G.7 CAMERA TRAP SURVEY REPORT

Camera Trap Survey Report

Divisional Forest Office, Sarpang
Department of Forests and Park Services
Ministry of Energy and Natural Resources

Background

As part of the Environment and Social Impact Assessment (ESIA) baseline study for the Gelephu-Taraythang road alignment, a comprehensive camera trap study was conducted along the proposed road site. A total of 40 camera traps were strategically installed across 22 survey grids (2 km x 2 km) to collect data on wildlife presence and their activity. This data is crucial for assessing the environmental and social impacts associated with road construction.

Camera trap data plays a significant role in the ESIA process by providing detailed understandings into the distribution and behavior of wildlife in the affected area. This information helps to:

1. **Assess Biodiversity:** By capturing images of various species, the data allows for an assessment of the biodiversity in the road alignment area. This includes identifying the presence of rare or endangered species that may be impacted by construction activities.
2. **Evaluate Wildlife Movement:** Camera traps provide data on wildlife movement patterns, which helps in understanding how the road may disrupt migration routes or daily movements. This information is critical for designing mitigation measures that minimize disruption to wildlife corridors.
3. **Identify Potential Impacts:** The data can reveal potential impacts such as habitat fragmentation or increased wildlife-human conflicts, which can inform the development of strategies to address these issues effectively.
4. **Support Mitigation Strategies:** By identifying areas of high wildlife activity or sensitive habitats, camera trap data aids in designing targeted mitigation measures, such as wildlife crossings or habitat restoration projects, to reduce the negative impacts of road construction.

The findings from this camera trap survey will be essential in mitigating the impacts of the road construction project. The data will be used to inform the planning and implementation phases, ensuring that construction activities are planned and executed in a manner that minimizes environmental and social impacts. By integrating these findings into the project design, it is possible to develop strategies that balance development needs with conservation goals, ultimately promoting more sustainable and environmentally responsible practices.

2. Methodology

2.1 Study area

The area falls through six gewogs (sub-districts) of Taraythang, Shershong, Chhuzergang, Samtenling, Gelephu and Umling. The study area encompasses diverse habitats like sub-tropical forests, grasslands and warm broadleaf forests, situated across varying altitudes from 150 to 398 meters above sea level.

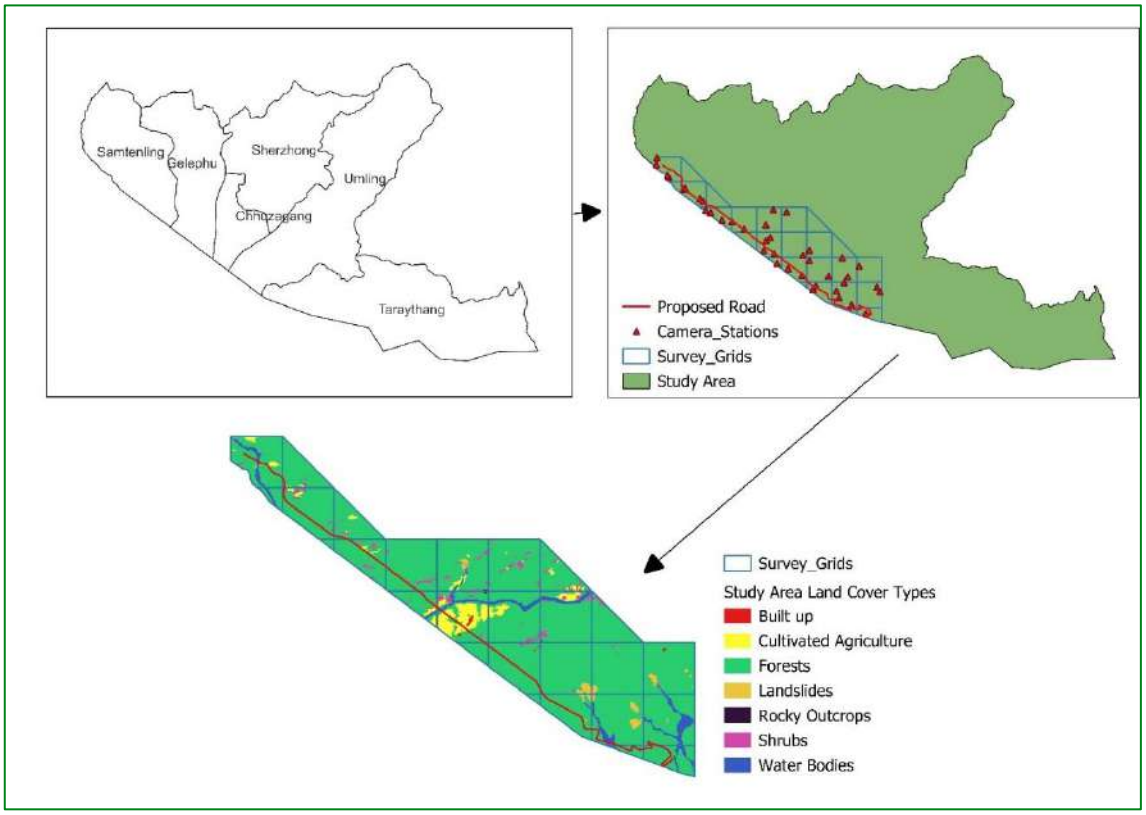

Figure 1. Map of camera trap study area

2.1.1 Climatic conditions

The study area is characterized by hot and humid climatic conditions with winter being moderately cool and comfortable, and summer being hot and humid, with significantly more rainfall than in winter. The average temperature in the area is around 22.4°C, ranging from a minimum of 18.6°C to a maximum of 39. 2°C. The highest rainfall occurs between May and September, peaking in July and August with levels exceeding 5000 mm.

