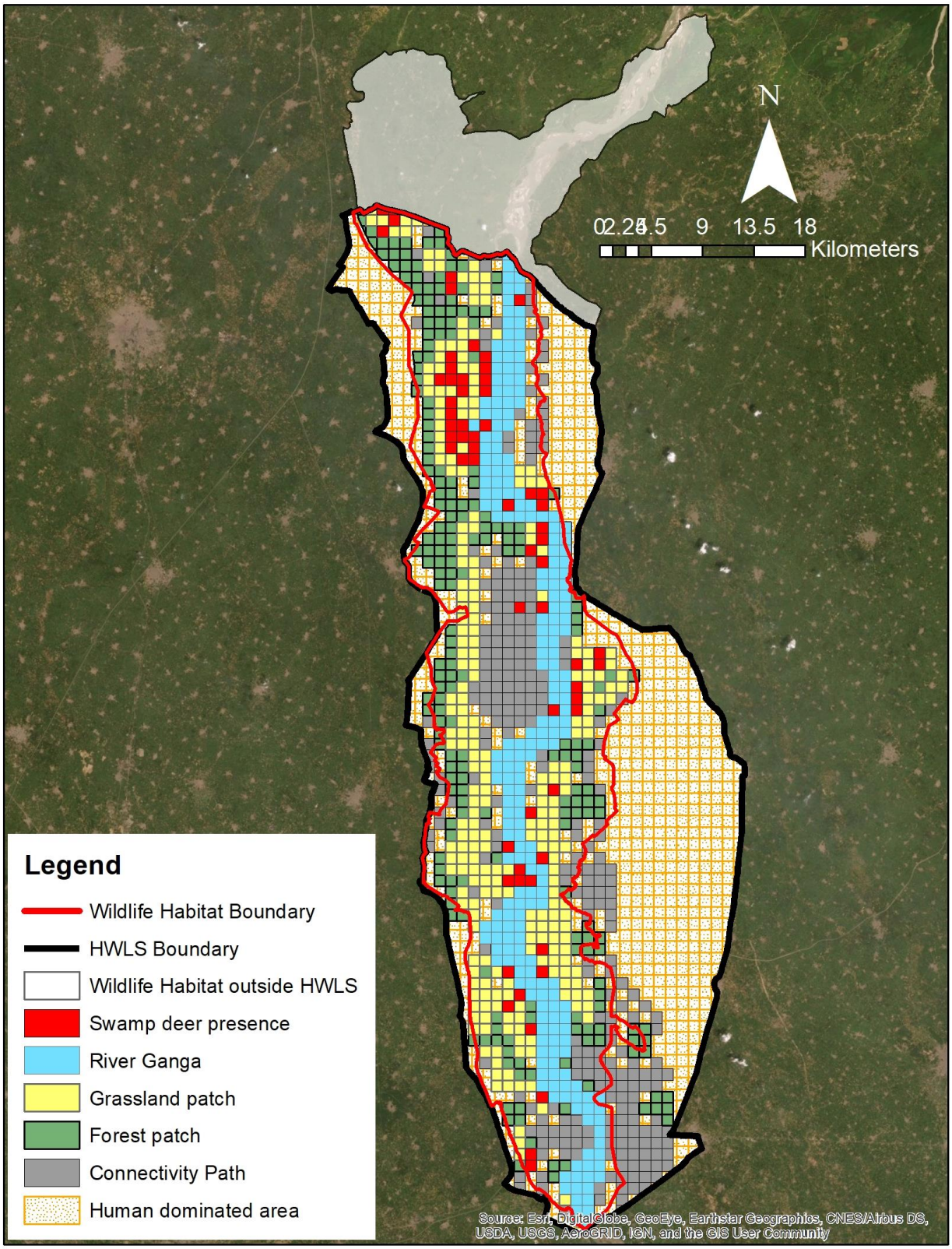

Figure 21: Existing (black) and proposed revised critical wildlife use boundary (red) for HWLS considering habitat use grids found during our study. Due consideration was given to get the maximum wildlife use area within the revised critical wildlife use boundary and remove other areas where human interventions are significant.

We have also calculated the approximate changes in area when compared with the original boundary.

The details are given below:

i) Area of the HWLS as per the original notification- 2073 km^2

ii) Critical wildlife use area within HWLS boundary- 1094.9 km^2

iii) Excluded area that are devoid of wildlife use and human dominated- 978.1 km^2

iv) Excluded area in left bank of Ganga- 712.8 km^2

v) Excluded area in right bank of Ganga- 265.3 km^2

The Uttar Pradesh Forest Department has further calculated the village level statistics, and ascertained district-wise number of villages those are excluded according to the proposed boundary. The details are presented in Table 1.

Name of District	**Existing Village in HWLS**	**Proposed Village within HWLS**	**Remaining Village outside HWLS**
Bijnor	327	119	208
Hapur	21	19	2
Meerut	114	101	13
Muzaffarnagar	106	94	12
Amroha	177	59	118
Total	**745**	**392**	**353**

Table 1: Village details for each district in Hastinapur Wildlife Sanctuary.

Finally, one of the most important findings of this study is the presence of critical grassland habitats attached with the northern boundary of Hastinapur Wildlife Sanctuary. Our surveys identified large grassland patches with confirmed swamp deer evidences outside Hastinapur Wildlife Sanctuary at the northern border (adjacent to as well as within the boundary of Uttarakhand state), covering an area of about 329.76 km^2. Radio tracking of collared swamp deers also showed extensive habitat use in this part as fawning ground, indicating the conservation importance of these fragmented habitats. Extensive GIS work showed that these critical areas outside HWLS reside both inside the Uttar Pradesh and Uttarakhand state boundaries. Figure 22 represents the critical habitats within Uttar Pradesh but outside HWLS boundary, covering an area of about 187.62 km^2. We recommend including this critical region in the revised HWLS boundary. However, in case this region is not added to the revised HWLS boundary, it should be notified as 'Ecosensitive zone' to protect the critical wildlife habitats.

