Otter- Hydrology Project:
Satpura Tiger Reserve

Project Progress Report

Feb 2022

Satpuda
Tiger Reserve

Wildlife
Conservation
Trust

BACKGROUND

Wildlife Conservation Trust (WCT) in collaboration with the Madhya Pradesh Forest Department started a project focusing on the status of rivers and streams originating from the Satpura Tiger Reserve. The project focuses on understanding the forest hydrology in the Satpura TR and studying the Eurasian otter (*Lutra lutra*) as an indicator species of the aquatic habitats in this landscape.

The project aims at achieving effective monitoring of forest streams/rivers and other species dependent on riparian ecosystems

The main objectives of the project are:

1. Understanding the current distribution of Eurasian otter and smooth-coated otter in relation to the status of perennial forest streams and water reservoirs.

2. Detailed hydrological monitoring across multiple seasons and assessing the availability of streamflow in forest areas that lie within the study area.

3. Developing detailed conservation recommendations based on active monitoring of hydro-ecological characteristics and identifying critical areas for conservation efforts specific to freshwater wildlife.

UPDATE

1. Camera-trap based surveys for the Eurasian Otters:

Camera trap-based surveys were carried out in key high elevation perineal streams and rivers in the Satpura Tiger Reserve. The camera traps were placed in areas where the probability of otter photo-capture was highest. Infrared-flash camera traps were used to monitor these sites to avoid disturbing the otters since they are mostly nocturnal in this landscape.

The camera traps were checked once every 7-10 days to collect data and change batteries if needed. Intensive camera trapping was carried out at sites where otter photo-captures were high; this allowed us to record the activity patterns and behaviour of otters in the wild. Based on the camera trap data, the Eurasian otter is mostly active at night except for a few stretches of the rivers which are highly inaccessible (areas that were relatively undisturbed even before the villages were relocated)

Through systematic camera trapping, we were able to map the distribution of the otters in the surveyed areas. These camera trapping sites have also been critical in narrowing down the tributaries for the occupancy surveys.

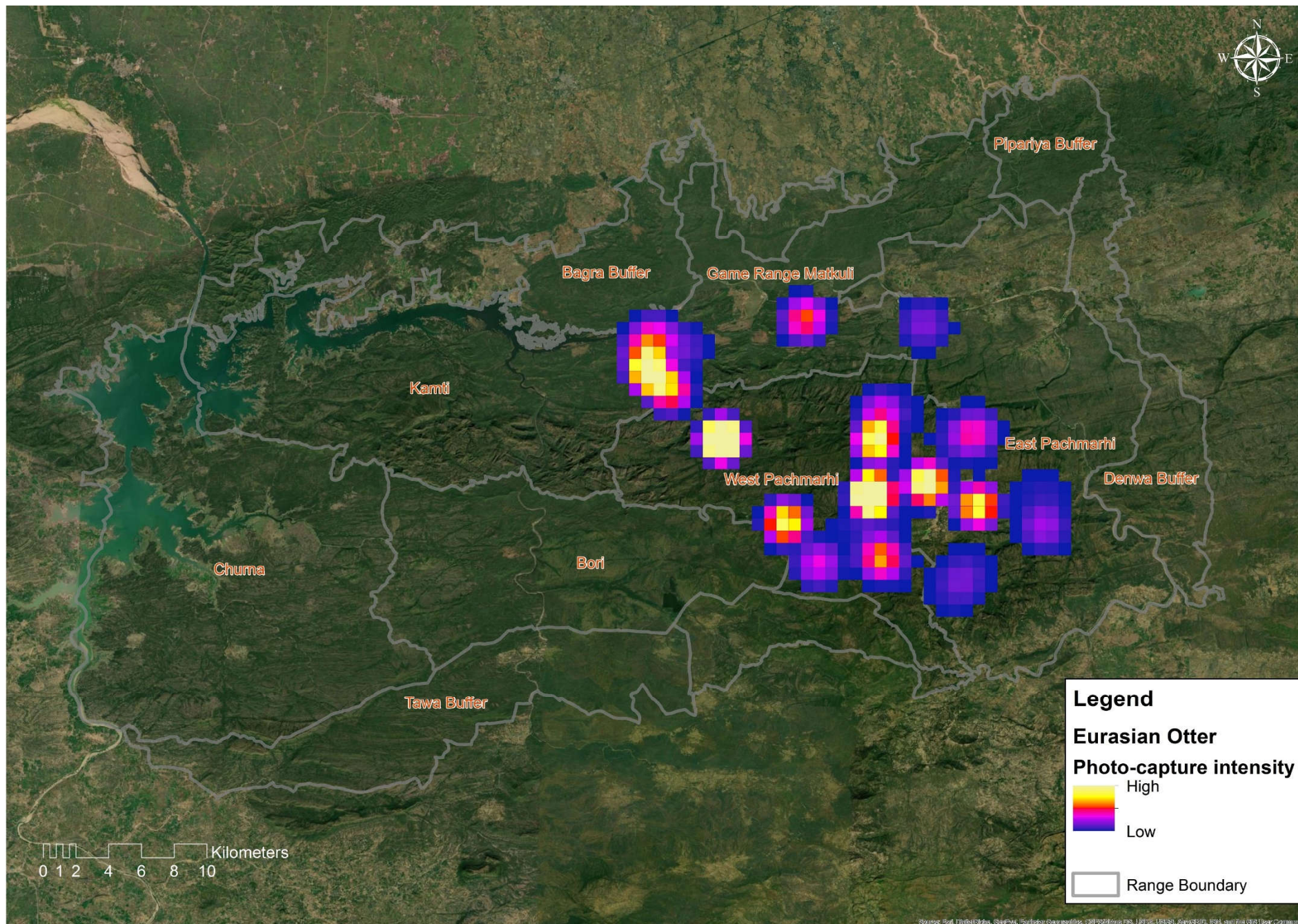
FIGURE 1: CAMERA TRAP IMAGE OF AN EURASIAN OTTER