2.1.2 Population

The population distribution across the six gewogs—Chhuzanggang, Gelephu, Serzhong, Samtenling, Umling, and Tareythang—reveal a diverse range of demographic characteristics. Gelephu is the most populous gewog, with a total of 6,457 residents. Its high population is attributed to its role as a major urban and commercial center, benefiting from its strategic location near the Indian border. Following Gelephu, Samtenling has a population of 2,801, while Serzhong has 2,707 residents. Chhuzanggang ranks next, with 2,499 inhabitants, making it the fourth most populous gewog. Umling, with 1,586 residents, is a more remote and rural area where agriculture and livestock rearing are the primary economic activities. Lastly, Tareythang, with a population of just 351, is the least populated and most rural of the gewogs.

2.1.3 Habitat and Vegetation:

2.1.3.1 Sub-tropical Forests: Dominating much of the study area, these forests are characterized by dense, evergreen vegetation, including species like *Chukrasia tabularis, Acrocarpus fraxinifolius, Ailanthus grandis, Bombax ceiba, Duabanga grandiflora, Shorea robusta, Tetrameles nudiflora* etc. The undergrowth is rich with shrubs, ferns, and climbers, providing cover and resources for numerous animal species.

2.1.3.2 Grasslands: Interspersed within the forests and riverbanks, these areas are composed primarily of tall grasses, such as *Miscanthus spp, Imperata spp and and Saccharum spp*, which are adapted to periodic disturbances like flooding, grazing, and fires. Grasslands are crucial habitats for herbivores as well as predators.

2.1.2.4. Warm Broadleaf Forests: These habitats are composed of a mixture of deciduous and evergreen trees, such as *Alangium chinense, Alnus nepalensis, Betula alnoides, Bischofia javanica, Callicarpa arborea, Castanopsis indica, Cordia obliqua, Dendrocalamus hookeri, Dichroa febrifuga, Engelhardia spicata, Entada spp. Helicia nilagirica*. The canopy cover is moderately dense, allowing sufficient light for a diverse understory.

2.2. Expected Wildlife Species:

The area is home to a variety of wildlife species, including several common and endangered species. Mammals like the Asian elephant (*Elephas maximus*), gaur (*Bos gaurus*), and barking deer (*Muntiacus muntjak*) are expected in these habitats. Predators such as the Royal Bengal tiger (*Pathera tigris*), common leopard (*Panthera pardus*) and smaller carnivores like the common palm civet (*Paradoxurus hermaphroditus*) are also likely to be present. Bird species such as the great hornbill (*Buceros bicornis*), green magpie (*Cissa chinensis*), red junglefowl (*Gallus gallus*), Indian peafowl (*Pavo cristatus*) and various raptors are frequently observed. Reptiles, including Burmese python, monitor lizards, and several snake species, add to the area's biodiversity.

2.3. Land-use types

The land-use and land-cover analysis of the study area shows a total area of **97,939.74 hectares (Ha)**, dominated by forests, which cover **96,905.87 Ha (98.94 % of the total area)**. This shows a significant portion of natural vegetation within the region. Cultivated agricultural land is much less prevalent, occupying **325.35 Ha (0.33%)**, reflecting limited agricultural activities (Table 1).

The data shows that the region is predominantly covered by forests, with other land-use types occupying much smaller portions.

Table 1. Summary of land-use type and area coverage in the study area

Land-Use/Cover class	Area (Ha)	Percentage
Built up	9.92	0.01
Cultivated Agriculture	325.35	0.33
Forests	96905.87	98.94
Landslides	79.39	0.08
Rocky Outcrops	2.84	0
Shrubs	187.14	0.19
Water Bodies	429.41	0.44
Grand Total	**97939.94**	**100**

3. Methods

3.1 Grid size and camera configuration

A grid size of 2 km x 2 km was laid out along the proposed Gelephu-Taraythang highway spanning a length of 18 km. To capture wildlife images, we used Reconyx HC500 Hyperfire camera traps. The devices were configured to capture five consecutive images per trigger, both during the day and at night, with no delay between triggers. This configuration was chosen to maximize the number of captured images and ensure comprehensive wildlife monitoring. The camera sensitivity was set to medium-high to detect even small species. These cameras, equipped with passive infrared technology, are triggered by both animal movement and body heat.

3.3 Camera installation and data collection

Within each grid, potential wildlife signs and tracks were thoroughly examined to assess wildlife activity. Camera stations were then strategically selected based on these observations to maximize wildlife captures. For each grid, two camera stations were designated, with one camera installed at each station. Camera trap was placed on either side of the trail at a height of 45-60 cm from the ground. On flat grounds, camera traps were set up at a 90^{o} to the trail but in slopy area, camera traps were positioned such that the slope of the trail is horizontal to the area of camera set-up. A specific camera ID was assigned to each camera trap.