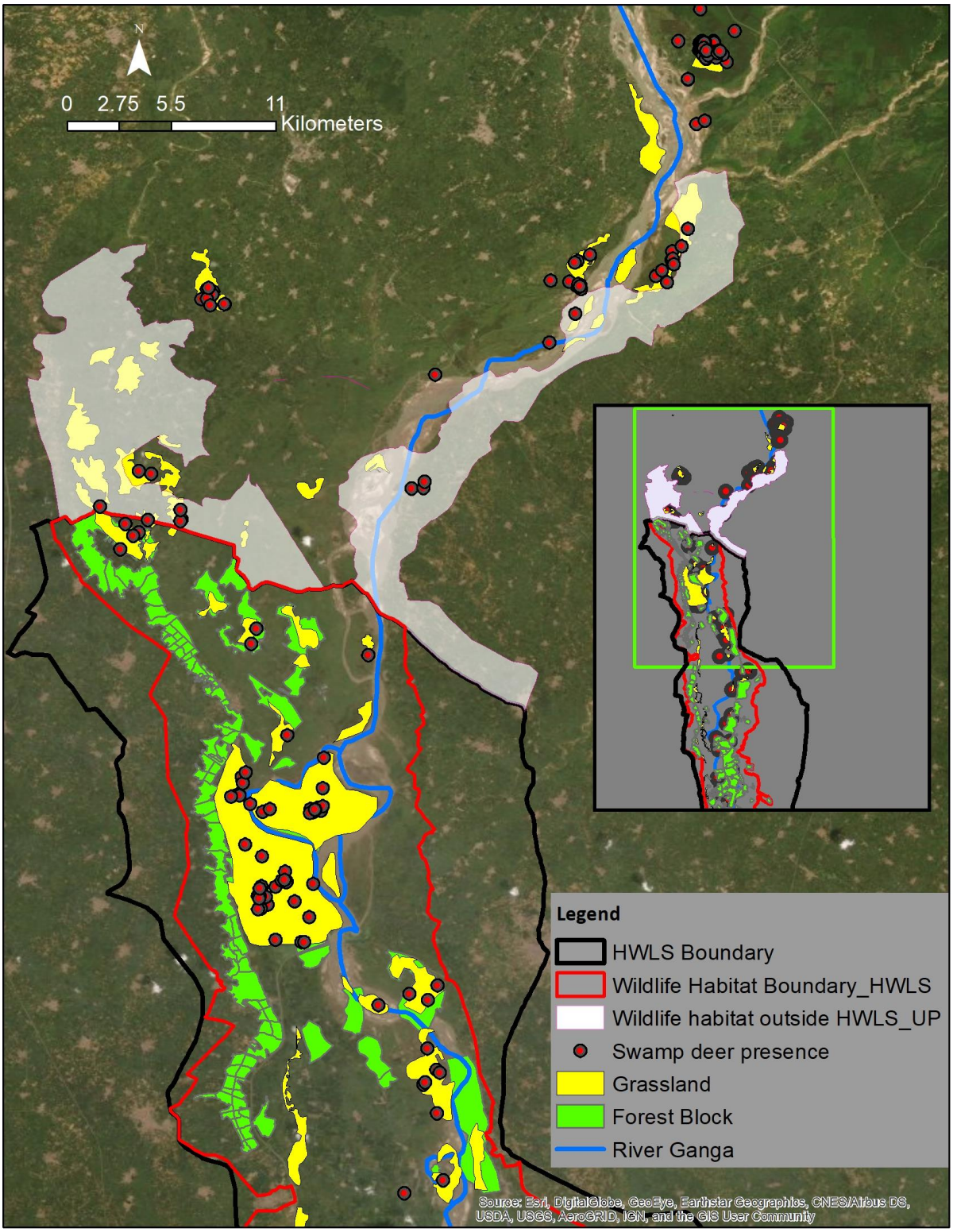

Figure 22: Proposed critical wildlife use boundary (red) for HWLS considering digitized grassland patches and confirmed swamp deer evidences. The area under the white boundary is extremely critical for swamp deer (approximately 187.62 sq. kms area), and should be either added with the revised boundary or notified as 'Ecosensitive zone'.

Similarly, we also identified some critical swamp deer habitats adjacent to HWLS boundary in Uttarakhand covering an area of 141.94 km^2 (Figure 23). We recommend developing a collaborative management and conservation action plan for these grassland habitats bordering Uttar Pradesh and Uttarakhand. Only such collaborative measures can ensure the survival of the fragmented grassland habitats and associated fauna in this entire landscape.

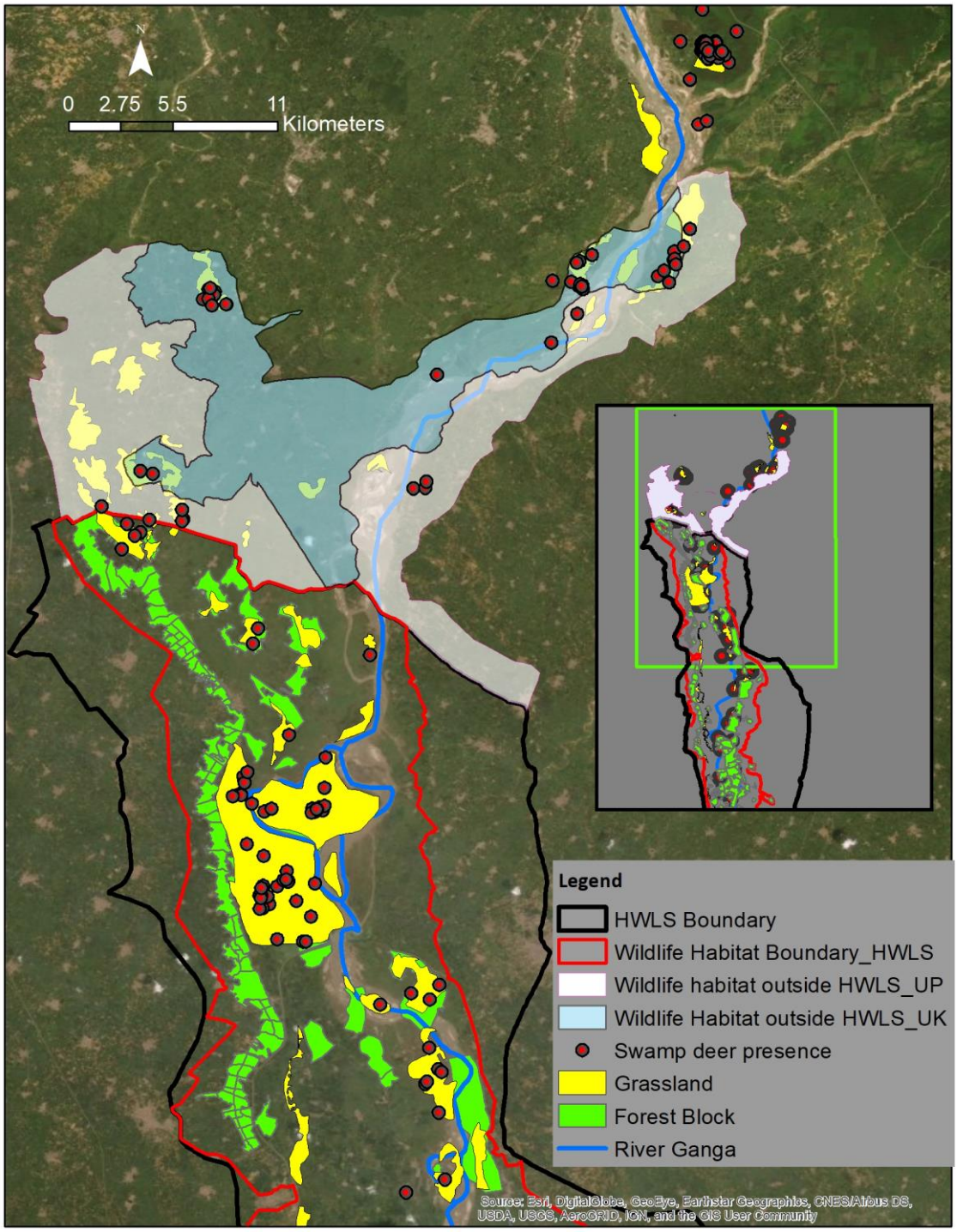

Figure 23: Proposed critical wildlife use boundary (red) for HWLS considering digitized grassland patches and confirmed swamp deer evidences. The area with green shade is within Uttarakhand and extremely critical for swamp deer.

Acknowledgement

We thank the Forest Departments of Uttarakhand and Uttar Pradesh for providing necessary permits (Permission nos: 90/5, 978/6-32/56, 1127/23-2-12(G) and 2233/23-2-12 (G)) to conduct this research. We are thankful to the Forest Department officials of respective areas, Suvankar Biswas, Supriya Bhatt, Sohini Sen, Amir Khan Sohel, Tista Ghosh, Imam, Ranju, Bhura, Annu and Ammi and Juri for helping us with survey. We acknowledge the help from the villagers living along Ganga for providing boats, tractors and manpower for survey. Our sincere thanks extends to the villagers of Tantwala and Gendikhata for providing help in radiocollaring swamp deer. In the field, Mr. Vinod Thakur provided technical help in standardising the drive-net method for radio-collaring. In the laboratory, Mr. A. Madhanraj and Ms Garima provided critical technical help. Our sincere thanks to the Director, Dean and the Wildlife Forensics and Conservation Genetics Cell of the Wildlife Institute of India for their support. Funding for this research was provided by the Uttar Pradesh Forest Department (For Hastinapur Wildlife Sanctuary) and Uttarakhand Forest Department (for Jhilmil Jheel Conservation Reserve), respectively.

