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A Study on Artificial Water Hole Utilization in Pilibhit Tiger Reserve, Uttar Pradesh

वन विभाग उत्तर प्रदेश

PILIBHIT TIGER RESERVE
Jewel of Terai

EARTH BRIGADE FOUNDATION

TSA FOUNDATION INDIA

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A Study on Artificial Water Hole Utilization in Pilibhit Tiger Reserve, Uttar Pradesh

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Uttar Pradesh, plays a vital role in preserving the biodiversity of our region. As human activities encroach upon natural habitats, ensuring that our wildlife has access to water sources becomes increasingly challenging. The implementation of artificial water holes is a significant step towards mitigating the effects of climate change and habitat degradation, especially during the dry seasons when natural water sources dwindle.

The current study on artificial water hole utilization in the Pilibhit Tiger Reserve, conducted by TSA Foundation India and generously supported by solar pumps from Earth Brigade Foundation, exemplifies our collective commitment to wildlife conservation. This research is both timely and vital, addressing the pressing need to protect our invaluable wildlife and the fragile ecosystems they depend on.

The findings of this study will provide valuable insights into how these artificial water sources are utilized by the wildlife, informing future conservation strategies and management practices. Furthermore, the introduction of solar pumps reflects our commitment to sustainable practices that minimize our ecological footprint while maximizing the benefits for wildlife.

I commend the TSA Foundation India for their diligent efforts in this study and the Earth Brigade Foundation for their generous support. Together, these organizations exemplify the collaborative spirit necessary for effective conservation. As we move forward, let us remain dedicated to the preservation of our natural heritage, ensuring that future generations inherit a thriving and diverse ecosystem. This study is a crucial contribution to that mission.

Regards

Sanjay Srivastava,

EXECUTIVE SUMMERY

Waterholes are vital components of wildlife habitats, significantly influencing the health and sustainability of ecosystems. In the core area of Pilibhit Tiger Reserve, a total of 10 artificial solar-powered waterholes were constructed by Earth Brigade Foundation under Project Aquarius across various ranges to provide essential drinking water for diverse wildlife species. This study, conducted during the driest months of May and June 2024, aimed to evaluate the effectiveness of these solar-operated water pumps in enhancing water availability for wildlife.

Utilizing camera traps, sign surveys, and direct observation methods, the research recorded a total of 33 different wildlife species, including 10 mammals, 1 reptile, 17 birds, and 4 butterfly species. Notable species observed included the tiger (*Panthera tigris*), spotted deer (*Axis axis)*, swamp deer (*Rucervus duvaucelii*), hog deer (*Axis porcinus*), wild boar (*Sus scrofa*), porcupine (*Hystrix indica*), and sloth bear (*Melursus ursinus*). The study revealed variability in species diversity and abundance among the waterholes. The highest species diversity was recorded at Lirsiya Taal in Gara Beat followed by Ajaniya Chandra Talab, with lower diversity observed at waterholes such as Devhanna No. 10 and Gadiyana, which are affected by human and cattle disturbances.. These water holes provided crucial relief for the animals during the summer, as the water levels in Mala had significantly receded.

Based on the findings, we recommend the installation of solar-powered pumps at existing waterholes with limited water supply. This approach will reduce the distance wildlife must travel for water and decrease the costs associated with water provisioning during the dry season, ultimately supporting the conservation of biodiversity in the Pilibhit Tiger Reserve.