Figure 2: Map showing the otter photo-capture intensity derived from camera trap data

Otter Occupancy and Habitat Assessment Satpura Tiger Reserve

Apart from camera trapping, we have started the fieldwork for the otter occupancy surveys. These surveys involve walking the complete length of the selected streams and rivers to assess the presence of otters as well as recording the habitat characteristics within each pre-defined segment of these streams/rivers.

FIGURE 3 OTTER TRACKS

The occupancy surveys will help in identifying the key factors affecting the presence of otters in this landscape and will also help in assessing the status of these streams/rivers with respect to the availability of suitable habitats for otters and their prey.

A reconnaissance survey was carried out from October 2020 to June 2021.

And the systematic survey was carried out from November 2021 to Feb 2022

We have completed the winter occupancy survey for all three major river catchments.

The same will be repeated for the summer season

Season 1

October 2020 – June 2021

29 locations (Figure 4) across 14 streams (Denwa, Bainganga, Bharna, Giddh Nala, Nagan Nala, Gohra Nala, Shernala, Ganjakunwar, Sawaniya, Machidhar Nala, Jambudip, Mithijhiri, Nagdwari, and Bori) were camera-trapped to collect basic ecological data on otter presence, habitat preference and activity patterns. This preliminary monitoring exercise was used to select the study area for the ongoing occupancy surveys, and identify potential otter capture sites for the tagging and telemetry component of the project.

The monitoring exercise during Season 1 was intermittent due to COVID-19 related delays and disruptions.
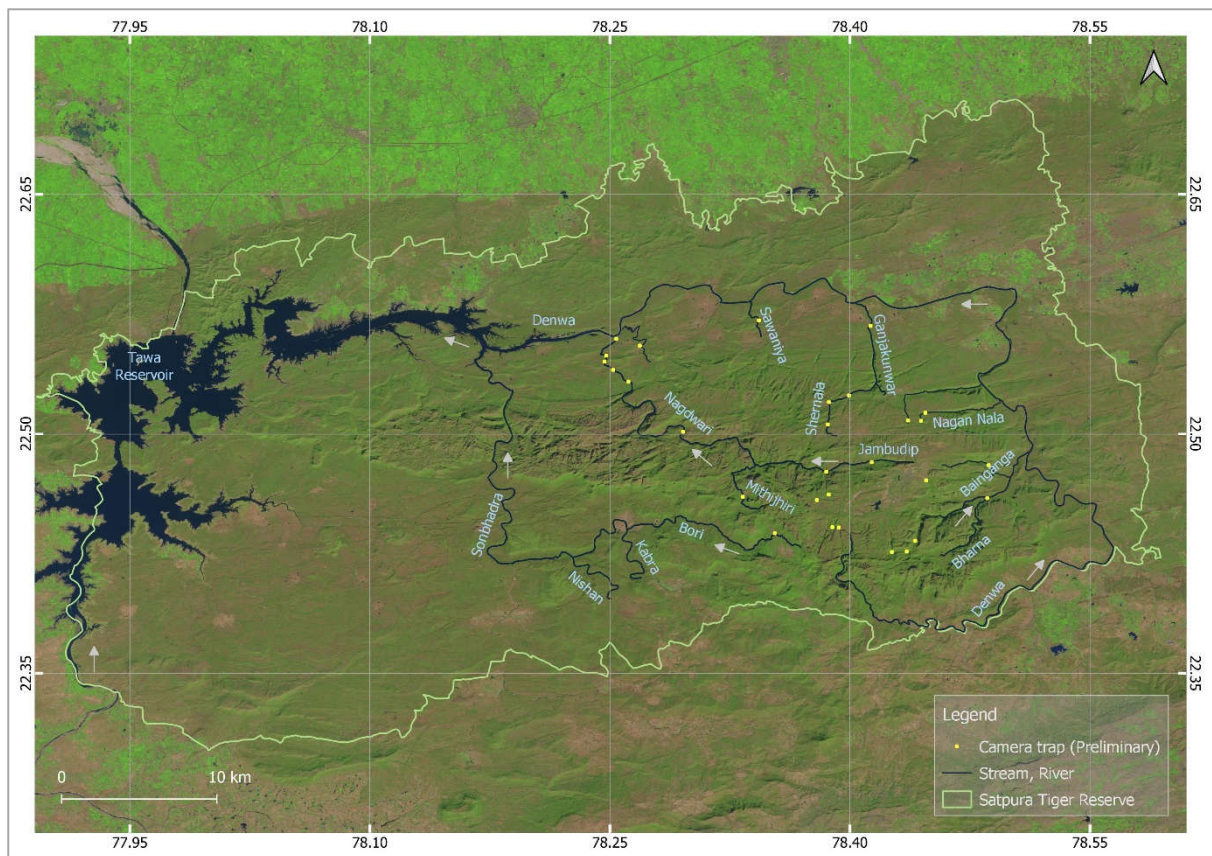
FIGURE 4 CAMERA-TRAP LOCATIONS DURING SEASON 1 OF THE PROJECT USED TO SELECT THE OCCUPANCY SURVEY STUDY AREA AND IDENTIFY POTENTIAL OTTER TRAPPING SITES FOR TELEMETRY AND TRACKING STUDIES
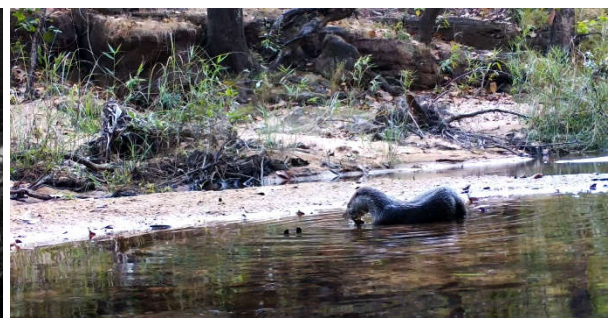
FIGURE 5 (A-E, TOP TO BOTTOM, LEFT TO RIGHT): SAMPLE OF SEASON 1 CAMERA-TRAP IMAGES FROM BHOOTAEL, MAHADEV-HANDIKHO SANGAM, NAGDWARI, RORIGHAT AND SUNDARKUND