Gelephu- Taraythang road alignment was extended towards Jigmeling and it was discussed in the meeting with ERM team that 2 camera traps will be installed within the 2kmx2km grids falling along the road alignment. Hence, we have installed 10 cameras across 5 grids along the extended road

Data collection was facilitated using the EpiCollect mobile application. The data collected included camera trap locations, habitat types, elevations, and the installation and retrieval dates of the camera traps. This data was recorded on mobile phones to ensure accuracy and ease of access. The camera traps were monitored in July 2024, and all captured images were promptly downloaded to computers from the SD cards to prevent data loss.

4. Data analysis

We used camera trap data from 37 stations, which were sorted and processed using Camera Trap File Manager (CTFM) software. The image data, extracted as a CSV file through CTFM, was analyzed using R statistical software version 4.4.1.

5. Results

5.1 Camera trap and wildlife detections

Camera traps were deployed to record the presence of terrestrial mammals, with installations beginning on July 13, 2024, and retrieval completed on August 29, 2024. Across 20 grids of 2x2 km each, we installed 40 camera traps, with the number of trap nights ranging from 1 to 75. Three camera traps were stolen, and two cameras (G9_C2 and G4_C2) did not capture any wildlife species, only images triggered falsely. Additionally, three camera traps were damaged by elephants and remained functional for only 1 to 14 trap nights (Table 2).

Table 2. Summary of Camera Trap Installation and Retrieval Dates along with information on active trap nights

Grid id	Camera	Installation date	Retrieval date	Trap night	Remarks
G1	C1	13/06/2024	02/08/2024	51	
	C2	13/06/2024	13/06/2024	1	Damaged
G2	C1	14/06/2024	08/08/2024	56	
	C2	14/06/2024	09/07/2024	26	
G3	C1	14/06/2024	08/08/2024	56	
	C2	14/06/2024	02/08/2024	50	
G4	C1	18/06/2024	06/08/2024	50	
	C2	17/06/2024	08/08/2024	53	
G5	C1	17/06/2024	19/06/2024	3	Damaged
	C2	14/06/2024	12/08/2024	60	
G6	C1	18/06/2024	27/07/2024	40	
	C2	18/06/2024	12/08/2024	56	
G7	C1	17/06/2024	30/06/2024	14	
	C2	17/06/2024	12/08/2024	57	
G8	C1	13/06/2024		0	Lost
	C2	15/06/2024	28/08/2024	75	
G9	C1	15/06/2024	07/08/2024	54	
	C2	15/06/2024	09/08/2024	56	
G10	C1	15/06/2024	07/08/2024	54	
	C2	15/06/2024	06/08/2024	53	
G11	C1	14/06/2024	12/08/2024	60	
	C2	14/06/2024	26/08/2024	74	
G12	C1	14/06/2024	12/08/2024	60	
	C2	14/06/2024	02/08/2024	50	
G13	C1	15/06/2024	31/07/2024	47	
	C2	15/06/2024	31/07/2024	47	
G14	C1	15/06/2024	07/08/2024	54	
	C2	14/06/2024	07/08/2024	55	
G15	C1	14/06/2024	09/08/2024	55	
	C2	14/06/2024	07/08/2024	53	
AG1	C1	19/07/2024	28/08/2024	40	
	C2	19/07/2024	29/08/2024	41	
AG7	C1	19/07/2024	28/07/2024	9	
	C2	19/07/2024	16/08/2024	28	
AG8	C1	19/07/2024	29/08/2024	40	
	C2	19/07/2024	28/08/2024	39	
AG14	C1	18/07/2024	28/08/2024	41	
	C2	18/07/2024		0	Lost
AG15	C1	18/07/2024	20/07/2024	2	Damaged
	C2	18/07/2024		0	Lost

Table 3. Location of camera traps with information on time of installation, altitude and habitat

