



Conservation Action Plan for Manipur's Brow-Antlered Deer or Sangai: An Integrated Approach

Annual Progress Report

2022-2023

Conservation Action Plan for Manipur's Brow-Antlered Deer or Sangai: An Integrated Approach

ANNUAL PROGRESS REPORT

2022-2023



Project Title	Conservation Action Plan for Manipur's Brow-antlered Deer or Sangai: An Integrated Approach
Project Duration	5 years (2016-2021) No cost extension (2021-2023 & 2023-2025)
Funding Agency	National Compensatory Afforestation Fund Management and Planning Advisory Council, Ministry of Environment, Forest and Climate Change, Government of India
Total Budget	19.9 Crores
1st Grant	1.3 Crores
2nd Grant	4.9 Crores
3rd Grant	4.1 Crores
Implementing Agencies	Wildlife Institute of India
Collaboration Agency	Manipur Forest Department
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Annual Progress Report Period	April 2022 - March 2023

Citation

WII (2023). Conservation Action Plan for Manipur's Brow-antlered Deer of Sangai: An Integrated Approach - Annual Report 2022-2023. Wildlife Institute of India, Dehradun and Manipur Forest Department.

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ACKNOWLEDGEMENTS

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1. BACKGROUND

The Manipur's brow-antlered deer (*Rucervus eldii eldii*) or Sangai occurs as a single, small and isolated population in Keibul Lamjao National Park (KLNP), located in the southern fringe of Loktak Lake, Manipur. The Park is characterized by floating meadows, locally known as *phumdis*, whose change in thickness will affect the survival of the species. Sangai is one of the most threatened cervid of India with a localized population and therefore, subject to high risk of extinction due to stochastic, demographic and environmental events. The species is listed in Schedule I of the Wild Life (Protection) Act, 1972, "Endangered" on the IUCN Red List, and Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna & Flora (CITES). The Park is surrounded by a dense human population dependent on its resources for their sustenance, putting pressure on the Park. The initial population of Sangai was 14 individuals in 1975. A critical look at the population growth rate of Sangai revealed a growth of 10% per annum during 1975-2003, which subsequently reduced to 5% per annum during 1984-2003. During 2006 – 2008, the growth rate of Sangai was more or less stable with the population size estimated at 90, 88 and 92 individuals' during 2006, 2007, and 2008 respectively, with a minimum of 66, 61 and 62 and maximum of 123, 127 and 137 Sangai at 95% confidence level (Hussain and Badola 2013) causing severe concern for its long-term survival. The changes in water regime due to the construction of Ithai barrage has led to rapid habitat deterioration. Besides, the Park is surrounded by a dense human population dependent on its resources for their sustenance, putting pressure on the Park. The species is listed in Schedule I of the Wild Life (Protection) Act, 1972, "Endangered" on the IUCN Red List of Threatened Species, and Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna & Flora (CITES).

As the Sangai population is growing within a restricted area without any scope for recolonization into the sinks, the Park's connectivity with its surrounding wetland and forest area needs to be identified and restored (Hussain and Badola 2013). The study on Sangai genetics conducted by the WII (2009) suggests that the Sangai population in the Park is susceptible to inbreeding depression, decreased fitness and lesser evolutionary potential. The captive stock in Delhi, Guwahati and Manipur Zoos also indicated a significant loss of genetic diversity due to inbreeding depression. The species is listed as "Endangered" on the IUCN Red List, Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna & Flora (CITES), and Schedule I of the Indian Wild Life (Protection) Act, 1972, warranting immediate conservation actions. The Loktak Lake is a Ramsar site, and efforts are being made by the Wildlife Institute of India to declare it a World Heritage Site.

In 2009, the Wildlife Institute of India (WII) in association with Manipur Forest Department (MFD) developed a 'Recovery Plan' for Sangai. The Ministry of Environment, Forest and Climate Change, Government of India under its Endangered Species Recovery Programme has taken up the project entitled "*Conservation Action Plan for Manipur's brow-antlered deer (Rucervus eldii eldii) or Sangai: An Integrated Approach*" with financial support from

the National Compensatory Afforestation Fund Management and Planning Authority (CAMPA). The objectives of the project are (a) Secure existing population in Keibul Lamjao National Park through science and innovation, (b) Create a second population at a select site in Manipur, (c) Improve habitat conditions, and protection measures (d) Involve local communities in conservation process of Sangai in both Keibul Lamjao National Park and at the reintroduction site and (e) Conducting applied research on the ecology of this species.

The project was launched at WII, Dehradun during the National launch workshop “Endangered Species Recovery Projects” on 16th May 2016. A memorandum of understanding (MoU) was signed with Manipur Forest Department (MFD) in July 2016 for the implementation of the project and field activities initiated subsequently. Subsequent to the launching of the project in 2016, a memorandum of understanding (MoU) was signed with Manipur Forest Department, and field conservation activities were initiated to secure the existing population in KLNP.

2. OBJECTIVES

To secure the long-term survival of Sangai in the wild, the following objectives are being carried out:

- A. Strengthening of existing population in KLNP.
- B. Establishment of second population in wild.
- C. Improved habitat condition and protection measures.
- D. Involving the local community in conservation efforts.
- E. Conducting applied research on the ecology of the species.

3. SCOPE OF WORK

As the existing Sangai population is growing within a restricted area without any scope for recolonization into the sinks, the connectivity of the Park with its surrounding wetland and forest area needs to be identified and restored. The conservation action for the recovery of the Sangai population will be in two stages, working simultaneously. In the first stage, the existing population in the KLNP will be strengthened, and habitat conditions will be improved. In the second stage, a new population in the wild will be established through conservation breeding programmes.

4. APPROACHES AND METHODOLOGIES

4.1. Strengthening of existing population in KLNP

Census will be conducted every alternate year to monitor the population trend in KLNP. Genetic monitoring of the wild and captive population will also be carried out using Next Generation Sequencing (NGS). A veterinary laboratory will be established at KLNP to monitor diseases for which a Project Officer/Veterinary Officer will be appointed along with the required support staff to maintain the laboratory. Screening of domestic livestock around the Park for diseases will also be carried out.

4.2. Establishment of a second population in wild

A rescue/conservation breeding centre will be established in Keibul, where a captive-bred Sangai population will be utilised for reintroduction. The current captive stock at various zoos, including the Iroishemba Zoo at Imphal, also needs to be examined and matched with the wild population. Survey of the possible reintroduction site and development and demarcation of the site will be done. A soft release site will be developed first, then extended to a larger area, and eventually, the entire site will be developed and maintained. For this purpose, land acquisition from the local landowners will also be done. The required construction work will be carried out by the Civil Construction Unit (CCU), which has an MoU with the Ministry of Environment, Forest and Climate Change (MoEF&CC), Government of India (GOI) and Wildlife Institute of India, Dehra Dun.

4.3. Improved habitat conditions and protection measures

Vulnerable sites around the Park will be fenced (chain-linked/ bund). Anti-poaching and vigilance camps will be established in the Park's northern, eastern and southern boundaries, which are more vulnerable to poaching and resource extraction. A year-round boat channel between Khordak and Toya, Khordak and Pabot, and Pabot and Toya will be maintained to aid patrolling by forest guards during the monsoon and early winter season when the water level in the Park is high. Protection camps will be established at strategic locations, primarily in the southeast boundary of the KLNP.

4.4. Involving the local community in conservation efforts

Ecodevelopment, livelihood options and awareness generation at KLNP and the reintroduction sites will be conducted to gain community support for Sangai conservation. Since the rising water level is a cause of concern for protecting and maintaining the ecological integrity of Loktak Lake and KLNP, it is proposed to conduct state-level stakeholder meetings to regulate water level periodically to mitigate and evaluate the situation. Training will be provided to the forest officials for better and scientific management of the Park. Capacity building of forest staff directly involved in patrolling and protection of the Park will also be conducted. A management plan for the Park and the reintroduction sites will be developed to assist in the management and long-term monitoring of these sites for the successful conservation of Sangai.