INTRODUCTION

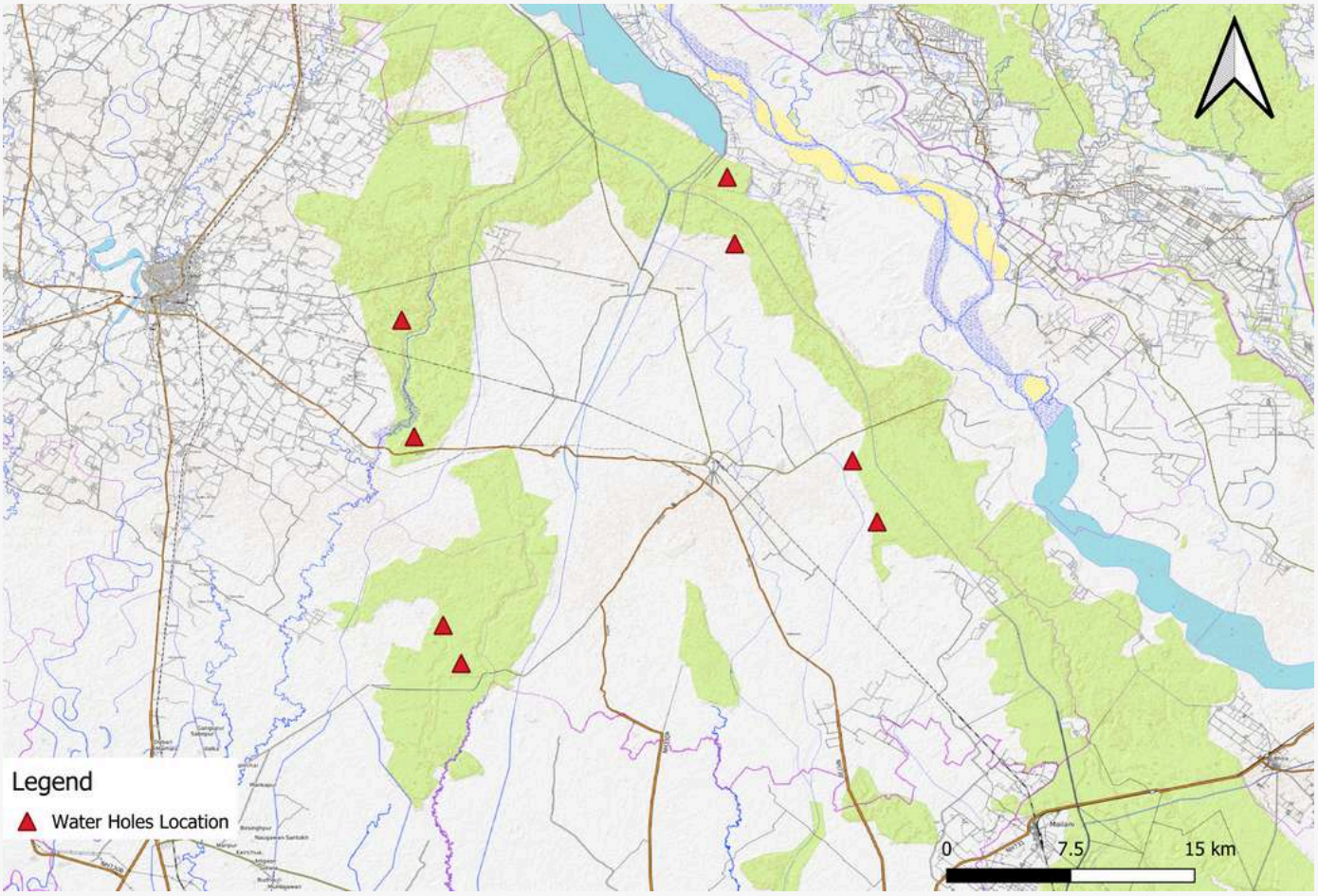
Nestled within the Terai Arc Landscape, the Pilibhit Tiger Reserve (PTR) stands as a diverse haven for a varied array of wildlife. With the River Gomti, a vital tributary of the Ganga, originating in PTR, the reserve is also catchment of several other rivers including Sharda, Chuka, Mala Khannot etc. This intricate network of waterways and landscapes provides a nurturing habitat to a wealth of aquatic life, including various endangered species of freshwater turtles. Pilibhit tiger reserve is located in the Pilibhit and Shahjahanpur district of Rohailkh and between latitude 28°50'7.40"N and 28°15'43.90"N and longitude 79°52'57.18"E and 80°23'10.82"E. In the north it is continuous with the Surai forest of Tarai-East forest division of Uttarakhand, while the Lagga-Bagga forest block maintains connectivity with Shukla Phanta National park in Nepal. On the south-east and east side Pilibhit abuts into North-Kheri forest division of the Dudhwa tiger reserve. PTR is located in the tarai of the western Himalayas and considerable portion in the south is more of a Gangetic plains character then pure tarai. The Reserve is managed under various forest ranges namely Barahi, Haripur, Deoria, Mala and Mahof. The vegetation of Pilibhit is a mosaic of dry and moist deciduous forests, scrub and grassland patches.

Free water sources play a crucial role in determining wildlife species' presence or absence, movement, and carrying capacity in seasonally dry and semi-arid environments. Nevertheless, waterholes are regarded as prime places for competition and predation (Knight, 1995; Valeix et al., 2010). PTR consists of several rivers, canals and perennial water sources which support wild inhabitants of the Pilibhit Tiger Reserve. The Sarda river is the lifeline of the reserve, connected with scattered channels, such as Hardoi Branch canal, Kheri Branch Canal, Subsidiary Canal to Sarda Sagar Dam. The Sarda River primarily runs along the northern boundary of the PTR.These river systems have water along their entire courses during the wet season. However during the dry season only their persistent perennial routes contain water (Torrence, 1981) forcing both wild and domestic herbivores to move long distances to access water. Artificial water holes are also been developed in the reserve where rain water gets stored however in dry season this holes gets dried up and water is brought there through water tanks which is not convinient.

To overcome the problem of continuous drinking water during driest within Pilibhit Tiger Reserve, 10 solar operated water pumps for providing drinking water to wildlife was installed by Earth Brigade Foundation under their flagship Project Aquarius.

The study aimed to unequivocally demonstrate the effectiveness of solar-powered water holes in attracting and supporting a diverse range of wildlife in Pilibhit Tiger Reserve.

METHODOLOGY



Study Area

The study focused on ten major solar powered water holes within Pilibhit Tiger Reserve donated by Earth Brigade Foundation in the following areas:

1. Gadiyana 2 Gajarola Beat, 25667
2. Chandra Tal, Mahof
3. Sambhar Tal, Mahof
4. Bifurcation II, Beat 66B, Barahi
5. Selha 62-B, Baraki
6. Lirsiya Tal Gara Beat 134-A
7. Gadiyana Jatpara
8. Devhanna No. 10, Deoriya range
9. Ajaniya Chandra Talab 127A, Maala
10. Devhanna No. 06, Deoriya range

To comprehensively assess the utilization of water holes by various wildlife species, we undertook a systematic survey in collaboration with dedicated frontline forest staff in the month of May-June 2024. We visited each water hole, employing GPS devices (Garmin Etrex 20) to accurately record the geographical coordinates. This ensured precise mapping of all locations.For each water hole, we meticulously measured both the total area and the effective where water remains.

To gain insights into wildlife behavior, we conducted thorough visual surveys of the surrounding landscape. We looked for signs of animal activity, including pugmarks (paw prints), claw marks indicative of larger predators, and scat, which provided valuable information about the presence of various species.