Grid id	Camera	Time (Installation)	Altitude (m)	Habitat	Latitude	Longitude
G1	C1	11:19	229	Sub-tropical	26.876824	90.461911
	C2	10:40	218	Sub-tropical	26.87537	90.469932
G2	C1	15:32	185	Grassland	26.87331	90.49707
	C2	10:44	173	Warm broadleaf	26.87031	90.47975
G3	C1	12:39	185	Warm broadleaf	26.86182	90.49712
	C2	11:50	162	Warm broadleaf	26.85494	90.49544
G4	C1	11:44	157	Grassland	26.8526	90.50365
	C2	10:46	155	Warm broadleaf	26.86412	90.5005
G5	C1	14:56	174	Warm broadleaf	26.88245	90.51367
	C2	16:25	208	Grassland	26.88427	90.50302
G6	C1	12:55	181	Subtropical	26.84167	90.51482
	C2	11:49	150	Subtropical	26.84533	90.50591
G7	C1	17:06	150	Grassland	26.8514	90.52679
	C2	16:36	159	Warm broadleaf	26.85496	90.53183
G8	C1	17:54	174	Subtropical	26.84731	90.53175
	C2	16:57	172	Subtropical	26.83702	90.52598
G9	C1	16:18	164	Subtropical	26.82691	90.53462
	C2	15:55	154	Subtropical	26.82904	90.53705
G10	C1	14:14	210	Subtropical	26.83619	90.5471
	C2	12:48	292	Subtropical	26.8493	90.55823
G11	C1	17:25	266	Subtropical	26.82553	90.55345
	C2	16:32	250	Subtropical	26.82076	90.55559
G12	C1	18:13	265	Subtropical	26.83136	90.55965
	C2	15:28	250	Grassland	26.81558	90.56543
G13	C1	10:37	342	Subtropical	26.8357	90.56252
	C2	11:34	295	Subtropical	26.84323	90.5718
G14	C1	13:37	230	Subtropical	26.80934	90.57691
	C2	10:23	242	Subtropical	26.80963	90.57051
G15	C1	12:34	320	Subtropical	26.82489	90.58842
	C2	11:50	300	Subtropical	26.82819	90.58599
AG1	C1	14:09	398	Sub-tropical	26.9219	90.40968
	C2	13:26	350	Sub-tropical	26.91665	90.40924
AG7	C1	12:11	334	Sub-tropical	26.90775	90.41923
	C2	11:35	340	Sub-tropical	26.90915	90.41832
AG8	C1	10:22	351	Sub-tropical	26.89912	90.43127
	C2	9:59	362	Sub-tropical	26.89978	90.43259
AG14	C1	12:29	332	Sub-tropical	26.89237	90.44422
	C2	12:05	313	Sub-tropical	26.89052	90.44678
AG15	C1	11:11	294	Sub-tropical	26.88239	90.45273
	C2	10:14	313	Sub-tropical	26.88411	90.44898

With the loss of 3 camera traps, the remaining 37 camera traps captured a total of 212,262 images with the survey effort of 1660 trap nights. Majority 84.9% (n=180,210) of the images were as a result of false tigger (no images of wildlife or human or livestock) and were removed from further analysis. However, 77.8% of the images captured were of human and livestock. The remaining 32,052 images were of humans, livestock, birds,

reptile and wild mammals. The wildlife captured were spread across 10 orders, 14 families and 18 species (3 EN, 2 NT, 3 VU, and 10 LC) (Table 4).

Table 4. Summary on taxonomic classification and conservation status of species

No.	Order	Family	Scientific name	Common name	Dzongkha name (Bhutanese)	** IUCN status
1	Primates	Cercopithecidae	*Macaca assamensis*	Assamese Macaque	Pcha	NT
2	Artiodactyla	Cervidae	*Muntiacus muntjak*	Barking Deer	Kasha	LC
3	Carnivora	Felidae	*Panthera pardus*	Common Leopard	Zhee	VU
4	Probosci	Elephantidae	*Elephas maximus*	Asian Elephant	Lamche	EN
5	Artiodactyla	Bovidae	*Bos gaurus*	Gaur	Relang	VU
6	Rodentia	Hystricidae	*Hystrix brachyura*	Himalayan Crestless Porcupine	Bjithu	LC
7	Artiodactyla	Cervidae	*Axis porcinus*	Hog Deer	Kasha	EN
8	Carnivora	Viverridae	*Viverra zibetha*	Large Indian Civet	Bja-Zig	LC
9	Squamata	Varanidae	*Varanus bengalensis*	Monitor Lizard	Lam Khandu	NT
10	Artiodactyla	Cervidae	*Rusa unicolor*	Sambar Deer	Shaw	VU
11	Carnivora	Canidae	*Cuon alpinus*	Wild Dog	Phaw	EN
12	Artiodactyla	Suidae	*Sus scrofa*	Wild Pig	Repha	LC
13	Carnivora	Viverridae	*Paguma larvata*	Himalayan Palm Civet	Bja-Zig	LC
14	Passeriformes	Sturnidae	*Acridotheres tristis*	Common Myna	NA	LC
15	Galliformes	Phasianidae	*Pavo cristatus*	Indian Peafowl	MaJaa	LC
16	Galliformes	Phasianidae	*Gallus gallus*	Red Junglefowl	Ribja	LC
17	Gruiformes	Rallidae	*Amaurornis phoenicurus*	White-breasted Waterhen	NA	LC
18	Pelecaniformes	Ardeidae	*Bubulcus ibis*	Cattle Egret	NA	LC

****IUCN Status**

EN: Endangered, NT: Near Threatened, VU: Vulnerable, LC: Least Concern

Livestock had the highest relative abundance followed by barking deer and human and the lowest was Himalayan crestless porcupine, sambar deer and large Indian civet (Table 5).