4.5. Conducting applied research on the ecology of the species

Primary research on the habitat, demography and genetics of Sangai and Hog deer will be carried out in KLNP. The habitat deterioration in the Park is due to the thinning of the floating meadows, *phumdis*. The water quality of Loktak Lake has deteriorated due to pollutants entering the Lake from Imphal, Bishnupur and the surrounding landscape, from both point and non-point sources. The other management-related research topics of interest include community structure and productivity of *phumdi*, water quality analysis and

extent of pollutant load, diseases and their impacts on population, socio-economic study, biomass demand of local people in the Park and the attitude of local people towards the Park.

5. WORK PROGRESS

5.1. Strengthening of existing population in KLNP

5.1.1. Release of the Integrated Management Plan of Keibul Lamjao National Park

To achieve the conservation of Sangai, “The Integrated Management Plan of Keibul Lamjao National Park, Manipur (2020-21 to 2030-31)”, prepared by the Wildlife Institute of India with support of the Manipur Forest Department was released on 20th June 2022 during an auspicious event held at Classic Grande, Imphal. The programme was attended by Shri G Asok Kumar, Director General, National Mission for Clean Ganga (NMCG) & Project Director NRCDC, Ministry of Jal Shakti, and Shri M H Khan, Addl. Chief Secretary (Forest & Environment), Govt. of Manipur, Shri Dr A K Joshi, PCCF& HoFF, Govt. of Manipur, Dr T. Brajakumar Singh, Joint Director, Directorate of Environment and Climate Change, Govt. of Manipur, Shri Moirangthem Asnikumar, Chairman Loktak Development Authority, Dr Kh Shamungou Singh, Chairman Technical Committee, Manipur State Wetlands Authority.



Figure 1: Release of the Integrated Management Plan of Keibul Lamjao National Park

Around 50 participants including representatives from different educational institutions, government departments, NGO's working for biodiversity conservation in Manipur, Gram Panchayat members, officials of the Forest Department and other dignitaries were present. On this occasion a documentary movie titled 'Sangai- The Animal That Looks at You' produced by WII was also broadcasted showing the ongoing activities of the project, the habitat condition and the difficulties faced during field survey. DCF (P&S) Shri Sanajaoba Khuraijam also presented a talk on the conservation status of Sangai and the present scenario of Sangai and its habitat from the perspective of a Park Manager.

5.2. Establishment of second population in wild

5.2.1. Development of Conservation Breeding Centre (CBC) for Sangai

A layout plan for developing a Conservation Breeding Centre (CBC) for Sangai at KLNP was prepared under the WII CAMPA-Sangai project in consultation with the Smithsonian Institute of Conservation Biology, USA and the National Institute of Animal Health, following the Central Zoo Authority guidelines. The plan initially proposed constructing four enclosures for keeping the animals (Figure 1). The Conservation Breeding Centre (CBC) at KLNP is initially proposed to construct four enclosures for keeping the animals (Fig. 1). The enclosures are designed according to the guidelines from Central Zoo Authority and each enclosure is designed to keep one animal with an area of 1500 sq.m. The enclosure contains one area for animal holding and handling and one resting area providing shade for the animals. Escape routes and visual barriers inside the enclosures are incorporated for the animals in case of emergencies. Also, movement of animals around the enclosures is also planned by constructing a road around the enclosures.



Figure 2: Action plan for CBC of Sangai and layout plan for initial development at KLNP





Figure 3: Landfilling activity using tipper and earth-movers in the CBC site

The WII CAMPA Sangai team in consultation with the Deputy Conservator of Forests (Park & Sanctuary), conducted the landfilling work during December-2022 and January-2023. Mapping of the landfilled area is ongoing for construction of enclosures.

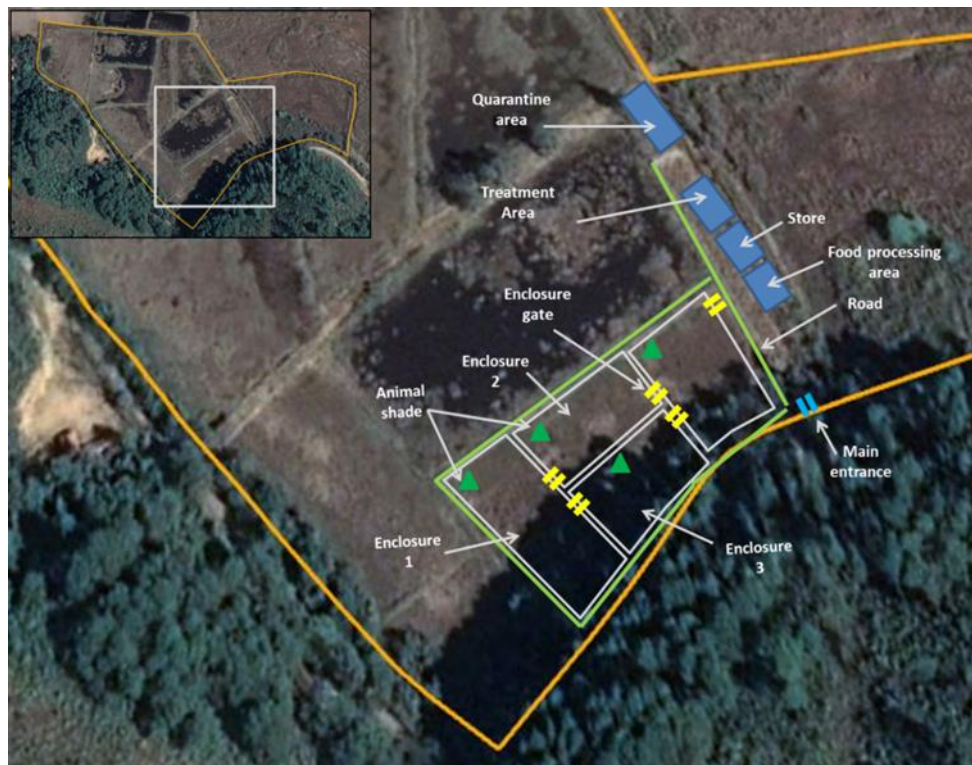


Figure 4: Enclosure design of the Conservation Breeding Centre (CBC) at KLNP

5.3. Improved habitat conditions and protection measures

5.3.1. Liaison with the Manipur Forest Department

5.3.1.1. Rescue and rehabilitation of wildlife

The research team also liaised with the Forest Department in matters pertaining to incidences of poaching, resource extraction by local communities and rescue of animals

from the park and surrounding area of the Park. Animals were rescued and treatments given for those required before rehabilitation in collaboration with the Manipur Forest Department. The rescued animals are treated or given first-Aid before rehabilitation and handed over to Manipur Zoological Garden for rehabilitation if not fit for release into the wild. If rescued animal(s) are healthy, they are released into the wild. From the month of January 2023 to April 2023, two hog deer were rescued and one Hume's pheasant was rescued. A hog deer rescued from Yawa Lamjao Toupokpi was given first-aid and released inside KLNK. while the other Hog deer and Hume's pheasant was handed over to Manipur Zoological Garden for rehabilitation.