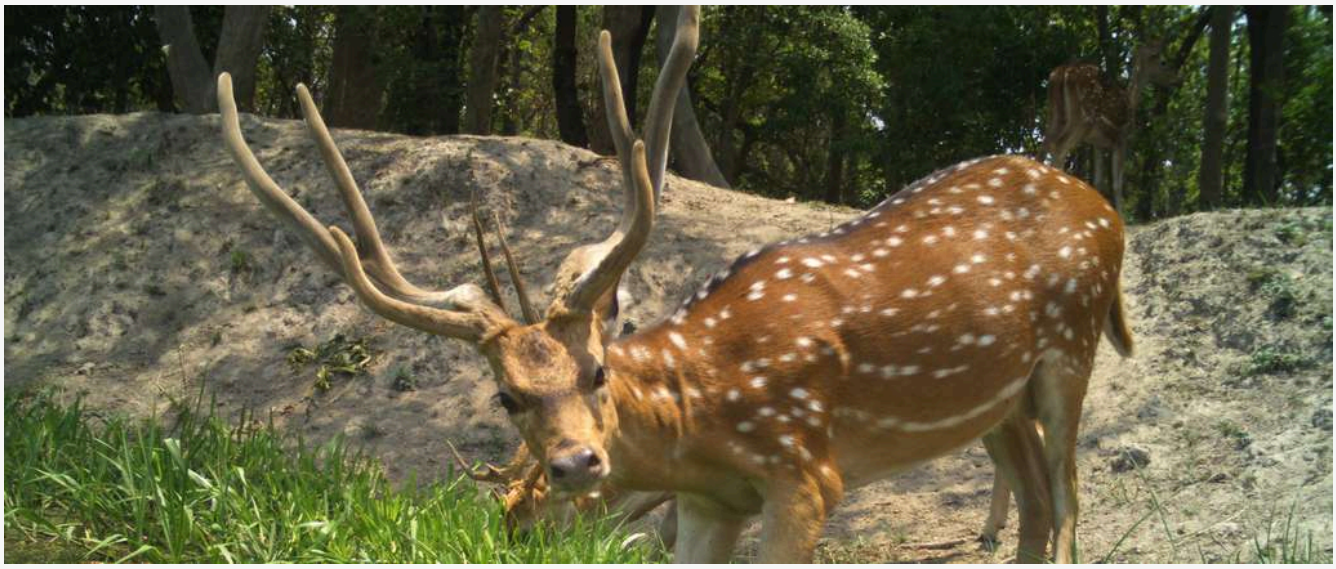
To capture detailed interactions of wildlife with the water holes, we strategically installed camera traps at seven selected sites, informed by the expertise of on-ground forest staff. Each water hole was equipped with a (Cuddeback camera), set to operate continuously with a 5-second delay between photos. The date and time were automatically recorded on each image. Cameras were positioned 2–3 meters from the water's edge in areas showing a high concentration of wildlife signs, such as footprints. Depending on local topography, traps were mounted on poles at a height of 60–70 cm to effectively capture large ungulates. We ensured a maximum trigger distance of approximately 20 meters and set cameras to medium sensitivity to minimize false triggers from moving vegetation.

Image 1: Discussion with field staff monitoring water holes.

Upon completing the survey, we retrieved the camera traps and transferred the image data from memory cards to a computer for species identification.

To enrich our understanding of the usage and effectiveness of the water holes, we also conducted discussion with local staff for added information recommendations provided by them

Image 2: Monitoring team installing camera trap for observation.



RESULTS

UTILIZATIONS OF ARTIFICIAL WATERHOLES BY WILDLIFE

The utilization of artificial waterholes by wildlife was determined through the analysis of images captured by the camera traps placed in each of the selected waterholes. Additionally, indirect animal surveys conducted in the study area, such as observing pug marks, fecal pellets, scat, and footprints, were used to analyze data and examine the use of artificial waterholes by wildlife. Frequent utilization of specific waterholes by animals was determined based on the observations, indirect signs and number of images captured by the camera traps at each location. A total of 33 different wildlife species were recorded in the study including mammals (n=10), reptile (n=1), birds (n=.17) and butterflies (n=4). Major species include Tiger (Panthera tigris), Spotted deer (Axis axis), Swamp deer (Rucervus duvaucelii), Wild Boar (Sus scrofa), Porcupine (hystrix indica), Sloth Bear (Melursys irsinus), various species of birds and butterflies. The species recorded in the selected artificial waterholes are detailed below.