Season 2

Phase 1: November 2021 – On-going

Occupancy surveys, i.e. estimation of the spatial distribution or proportion of area occupied, are being undertaken along approximately 138 km of stream length in the Denwa River System (including the tributaries Bainganga, Bharna, Jambudip, Mithijhiri, Nagdwari, Bori, Kabra, Nishan, and Sonbhadra).

This stream network has been divided into 46 segments, each measuring 3 km long, and a total of 105 camera traps have been deployed, with a minimum of 2 camera traps per segment (Figure 6).

Additionally, the survey is recording otters signs (spraint, spoor, holt, Figure 8), and assessing stream habitat characteristics such as channel width, pool depth, instream habitat type (pool, riffle, run, cascade), substrate type, presence of pool refugia, cover (vegetation, boulders), and bank slope (Figure 9). Further, prey (fish) availability is being assessed through underwater video recordings (Figure 10) at 51 sampling sites (Figure 11).
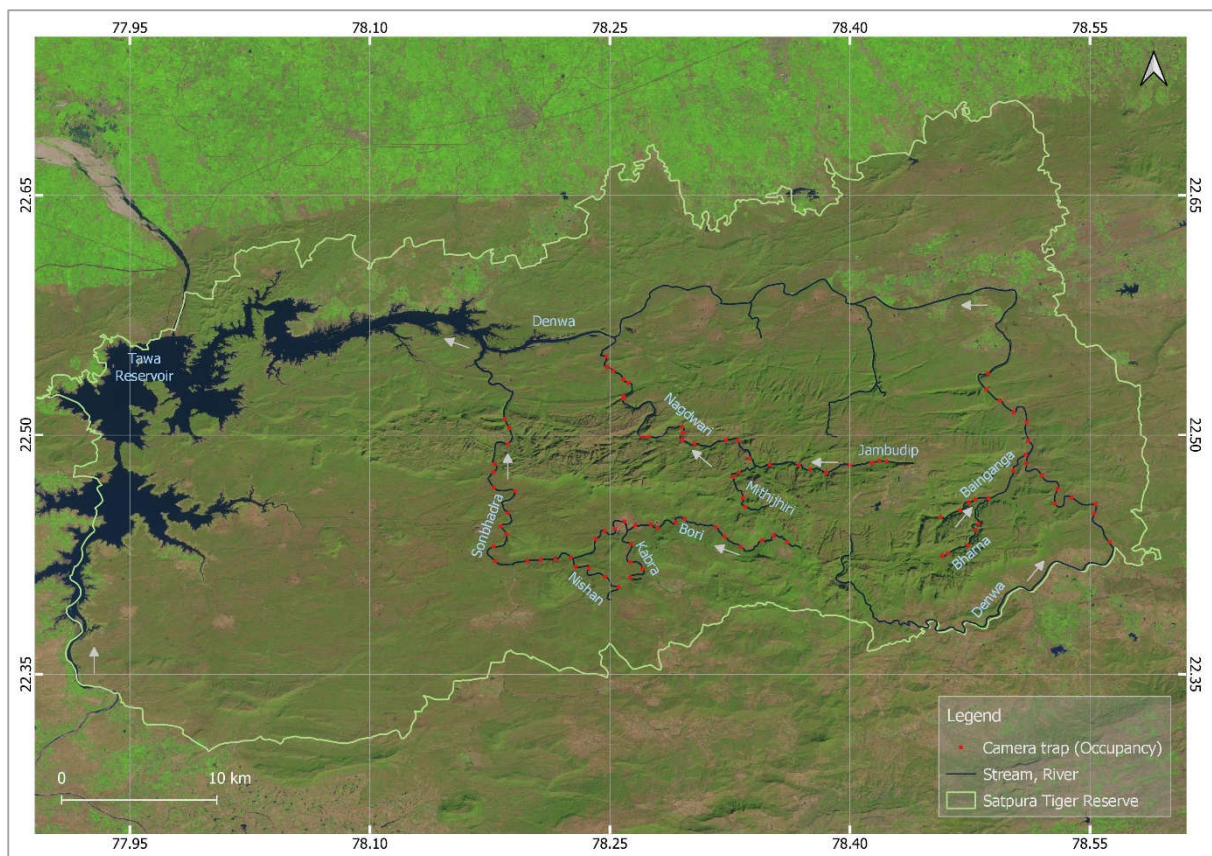