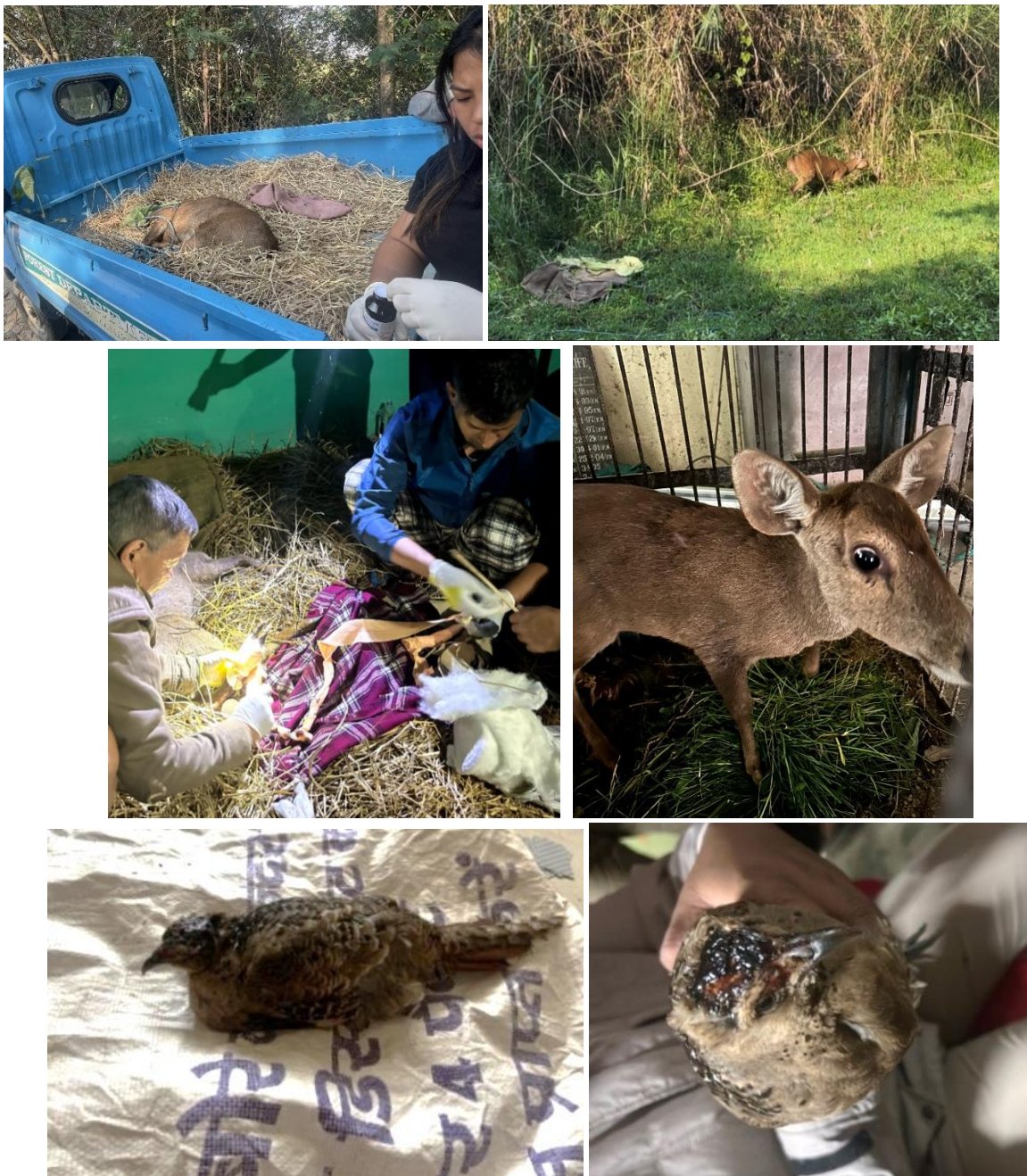


Figure 5: Rescued Hog deer (*Axis porcinus porcinus*) and Nongin or Mrs. Hume's pheasant (*Syrmaticus humiae*).

The frontline staff encountered carcasses of Hog deer and Sangai during their routine patrolling inside the park. As per requested by the Manipur Forest Department, team WII conducted post-mortem of the reported carcasses along with the frontline staff. A total of six carcasses were encountered from the month of January 2023 to April 2023 out of which two carcasses belong to male Sangai deer and four belongs to Hog deer (2 male, 1 female, 1 fawn). Cause of death could be determined only for one carcass of Sangai as drowning due to entanglement of vegetations while the other one was of Hog deer fawn succumbed to drowning. The rest of the carcasses i.e., 4 carcasses, cause of death could not be determined as they were unfit for post-mortem as only remnants like skull, bones and hides were found.

Table 1: Table showing the list of post-mortems conducted on different animals encountered inside the Park

Date	Species	Sex	Age group	Location	GPS location	Cause of death
20.01.2023	Hog deer	Male	Adult	Thangbirel Yangbi	N24°29'12" E93°49'24"	Undetermined due to advanced decayed
13.02.23	Sangai deer	Male	Adult	Hiramphatpi	N24°28'45" E93°49'54"	Undetermined due to advanced decayed
17.02.23	Hog deer	Male	Fawn	Khordak Range 2	N24°30'12.948" E93°51'5.826"	drowning
02.03.23	Sangai deer	Male	Adult	Gourahari Yangbi	N24°28'26.934 E93°50'19.92"	Drowning due to entanglement of vegetations
23.03.23	Hog deer	Male	Adult	Nashik Houbi	N24°30'30.59" E93°49'54.22"	Advanced decayed
12.04.23	Hog deer	Female	adult	Khordak range 2	N24°30'0.8784" E93°51'7.5132"	Advanced decayed



Figure 6: Carcass of Sangai (*Rucervus eldii eldii*) encountered inside KLNP.



Figure 7: Carcass of Hog deer encountered inside KLNP

5.3.2. Vaccination of livestock and pets around the Park

Wildlife Institute of India, Dehradun conducted 3 animal health camps from 28th February to 1st April 2023 at Chingthi Komlakhong – Hiyangkhong, Khordak and Keibul villages. These animal health camps were jointly organized by CAMPA-Sangai team and office of the Deputy Conservator of Forests (Park & Sanctuary) in collaboration with local NGO Environmental Social reformation and Sangai Protection Forum (ESRSPF). The main objective of these camps were to involve local communities in our conservation efforts and build trust.



Figure 8: Vaccination camps for livestock and pets in the fringe villages of KLNP

A total of 126 pet animals were vaccinated against rabies and the livestock owners consulted about the ailments their animals are suffering from. As per complaints of the farmers, free medicines were distributed. In addition to free health camps, WII conducts disease surveillance around the park periodically creating awareness among the farmers about zoonotic diseases and its importance and effects on the wild population inside the park. Apart from disease surveillance, WII team also take care of sick animals as or when reported by the farmers.

5.4. Involving the local community in conservation efforts

5.4.1. Awareness and outreach

5.4.1.1. Celebration of International Day for Biological Diversity 2022

To increase the understanding and awareness of the various biodiversity issues, the International Day for Biological Diversity was celebrated through awareness talks and on-spot quiz on 22nd May 2022. The programme was aimed to create awareness on the vital importance of preserving our Biodiversity. It was conducted signifying the role of students in bringing a change in the society and making them messengers for the conservation of biodiversity in their surroundings. The event was attended by 49 participants which included teachers and guardians of the students. Dr Sharmila Naosekham, Project Fellow, WII CAMPA-Sangai gave a talk on the importance, role of biodiversity in our life. The talk was followed by a quiz competition under the theme' "Building a shared future for all".



Figure 9: Students' participation in awareness talk and on-spot quiz competition during the celebration of International Day for Biological Diversity

Prizes were given to the winners as an encouragement. The event was organized by WII and Office of the Deputy Conservator of Forests (Park & Sanctuary) in collaboration with the Environmental Social Reformation and Sangai Protection Forum (ESRSPF) at Chingmei Upper Primary School, Chingmei, Bishnupur District, Manipur.