Table 5. Summary of Camera Trap Data: Station Count, Trap Success, Trap Nights, Detections, Relative Frequency, and Relative Abundance of wildlife species

No.	Species	No. of trap stations	No. of trap success	Trap night	No. of detections	Relative frequency	Relative abundance
1	Assamese Macaque	40	6	1660	309	0.00964	18.61
2	Barking Deer	40	23	1660	2808	0.08756	169.16
3	Birds	40	16	1660	321	0.01001	19.34
4	Common Leopard	40	2	1660	10	0.00031	0.60
5	Elephant	40	17	1660	1510	0.04708	90.96
6	Gaur	40	4	1660	950	0.02962	57.23
7	Himalayan Crestless Porcupine	40	1	1660	4	0.00012	0.24
8	Himalayan Palm Civet	40	3	1660	22	0.00069	1.33
9	Hog Deer	40	6	1660	221	0.00689	13.31
10	Human	40	22	1660	2028	0.06324	122.17
11	Large Indian Civet	40	2	1660	6	0.00019	0.36
12	Livestock	40	25	1660	22914	0.7145	1380.36
13	Monitor Lizard	40	2	1660	9	0.00028	0.54
14	Sambar Deer	40	1	1660	3	0.00009	0.18
15	Wild Dog	40	1	1660	35	0.00109	2.11
16	Wild Pig	40	18	1660	920	0.02869	55.42

With regard to the presence of wildlife, camera station G2_C1 had highest wildlife detections (n=956) and G5_C1 had lowest detections (n=6) (Fig.2). Similarly, camera station G5_C1 had highest detections of human (n=11) and livestock (n=7335) and G15_C1 had the lowest detections of human (n=2) and livestock (n=0) (Fig. 3).

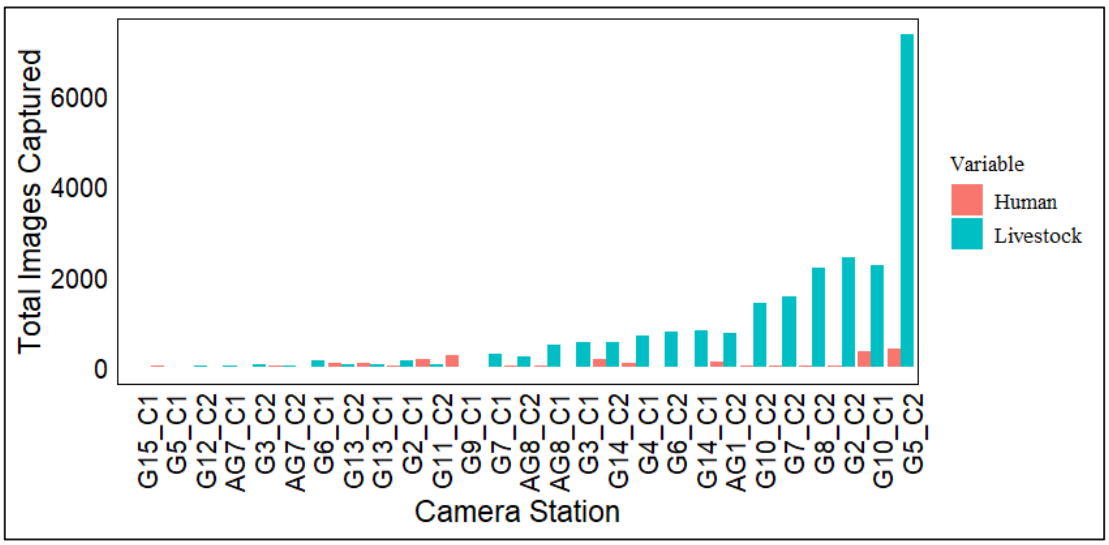

Figure 2. Detection pattern of human and livestock across different camera stations

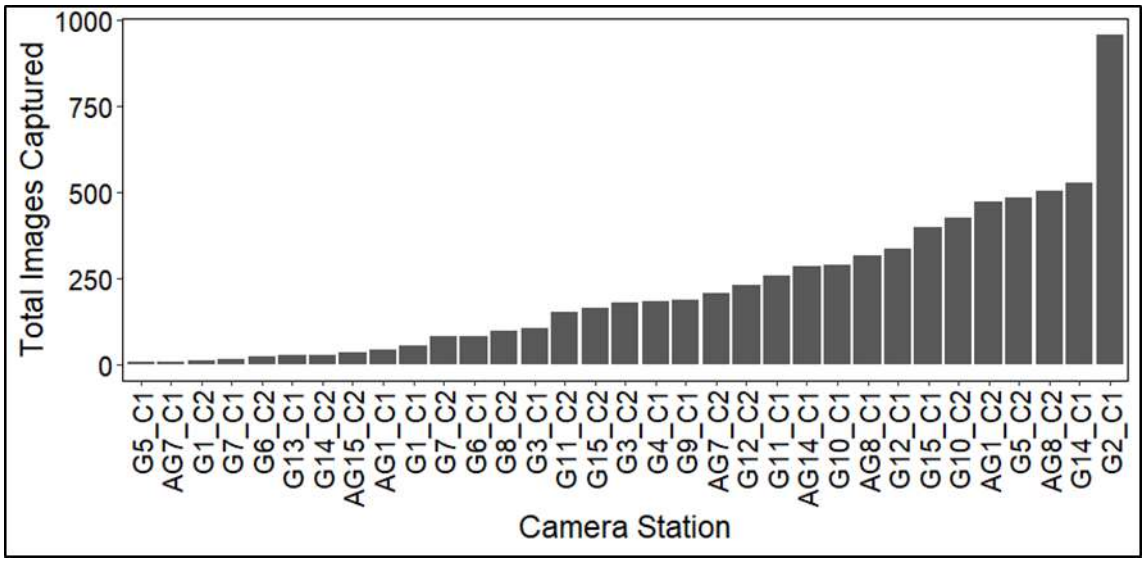

Figure 3. Detection of wildlife species across different camera stations

5.2 Wildlife species and activity pattern

Eighteen wildlife species were recorded through this camera trap activities. Of these 18 species, 8 species (including livestock and human) had more than 200 detection counts and so, we also analyzed their activity pattern.