FIGURE 6 CAMERA-TRAP LOCATIONS DURING SEASON 2 (PHASE 1) OCCUPANCY AND HABITAT ASSESSMENT SURVEYS

FIGURE 7 (A-E, TOP TO BOTTOM, LEFT TO RIGHT): SAMPLE OF SEASON 2 CAMERA-TRAP IMAGES FROM BHARNA (TOP), NAGDWARI (MIDDLE) AND SONBHADRA (BOTTOM)

FIGURE 8 OTTER SIGNS RECORDED DURING THE SURVEY. **F**ISH AND CRUSTACEAN PREY REMAINS ARE VISIBLE ON CLOSE EXAMINATION OF THE SPRAINT (LEFT), WHICH IS USUALLY COVERED BY A DARK, GREASY COATING WHEN FRESH, AND THEN GRADUALLY FADES TO GREY-WHITE WITH AGE. **O**TTER SPOOR **O**TTER SPOOR (FOOTPRINTS, RIGHT) ARE USUALLY DISTINCTIVE, WITH FIVE ROUNDED TOES ARRANGED IN A SEMI-CIRCLE AROUND A LARGE CENTRAL PAD, ALONG WITH WEBBING AND CLAW MARKS. **H**OWEVER, THE FIFTH TOE, WEBBING AND CLAW MARKS ARE NOT ALWAYS VISIBLE

FIGURE 9 REPRESENTATION OF IN-STREAM HABITAT TYPES – POOL (P), RIFFLE (RI), CASCADE (C), RUN (R). **STREAM HABITATS ARE CLASSIFIED AT DIFFERENT SCALES ACROSS THE STREAM / SEGMENT / POOL-RIFFLE SEQUENCE / MICRO-HABITAT LEVEL**