5.4.1.2. Celebration of World Environment Day 2022

WII CAMPA-Sangai team also took part in the global celebration of World Environment Day on 5th June 2022 under the slogan “Only One Earth” with the focus on “Living Sustainably in Harmony with Nature”. World Environment Day was celebrated in collaboration with Manipur Forest Department; Environmental Social Reformation and Sangai Protection Forum (ESRSPF), Childhood Friends of Keibul Lamjao, Atomyaima Junior High School and local clubs of Keibul Lamjao. Dr Chongpi Tuboi, Project Scientist CAMPA-Sangai gave a talk to the school students and audience gathered in the programme highlighting our role in saving Earth and maintaining a clean environment. Drawing competitions were held for the students and prizes were distributed to the winners. A total of 70 students participated in the competition. A mass gathering was observed in this programme including the guardians of the students. The programme was successful in giving the message on the importance of a healthy environment to the different group of audience present on the occasion. Information brochures on Waterbirds and Grassland birds of surrounding area prepared by WII CAMPA-Sangai team was also distributed as a part of the celebration. A tree plantation drive was also carried out at Keibul Lamjao National Park and its surrounding landscape including the Khongjaingamba Wildlife Sanctuary





Figure 10: Glimpses of tree plantation, awareness programme and painting competition during the celebration of World Environment Day 2022

5.4.1.3. Celebration of Har Ghar Tiranga

Taking part in the National Campaign on Har Ghar Tiranga WII CAMPA-Sangai team also carried out this campaign in different parts of the state along with spreading the awareness on Sangai conservation. The campaign took place from 11th August 2022 to 15th August 2022. The campaign started from Tamenglong district on 11th August 2022 which was jointly organized by Manipur Forest Department. A rally by the students of Kumbi Sandhong Upper Primary School, Kumbi, Bishnupur district was also organized on this occasion. Tricolor flag was hoisted at Range Forest Office, Keibul Lamjao along the DCF (Park & Sanctuary) and other Forest staff on 13th August 2022. On the occasion of 75 years of Indian Independence on 15th August, Har Ghar Tiranga Campaign was conducted at Kendriya Vidyalaya Lamphelpat Imphal.



Figure 11: Some glimpses from the observation of Har Ghar Tiranga

5.4.1.4. Field tour programme with students of Kendriya Vidyalaya, Loktak Project

A field tour programme for the students from class 12 of Kendriya Vidyalaya Loktak Project was conducted at IB-II of KLNP on 27th September 2022. During the programme, students were made aware about the current threats faced by Sangai and its conservation efforts. Later, they were taken inside the Park and made acquainted with various field scientific knowledge such as plot sampling techniques for vegetation analysis. A total of 33 students, teachers and staff of Manipur Forest Department took part in the programme.



Figure 12: Group photo with the students participated in the field tour programme

5.4.1.5. Celebration of 67th Wildlife Week 2022

On 8th October 2022 67th edition of Wildlife Week was celebrated at Kumbi Sandhong Upper Primary School, Bishnupur District, Manipur. The event was organised by the Wildlife Institute of India, Dehradun in collaboration with Manipur Forest Department and included activities such as On-spot painting and Slogan writing competition under the theme 'Human and Wildlife Co-existence', followed by an awareness talk on wildlife conservation and the role of each individual towards conservation by Dr. Sharmila Naosekpm. The celebration was attended by 200 participants including students and teachers from various schools around Keibul Lamjao. Certificates and prizes of the activities were distributed on the spot.





Figure 13: Participation of local school children in the celebration of Wildlife Week 2022

5.4.1.6. Exhibition stall in the Manipur Sangai Festival 2022

Sangai, the pride of Manipur is on the verge of extinction with its dwindling population. More than ever, ensuring public support is critical to conserve this endangered species. This calls for generating awareness among the masses. The Wildlife Institute of India in collaboration with the Manipur Forest Department (Wildlife Division) set up an exhibition stall named as 'Manipur: The Cradle of Sangai' at the 'Manipur Sangai Festival', the biggest annual cultural festival of the State organized by Manipur Tourism Department from 21st till 30th of November, 2022. This festival is being celebrated to promote Manipur as a world class tourism destination and at the same time showcasing its rich culture as well as biodiversity. The stall was visited by all kinds of tourist including local, national and international tourist who were inspired on witnessing a glimpse of the rich natural heritage of the state. The stall showcased the rich biodiversity of Keibul Lamjao National Park. Informative brochures, pamphlets, booklets, etc. were distributed among the visitors and the exhibition of products handcrafted by the local women SHGS under WISC of Keibul Lamjao National Park. The stall was decorated with standees on biodiversity of Keibul Lamjao National Park. The replicas of Sangai at the stall became a major spot for taking pictures for the visitors.



Figure 14: Public information dissemination on Sangai conservation in the exhibition stall opened during the Manipur Sangai Festival 2022

5.4.1.7. Celebration of World Wetlands Day 2023

World Wetlands Day 2023 was observed today at Kumbi Sandong Upper Primary School, Kumbi, Bishupur district in collaboration with the Manipur Forest Department with the objective of generating awareness among the school children on wetlands by highlighting their importance and conservation issues. Awareness talks were given by the project personnel of WII CAMPA - Sangai team on conservation of Wetlands in a very simple way that could be perceived easily by the group of students. The participants were made aware

of their contributions towards wetlands conservation and biodiversity since they were all from the fringe villages around Keibul Lamjao National Park. The students were encouraged to take part in further programmes and help on spreading the awareness messages on conservation of Sangai and its habitat. The participants were very much motivated on when their roles in wetland conservation was highlighted. A Quiz competition was held which was participated by around 150 students from both junior and senior classes. The schools that took part in the programme were Kumbi Sandhong Upper Primary School, New Model Public School and Sambanlei Sekpil School. Prizes were distributed to the winners.



Figure 15: Students' participation in the on-spot quiz competition during the World Wetlands Day Celebration

5.4.1.8. Celebration of World Wildlife Day 2023

In view of the World Wildlife Day 2023, on 3rd March 2023 an awareness cycle rally was organized with school students in collaboration with the Office of the DCF (Park & Sanctuary), Manipur Forest Department and Environmental Social Reformation & Sangai Protection Forum (ESRSPF). Around 200 students of different classes from Loyalam Public School, Paradise Gardening School, Chingmei Upper Primary School, Kumbi Sandhong Upper Primary School & Atomyaima Junior High School from Keibul, Chandpur, Moirang Khunou and Kumbi participated in the cycle rally. The objective was to create awareness among the locals, the school students and local club members regarding wildlife conservation and role of community participation in the conservation process along the stretch of the rally. A short introductory programme for the participants was also organized which was attended by the Ranger Officers and frontline staff of KLNP and ESRSPF. The rally started from the

gate of Keibul Lamjao National Park and was ended at the Sangai Ethnic Park at Moirang Khunou covering stretch of around 3 kms. Media persons were invited for the coverage of the programme so that the message reached a larger audience.



Figure 16: Awareness Cycle Rally from KLNP to Sangai Ethnic Park at Moirang Khunou to raise public awareness on importance of wildlife

5.4.2. Consultation Workshops and Capacity Building

5.4.2.1. Training programme on vermicomposting

WII in collaboration with the Green Foundation Imphal organized a one-day training programme on vermicomposting in Range-I area of KLNP on 8th June 2022. Around 34 participants from two village farmers' society participated in the training programme. Experts from Mission Organic Manipur delivered hands on training on the methods and techniques of vermicomposting to the participants. Vermicomposting is known to have great use to villagers which could be done with small investment and available natural resources in a sustainable way. Further training on organic farming is being planned to conduct after motivated them through field exposures in successful organic farming sites in Manipur.