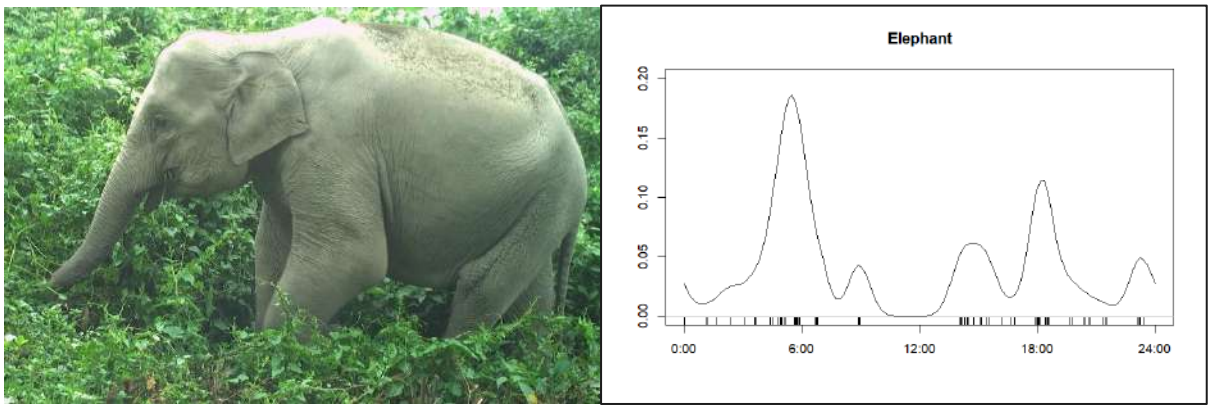

Figure 4. Asian elephant and their activity pattern. They are more active during dawn and dusk showcasing crepuscular behavior

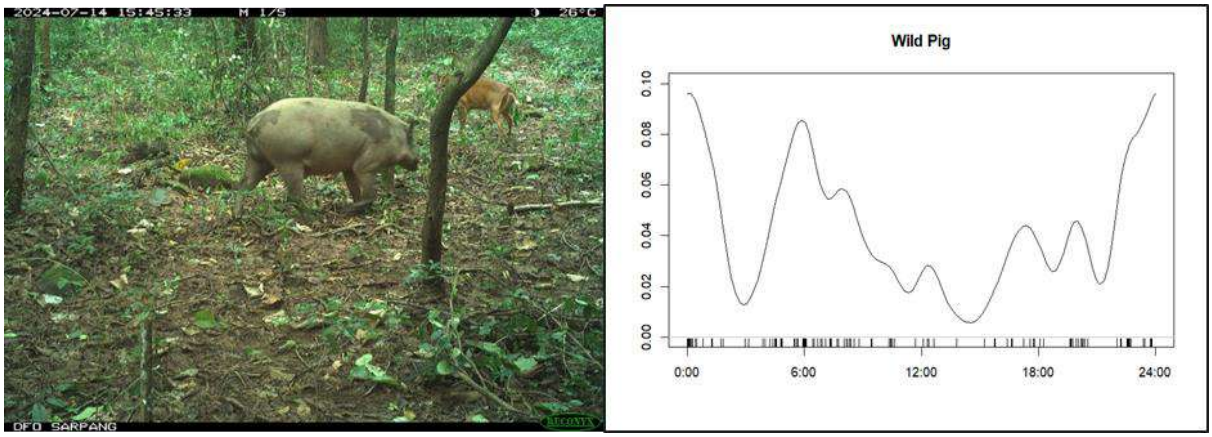

Figure 5. Wild pig and their activity pattern. They are more active during night showcasing nocturnal behaviour

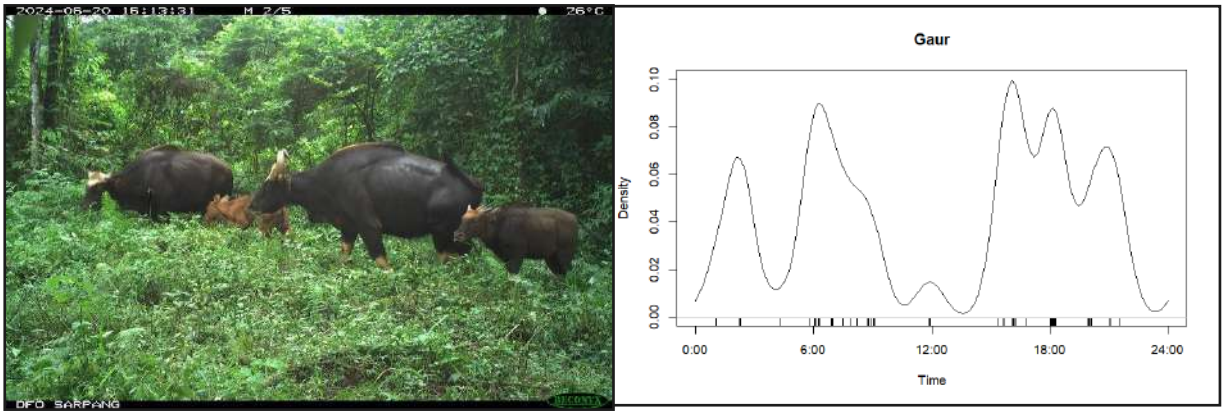

Figure 6. Gaur and their activity pattern. They are more active during dusk and dawn showcasing crepuscular behaviour