FIGURE 10 (A-D): STILLS FROM UNDERWATER FISH SAMPLING VIDEOS IN THE BAINGANGA AND NAGDWARI RIVERS
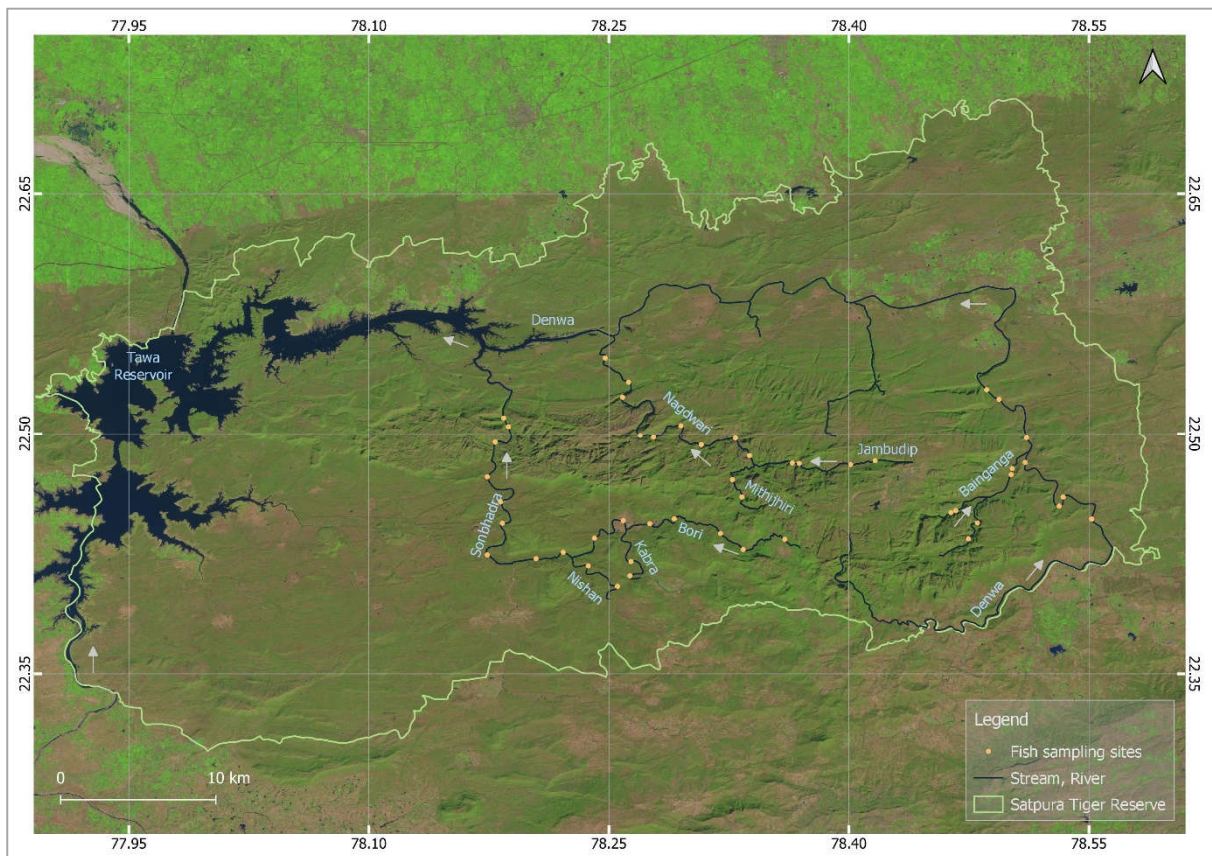
FIGURE 11 FISH SAMPLING SITES DURING SEASON 2 (PHASE 1) OCCUPANCY AND HABITAT ASSESSMENT SURVEYS

Radio Telemetry of Otters:

To understand the movement and ecology of otters, preparations for otter telemetry were completed. A specialised telemetry harness to fit the receiver on otters was designed. Equipment and tags were finalized for the project in consultation with the veterinarians and biologists. Traps to safely capture otters were successfully tested in the field for acceptance by wild otters. Video surveillance equipment was developed and installed to monitor the otter traps to tag the animals with minimum handling and stress.

FIGURE 13 DUMMY TRAP CAGES HAVE BEEN SET UP AT SITES WITH A HIGH FREQUENCY OF OTTER DETECTIONS. THESE ARE POTENTIAL OTTER CAPTURE SITES FOR THE TAGGING AND TELEMETRY COMPONENT OF THE PROJECT AND ARE BEING MONITORED REGULARLY WITH 2-3 CAMERA TRAPS, AND WATER LEVEL RECORDERS (WLR) IN THE VICINITY (SEE TOP). OLFACTORY LURES (FISH-SCENT) ARE OCCASIONALLY PLACED IN THE DUMMY TRAPS TO ATTRACT OTTERS AND GET THEM ACCUSTOMED TO THESE TRAPS PRIOR TO THE DEPLOYMENT OF LIVE TRAPS. OTTERS ARE NOW REGULARLY VISITING AND ENTERING THE DUMMY TRAPS AS SEEN IN THE IMAGES AT THE BOTTOM.

FIGURE 14 A EURASIAN OTTER INVESTIGATES THE TRAP

FIGURE 16 IMAGE SHOWING THE TRAP ACCEPTANCE BY OTTERS

FIGURE 17: RADIO- TAG HARNESS DESIGNED FOR THE

2. Hydrological Monitoring:

Monitoring of rivers and reservoirs will help in understanding the complexities of hydrological systems, which govern in-stream water availability and how it might affect the distribution of associated wildlife.

We completed the installation of Acoustic Water Level Recorders (WLRs) at multiple sites to measure the changes in water levels in the streams/rivers. At each of these WLR sites, we are manually mapping the stream profile and measuring the water flow velocities, this will also allow us to calculate the volume of flow in the streams.

FIGURE 18: FIELD INSTALLATION OF AN ACOUSTIC WATER LEVEL RECORDER (WLR)

Stream-gauging and water-quality monitoring are underway to understand the hydrological influences on otter occupancy and habitat use in the Satpura Tiger Reserve.

Stream gauging involves (a) recording stage on a continuous basis, (b) periodic measurements of discharge, and (c) establishing a stage-discharge relationship to obtain a continuous record of discharge from stage records.

The stage is the height of the water surface above an established depth where the level is zero. The zero level is arbitrary and will be close to the bottom of the channel if the river section is shallow. A continuous record of stage is obtained by systematic observation of staff gauges, or with automatic water level recorders (WLR).