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Annexures

क्रम-संख्या—528

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लाइसेन्स सं० डब्लू० पी०—41

(लाइसेन्सड टू पोस्ट विदाउट प्रीपेमेन्ट)

सरकारी गजट, उत्तर प्रदेश

उत्तर प्रदेशीय सरकार द्वारा प्रकाशित

असाधारण

विधायी परिशिष्ट

भाग—4, खण्ड (ख)

(परिनियत आदेश)

लखनऊ, सोमवार, 11 अगस्त, 1986

श्रावण 20, 1908 शक सम्वत्

उत्तर प्रदेश सरकार

वन अनुभाग-3

संख्या 3782/14-3-57-84

लखनऊ : 30 जुलाई, 1986

अधिसूचना

प० आ०—514

चूंकि राज्य सरकार की राय है कि वह क्षेत्र, जिसके ब्यौरे नीचे दी गई अनुसूची में दिये गये है, वन्य जीवों और उनके पर्यावरण के संरक्षण, संवर्द्धन और विकास के प्रयोजन के लिए पर्याप्त पारिस्थितिक, प्राणिजात, पादपजात, भू-आकृतितत्व, आकृतिक और प्राणितत्वीय महत्व का है,

अतएव, अब, वन्य जीव (संरक्षण) अधिनियम, 1972 (अधिनियम संख्या 53 सन् 1972) की धारा 18 की उपधारा (1) के अधीन शक्ति का प्रयोग करके राज्यपाल 2073 वर्ग किलोमीटर पर फैले उक्त क्षेत्र को एक अभयारण्य के रूप में घोषित करते है, जिसका नाम "हस्तिनापुर अभयारण्य" होगा।

अनुसूची

"हस्तिनापुर अभयारण्य" से संलग्नित किये जाने वाले क्षेत्र का ब्यौरा

सीमा का विवरण

1—उत्तर—गंगा बैराज (मवीकरणगढ़) से गंगा नदी तक कच्चा किन्तु स्थायी मार्ग होकर, बिजनौर जिले में कच्चा मार्ग ओल्ड गंगा नदी सुमेरा कला तक, सुमेरा कला से पक्का मोटर मार्ग होकर भटावर तक।

2--पूर्व:--बिजनौर जिले में भंडावर से बिजनौर, गंज, उल्हेड़ा (सभी बिजनौर जिले में) से धनौरा मण्डी (जिला मुरादाबाद) होकर पक्का मोटर मार्ग द्वारा गजरौला तक।

3--दक्षिण:--गजरौला से ब्रजघाट, गढ़ और मध्य गंगा नहर के किनारे-किनारे पक्का मोटर मार्ग द्वारा दौराई ग्राम तक (ये सभी स्थान गाजियाबाद जिले में हैं)।

4--पश्चिम:--दौराई ग्राम से मध्य गंगा नहर के साथ अब्दुल्लापुर (जिला मेरठ) तक जाने वाले मार्ग के साथ-साथ अब्दुल्लापुर, गंगा नगर, जानीखुर्द, हस्तिनापुर मोटर मार्ग तक, हस्तिनापुर से बहसूमा तक कच्चा किन्तु स्थाई मार्ग द्वारा, रजवाहे से ककरौली (जिला मुजफ्फरनगर), ककरौली से भोकरहेड़ी मोटर मार्ग और भोकरहेड़ी से बेहड़ा और रजवाहा तक।

क्षेत्र:--इस अभयारण्य में यहां नीचे दिया गया क्षेत्र सम्मिलित है :--

वन प्रभाग का नाम	रेंज का नाम	क्षेत्रफल (वर्ग कि0मी0 में)
1--मुजफ्फरनगर वन प्रभाग	.. मीरापुर रेंज	25.99
2--मेरठ वन प्रभाग	.. हस्तिनापुर और गढ़ रेंज	54.49
		5.93
3--मुरादाबाद वन प्रभाग	.. अमरोहा रेंज	61.23
4--बिजनौर वन प्रभाग	.. चांदपुर और	38.62
अन्य क्षेत्र	.. बिजनौर रेंज	1886.74
	योग ..	2073.00

आज्ञा से,
कृष्ण पाण्डे,
सचिव।

In pursuance of provisions of clause (3) of Article 348 of the Constitution, the Governor is pleased to order the publication of the following English translation of notification no. 3782/XIV-3-57-84, dated July 30, 1986 :

No. 3782/XIV-3-57-84

Dated Lucknow, July 30, 1986

WHEREAS the State Government is of the opinion that the area, the details of which are given in the Schedule below is of adequate ecological, faunal, floral, geomorphological, natural and zooligical significance for the purpose of protecting, propagating and developing wild life therein and its environment.

Now, THEREFORE, in exercise of the powers under sub-section (1) of section 18 of the Wild Life (Protection) Act, 1972 (Act no. 53 of 1972), the Governor is pleased to declare the said area spread over 2073 sq. KM. as a sanctuary to be named as "Hastinapur Sanctuary".

Schedule

Details of the area to be included in "Hastinapur Sanctuary"

Boundary Description

1. *North*--Village Behra (Muzzafarnagar) to Ganga river by Kuchha but permanent road, Ganga river up to Sunera Kalan in Bijnor district Kuchha road, Sunera Kalan to Bhandawar by pucca motor road.

2. *East*--From Bhandawar in Bijnor district along Bijnor, Ganj, Ulhera, (all in Bijnor district) via Dhandaura Mandi (Moradabad district) up to Gajraula by pucca motor road.

3. *South*—Gajraula to Brijghat, Garh and along bank of Madhya Ganga Canal up to Dotai village (all the three places are in Ghaziabad district) by pucca motor road.

4. *West*—From Dotai village along Madhya Ganga Canal along road leading to Agwanpur (Meerut district) to Agwanpur Nangla Gosain, Jaisinghpur, motor road up to Hastinapur, from Hastinapur to Rahimapur by Kuchha but permanent road, from Rajwaha, to Kakroli (Muzzafarnagar district), Kakroli to Morena motor road and from Morena to Bodla and Rajwaha.

Area:—This Sanctuary will comprise area given hereunder :

Name of Forest Division	Name of Range	Area (in Sq. Km.)
1. Muzzafarnagar forest division	Meerapur Range	25.99
2. Meerut forest division	Hastinapur and Garh Range	51.19 5.93
3. Moradabad forest division	Dhandaura Range	61.23
4. Bijnor forest division	Chandpur and Bijnor Range	38.62 1886.71
Other areas	Total	2073.09

(74)

S. K. UPADHYAYA
IFS
Principal Chief Conservator Forest
(Wild Life) U.P.

Letter No. 1951/ 26-11
Off : 17, RANA PRATAP MARG,
LUCKNOW (U.P.)
Ph. :0522-2206584

Date : 12-12-2017

To,

The Director
Wildlife Institute of India
Chandrabani, Dehradun
Uttarakhand

Sub: **Management effectiveness (ME) study of Hastinapur Wildlife Sanctuary – regarding**

Dear Sir,

You are aware that Hastinapur wildlife sanctuary is notified as wildlife sanctuary under section 18 of Wildlife(P) Act, 1972 vide U.P. govt. notification no. 3782/14-3-57/84 dated 30.06.1986. The sanctuary spreads over an area of 2073 sq.km. in Meerut, Hapur, Muzaffarnagar, Bijnore and Amroha districts of western U.P extending on either side of River Ganges from Bijnore barrage to Garhmukteshwar in Hapur district.

The main objective of notifying this area as wildlife sanctuary was to provide protection to the scattered habitats of state animal "Barasingha", which existed in the swampy area along the Ganges. The landforms inside the sanctuary include Khola (elevated alluvial deposition, lying parallel to the river), Khadar (low-lying sandy river bank on either side of the Ganga), and the Boodhi Ganga, a belt of swamps, marshes, channels, and shallow lakes following the old bed of the Ganga, which runs parallel to the Ganga at the western edge of the sanctuary.