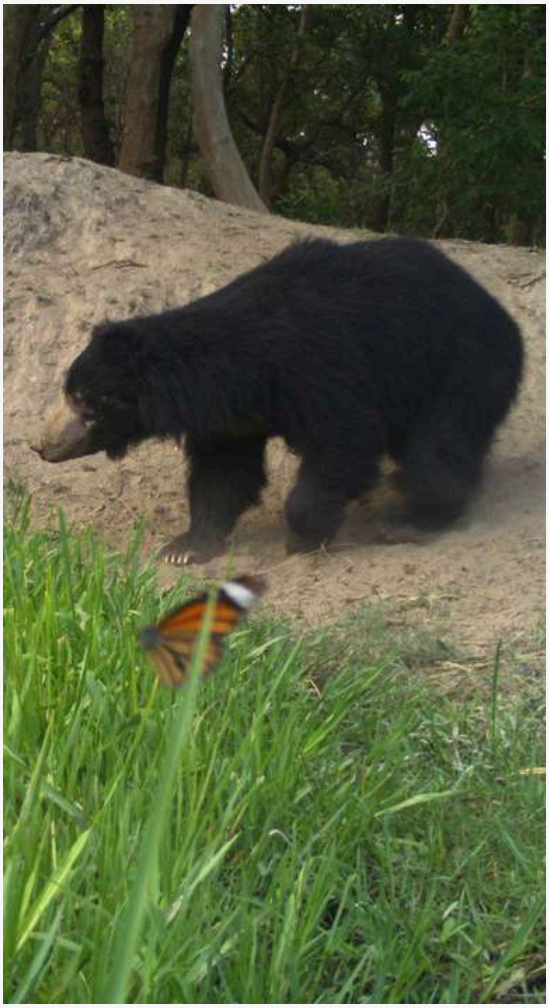


Table 1: List of wildlife spotted along water holes in Pilibhit Tiger Reserve

Sl No.	Common Name	Scientific Name
Mammals		
1	Spotted Dear	*Axis axis*
2	Tiger	*Panthera tigris*
3	Sloth Bear	*Melursys irsinus*
4	Wild Boar	*Sus scrofa*
5	Rhesus macaque	*Macaca mulatta*
6	Hanuman langur	*Semnopithecus entellus*
7	Indian Porcupine	*Hystrix indica*
8	Blue Bull	*Boselaphus tragocamelus*
9	Swamp Deer	*Rucervus duvaucelii*
10	Hog Deer	*Axis porcinus*
Reptile		
11	Bengal Monitor Lizard	*Varanus bengalensis*
Birds		
12	Rufous Treepie	*Dendrocitta vagabunda*
13	Rock Eagle Owl	*Bubo bengalensis*
14	Indian Peafowl	*Pavo cristatus*

Sl No.	Common Name	Scientific Name
15	Pond Heron	*Ardeola grayii*
16	Black Drongo	*Dicrurus macrocercus*
17	Greater Coucal	*Centropus sinensis*
18	Shikra	*Accipiter badius*
19	Creasted Serpent Eagle	*Spilornis cheela*
20	Changeable Hawk Eagle	*Nisaetus cirrhatus*
21	Spotted Dove	*Spilopelia chinensis*
22	Eurasian collared dove	*Streptopelia decaocto*
23	Red Wattled Lapwing	*Vanellus indicus*
24	White Throated Kingfisher	*Halcyon smyrnensis*
25	Red Naped Ibis	*Pseudibis papillosa*
26	Baya Weaver	*Ploceus philippinus*
27	Yellow Throated Sparrow	*Petronia xanthocollis*
28	Chestnut Tailed Starling	*Sturnia malabarica*
29	Indian Jungle Crow	*Corvus culminatus*
Butterflies		
30	Spotted Sword Tail	*Graphium nomius*
31	Common Emigrant	*Catopsilia pomona*
32	Common Grass Yellow	*Eurema hecabe*
33	Stripped Tiger	*Danaus genutia*

Water holes studied showed a variation in species diversity and number. In Lirsiya Taal in Gara Beat 134 (named due to presence of Lirsi grass in the area) highest diversity of species was recorded which included Tigers, Sloth Bear, Wild Boar. followed by Ajaniya Chandra Talab 127A, Maala, Bifurcation II, Beat 66B, Barahi and Selha 62-B, Baraki, Chandra Tal, Mahof, Sambhar Tal, Mahof. Least species diversity was recorded from Devhanna No. 10, Deoriya range, Devhanna No. 10, Deoriya range followed by Gadiyana 2 Gajarola Beat, 25667 and Gadiyana Jatpara.