Figure 17: Training of local farmers' groups on vermicomposting methods and techniques

5.4.2.2. One-Day National Level Workshop on Protection and Conservation of Wetlands

On 27th August 2022 a One-day National Level Workshop on 'Protection and Conservation of Wetlands' was jointly organized by WII CAMPA-Sangai, Department of Zoology, Manipur University; Department of Environmental Science, Pole Star College; Biodiversity, Ecology & Environment Network (BEENET) Manipur at Manipur University. The workshop was inaugurated by Shri Prof. Naorem Lokendra Singh Hon'ble Vice Chancellor, Manipur University. Other dignitaries who graced the workshop includes Prof. Thingbaijam Binoy Singh, Head of Zoology Department, Manipur University, Prof. M Damayanti Devi, Head of Botany Department, Manipur University, Prof. N Mohilal Meitei, Working President BEENET Manipur and Dr T. Brajakumar Singh, Joint Director, Directorate of Environment and Climate Change, Govt. of Manipur. The workshop highlighted the status of wetlands in Manipur and North East India and their conservation issues.





Figure 18: Glimpses of the National Workshop on Protection and Conservation of Wetlands

The workshop consisted of 3 technical sessions by resource persons from different Departments. Dr T. Brajakumar Singh, Joint Director, Directorate of Environment and Climate Change, Govt. of Manipur gave a presentation on “Wetlands and Global Climate Change”. The presentation highlighted the roles played by wetlands and the relation of vanishing wetlands with global climate change. Dr Likmabam Sanjoy Meitei, Assistant Professor, Dept. of Environmental Science, DM College of Science gave importance to the different RAMSAR sites in North-East India in his presentation titled “Ecological threats and degradation of RAMSAR sites in North-East India”. His presentation gave a figure of the vanishing wetlands in North-East India and the urgency in their conservation efforts. Dr Chongpi Tuboi, Project Scientist, WII CAMPA-Sangai also emphasized through a presentation on the current status of Keibul Lamjao National Park, a part of RAMSAR site Loktak Lake and its associated wildlife, particularly Sangai. The workshop was attended by 109 participants including faculty members and researchers from different colleges of the state and Manipur University. Certificate of participation was distributed to all the participants.

5.4.2.3. One-Day orientation programme with MSRLM for development of women SHGs around KLNP

A one-day orientation programme for the development of women Self Help Groups (SHGs) with Manipur State Rural Livelihoods Mission (MSRLM) was jointly organised by the Wildlife Institute of India and Manipur Forest Department on 2nd December 2022. The program was attended by 90 local women from 13 SHGs from surrounding villages of Keibul Lamjao National Park. The SHGs interacted with the MSRLM officials and WII researchers. This gave an opportunity for the local women to clear their doubts and develop a better understanding on the management of their groups. Moreover, MSRLM staff were made aware on the conservation issues of Sangai and importance of involving the local communities in conservation process. MSRLM staff were also made aware of the urgent need of an alternative livelihood of the community around KLNP for the best conservation efforts of Sangai and its habitat. The programme would not only help in strengthening the

functioning of SHGs, but also sustain their convergence with MSRLM in areas of sustainable livelihood promotion around the Park which will have a great impact on the conservation process of Sangai.



Figure 19: Orientation of MSRLM staff of Bishnupur District and Interaction with women SHGs during the programme

5.4.2.4. One-Day Orientation Programme on Post-COVID livelihood improvement of local community living around KLNP through Science & Technology

COVID-19 has triggered one of the worst job crises globally increasing poverty and widen inequalities. A one-day orientation programme as a step towards building trust between the WII team and local community was organized under the heading, " Post COVID livelihood improvement of local community living around Keibul Lamjao National Park through Science & Technology" in collaboration with Manipur Forest Department and Green foundation at Keibul Mayai Leikai on 12th January 2023. A total number of 43 participants took part in the programme. Participants were briefed upon different livelihood trainings which would be imparted to the villagers around KLNP by various training partners in association with the Green Foundation under the aegis of Department of Science and Technology, Govt. of India. Later, during the discussion session, strength, opportunities and challenges in taking up alternate livelihoods by the villagers were thoroughly discussed upon between the participants and experts present in the programme.



Figure 20: People participation in the awareness programme on post-COVID livelihood improvement of local community

5.5. CONDUCTING APPLIED RESEARCH ON THE ECOLOGY OF THE SPECIES

5.5.1. Population monitoring of Sangai in KLNP

5.5.1.1. Training of volunteers and forest guards

For the population estimation exercise, pre census training was carried for 48 selected volunteers and front-line staff of KLNP. Volunteers included members of different NGOs namely Wildlife Institute of India (WII), Manipur Forest Department, People for Animal (PFA), Environmental Social Reformation and Sangai Protection Forum (ESRSPF), Green Brigade Manipur (GB), Unique Wildlife Protection Committee (UWPLC) and Doordarshan Manipur. Two days training program was conducted at Manipur Zoological Garden, Iroisemba and Keibul Lamjao National Park (KLNP) on 13th and 14th March, 2023 respectively.

On the first day of the training program the principles of distance sampling technique in wildlife population estimation and the importance of population estimation of any species with special reference to Sangai and Hog deer were explained to the volunteers. Basic identification features and differentiation of Sangai and Hog deer based on the morphology of the species were explained to avoid confusion and mis-identification of individuals during

the census. Information on differentiation between male and female, different age classes between both the species of deer were also described to the volunteers to improve their identification skills. As part of the training program at Iroisemba, mock point counts were conducted and each volunteer was observed independently before the inception of the actual survey to ensure that each team member could correctly observe and identify the species and individual characteristics.

On the following day, hands on training were conducted and the use of instruments such as binoculars, range finders, etc. were demonstrated to the volunteers enabling them to record the measurements with accuracy during the point count surveys. Datasheet entry, precautions to avoid double counting of animals and do's and don'ts inside the Park were also briefed. We ensured that the volunteers completed the datasheets precisely. A drill was also conducted inside the park at the nearest machan to ensure that the volunteers are well trained for the upcoming population estimation.



Figure 21: Training workshop of volunteers and forest staff for population estimation of Sangai and associated species in KLNP

5.5.1.2. Fire line cutting and machan construction

For demarcation and enhanced visibility, fire lines were constructed over a length of 300-500m and width of 30m. Controlled burning of fire lines was carried out to enhanced visibility 1month before the estimated date for population estimation. The burning of fire lines also plays an important role in population estimation as new shoots attracts animals for feeding and hence helps in counting individual animals. A total of 29 machans were constructed out of which 9 machans/watch towers were permanent and 20 machans were temporary structures constructed using bamboo poles at an approximate height of 6 to 7m. The machans were constructed to cover all parts of the park and at a distance avoiding overlapping from other machans and the range considered for counting of individual animals to avoid the possibility of double counts or flushing of animals to the other machans.

Distance sampling using line transects and point counts have been used extensively to estimate wildlife populations and have been used successfully in a very diverse array of taxa including trees, shrubs and herbs, insects, amphibians, reptiles, birds, fish, and marine and land mammals (Buckland *et al.* 2001). Point counts are used to sample populations for estimating densities in local areas, determining trends in populations over regional areas, assessing habitat preferences and other scientific and population monitoring purposes (Buckland *et al.* 1993). We adopted point count method for population estimation because of the inaccessibility of the terrain due to the predominantly floating habitat conditions (*phumdis*) conjoined with the elusive behaviour of the species. We used a double-observer approach developed to estimate detection probabilities and to increase detection accuracy (Nichols *et al.* 2000, Burnham *et al.* 1980, Buckland *et al.* 2001).

The population estimation survey was conducted for 5 consecutive days from 23rd to 27th March 2023. For each machan, two or three volunteers were assigned permanently throughout the census. The observation timing was fixed at 05:30-08:30 AM i.e., 3 hours. The volunteers are expected to reach their respective machan 45min ahead of the fixed time for starting the count. The volunteers of range 1 assemble at the park gate at 03:00AM and dispersed for their respective/assigned location as some of the machans are located far away. The volunteers of range2, as the machan locations are nearer, assemble at 04:00AM at range2 office and dispersed for their respective machan. During each point count, a designated “primary observer” indicates to the “secondary observer” all the animals detected, who then records all the detections. Both the observer had performed the same duty for the whole duration of the population estimation. To avoid double count of the individuals, the primary observer kept on track of the individual recorded. Distance was measured using a laser rangefinder and 8 x 40 prismatic binoculars were used to aid counting of individuals. The data analysis of population estimation survey is in process.