FIGURE 19 STAFF GAUGE AND WLR INSTALLATION AT DEHLIYA, DENWA RIVER

WLRs and staff gauges have been installed at 13 locations (Figure 3) in the study area within the Denwa River System (including the tributaries Bainganga, Shernala - Ganjakunwar, Sawaniya, Jambudip - Mithijhiri - Nagdwari, and Bori - Sonbhadra). The upper catchments of these stream gauging sites are also being assessed for the installation of rain gauges in the following weeks.
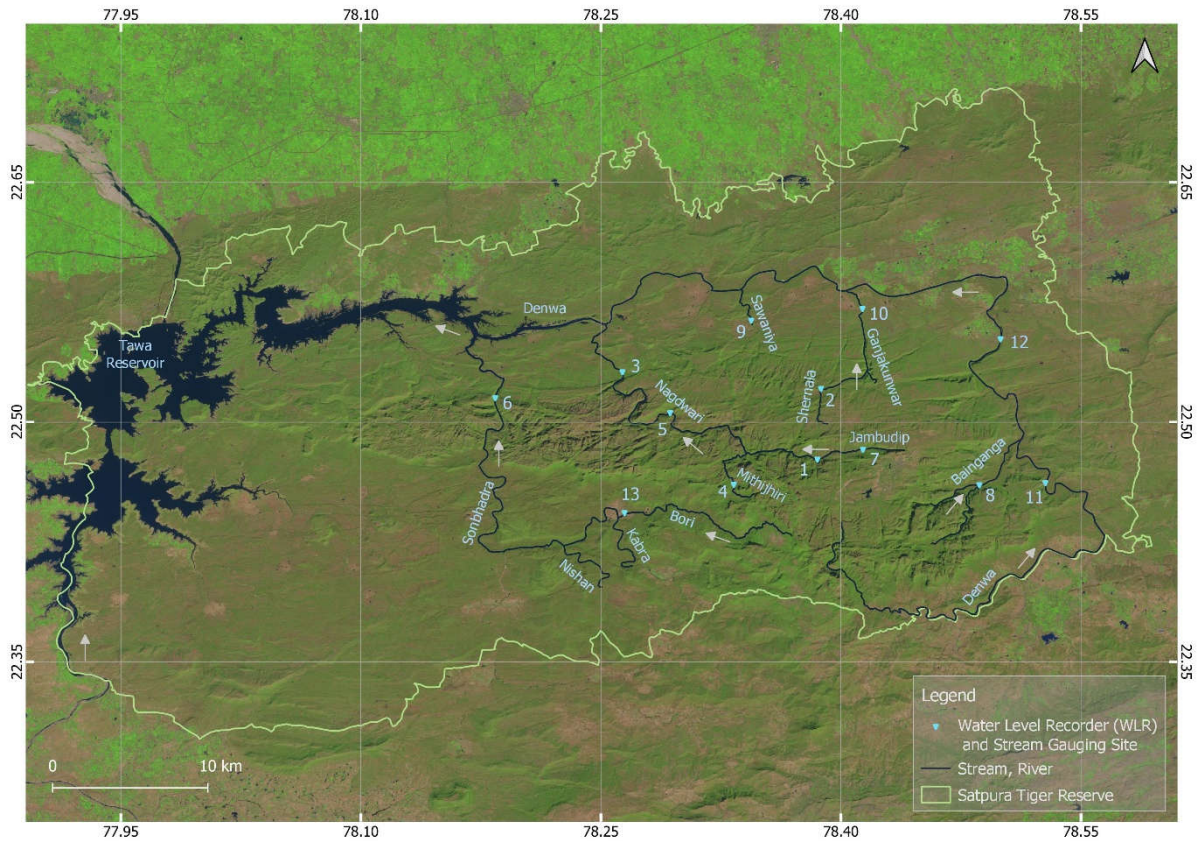
FIGURE 20 : LOCATIONS OF WATER LEVEL RECORDERS AND STREAM GAUGING SITES IN THE SATPURA TIGER RESERVE

Discharge (flow) is the volumetric rate of flow of water in a stream. Discharge is usually expressed in cubic metres per second (Cumecs or m³/sec). Discharge measurements will be made at periodic intervals to define the stage-discharge relationship or to define any change in the relationship caused by changes in channel geometry and/or channel roughness. Discharge cannot be measured directly, but will be computed from variables that can be measured directly, such as stream width, stream depth and flow velocity. The velocity-area method being used here requires measurement of the stream cross-sectional area and stream velocity. Discharge is then calculated as Q = VA, where Q is discharge in m³/sec (Cumecs), V is stream velocity (m/sec), and A is the cross-sectional area (m²).