However, as per the boundaries specified in aforesaid notification, the sanctuary also includes vast civil/private lands e.g. human settlements, villages, towns and large tract of agricultural areas (Nearly 60% of the total area under notification, i.e. 1600 sq. km.), besides small extent of forest/ community/ government land. Due to this Sanctuary has fragmented and highly disturbed habitat for the wildlife and this is against the basic principles of Scientific Wildlife Management. Consequently, the process of settlement of rights of the sanctuary under section 19 to 25 has remained inconclusive resulting in serious managerial problems.

In view of the above, it seems pertinent to carry out a review of management effectiveness (ME) of Hastinapur Sanctuary in terms of its biological, ecological and

Urgent
Dr Samrat
Pls submit
above report

ecosystem service value and rationalization of its boundaries to include potential habitats of important faunal species. The objective of the aforesaid exercise is also to map suitable wildlife habitats in line with the conservation objectives and also to exclude areas of private ownership facilitating smooth management of the sanctuary.

Further, it has been decided to request Wildlife Institute of India to carry out the aforesaid management effectiveness (ME) study in respect of Hastinapur sanctuary at the earliest. Hence, you are requested to kindly take up the work and give the report 15 days.

Thanking you

Yours faithfully,

12/12

(S K Upadhyaya)
Principal Chief Conservator
of Forest (Wild Life) U.P.,
Lucknow

Copy to following for information and necessary action :

1 Principal Secretary, Forest and Wildlife, Government of Uttar Pradesh, Lucknow
2 Principal Chief Conservator of Forest and HoFF, Uttar Pradesh, Lucknow

(S K Upadhyaya)
Principal Chief Conservator
of Forest (Wild Life) U.P.,
Lucknow

Copy to CF Merrut Circle, Merrut to contact Director WII and coordinate the work immediately

(S K Upadhyaya)
Principal Chief Conservator
of Forest (Wild Life) U.P.,
Lucknow

कार्यालय प्रधान मुख्य वन संरक्षक, वन्य जीव, उत्तर प्रदेश, लखनऊ।

पत्रसंख्या– 2913 /23–7–1(हस्तिनापुर वन्य जीव विहार) ,लखनऊः दिनांकः फरवरी 28,2019

सेवा में,

निदेशक,
भारतीय वन्य जीव संस्थान,
चन्द्रबनी, देहरादून
(उत्तराखण्ड)।

12
05/3/19

विषयः– मा0 मुख्य मंत्री जी, उ0प्र0 की अध्यक्षता में दिनांक 30.08.2018 को उ0प्र0 राज्य वन्य जीव बोर्ड की आठवीं बैठक का कार्यवृत्त।

संदर्भः– इस कार्यालय का पत्र संख्या–644/26–11 (राज्य वन्य जीव बोर्ड) दिनांक 13.09.2018 एवं पत्र संख्या–271/23–7–1 दिनांक 31.12.2018.

महोदय,

कृपया उपरोक्त विषयक संदर्भित पत्रों का अवलोकन करने का कष्ट करें। विषयक प्रकरण में मा0 मुख्य मंत्री जी, उ0प्र0 की अध्यक्षता में दिनांक 30.08.2018 को उ0प्र0 राज्य वन्य जीव बोर्ड की 8वीं बैठक में लिए गए निर्णय के क्रम में वन्य जीव (संरक्षण) अधिनियम, 1972 के प्राविधानों के अन्तर्गत हस्तिनापुर वन्य जीव विहार की वन्दोबस्ती प्रक्रिया पुनः किए जाने के दृष्टिगत आपसे विभिन्न विधिक पहलुओं तथा वन प्रबन्धन की दृष्टि से वन एवं वन्य जीवों के उचित संरक्षण हेतु अध्ययन कर रिपोर्ट प्रस्तुत करने की अपेक्षा की गई है। इस सम्बन्ध में उक्त संदर्भित पत्रों द्वारा आपसे अनुरोध किया गया है, जिसके क्रम में अपेक्षित अध्ययन रिपोर्ट अब तक अप्राप्त है।

बारासिंघा (swamp deer) जो कि उ0प्र0 का राज्य पशु भी है, की संख्या एवं उनके माइग्रेशन (migration) पैटर्न तथा उनके वास स्थल के क्षेत्र को चिन्हित कर कॉरिडोर को समावेशित करते हुए वन बन्दोबस्त की कार्यवाही पुनः प्रारम्भ करने पर विचार किया जाए। इस कार्य को वैज्ञानिक ढंग से सम्पन्न कराने हेतु भारतीय वन्यजीव संस्थान, (Wildlife Institute of India) देहरादून का सहयोग लिया जाए।

अतः विषयक प्रकरण में पुनः अनुरोध है कि मा0 बोर्ड द्वारा दिये गये उक्त निर्देशों के क्रम में हस्तिनापुर वन्य जीव विहार की वन बन्दोबस्त कार्यवाही पुनः प्रारम्भ किये जाने हेतु बारासिंघा (swamp deer) के माइग्रेशन (migration) पैटर्न तथा उनके वासस्थल के क्षेत्र को चिन्हित कर कॉरिडोर को समावेशित करते हुए वैज्ञानिक ढंग से अध्ययन कराये जाने हेतु आवश्यक कार्यवाही प्राथमिकता से कराने का कष्ट करें। प्रकरण महत्वपूर्ण है, अतः आपका व्यक्तिगत ध्यानाकर्षण अपेक्षित है।

DWII OFFICE
DIARY NO.: 8225
DATE: 06/03/19

भवदीय,

(सुनील पाण्डेय)
प्रधान मुख्य वन संरक्षक, वन्य जीव,
उत्तर प्रदेश, लखनऊ।

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Details of Swam deer evidences from upper Gangetic Plains				
Sample type	Lat	Long	Place	State
Antler	29.7968	78.21361667	N side of Factory, JJCR	Uttarakhand
Antler	29.7967	78.21363333	N side of Factory, JJCR	Uttarakhand
Antler	29.79673333	78.21361667	N side of Factory, JJCR	Uttarakhand
Antler	29.79683333	78.21358333	N side of Factory, JJCR	Uttarakhand
Antler	29.7968	78.21361667	N side of Factory, JJCR	Uttarakhand
Antler	29.79808333	78.21056667	Left side of Factory,JJCR	Uttarakhand
Antler	29.7982	78.2107	Left side of Factory,JJCR	Uttarakhand
Antler	29.79828333	78.21231667	Left side of Factory,JJCR	Uttarakhand
Antler	29.79893333	78.2126	Left side of Factory,JJCR	Uttarakhand
Antler	29.80046667	78.21146667	Left side of Factory,JJCR	Uttarakhand
Antler	29.8005	78.21155	Left side of Factory,JJCR	Uttarakhand
Antler	29.79843333	78.21066667	N side of Factory,JJCR	Uttarakhand
Antler	29.7975	78.21255	N side of Factory,JJCR	Uttarakhand
Antler	29.80111667	78.20001667	N side of Factory,JJCR	Uttarakhand
Antler	29.79585	78.21321667	N side of Factory,JJCR	Uttarakhand
Antler	29.7964	78.21411667	N side of Factory,JJCR	Uttarakhand
Antler	29.79621667	78.21453333	N side of Factory,JJCR	Uttarakhand
Antler	29.7999	78.21298333	NW of Factory,JJCR	Uttarakhand
Antler	29.80013333	78.2129	NW of Factory,JJCR	Uttarakhand
Antler	29.79746667	78.2134	NW of Factory,JJCR	Uttarakhand
Antler	29.79585	78.21321667	North of Factory,JJCR	Uttarakhand
Antler	29.80013333	78.2129	NW of Factory,JJCR	Uttarakhand
Antler	29.79555	78.21435	Opposite Watch Tower 1,JJCR	Uttarakhand
Antler	29.79555	78.21435	Opposite Watch Tower 1,JJCR	Uttarakhand
Antler	29.79526667	78.21703333	Opposite Watch Tower 1,JJCR	Uttarakhand
Antler	29.79546667	78.21418333	Opposite Watch Tower 1,JJCR	Uttarakhand
Antler	29.79598333	78.21358333	Opposite Watch Tower 1,JJCR	Uttarakhand
Antler	29.7954	78.21311667	Opposite Watch Tower 1,JJCR	Uttarakhand
Antler	29.79681	78.21397	Central area,JJCR	Uttarakhand
Antler	29.79576	78.21668	Opposite Watch Tower 2,JJCR	Uttarakhand
Antler	29.68404	77.97776	Dharampur, Luxor	Uttarakhand
Antler	29.6857	78.1521	Ranjitpur, luxor	Uttarakhand
Antler	29.79998	78.21203	NWof Factory,JJCR	Uttarakhand
Antler	29.79544	78.21772	Opposite Watch Tower 2,JJCR	Uttarakhand