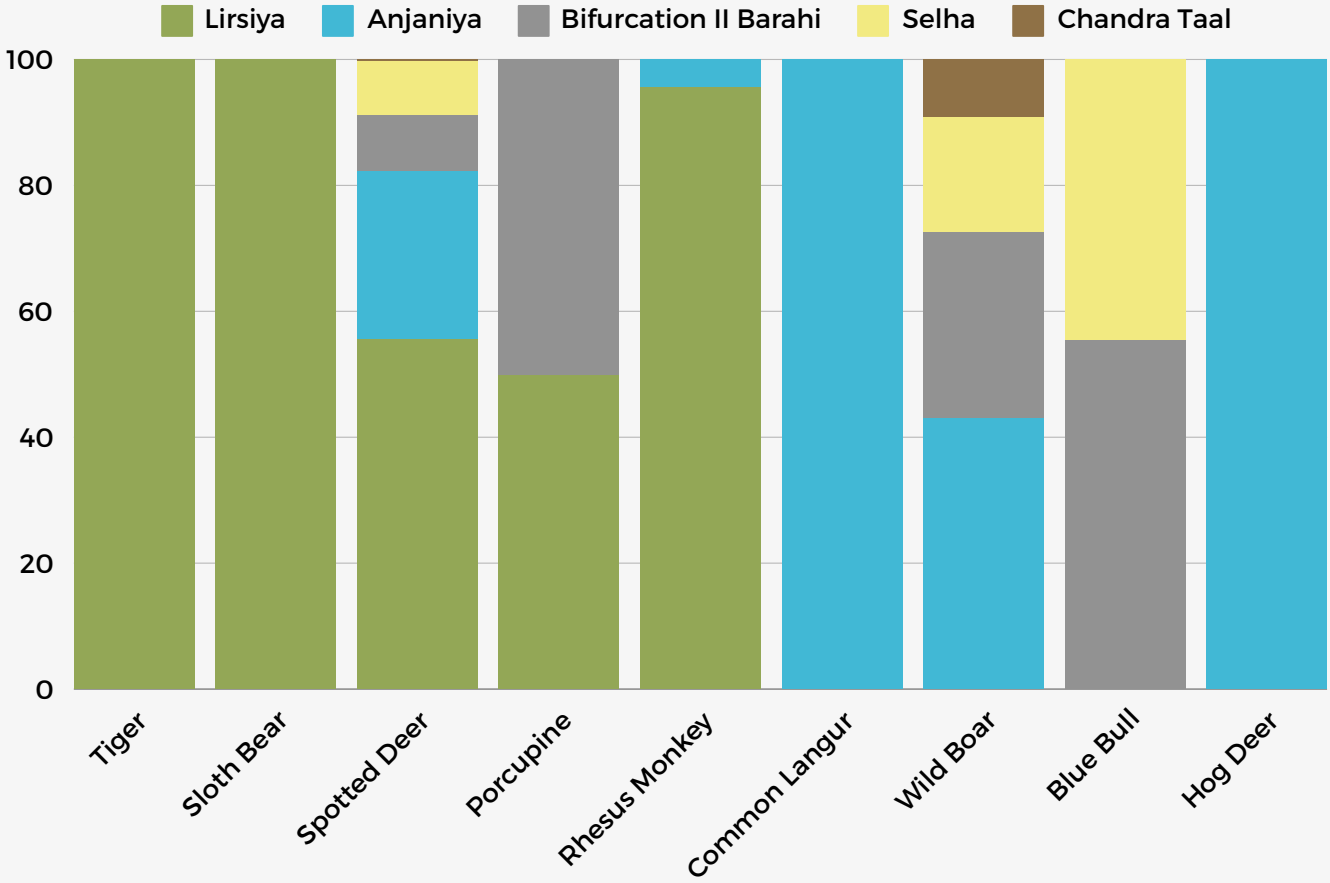


Image 3: Graph showing mammals documented in various water holes

TEMPORAL ACTIVITY PATTERN

The temporal activity pattern in the use of artificial waterholes by predator including tiger and its prey species was recorded through the details obtained from camera traps. Artificial waterholes were mostly used by prey species during evening from 17:00-18:00 hrs while predators were found using the artificial waterholes mostly in night or early morning. Tiger was recorded in mid-night, sloth bear was observed both during night early morning and late evening, wereas wild boar was observed all along the day. They were found utilizing the waterholes for different purposes like drinking and wallowing, Among mammal species spotted dear was found to utilise the waterholes the most.

Image 4: Lirsiya Tal Gara Beat 134-A water hole and map

LIRSIYA TAL GARA BEAT 134-A

**Location:28.53222, 079.96172

The total area of the waterhole was measured at 5,084 square meters. This site exhibited the highest species diversity with species richness of 16 as recorded by camera traps. The waterhole, with a depth of approximately 1 meter, was extensively covered with aquatic vegetation and grasses, indicating a vibrant ecological succession that facilitates easy access for wildlife.

According to Forester Ram Bharat, this waterhole is an older structure; however, the installation of a solar-powered water pump has ensured that it retains water year-round. Due to the absence of alternative water sources in the vicinity, this pond serves as a crucial resource for a diverse array of animals.

Species observed utilizing this waterhole include the tiger, sloth bear, spotted deer, porcupine, and rhesus monkey. Additionally, a variety of bird species frequent the area, including the crested serpent eagle, shikra, spotted dove, rock eagle owl, black drongo, greater coucal, pond heron, peafowl, treepie, and jungle crow. The presence of this diverse wildlife underscores the ecological significance of the waterhole as a vital habitat within the surrounding environment.

Photo plate 1: Few camera traps images captured in Lirsiya Taal from top left Spotted Dear, Tiger, Indian Porcupine, Wild Boar, Sloth Bear utilising the water hole

Image 5: Ajaniya Chandra Talab 127A, Maala water hole

AJANIYA CHANDRA TALAB 127A, MAALA

Location: 28.60421, 079.95404

The total area of the waterhole was measured at 386 square meters, making it the site with the second-highest species diversity after Lirsiya Taal. Notably, there are no nearby water sources, which emphasizes the ecological importance of this waterhole. The depth of the hole is approximately 4 feet; however, due to the sandy substrate, water retention is limited. Nonetheless, the continuous supply of water from a solar-powered pump ensures that this waterhole remains a vital resource for wildlife during the dry season.

A total of 14 wildlife species were recorded at this site, the highest number after the Lirsiya Taal. Documented species include wild boar, spotted deer, and peafowl. There was a notably higher abundance of grey langurs compared to rhesus monkeys, as well as a significant population of wild boar. Additionally, sloth bears were observed in notable numbers.

Several rare bird species were also documented at this waterhole, including the chestnut-tailed starling, crested serpent eagle, and changeable hawk-eagle. This diversity highlights the ecological significance of the waterhole as a crucial habitat supporting various wildlife species.