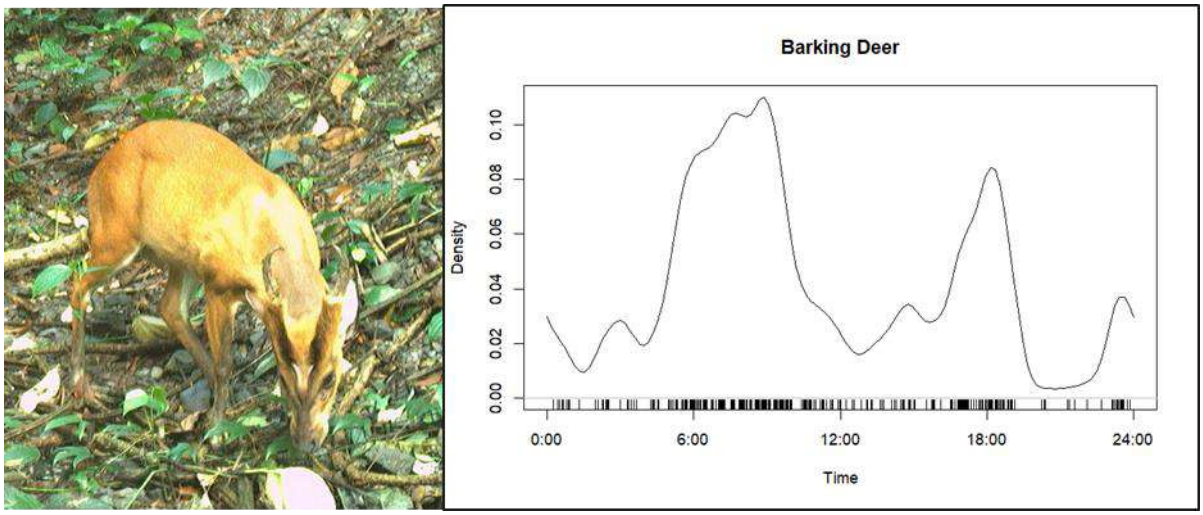

Figure 7. Barking deer and their activity pattern. They are more active during dusk and dawn showcasing crepuscular behaviour

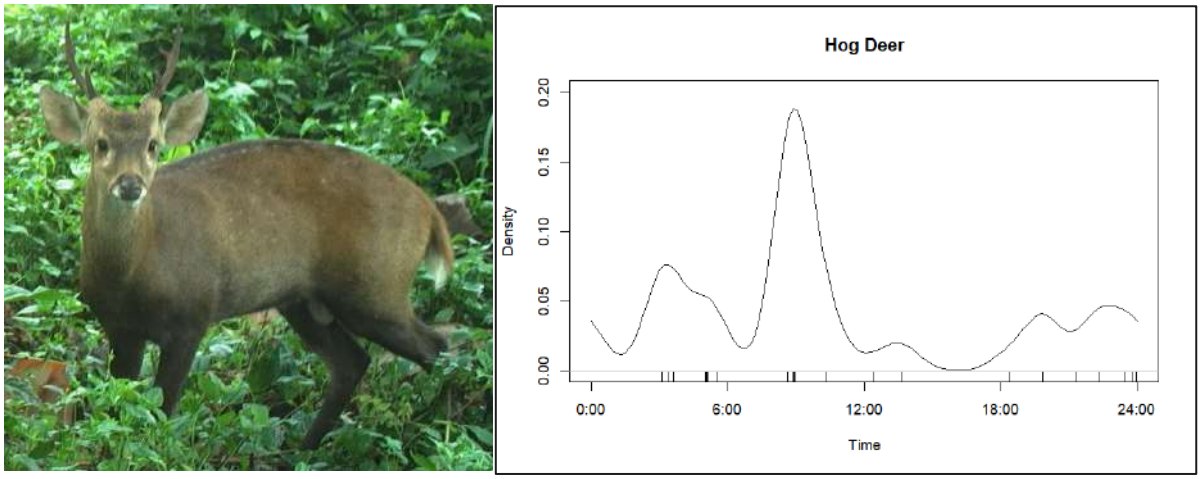

Figure 8. Hog deer and their activity pattern. They are more active during day showcasing diurnal behaviour