Figure 22: Machan used for population estimation of Sangai and associated species at KLNPN



Figure 23: Volunteers during population estimation survey of Sangai and associated species in KLNP

5.5.2. Drone Survey

Technological interventions such as remote sensing can play a crucial role in conserving inaccessible wetlands and their associated species. The floating meadows of Keibul Lamjao National Park (KLNP) in Manipur, India, are the only home to the last remaining wild population of the endangered and endemic Eld's deer, locally known as Sangai (*Rucervus eldii eldii*). Apart from the rampant change in land use and altering water regimes induced by anthropogenic pressure, monitoring of the population and habitat quality remains a challenge. Moreover, conventional surveys that involve infiltrating animal habitats could adversely affect the habits and behavior of such shy species as a response to human presence. This study assesses the scope of Unmanned Aerial Vehicles (UAVs) to non-invasively access such a challenging habitat and detect the ungulate individuals of interest. A rotary-wing quadcopter mounted with a vision-based sensor was tested in this landscape conditions for its durability, failsafe range, flexibility, visualization, detection, resolution, response to wind and weather in terms of steadiness of flight, stabilization, and camera capabilities. The preliminary results of the drone survey based on three different time frames suggest that it is feasible to soar through the floating meadows to detect deer with Thermal Infrared (TIR) imaging in the night and early morning with both TIR and Visible Imaging Sensor (VIS) without creating a disturbance in animal behavior. A flying height of nearly 90 m with the VIS for vegetation and 20-25 m with TIR for animal presence yielded the best results. We have also established the least distracting technique of sampling by analyzing the behavioral response of the deer to the presence of drone. This study has paved a safe and practical way for acquiring accurate ground information that can assist in population estimation, habitat assessment, and wildfire detection to aid the conservation of an invaluable natural asset.

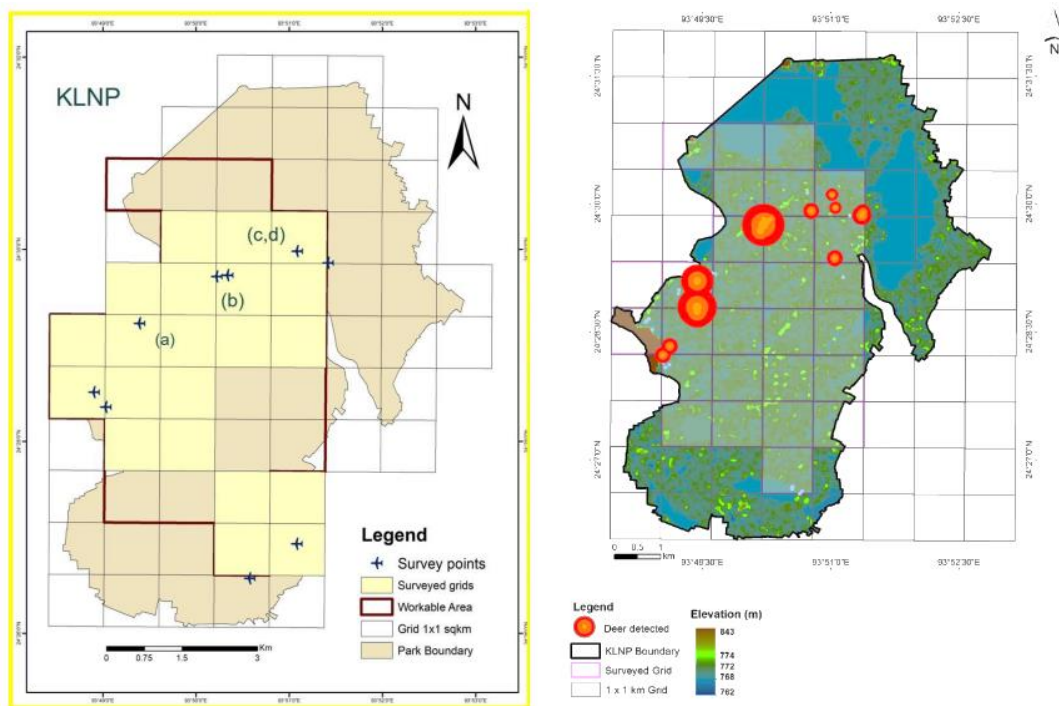


Figure 24: Study Design & Heat map of deer detected in surveyed grid

5.5.3. Monitoring of phumdi thickness and water level

Habitat improvement is one of the most critical steps toward Sangai conservation, areas vulnerable to poaching and human disturbances have been identified, and appropriate measures have been incorporated into the management plan. Patrolling routes by foot, boat and vehicle have been identified and mapped. Monitoring of *phumdi* thickness, water level and tall grass management areas for improved habitat conditions have been mapped.

Pellet distribution surveys and vegetation transects are being carried out across the season to study the habitat use pattern of Sangai and associated species. In addition, as a part of habitat monitoring, vegetation sample along with *phumdi* thickness, water level, ground cover and disturbance signs were recorded. Vegetation data were collected using the quadrat method (Mueller-Dombois and Ellenberg 1974). A total of 35 vegetation transects were sampled from January 2022 to February 2022. Each transect is 500 meters in length and 2 meters wide, and at every 50 m intervals, a quadrat of 0.5 x 0.5 meters was laid. In each quadrat, the total number of each plant species, the type and the average height of each species were recorded. In addition, pellets encountered rate, *phumdi* thickness, water level above and below the *phumdi*, ground cover and disturbance signs were recorded. The *phumdi* thickness and water level were measured using a bamboo pole based on the laid transects. A vertically held bamboo pole (of 10 feet with a nail at its base) is inserted inside the *phumdi*; the depth of the *phumdi* and the level of water inside the *phumdi* were recorded using a measuring tape. Water level monitoring inside the Keibul Lamjao National Park (KLNP) is also carried out regularly to check the fluctuating water level across the season and to observe the trend. The Park is divided into zones based on the measured

thickness of *phumdi*. A thickness >120 cm is considered thick, between 60.1 to 120 cm as medium, and a thickness <60 cm is considered thin. Data analysis of phumdias thickness and water level monitoring at KLNP and Ithai Barrage is in process.



Figure 25: Transect survey and water level monitoring inside the Park

5.5.4. Stress physiology

Stress physiology is an important aspect of species management as high levels of stress can reduce the reproductive capacity, and its ability to cope up with the threats to their survival. Fecal glucocorticoid metabolite (FGM) concentration is a reliable widely used non-invasive method for quantifying stress, in wildlife population. Also, it can be used to assess the impacts of social biological, environmental and anthropogenic factors. The measurement of FGM is valuable for endangered species that are elusive with low population density where non-invasive techniques are preferred. Eld's deer is a highly conservation dependent species and several species translocation programs are ongoing for establishing its viable populations in the wild. Assessment of stress physiology of founder and translocated populations can therefore play a vital role in increasing the efficiency and implementation of the ongoing conservation efforts. In this study, we attempted to assess the Fecal Glucocorticoid Metabolites concentrations in wild and captive populations of Eld's deer in India to assess their stress profile. We used non-invasive sampling approach and analyzed the FGM concentrations using fresh fecal pellet samples collected from wild (n=20) and captive populations (n=29) of Eld's deer in India.