Photo plate 2: Few camera traps images captured in Ajaniya Chandra Talab from top left Hanuman langur, Hog deer, Creasted serpent eagle, Changeable hawk eagle, Sloth bear with cub and Wild Boar with cubs and utilising the water hole

Image 6: Bifurcation II, Beat 66B, Barahi water hole

BIFURCATION II, BEAT 66B, BARAHI

Location: 28.65127 080.15937

The total area of the waterhole was measured at 1495 square. Nine species of wildlife was documented from this water holewhich includes potted deaar, Wild Boar, Indian Porcupine, Spotted Dear and Blue Bull. One individual of Bengal Monitor Lizard was also documented from this water hole. Species of Red Watlled Lapwing, White throated Kingfisher, Red Naped ibis was also recorded. Less species diversity may be due to the presence of another water hole at about 500 meters water

Image 7: Left- Red Naped Ibis and Blue bull, Right- Bengal Moinitor Lizard

Image 8: Selha 62B, Baraki water hole

SELHA 62-B, BARAKI

Location: 28.69240 080.15475

The total area of the waterhole was measured at 374 square meters. Six species of wild animals were documented from this water hole which included spotted deaar, Peafowl, Wild Boar, White throated kingfisher, Treepie and Blue bull . This water hole was quite near to irrigitaional canal and a good source of water informs of streams is loacted near to this water hole. Forest guard Kanhei Lal mentioned sporadic visit of Tiger near the water hole

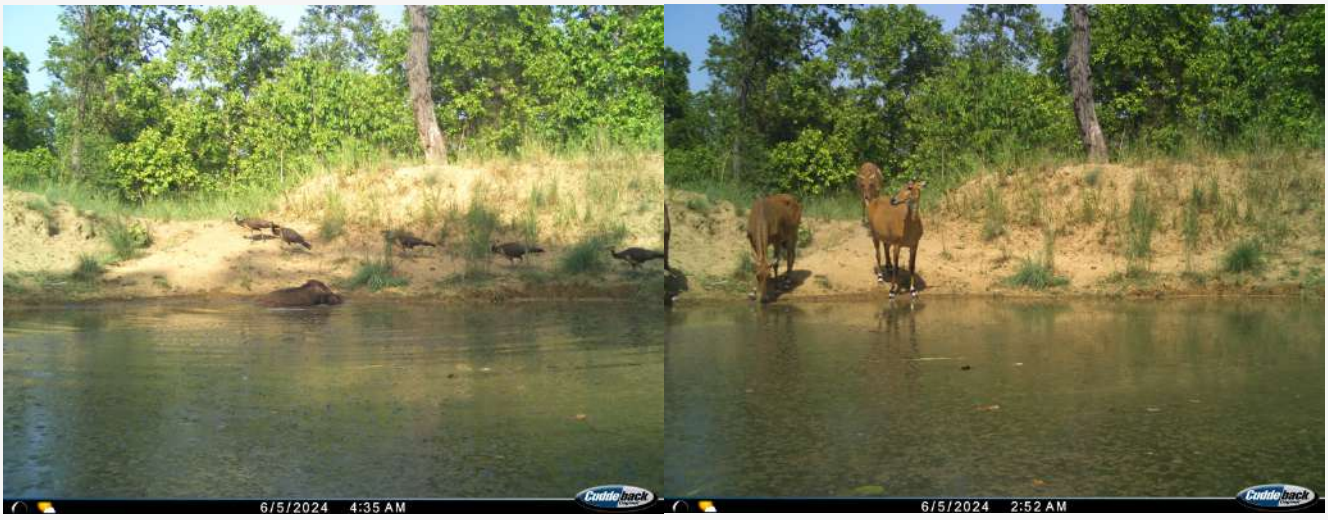


Image 9: Left- Wild Boar along with Peafowl, Right- Blue bull

Image 10: Left Sambhar tal and right Chandra Tal in Mahof Range

CHANDRA TAL, MAHOF

Location: 28.69240 080.15475

Chandra Taal in Mahof is majorly comprised of large patches of grassland. With irrigation canal at just 600meters from the tal the area is always filled with water due to seepage. In camera trap only Spotted dear and Wild Boar was documented. However we had also spotted Swamp deer during observation. Forest staff mentioned Tigers are often seen to utilize the area. The solar is working properly with steady source of water year long.

Image 11: Left- Wild Boar and Spotted dear recorded in camera trap from Chandra tal