FIGURE 21 MEASUREMENTS OF STREAM WIDTH, DEPTH AND FLOW VELOCITY. FOREST PATROLLING STAFF OCCASIONALLY PARTICIPATED DURING THESE SURVEYS

TABLE 1 SUMMARY DETAILS OF THE CHANNEL PROFILE AND STREAM-GAUGING MEASUREMENTS

WLR #	Station / Stream	Date	Channel Width (m)	Staff Gauge (m)	Cross-section Area (sqm)	Discharge (cumecs)	Wetted Perimeter (m)	Hydraulic Radius (m)
1	Sundarkund / Jambudip	19/10/2021	5.80	0.50	0.84	0.33	6.09	0.14
		05/02/2022	5.20	47.00	0.93	0.22	5.53	0.17
2	Ghodanaar / Shernala	10/02/2022	1.00	NA	0.13	0.05	1.26	0.10
3	Bhootael / Nagdwari	23/10/2021	6.50	0.53	4.37	1.44	7.87	0.55
		07/02/2022	6.60	0.45	3.94	1.07	7.74	0.51
4	Kajri / Mithijhiri	20/10/2021	3.50	0.47	0.83	0.09	3.98	0.21
		06/02/2022	2.75	0.40	0.39	0.04	3.02	0.13
5	Gondiya / Nagdwari	11/11/2021	9.40	0.81	6.18	0.73	10.75	0.57
		07/02/2022	10.00	0.79	4.94	0.57	10.99	0.45
6	Lagda, Sonbhadra	03/12/2021	7.00	0.54	1.16	0.90	7.33	0.16
		08/02/2022	4.10	0.13	0.54	0.36	4.36	0.13
7	Jambudip / Jambudip	21/10/2021	3.00	0.33	0.43	0.08	3.29	0.13
		06/02/2022	3.00	0.30	0.31	0.05	3.21	0.10
8	Kanjighat / Bainganga	24/11/2021	6.80	NA	1.43	0.60	7.16	0.20
		28/01/2022	6.94	NA	1.00	0.32	7.23	0.14
9	Anjandhana / Sawaniya	16/10/2021	3.60	0.45	1.27	0.27	4.34	0.29
		08/02/2022	2.80	0.38	0.70	0.10	3.30	0.21
10	Ganjakunwar / Ganjakunwar	NA	NA	NA	NA	NA	NA	NA
11	Dehliya / Denwa	28/01/2022	5.50	0.66	0.89	0.54	5.82	0.15
		19/02/2022	5.60	0.65	0.84	0.43	5.91	0.14
12	Muar / Denwa	09/02/2022	5.00	0.41	3.81	0.70	6.52	0.58
13	Bori / Bori	10/02/2022	1.12	0.34	0.07	0.03	1.24	0.05

In addition, five water quality parameters (Table 2) were recorded from 43 locations during Phase 1 of the otter occupancy and habitat assessment surveys to investigate the influence of water quality on otters and their fish prey.

FIGURE 22 COLLECTING DATA ON WATER QUALITY PARAMETERS

TABLE 2 SUMMARY DETAILS OF THE WATER QUALITY SAMPLING

River System	Temperature (°C)		pH		Conductivity (uS/cm)		Dissolved Oxygen (ppm)		Total Dissolved Solids (ppm)		
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	
Denwa	14.84	22.65	7.2	8.65	54	107	7.6	10.42	27	53	
Nagdwari	15.71	18.83	6.67	7.8	25	31	5.3	9.74	12	16	
Sonbhadra	14.22	24.4	6.73	8.44	69	163	6.2	10.09	34	81	