Quantification of FGM levels using Corticosterone Enzyme Immuno Assay (EIA) revealed significantly higher FGM concentrations in the wild population (28.73 ± 16.93 pg/50 μ l) compared to the captive populations (14.88 ± 9.86). Moreover, the FGM concentration varied among the captive populations with Alipore Zoo (10.71 ± 11.94 pg/50 μ l) exhibiting significantly lower levels compared to Manipur Zoo (19.05 ± 4.65 pg/50 μ l). Further studies on the environmental, social, and other anthropogenic factors affecting the levels of FGM needs to be investigated for better management and conservation of this species. The report (see Annexures) has been submitted to West Bengal Forest Department and biological sample has been collected from Alipore Zoological Garden for further assessment of stress physiology.

5.5.5. Dependence of local community on biomass in Park

The Park is surrounded by 36 fringe villages within a 3 km radius from the park boundary. The overall socio-economic condition of the local people living around the park is generally characterized by poor economic condition along with limited livelihood options. Previous preliminary findings of WII indicated that the local villagers are highly dependent on natural resources found in the Park for both subsistence as well as commercial purposes. The low economic status of the people due to limited livelihood options available to them is one of the major attributes to their continued dependence on the Park for their livelihoods. Studies have also identified these anthropogenic pressures on the Park as one of the threats which affects the habitat of Sangai and other animals in the Park.

Therefore, in order to examine the biomass demand of local people inside the Park, WII has been conducting regular monitoring of entry/exit points along the boundary of the Park. A total of 18 such entry points have been identified and these entry points are being monitored by engaging local people from each respective villages. Information is being collected on extent of biomass demand, type of biomass and their perceptions on conservation of Park using both datasheet and through ODK mobile application across seasons. The collected information would aid in conservation planning of Sangai and its habitat. Moreover, it would assist conservation planners while developing ecodevelopment planning around the Park.



Figure 26: Photographs showing resource extraction activities of the local people in the Park

Table 2: Summary of the activities implemented and milestone achieved during 2016-2023 and future activity plan.

Objectives	Proposed activities	Activities implemented and milestone achieved	Activities pending/ To be done/ Way forward
A. Strengthening of existing population in KLNP	1. Census will be conducted in alternate years to monitor the population trend in KLNP.	<ul style="list-style-type: none"> • An Integrated Management Plan of KLNP has been prepared and released. Collaborative implementation of the plan by the Manipur Forest department (MFD) and Wildlife Institute of India (WII) is in process to strengthen the existing the population of Sangai and associated species in Keibul Lamjao National Park (KLNP). • Population estimation of Sangai and associated species has been conducted. Standardisation of advanced techniques for population estimation based on optical and thermal imaging using Unmanned Aerial Vehicle (UAV) or drones is in progress. The estimated population size of Sangai is 76 individuals of all age and sex with a minimum of 51 and maximum of 101 individuals in KLNP. 	<p>WII has prepared an Integrated Management Plan (2021-2031) based on extensive field work and multiple consultation workshops with relevant stakeholders. The plan outlines strategies for restoration and management of habitat conditions and strengthening the existing population of Sangai in KLNP. Effective implementation of the management plan is crucial and following activities need to be continued for achieving this objective.</p> <ol style="list-style-type: none"> 1. Collaborative implementation of the Integrated Management Plan of KLNP by MFD and WII will be ensured to strengthen the existing population of Sangai in KLNP. 2. Population estimation of Sangai and associated species in KLNP needs to be conducted to monitor the population trend of Sangai and detect any change in the population size. 3. Assessment of population size of hog deer and wild pig in KLNP needs to be conducted to examine the extent of competition and its impact on Sangai population. 4. Estimation of population size using drones will be implemented to obtain accurate estimates of Sangai population.
	2. Genetic monitoring of the wild and	<ul style="list-style-type: none"> • Genetic profiling of captive and wild populations of Sangai has been conducted. The whole genome of Sangai using Next 	<ol style="list-style-type: none"> 5. Monitoring of genetic structure of founder individuals, release stock and reintroduced population of Sangai using

	<p>captive population will be carried out.</p>	<p>Generation Sequencing has been completed and the analysis is in process.</p>	<p>advanced genomic tools is in process and need to be continued.</p>
	<p>3. A veterinary lab will be established at KLNP to monitor diseases for which a Project Officer/Veterinary Officer will be appointed along with the required support staff to maintain the lab. Screening of domestic livestock around the Park for diseases will also be carried out.</p>	<ul style="list-style-type: none"> • A veterinary centre has been established at KLNP. Regular ring vaccination program and disease surveillance for livestock is being conducted since the inception of the Project. Disease surveillance for Sangai and Hog deer in collaboration with the State Veterinary Department has also been conducted. • Capacity building of Forest staff and local volunteers through training on conducting population estimation, wildlife surveys and rescue and rehabilitation, and sensitisation workshops on management and conservation issues and community-based conservation in KLNP. 	<p>6. Development of the established veterinary centre is ongoing, which will be continued for handling rescue and rehabilitation.</p> <p>7. Disease surveillance and vaccination programmes will be continued in collaboration with the State Veterinary Department and MFD.</p> <p>8. Continue conservation education and awareness campaigns for capacity building of frontline staff and local youths in KLNP and reintroduction site.</p>
<p>B. Establishment of second population in wild</p>	<p>1. A rescue/conservation breeding centre will be established in Keibul where stocks that will be utilised for reintroduction will be maintained by capturing stray animals. The current captive</p>	<ul style="list-style-type: none"> • An Action plan for conservation breeding of Sangai has been prepared and submitted to the MFD. • Land acquisition for establishment of Conservation Breeding Centre at KLNP initiated, land filling and development of enclosures is ongoing. • Using the standardized protocols, translocation of four Sangai individuals from Sangai Breeding Centre at Langol to Manipur Zoological Garden, Iroisemba has been conducted and the translocated individuals are breeding successfully. 	<p>1. The Conservation Breeding Centre (CBC) of Sangai at KLNP is being developed. At present, landfilling at the centre is ongoing which will be followed by construction of enclosures for keeping Sangai along with other required breeding facilities.</p> <p>2. As the conservation breeding of Sangai is a collaborative task, WII will develop the capacity of the front-line staff of Manipur Forest Department in conservation breeding techniques to ensure effective implementation of the task.</p> <p>3. Based on the current progress of CBC development, the CBC is proposed to be functional within six to eight months.</p>

<p>stock at various zoos, including the Iroishemba Zoo at Imphal, also needs to be examined and matched with the wild population.</p>		<p>4. Subsequent to the development of the CBC, Sangai individuals from wild population of KLNP will be acquired immediately to develop the founder stock. Afterward, the founder stock will be breed following the conservation breeding guidelines to develop the first release stock.</p> <p>5. The viability of the founder and release stock will be continuously monitored using advanced genomic tools and stress physiological assessment of the stock.</p>
<p>2. Survey of the possible reintroduction site and development and demarcation of the site will be done.</p>	<ul style="list-style-type: none"> • Five potential sites were surveyed, and Pumlen Pat and adjoining Thongam Mondum Reserve Forest were identified as the best suitable site for establishing a second home for Sangai. • State, site and village level consultation involving multiple stakeholders on the establishment of Pumle Pat Thongam Mondum Conservation Reserve to establish a second home for Sangai and consult the stakeholders regarding their perceptions on the problems and issues towards conservation of Sangai has been conducted. The process of formation of Conservation Reserve Committee and declaration of Pumlen Pat as a Conservation Reserve is being taken up by the Manipur Forest Department. • Consultations, trust building activities, livelihood trainings and conservation awareness programmes also conducted. 	<p>6. Community outreach and capacity building activities will be carried out in the Sangai reintroduction site to generate public awareness on Sangai and conservation importance of wetland and enhance their capacities to improve their livelihoods and promote eco-tourism for sustainable development of the area.</p>
<p>3. A soft release site will be developed first which will then be extended to a larger area and eventually the whole site will be</p>	<ul style="list-style-type: none"> • Mapping of the reintroduction site and soft release site in the proposed Conservation Reserve has been completed. • Due to the political unrest and administration inertia, the development of reintroduction site and soft release site is still pending. 	<p>7. The proposed reintroduction site is presently under the control of the District Collectors of Bishnupur and Kakching districts, it is pertinent that MFD should acquire the possession of the proposed site, so that the demarcation and development of the physical boundaries of the reintroduction and soft release site will be conducted.</p> <p>8. Once the reintroduction is done, the reintroduction site</p>