Antler	29.79552	78.21668	Opposite Watch Tower 2,JJCR	Uttarakhand
Antler	29.68116	77.97928	Dharampur, Luxor	Uttarakhand
Antler	29.67937	77.97664	Dharampur, Luxor	Uttarakhand
Antler	29.67607	77.97833	Dharampur, Luxor	Uttarakhand
Antler	29.79887	78.21159	Opposite Watch Tower 2,JJCR	Uttarakhand
Antler	29.68741	78.14837	Purana Khara,Ranjitpur, luxor	Uttarakhand
Antler	29.68778	78.13951	Ranjitpur, luxor	Uttarakhand
Antler	29.68553	78.15282	Ranjitpur, luxor	Uttarakhand
Antler	29.79553	78.21378	Central area,JJCR	Uttarakhand
Antler	29.80612	78.22693	JJCR campus	Uttarakhand
Antler	29.5745	77.96466	Joga Jheel	Uttarakhand
Antler	29.7968	78.21361	JJCR	Uttarakhand
Antler	29.79551	78.21873	JJCR	Uttarakhand
Antler	29.79644	78.21994	JJCR	Uttarakhand
Faecal	29.79455	78.21761667	Jhilmil jhil, Rasiyabad, opposite Watcch twr2	Uttarakhand
Faecal	29.79546667	78.21756667	Jhilmil jhil, Rasiyabad, opposite Watcch twr2	Uttarakhand
Faecal	29.79146667	78.22301667	Jhilmil jhil, Rasiyabad, opposite Watcch twr2	Uttarakhand
Faecal	29.79146667	78.22301667	Jhilmil jhil, Rasiyabad, opposite Watcch twr2	Uttarakhand
Faecal	29.79455	78.21761667	Jhilmil jhil, Rasiyabad, opposite Watcch twr2	Uttarakhand
Faecal	29.79473333	78.22108333	Jhilmil jhil, Rasiyabad, opposite Watcch twr2	Uttarakhand
Faecal	29.78316667	78.20471667	Ganga beat, Rasiyabad,near JJCR	Uttarakhand
Faecal	29.7833	78.20475	Ganga beat, Rasiyabad,near JJCR	Uttarakhand
Faecal	29.78348333	78.20455	Ganga beat, Rasiyabad,near JJCR	Uttarakhand
Faecal	29.79686667	78.2101	Jhilmil jhil, Rasiyabad	Uttarakhand
Faecal	29.79703333	78.2109	N side of Factory, JJCR	Uttarakhand
Faecal	29.79723333	78.21121667	N side of Factory, JJCR	Uttarakhand
Faecal	29.79716667	78.21156667	N side of Factory, JJCR	Uttarakhand
Faecal	29.79726667	78.2119	N side of Factory, JJCR	Uttarakhand
Faecal	29.79755	78.21231667	N side of Factory, JJCR	Uttarakhand
Faecal	29.79771667	78.21255	N side of Factory, JJCR	Uttarakhand
Faecal	29.7979	78.2129	N side of Factory, JJCR	Uttarakhand
Faecal	29.79806667	78.21323333	N side of Factory, JJCR	Uttarakhand
Faecal	29.79826667	78.21355	N side of Factory, JJCR	Uttarakhand
Faecal	29.79716667	78.2137	N side of Factory, JJCR	Uttarakhand
Faecal	29.79706667	78.21385	N side of Factory, JJCR	Uttarakhand
Faecal	29.79698333	78.21388333	N side of Factory, JJCR	Uttarakhand

Faecal	29.7968	78.21365	N side of Factory, JJCR	Uttarakhand
Faecal	29.79671667	78.21403333	N side of Factory, JJCR	Uttarakhand
Faecal	29.79666667	78.21418333	N side of Factory, JJCR	Uttarakhand
Faecal	29.79663333	78.21405	N side of Factory, JJCR	Uttarakhand
Faecal	29.7968	78.21365	N side of Factory, JJCR	Uttarakhand
Faecal	29.79808333	78.21056667	N side of Factory, JJCR	Uttarakhand
Faecal	29.7982	78.2107	N side of Factory, JJCR	Uttarakhand
Faecal	29.79843333	78.21066667	N side of Factory, JJCR	Uttarakhand
Faecal	29.79828333	78.21231667	N side of Factory, JJCR	Uttarakhand
Faecal	29.79893333	78.2126	N side of Factory, JJCR	Uttarakhand
Faecal	29.8002	78.21031667	Left side of Factory,JJCR	Uttarakhand
Faecal	29.80036667	78.2104	Left side of Factory,JJCR	Uttarakhand
Faecal	29.8165	78.2105	Left side of Factory,JJCR	Uttarakhand
Faecal	29.80111667	78.21131667	Left side of Factory,JJCR	Uttarakhand
Faecal	29.80066667	78.21105	Left side of Factory,JJCR	Uttarakhand
Faecal	29.80061667	78.21083333	Left side of Factory,JJCR	Uttarakhand
Faecal	29.80055	78.21091667	Left side of Factory,JJCR	Uttarakhand
Faecal	29.8007	78.21085	Left side of Factory,JJCR	Uttarakhand
Faecal	29.80075	78.21066667	Left side of Factory,JJCR	Uttarakhand
Faecal	29.80075	78.21085	Left side of Factory,JJCR	Uttarakhand
Faecal	29.80085	78.2109	Left side of Factory,JJCR	Uttarakhand
Faecal	29.79908333	78.2128	Left side of Factory,JJCR	Uttarakhand
Faecal	29.80043333	78.21155	Left side of Factory,JJCR	Uttarakhand
Faecal	29.80048333	78.2113	Left side of Factory,JJCR	Uttarakhand
Faecal	29.80056667	78.21136667	Left side of Factory,JJCR	Uttarakhand
Faecal	29.80051667	78.21181667	Left side of Factory,JJCR	Uttarakhand
Faecal	29.80051667	78.21171667	Left side of Factory,JJCR	Uttarakhand
Faecal	29.8006	78.2117	Left side of Factory,JJCR	Uttarakhand
Faecal	29.80065	78.21146667	Left side of Factory,JJCR	Uttarakhand
Faecal	29.80056667	78.21145	Left side of Factory,JJCR	Uttarakhand
Faecal	29.80046667	78.21146667	Left side of Factory,JJCR	Uttarakhand
Faecal	29.79998333	78.21181667	Left side of Factory,JJCR	Uttarakhand
Faecal	29.79828333	78.21233333	Left side of Factory,JJCR	Uttarakhand
Faecal	29.79686667	78.21266667	N side of Factory,JJCR	Uttarakhand
Faecal	29.79688333	78.21276667	N side of Factory,JJCR	Uttarakhand
Faecal	29.79681667	78.21288333	N side of Factory,JJCR	Uttarakhand