Using GIS and Remotely Sensed imageries, we have mapped the water catchment areas for major rivers in the study area. These catchment areas will help us to analyse the hydrology data separately for each catchment along with the otter presence data obtained from areas within respective catchments.
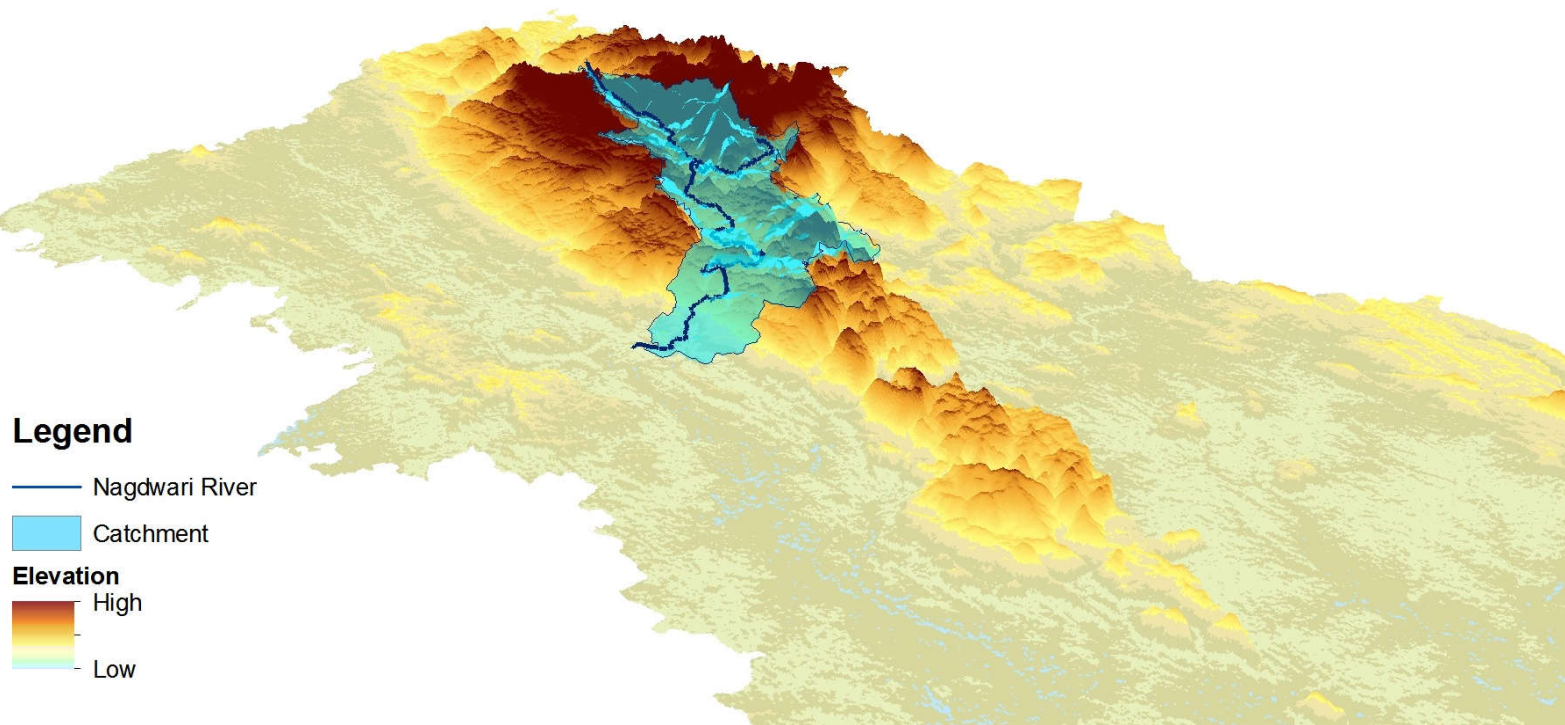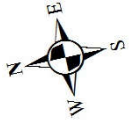
FIGURE 23 MAP SHOWING THE CATCHMENT AREA OF THE NAGDWARI RIVER

We have also placed rain gauges within each water catchment area to precisely collect the rainfall data and correlate it with the dry-season water flow from the streams/rivers of each of these catchments.

We have also placed rain gauges within each river catchment to precisely collect the rainfall data and correlate it with water flow. This will provide information on how much water translates into surface flows and it will also throw light on the hydrologic characteristic of the catchment.

Figure 24: Installation of rain-gauges in the field

Planned Work:

Camera trapping activity will continue on current sites and additional sites will be added as we move ahead with the project. Such multi-season camera trapping will help in understanding the seasonal changes in the distribution of otters in this landscape.

Occupancy surveys will be repeated to determine changes in otter [presence and changes in habitats across seasons.

Hydrology related data collection and additional installation of WLRs will be carried out to understand the changes in water level and discharge with changing seasons.

Otter tagging work is planned in the coming months for which sites have been selected.
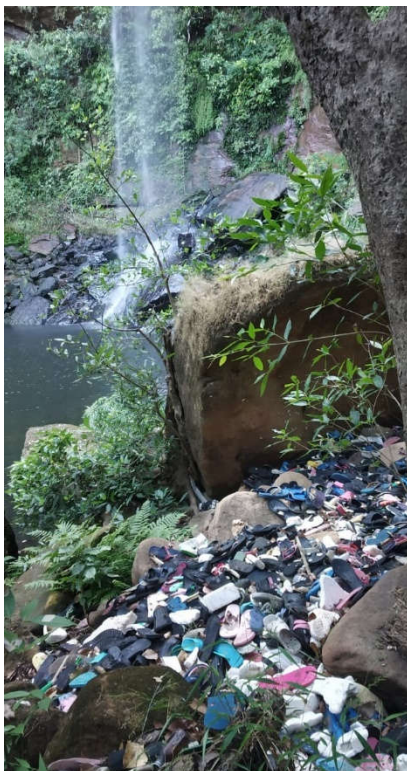
FIGURE 25: POST MONSOON DEPOSITION OF WASTE IN THE STREAMS FROM THE PACHMARHI PLATEAU

FIGURE 26: OTTER PLAYING WITH A PLASTIC BOTTLE

Most of the streams originate from the Pachmarhi plateau which is a popular tourist destination. Waste management and plastic pollution are major concerns faced by the forest department as the Pachmarhi town is geographically situated right in the middle of the tiger reserve.

With awareness programs carried out by the forest department for the tourist guides and enforcement of fines for littering, the plastic waste at several of the tourist spots and view-points has been reduced.

However, in the monsoon, the garbage from the plateau ends up in the tiger reserve with the flowing water. These streams are the prime habitats of the Eurasian otter and the waste from the Pachmarhi town impacts the aquatic life downstream.

We will be looking at water quality and the presence of plastic waste in these streams to assess the level of impact of pollution on these habitats. We will be jointly working with the forest department and the army cantonment to develop on-ground solutions to reduce the discharge of plastic waste in these river systems.