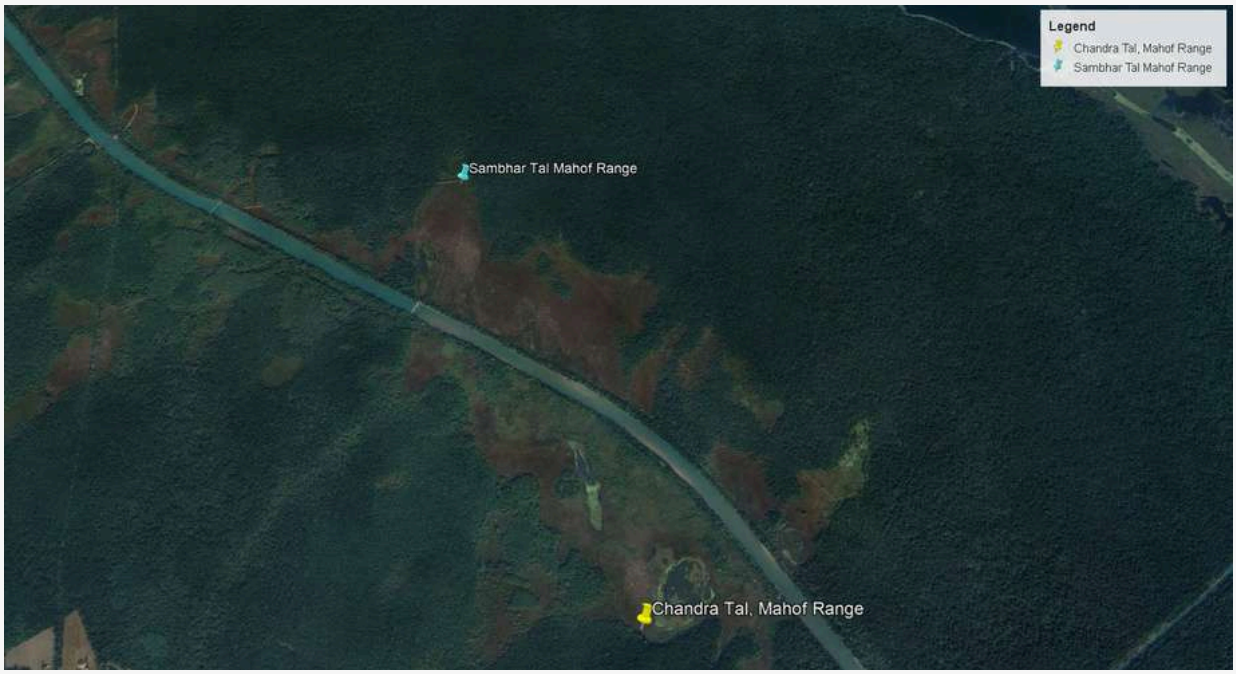


Image 12: Map showing Chandra Tal and Sambhar Tal in Mahof Range

SAMBHAR TAL, MAHOF

Location: 28.715500 80.093600

Similar to Chandra Taal, this area is predominantly characterized by grassland ecosystems supported by seepage from surrounding water sources. Unfortunately, camera traps could not be installed in this location due to the presence of tall grasses, which obstructed visibility and accessibility. During our observations, we recorded a herd of swamp deer in the vicinity, and a tiger was noted along the adjacent road. The entire area is actively utilized by a variety of wildlife species. The solar-powered water source plays a crucial role in hydrating the landscape, ensuring that the area remains consistently damp, which supports diverse flora and fauna. This hydrological dynamic enhances the ecological value of the region as a habitat for wildlife.

Image 13: Swamp Deer as observed in Sambhar Tal

Image 14: Devhanna No. 10 water hole and map

DEVHANNA NO. 10 AND DEVHANNA NO. 6

Location:28.39238 079.99075, and 28.41588 079.97926

Located in the Deoriya range, both waterholes maintain a consistent water supply throughout the year. Each waterhole is surrounded by abundant vegetation, attracting a diverse array of wildlife species. Observed visitors to these ponds include wild boar, spotted deer, blue bull (nilgai), hanuman langur, wild boars.According to forest staff, tigers have not been recorded utilizing these waterholes. Additionally, avian species such as the baya weaver and myna have been documented in the area. Notably, three butterfly species Spotted sword tail, Common Emigrant and Common Grass Yellow were also identified around these waterholes, further highlighting the ecological richness of this habitat. The combination of perennial water and surrounding vegetation creates a vital resource for various wildlife species in this region.Devhana No. 6 was seen to be utilised by cattle with disturbance from local people also.

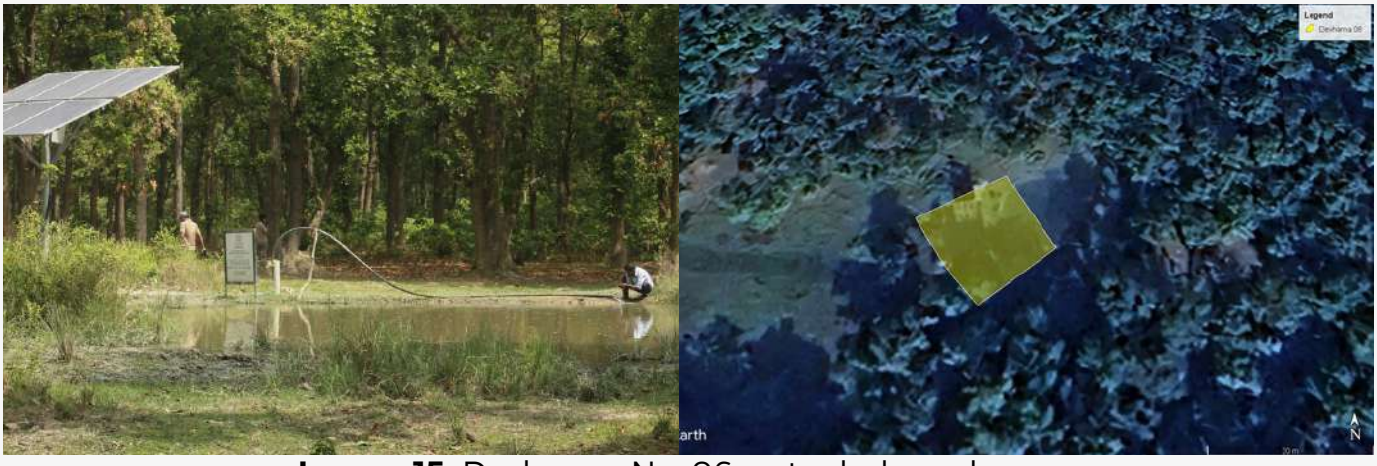


Image 15: Devhanna No. 06 water hole and map

Photo plate 3: Few camera traps images captured in Devhanna No. 10 and No. 06 from top Spotted sword tail, Common Emigrant and Common Grass Yellow, Hanuman Langur, Spotted Deer, Wild Boar, Rhesus Monkey

Image 16: Gadiyana Jatpura and Gadiyana II water hole and map

GADIYANA JATPURA AND GADIYANA II

Location: 28.51745 080.23203, 28.47964 080.24718

The waterholes located in the Gajrola Beat are in close proximity to human habitation. Camera traps deployed at both sites recorded predominantly cattle activity, indicating the influence of human presence on wildlife utilization patterns. Each waterhole covers an area of approximately 1,076 square meters.