Faecal	29.79706667	78.21258333	N side of Factory,JJCR	Uttarakhand
Faecal	29.7972	78.21245	N side of Factory,JJCR	Uttarakhand
Faecal	29.79703333	78.21246667	N side of Factory,JJCR	Uttarakhand
Faecal	29.79715	78.21245	N side of Factory,JJCR	Uttarakhand
Faecal	29.79715	78.2125	N side of Factory,JJCR	Uttarakhand
Faecal	29.79901667	78.21115	N side of Factory,JJCR	Uttarakhand
Faecal	29.79926667	78.21085	N side of Factory,JJCR	Uttarakhand
Faecal	29.7994	78.21071667	N side of Factory,JJCR	Uttarakhand
Faecal	29.79885	78.2113	N side of Factory,JJCR	Uttarakhand
Faecal	29.79851667	78.21173333	N side of Factory,JJCR	Uttarakhand
Faecal	29.7974	78.21256667	N side of Factory,JJCR	Uttarakhand
Faecal	29.7971	78.21265	N side of Factory,JJCR	Uttarakhand
Faecal	29.79718333	78.21286667	N side of Factory,JJCR	Uttarakhand
Faecal	29.79705	78.21278333	N side of Factory,JJCR	Uttarakhand
Faecal	29.79695	78.21283333	N side of Factory,JJCR	Uttarakhand
Faecal	29.79698333	78.21273333	N side of Factory,JJCR	Uttarakhand
Faecal	29.79715	78.21223333	N side of Factory,JJCR	Uttarakhand
Faecal	29.7971	78.21288333	N side of Factory,JJCR	Uttarakhand
Faecal	29.79703333	78.21281667	N side of Factory,JJCR	Uttarakhand
Faecal	29.79708333	78.21261667	N side of Factory,JJCR	Uttarakhand
Faecal	29.7972	78.21226667	N side of Factory,JJCR	Uttarakhand
Faecal	29.79636667	78.21315	N side of Factory,JJCR	Uttarakhand
Faecal	29.79668333	78.21328333	N side of Factory,JJCR	Uttarakhand
Faecal	29.79645	78.2131	N side of Factory,JJCR	Uttarakhand
Faecal	29.79631667	78.21371667	N side of Factory,JJCR	Uttarakhand
Faecal	29.7963	78.21311667	N side of Factory,JJCR	Uttarakhand
Faecal	29.79638333	78.21346667	N side of Factory,JJCR	Uttarakhand
Faecal	29.79656667	78.2133	N side of Factory,JJCR	Uttarakhand
Faecal	29.79648333	78.21303333	N side of Factory,JJCR	Uttarakhand
Faecal	29.79623333	78.21333333	N side of Factory,JJCR	Uttarakhand
Faecal	29.79651667	78.21321667	N side of Factory,JJCR	Uttarakhand
Faecal	29.79661667	78.21323333	N side of Factory,JJCR	Uttarakhand
Faecal	29.79655	78.21343333	N side of Factory,JJCR	Uttarakhand
Faecal	29.79658333	78.21336667	N side of Factory,JJCR	Uttarakhand
Faecal	29.79651667	78.21355	N side of Factory,JJCR	Uttarakhand
Faecal	29.79661667	78.21308333	N side of Factory,JJCR	Uttarakhand

Faecal	29.79686667	78.21363333	N side of Factory,JJCR	Uttarakhand
Faecal	29.79671667	78.21368333	N side of Factory,JJCR	Uttarakhand
Faecal	29.79666667	78.21338333	N side of Factory,JJCR	Uttarakhand
Faecal	29.79675	78.21353333	N side of Factory,JJCR	Uttarakhand
Faecal	29.79676667	78.21383333	N side of Factory,JJCR	Uttarakhand
Faecal	29.79678333	78.21353333	N side of Factory,JJCR	Uttarakhand
Faecal	29.79665	78.21351667	N side of Factory,JJCR	Uttarakhand
Faecal	29.7969	78.21376667	N side of Factory,JJCR	Uttarakhand
Faecal	29.79675	78.21366667	N side of Factory,JJCR	Uttarakhand
Faecal	29.79688333	78.21388333	N side of Factory,JJCR	Uttarakhand
Faecal	29.79848333	78.21373333	N side of Factory,JJCR	Uttarakhand
Faecal	29.79668333	78.21301667	N side of Factory,JJCR	Uttarakhand
Faecal	29.79703333	78.21368333	N side of Factory,JJCR	Uttarakhand
Faecal	29.7969	78.21361667	N side of Factory,JJCR	Uttarakhand
Faecal	29.79668333	78.21348333	N side of Factory,JJCR	Uttarakhand
Faecal	29.80061667	78.21605	Left of watch tower no. 3,JJCR	Uttarakhand
Faecal	29.80068333	78.21628333	Left of watch tower no. 3,JJCR	Uttarakhand
Faecal	29.8008	78.2165	Left of watch tower no. 3,JJCR	Uttarakhand
Faecal	29.80055	78.21605	Left of watch tower no. 3,JJCR	Uttarakhand
Faecal	29.80048333	78.21606667	Left of watch tower no. 3,JJCR	Uttarakhand
Faecal	29.80033333	78.21705	Left of watch tower no. 3,JJCR	Uttarakhand
Faecal	29.80033333	78.21705	Left of watch tower no. 3,JJCR	Uttarakhand
Faecal	29.80071667	78.21673333	Left of watch tower no. 3,JJCR	Uttarakhand
Faecal	29.8006	78.21683333	Left of watch tower no. 3,JJCR	Uttarakhand
Faecal	29.80041667	78.21693333	Left of watch tower no. 3,JJCR	Uttarakhand
Faecal	29.80111667	78.21678333	Left of watch tower no. 3,JJCR	Uttarakhand
Faecal	29.8004	78.21708333	Left of watch tower no. 3,JJCR	Uttarakhand
Faecal	29.8005	78.21698333	Left of watch tower no. 3,JJCR	Uttarakhand
Faecal	29.79646667	78.21446667	N side of Factory,JJCR	Uttarakhand
Faecal	29.79641667	78.21478333	N side of Factory,JJCR	Uttarakhand
Faecal	29.79643333	78.21181667	N side of Factory,JJCR	Uttarakhand
Faecal	29.7934	78.21305	N side of Factory,JJCR	Uttarakhand
Faecal	29.79656667	78.21435	N side of Factory,JJCR	Uttarakhand
Faecal	29.79375	78.21295	N side of Factory,JJCR	Uttarakhand
Faecal	29.793	78.2133	N side of Factory,JJCR	Uttarakhand
Faecal	29.79313333	78.21315	N side of Factory,JJCR	Uttarakhand

Faecal	29.79308333	78.2132	N side of Factory,JJCR	Uttarakhand
Faecal	29.79306667	78.21336667	N side of Factory,JJCR	Uttarakhand
Faecal	29.79978333	78.21291667	NW of Factory,JJCR	Uttarakhand
Faecal	29.79955	78.21293333	NW of Factory,JJCR	Uttarakhand
Faecal	29.79938333	78.21301667	NW of Factory,JJCR	Uttarakhand
Faecal	29.8002	78.21261667	NW of Factory,JJCR	Uttarakhand
Faecal	29.8	78.21276667	NW of Factory,JJCR	Uttarakhand
Faecal	29.7999	78.21298333	NW of Factory,JJCR	Uttarakhand
Faecal	29.80013333	78.2129	NW of Factory,JJCR	Uttarakhand
Faecal	29.7972	78.21345	NW of Factory,JJCR	Uttarakhand
Faecal	29.8004	78.21286667	NW of Factory,JJCR	Uttarakhand
Faecal	29.79756667	78.21326667	NW of Factory,JJCR	Uttarakhand
Faecal	29.79746667	78.2134	NW of Factory,JJCR	Uttarakhand
Faecal	29.80013333	78.21281667	NW of Factory,JJCR	Uttarakhand
Faecal	29.67618	77.97735	Dharampur, Luxor	Uttarakhand
Faecal	29.68554	78.15325	Ranjitpur, luxor	Uttarakhand
Faecal	29.68536	78.1536	Ranjitpur, luxor	Uttarakhand
Faecal	29.6855	78.15297	Ranjitpur, luxor	Uttarakhand
Faecal	29.68551	78.15354	Ranjitpur, luxor	Uttarakhand
Faecal	29.68619	78.15275	Ranjitpur, luxor	Uttarakhand
Faecal	29.69728	78.15238	Sidmandir,Luxor	Uttarakhand
Faecal	29.69642	78.15117	Sidmandir,Luxor	Uttarakhand
Faecal	29.68519	78.15361	Ranjitpur, luxor	Uttarakhand
Faecal	29.79468	78.21418	Central area,JJCR	Uttarakhand
Faecal	29.79517	78.21452	Central area,JJCR	Uttarakhand
Faecal	29.79553	78.21378	Central area,JJCR	Uttarakhand
Faecal	29.79811	78.21207	N of Factory,JJCR	Uttarakhand
Faecal	29.79628	78.21678	Central area,JJCR	Uttarakhand
Faecal	29.79661667	78.21972222	Central area,JJCR	Uttarakhand
Faecal	29.79658611	78.21927222	Central area,JJCR	Uttarakhand
Faecal	29.79626944	78.21885833	Central area,JJCR	Uttarakhand
Faecal	29.79637778	78.218575	Central area,JJCR	Uttarakhand
Faecal	29.79531667	78.21748889	Central area,JJCR	Uttarakhand
Faecal	29.79324	78.21323	Central area,JJCR	Uttarakhand
Faecal	29.79454	78.21434	Central area,JJCR	Uttarakhand
Faecal	29.79353	78.21807	Central area,JJCR	Uttarakhand