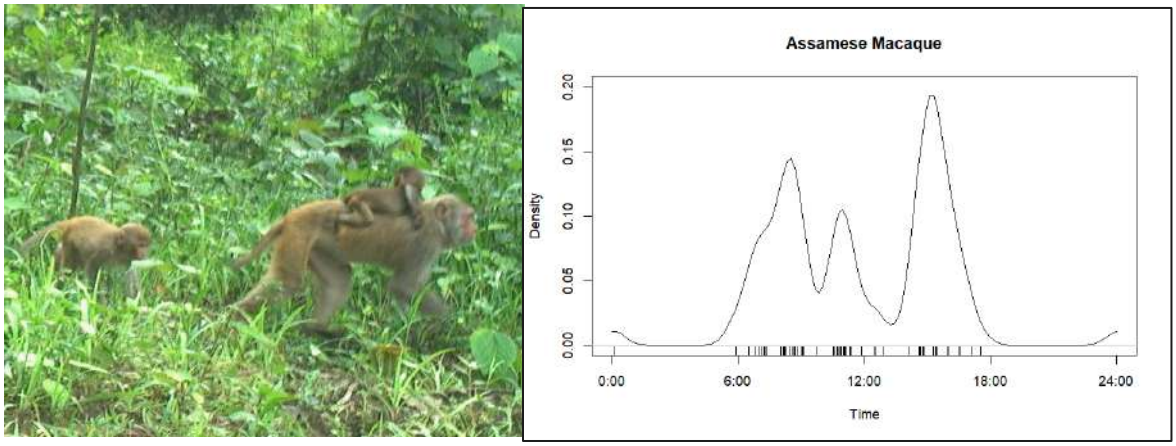

Figure 9. Assamese macaque and their activity pattern. They are more active during day showcasing diurnal behaviour

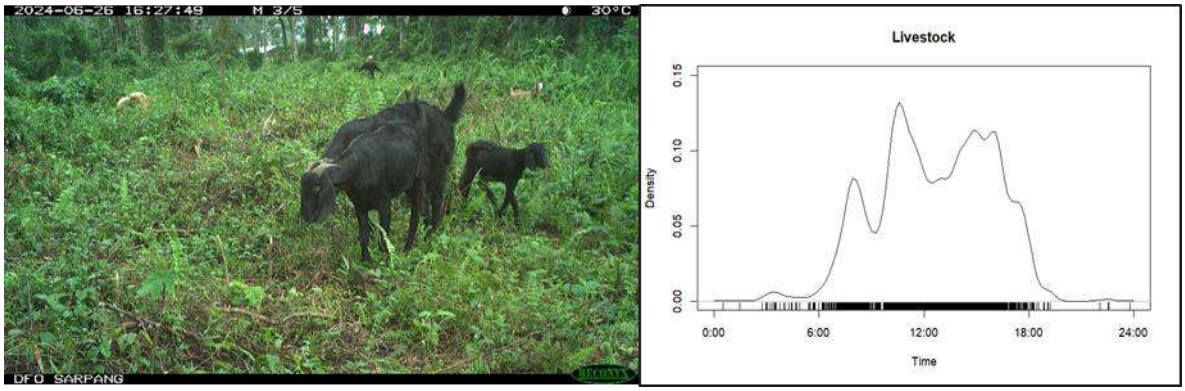

Figure 10. Livestock and their activity pattern. They are more active during day showcasing diurnal behaviour

Figure 11. Human and their activity pattern. They are more active during day showcasing diurnal behaviour

Figure 12. Monitor Lizard

Figure 13. Red Junglefowl

Figure 14. Himalayan Palm Civet

Figure 15. Wild dog

Figure 16. Indian Peafowl

Figure 17. Cattle Egret

Figure 18. Common leopard

Figure 19. Sambar deer

Figure 20. Common Myna on the back of a cow

5.3 Habitat description for each grid location

5.3.1 Sub-tropical Forests: (Grids 01, 06, 08, 09, 10, 11, 12, 13, 14, 15)

Figure 21. Subtropical forest

Description: These grids are characterized by sub-tropical forests found at altitudes ranging from 150 to 398 meters. The sub-tropical forests have dense canopy covered with a rich diversity of evergreen and deciduous trees, shrubs, and thick undergrowth. These forests typically occur in warm, humid conditions and support a wide variety of wildlife, including insects, birds, mammals, and reptiles. The higher elevation sub-tropical forests (such as those in Grid 01 and 15) are likely to have slightly cooler microclimates compared to those at lower elevations (such as in Grid 06).

5.3.2 Warm Broadleaf Forests: (Grids 03, 04, 05, 07)

Figure 22. Warm broadleaved forests

Description: These grids predominantly feature warm broadleaf forests, found at altitudes between 155 and 362 meters. Warm broadleaf forests are characterized by a mix of evergreen and semi-deciduous trees, often with a medium-dense canopy that

provides a moderate amount of shade. These forests offer diverse habitats for various species, including numerous bird species, small to medium-sized mammals, and rich insect life. The combination of warm temperatures and ample moisture in these areas makes them conducive to a variety of plant and animal species.

5.3.3 Grasslands: (Grids 02, 04, 05, 07, 12):

Figure 23. Grasslands

Description: These grids include areas of grasslands, typically found at lower altitudes (ranging from 155 to 185 meters). Grasslands are open habitats characterized by herbaceous vegetation, including grasses and other non-woody plants. They provide vital grazing areas for herbivores, as well as habitats for ground-nesting birds and various small mammals and reptiles. Grasslands can also act as transitional zones between different forest types, enhancing habitat diversity and supporting species that require mixed environments.