As mentioned by forest staff at Gadiyana Jatpura, the solar water pump is rendered ineffective during the winter months, as the positioning of the solar panels limits their exposure to sunlight. Forest staff mentioned large mammals visits the water hole very rarely, spotted deer, wild boar are sighted, Tiger sighting is very rare in these water holes. The juxtaposition of human habitation and wildlife activity at these waterholes highlights the need for ongoing monitoring and management to ensure that the ecological integrity of these habitats is maintained while accommodating the needs of local communities.

Image 17: Gadiyana Jatpura water hole and map

Table 2: Wildlife species as recorded along studied water holes in Pilibhit Tiger Reserve

Animals	Lirsiya	Anjaniya	Bifurcation II Barahi	Selha	Chandra Taal	Sambhar Taal	Devhana No. 10
Tiger	2	-	-	-	-	-	-
Sloth Bear	4	15	-	-	-	-	-
Hog deer	-	4	-	-	-	-	-
Spotted Deer	243	117	39	37	25	-	50
Porcupine	2	-	2	-	-	-	-
Rhesus Monkey	88	64	-	-	-	-	45
Common Langur	-	104	-	-	-	-	22
Wild Boar	-	57	13	8	4	-	30
Swamp Deer	-	-	-	-	-	30	-
Blue Bull	-	-	5	4	-	-	-
Monitor Lizard	-	-	1	-	-	-	-
Treepie	13	-	-	5	-	-	-
Jungle Crow	2	-	-	-	-	-	-
Rock Eagle Owl	3	-	-	-	-	-	-
Peafowl	8	2	24	13	-	-	-
Baya Weaver	-	-	-	-	-	1	-
Pond Heron	1	-	-	-	-	-	-
Drongo	1	4	-	-	-	-	-
Greater Coucal	3	-	-	-	-	-	-
Shikra	1	-	-	-	-	-	-
Creasted Serpent Eagle	3	1	-	-	-	-	-
Spotted Dove	2	2	-	-	-	-	-
Lapwing	-	-	11	-	-	-	-
Kingfisher	-	2	2	1	-	-	-
Red Naped Ibis	-	-	14	-	-	-	-
Eurasian collared dove	-	1	-	-	-	-	-
Yellow throated sparrow	-	2	-	-	-	-	-
Chestnut Tailed Starling	-	2	-	-	-	-	-
Changeable Hawk	-	1	-	-	-	-	-

CONCLUSION

This study underscores the critical role that solar-powered waterholes play in enhancing water availability for wildlife in the Pilibhit Tiger Reserve, particularly during the dry months of May and June. The study's findings highlight the significant role these artificial water sources play in supporting a diverse range of species, thus contributing to the overall health and sustainability of the ecosystem.

The recorded diversity of 33 species, including notable mammals such as tigers, deers, sloth bears, wild boars along with various avian species highlights the effectiveness of these water sources in attracting and supporting biodiversity. The variation in species richness among the different waterholes indicates that environmental factors and human activity can influence wildlife utilization patterns.

Given the positive outcomes observed, we recommend the strategic installation of additional solar-powered pumps at existing waterholes with limited water supply. By doing so, we can further reduce the distance that wildlife must travel to access water and minimize resource costs associated with manual water provisioning. This initiative will not only enhance the resilience of wildlife populations but also contribute to the overall ecological integrity of the Pilibhit Tiger Reserve. Continued monitoring and adaptive management will be essential to ensure the long-term success of these interventions in supporting the diverse fauna that inhabit this vital ecosystem. This initiative will not only alleviate the pressures on existing water sources but also promote biodiversity conservation efforts in the reserve, ensuring a thriving habitat for future generations.

RECOMMENDATIONS

- Water holes are important for wildlife, water hole utilisation study was conducted for the first time in Pilibhit Tiger Reserve. We recommend continuous monitoring of the already installed water holes through more camera traps being installed.

- Observing the importance of these water hole more needs to be installed over Pilibhit Tiger Reserve after proper identification of area so wildlife doesn't have to travel a huge distance for water.Comprehensive assessments should be conducted of potential sites for new solar-powered waterholes, focusing on areas with limited access to natural water sources. Prioritize locations that support high wildlife diversity and are strategically positioned to minimize human-wildlife conflict. Construction of water holes may be avoided in the fringe areas to avoid conflict.

- In larger water holes more pumps may be installed and substrate of the hole must be evaluated properly to ensure water storage.

- Ensure optimal placement of solar panels to maximize sunlight exposure throughout the year, particularly in winter months when solar energy generation may decline.Regularly monitor and maintain solar panel installations to ensure efficiency and functionality.For example in Gadiyana Jatpura the solar doesn't work in winter as it don't recieve enough sunlight

- Incorporate natural features into the design of waterholes, such as gradual slopes and surrounding vegetation, to facilitate easy access for various wildlife species. Enhance the surrounding habitat with native plant species to support biodiversity and create a more inviting environment for wildlife.

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