Faecal	29.59607	77.95029	Joga jheel	Uttarakhand
Faecal	29.59759	77.9444	Joga jheel	Uttarakhand
Faecal	29.76195	78.2087	Sidh Mandir	Uttarakhand
Faecal	29.76372	78.2127	Sidh Mandir	Uttarakhand
Faecal	29.79454	78.21434	Central area,JJCR	Uttarakhand
Faecal	29.57382	77.96422	Joga Jheel	Uttarakhand
Faecal	29.65821	78.13898	River island downstream of Ranjitpur	Uttarakhand
Faecal	29.67205	78.15133	River island downstream of Ranjitpur	Uttarakhand
Faecal	29.64297	78.08483	Balawali bridge	Uttarakhand
Faecal	29.79551	78.21873	JJCR	Uttarakhand
Faecal	29.67669	77.98523	Dharampur, luxor range	Uttarakhand
Faecal	29.67669	77.98485	Dharampur, luxor range	Uttarakhand
Faecal	29.579	77.96425	Kanawali jheel	Uttarakhand
Direct Sighting	29.79546667	78.21756667	JJCR	Uttarakhand
Antler	29.3744	78.02147	Near Bijnor Barrage	Uttarapradesh
Antler	29.40073	78.00932	Near Bijnor Barrage	Uttarapradesh
Antler	29.38626	78.02523	Near Bijnor Barrage	Uttarapradesh
Antler	29.70186	78.19725	Near Boriasood	Uttarapradesh
Antler	29.43668	78.03071	Near Rauli Ghat	Uttarapradesh
Antler	29.43628	78.02729	Near Rauli Ghat	Uttarapradesh
Antler	29.43643	78.02666	Near Rauli Ghat	Uttarapradesh
Antler	29.43746	78.02573	Near Rauli Ghat	Uttarapradesh
Antler/Tissue	29.43809	78.02887	Near Rauli Ghat	Uttarapradesh
Antler/Tissue	29.69774	78.19683	Amichand/Nangal	Uttarapradesh
Antler	29.43576	78.02649	Near Rauli Ghat	Uttarapradesh
Antler	29.43554	78.02547	Near Rauli Ghat	Uttarapradesh
Antler	29.39511	78.00148	Khadar, Tibri, HWLS	Uttarapradesh
Antler	29.39618	78.00094	Khadar, Tibri, HWLS	Uttarapradesh
Antler	29.39618	78.00094	Khadar, Tibri, HWLS	Uttarapradesh
Antler	29.39712	78.0013	Khadar, Tibri, HWLS	Uttarapradesh
Antler	29.39511	78.00148	Khadar, Tibri, HWLS	Uttarapradesh
Antler	29.37543	78.00934	Khadar, HWLS	Uttarapradesh
Antler	29.39384	78.0184	Khadar, HWLS	Uttarapradesh
Antler	29.71235	78.20478	Amichand	Uttarapradesh
Antler	29.39214	78.00549	Khaddar, HWLS	Uttarapradesh
Antler	29.39579	78.00475	Khaddar, HWLS	Uttarapradesh

Antler	29.40097	78.00246	Khaddar, HWLS	Uttarapradesh
Antler	29.39985	78.00177	Khaddar, HWLS	Uttarapradesh
Antler	29.39607	78.00163	Khaddar, HWLS	Uttarapradesh
Antler	29.45097	77.9934	Bihargarh, HWLS	Uttarapradesh
Antler	29.42721	77.99046	Bihargarh, HWLS	Uttarapradesh
Antler	29.45256	77.9933	NearBihargarh, HWLS	Uttarapradesh
Antler	29.44963	77.99379	NearBihargarh, HWLS	Uttarapradesh
Antler	29.40272	78.01436	Khadar, HWLS	Uttarapradesh
Antler	29.40779	78.01385	Khadar, HWLS	Uttarapradesh
Antler	29.40209	78.02709	Khadar, HWLS near river	Uttarapradesh
Antler	29.4434	77.98825	Between Khadar and Bihargarh	Uttarapradesh
Antler	29.39022	78.00221	Khadar, HWLS	Uttarapradesh
Antler	28.3922	80.4376	Jadhi Phata, KIWLS	Uttarapradesh
Antler	29.30669	78.07943	Dharmapur, Jansat Rnage, MUFD HWLS	Uttarapradesh
Antler	29.5976	77.94432	Jogga/Almawala Jheel, MUFD/HFD	Uttarapradesh
Antler	29.57431	77.9486	Jogga/Almawala Jheel, MUFD/HFD	Uttarapradesh
Antler	29.56841	77.94431	Jogga/Almawala Jheel, MUFD/HFD	Uttarapradesh
Antler	29.56681	77.94172	Jogga/Almawala Jheel, MUFD/HFD	Uttarapradesh
Antler	29.5604	77.93562	Jogga/Almawala Jheel, MUFD/HFD	Uttarapradesh
Antler	29.47254	78.01493	Sukratal Khadar, MUFD HWLS	Uttarapradesh
Antler	29.43756	78.00649	Near Rauli Ghat, MUFD HWLS	Uttarapradesh
Antler	29.44001	77.99713	Near Rauli Ghat, MUFD HWLS	Uttarapradesh
Antler	29.06274	78.06206	Jalalpur, Hastinapur Range, MFD, HWLS	Uttarapradesh
Antler	28.81634	78.0906	Kotla Jheel Garh range, HFD HWLS	Uttarapradesh
Antler	29.34985	78.07257	River island, Jeevanpuri khadar BR BFD	Uttarapradesh
Antler	29.6872	78.19477	Nangal	Uttarapradesh
Antler	29.41511	78.00275	Northern part of Biharghar Jheel	Uttarapradesh
Antler	29.4362	78.00319	Rawali ghat	Uttarapradesh
Antler	28.81827	78.09102	Kopla Jheel Garh range, HFD HWLS	Uttarapradesh
Fecal	29.52276	78.00008	Bailia Khadar, Sukartal	Uttarapradesh
Fecal	29.44432	77.99126	Between Khadar and Bihargarh	Uttarapradesh
Fecal	29.42078	77.99469	Between Khadar and Bihargarh	Uttarapradesh
Fecal	29.44379	77.99211	Between Khadar and Bihargarh	Uttarapradesh
Fecal	29.4434	77.98825	Between Khadar and Bihargarh	Uttarapradesh
Fecal	29.45097	77.9934	Bihargarh, HWLS	Uttarapradesh
Fecal	29.69832	78.19736	Bihargarh, HWLS	Uttarapradesh

Fecal	29.30669	78.07943	Dharmapur, Jansat Rnage, MUFD HWLS	Uttarapradesh
Fecal	29.30802	78.08026	Dharmapur, Jansat Rnage, MUFD HWLS	Uttarapradesh
Fecal	29.31386	78.08555	Dharmapur, Jansat Rnage, MUFD HWLS	Uttarapradesh
Fecal	29.31245	78.08703	Dharmapur, Jansat Rnage, MUFD HWLS	Uttarapradesh
Fecal	29.29332	78.08564	Dharmapur, Jansat Rnage, MUFD HWLS	Uttarapradesh
Fecal	29.32396	78.08112	Downstream of barrage, Jansat MUFD HWLS	Uttarapradesh
Fecal	29.44733	78.03172	East of Sukartal, MFD HWLS	Uttarapradesh
Fecal	29.17675	78.09907	Hadipur Gaori,Hastinapur,MFD,HWLS	Uttarapradesh
Fecal	29.17916	78.10251	Hadipur Gaori,Hastinapur,MFD,HWLS	Uttarapradesh
Fecal	29.21782	78.12291	Jahanabad ahtmali	Uttarapradesh
Fecal	29.04359	78.06616	Jalalpur, Hastinapur Range, MFD, HWLS	Uttarapradesh
Fecal	29.04308	78.07624	Jalalpur, Hastinapur Range, MFD, HWLS	Uttarapradesh
Fecal	29.04122	78.0828	Jalalpur, Hastinapur Range, MFD, HWLS	Uttarapradesh
Fecal	29.049	78.07023	Jalalpur, Hastinapur Range, MFD, HWLS	Uttarapradesh
Fecal	29.06274	78.06206	Jalalpur, Hastinapur Range, MFD, HWLS	Uttarapradesh
Fecal	29.35368	78.08591	Jeevanpuri Khadar, BR BFD HWLS	Uttarapradesh
Fecal	29.34677	78.08136	Jeevanpuri Khadar, BR BFD HWLS	Uttarapradesh
Fecal	29.25522	78.07018	Jeevanpuri Khadar, BR BFD HWLS	Uttarapradesh
Fecal	29.22312	78.13685	Jheel adjacent to chhoya river	Uttarapradesh
Fecal	29.21966	78.13874	Joagli Jheel Jahanabad swamp,ChandpurR BFD HWLS	Uttarapradesh
Fecal	29.21906	78.13968	Joagli JheelJahanabad swamp,ChandpurR BFD HWLS	Uttarapradesh
Fecal	29.57431	77.9486	Jogga/Almawala Jheel, MUFD/HFD	Uttarapradesh
Fecal	29.56841	77.94431	Jogga/Almawala Jheel, MUFD/HFD	Uttarapradesh
Fecal	29.56681	77.94172	Jogga/Almawala Jheel, MUFD/HFD	Uttarapradesh
Fecal	29.57243	77.93801	Jogga/Almawala Jheel, MUFD/HFD	Uttarapradesh
Fecal	29.5807	77.92602	Jogga/Almawala Jheel, MUFD/HFD	Uttarapradesh
Fecal	28.98677	78.09964	Kali dhab, Dhanaura R AFD HWLS	Uttarapradesh
Fecal	28.96365	78.09395	Kali dhab, Dhanaura R AFD HWLS	Uttarapradesh
Fecal	28.44065	80.66586	Karmaihan , South Sonaripur, DTR	Uttarapradesh
Fecal	28.31738	81.1128	Kerelua Phata, KWLS	Uttarapradesh
Fecal	29.4037	78.01216	Khadar, HWLS	Uttarapradesh
Fecal	29.40308	78.01457	Khadar, HWLS	Uttarapradesh
Fecal	29.40272	78.01436	Khadar, HWLS	Uttarapradesh
Fecal	29.39022	78.00221	Khadar, HWLS	Uttarapradesh
Fecal	29.39618	78.00094	Khadar, Tibri, HWLS	Uttarapradesh
Fecal	29.39511	78.00148	Khadar, Tibri, HWLS	Uttarapradesh

Fecal	29.39442	78.00201	Khaddar, HWLS	Uttarapradesh
Fecal	29.39607	78.00163	Khaddar, HWLS	Uttarapradesh
Fecal	29.39985	78.00177	Khaddar, HWLS	Uttarapradesh
Fecal	29.40097	78.00246	Khaddar, HWLS	Uttarapradesh
Fecal	28.94667	78.07333	Khanpur, Parikshitgarh range, MFD HWLS	Uttarapradesh
Fecal	29.26161	78.08855	khera ahtmal	Uttarapradesh
Fecal	28.81296	78.09084	Kopla Jheel Garh range, HFD HWLS	Uttarapradesh
Fecal	28.81714	78.08763	Kotla Jheel Garh range, HFD HWLS	Uttarapradesh
Fecal	28.82105	78.0918	Kotla Jheel Garh range, HFD HWLS	Uttarapradesh
Fecal	28.81634	78.0906	Kotla Jheel Garh range, HFD HWLS	Uttarapradesh
Fecal	28.87018	78.10226	Kutubpur, Garh range, HFD HWLS	Uttarapradesh
Fecal	29.51033	78.0533	Mirapur Khadar	Uttarapradesh
Fecal	29.69556	78.19797	Nangal	Uttarapradesh
Fecal	29.45479	77.99519	Nangal	Uttarapradesh
Fecal	29.68992	78.18937	Nangal	Uttarapradesh
Fecal	29.6872	78.19477	Nangal	Uttarapradesh
Fecal	29.46171	78.0322	NE of Sukartal,MFD HWLS	Uttarapradesh
Fecal	29.03015	78.04773	Near Hatoopora,MFD HWLS	Uttarapradesh
Fecal	29.69268	78.19235	Near Nangal	Uttarapradesh
Fecal	29.69268	78.19235	Near Nangal	Uttarapradesh
Fecal	29.43887	78.03151	Near Rauli Ghat	Uttarapradesh
Fecal	29.43809	78.02887	Near Rauli Ghat	Uttarapradesh
Fecal	29.43643	78.02628	Near Rauli Ghat	Uttarapradesh
Fecal	29.43887	78.03151	Near Rauli Ghat	Uttarapradesh
Fecal	29.43716	78.02806	Near Rauli Ghat	Uttarapradesh
Fecal	29.43716	78.028	Near Rauli Ghat	Uttarapradesh
Fecal	29.43756	78.00649	Near Rauli Ghat, MUFD HWLS	Uttarapradesh
Fecal	29.44001	77.99713	Near Rauli Ghat, MUFD HWLS	Uttarapradesh
Fecal	29.45256	77.9933	NearBihargarh, HWLS	Uttarapradesh
Fecal	29.44963	77.99379	NearBihargarh, HWLS	Uttarapradesh
Fecal	28.96908	78.06496	Parikshitgarh range, MFD HWLS	Uttarapradesh
Fecal	28.91859	78.09173	Parikshitgarh range, MFD HWLS	Uttarapradesh
Fecal	28.93459	78.07055	Parikshitgarh range, MFD HWLS	Uttarapradesh
Fecal	29.09761	78.08604	Rahmanpur Khadar, Chandpur R BFD HWLS	Uttarapradesh
Fecal	29.3445	78.05795	River island, BR BFD	Uttarapradesh
Fecal	29.5893	78.07367	Sukhapur Bijnor	Uttarapradesh

Fecal	29.58956	78.07931	Sukhapur Bijnor	Uttarapradesh
Fecal	29.59235	78.07975	Sukhapur Bijnor	Uttarapradesh
Fecal	29.47254	78.01493	Sukratal Khadar, MUFD HWLS	Uttarapradesh
Direct Sighting	29.45097	77.9934	Bihargarh, HWLS	Uttarpradesh
Direct Sighting	29.04308	78.07624	Jalalpur, Hastinapur Range, MFD, HWLS	Uttarpradesh

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