	developed and maintained. For this purpose, land acquisition from the local landowners will also be done.		needs protection and strengthening in terms of habitat improvement as it is outside forested area. Reintroduction can be delayed till adequate stock is developed or can be done directly from wild-to-wild relocation, based on the availability of the reintroduction site.
C. Improved habitat condition and protection measures	1. Fencing (chain-linked/ bund) will be constructed at vulnerable sites around the Park.	1. Strategies for the activities of this objective have been provided in the Integrated Management Plan of KLNP, which is developed for ten years (2021-2031), will be implemented by the MFD with technical assistance from WII. The plan broadly includes the following strategies for improving habitat conditions:	The management plan of KLNP, which is developed for ten years need to be implemented by the Park authorities (2021-2031) with technical assistance from WII to secure the existing Sangai population in KLNP and improve the quality of deteriorating habitat conditions. The strategies broadly include to achieve the following tasks for improving habitat conditions and protection measure:
	2. Anti-poaching camps will also be constructed at these sites especially in the northern, eastern and southern side of the Park, which are more vulnerable to poaching as well as resource extraction.	<ul style="list-style-type: none"> i. Demarcation of the physical boundaries of the Park using chain link fencing to regulate the illegal entry in the Park premises. ii. Identification of priority zones for habitat restoration and management for improving the habitat conditions and enhanced protection plan for improved protection has been proposed in the Integrated Management Plan. iii. Patrolling routes for foot patrolling and boat trails with anti-poaching camps at strategic location for enhanced protection measures. iv. Liaison with MFD in matters about incidences of poaching, resource extraction by local communities and rescue of animals from the Park and the surrounding area for increased protection. v. Sensitisation workshops for frontline staff of KLNP are being 	
	3. A year-round boat channel between Khordak and Toya,		

	<p>Khordak and Pabot and Pabot and Toya will be maintained to aid patrolling by the forest guards during the monsoon and early winter season, when the water level in the Park is high.</p>	<p>regularly conducted to discuss the management, conservation and rescue operation of wild animals.</p> <p>vi. Two firefighting stations were established in collaboration with Manipur Forest Department.</p>	<p>relevant stakeholders, and frontline staff capacity for improved protection.</p>
	<p>4. Protection camps will be established at strategic location especially in Southeast side of the KLNP.</p>		
<p>D. Involving community in conservation efforts, and</p>	<p>1. Eco-development, livelihood interventions and awareness generation at KLNP and the reintroduction site will be conducted to gain community support in Sangai conservation.</p>	<p>1. Livelihood training (N=28) including leadership training, exposure tours, and institution building of women SHGs around KLNP. Currently, there are 12 women SHGs which are actively functioning under the banner 'Women Initiative for Sangai Conservation', collaboratively initiated by WII and MFD.</p> <p>2. Establishment of a souvenir shop has been established at KLNP for promoting local products through these SHGs.</p> <p>3. 35 sensitisation cum consultation meetings in the fringe villages of KLNP for involving the local communities in the management planning of KLNP.</p> <p>4. Two site-level workshop, 15 village-level consultation</p>	<p>1. Micro-planning of the surrounding fringe villages is in the process for constituting village level institutions. After preparing the micro-plan of these villages, Eco-development Committees (EDCs) will be established in the fringe villages of KLNP in collaboration with the MFD.</p> <p>2. Strengthening the convergence process of women Self Help Groups (SHGs) with line agencies and other stakeholders and effective marketing strategies for more extensive local women's involvement in sustainable livelihood activities.</p> <p>3. Continued conservation education and outreach activities for the local communities and school children are necessary for</p>

		<p>workshops covering 12 villages, 1 state-level stakeholders consultation meeting, and 15 trust-building activities including health camps were organised at the reintroduction site to establish the second population of Sangai.</p> <p>5. Conservation education and outreach of 3382 school children at 16 schools around the Park, and 316 police and para-military personnel of Manipur.</p> <p>6. 8 webinars and 49 awareness activities for the different target audience and local people of KLNP and Pumlun Pat were organised through different occasions such as important environmental days.</p> <p>7. A series of mobilisation meetings (N=4) organised for the 'Friends of Sangai' volunteer's network.</p> <p>8. Wide dissemination of Sangai conservation issues through print and electronic media, information standees at Imphal International Airport, and public display of information hoardings at different places in Imphal and around the Park.</p>	<p>keeping-up mass awareness generation.</p> <p>4. Continued consultation meetings and workshops with the local communities for any conservation actions that concern the local people's welfare.</p> <p>5. The Friends of Sangai (FoS) volunteers' network will be expanded and strengthened through continued mobilisation and awareness activities. Moreover, the necessary capacity building of these volunteers will be conducted.</p>
	<p>2. Since water level is an issue for the security of KLNP, and as it also affects the people living around the National Park, state-level stakeholder meetings for maintenance of water level will also</p>	<p>9. A series of Focus Group Discussions (FGDs) were organised in the fringe villages of KLNP for assessing the people's experiences and perceptions on the Park's water resource (as resources, quality and changes).</p>	<p>6. Liaison with National Hydro Power Corporation (NHPC), Loktak Development Authority (LDA), Loktak Hydro Power Project, will be conducted to maintain the required water level in KLNP for ensuring increased habitat availability to Sangai.</p> <p>7. State – level consultation meetings with relevant stakeholders to be conducted for maintaining the required water level at KLNP.</p>

	be conducted.		
E. Conducting applied research on the ecology of the species	1. Apart from demographic and genetic monitoring the basic research and monitoring of the habitat in KLNP will be carried out so as to detect any change. The deterioration of habitat in the Park is due to the thinning of the <i>phumdis</i> . The water quality of the Loktak Lake has deteriorated due to pollutants entering the lake from Imphal and Bishnupur and as well as the surrounding landscape, both point and non-point sources.	<ol style="list-style-type: none"> 1. Monitoring of population trend of Sangai and Hog deer in KLNP was conducted using standardized methods and standardization of advanced techniques for estimating the population size using drones and genetics is in process. 2. Genetic profiling of captive and wild populations of Sangai has been conducted. The whole genome of Sangai has been sequenced using Next Generation Sequencing and the analysis is in process. 3. Preliminary profiling of stress physiology of captive and wild population of Sangai has been conducted. Further assessment of stress physiology of Sangai and hog deer is in progress. 4. Continuous monitoring of habitat conditions, including phumdi thickness and the water level, is being carried out to detect any change in the existing habitat condition. 	<p>Most of the proposed research work has already been covered within the ongoing project. However, monitoring of population trend of Sangai and associated species, habitat monitoring including phumdi thickness and water levels along with dependency of local communities will be continued simultaneously with the conservation breeding programme of Sangai or till the No Cost Extension period.</p> <p>The continuous activities under this objective are:</p> <ul style="list-style-type: none"> • Monitoring population status and trends of Sangai and associated species. • Monitoring genetic structure and stress physiology of Sangai and Hog deer will be continued. • Assessment of habitat quality, including plant community structure, phumdi thickness and invasive species in KLNP will be continued. • Assessment of water level and water quality in KLNP will be continued.
	2. The other management-related research	<ol style="list-style-type: none"> 5. Disease investigation and estimation of livestock population in the fringe villages were carried out. 6. Profiling of haematology and serum biochemistry parameters of 	<ul style="list-style-type: none"> • Assessment of habitat quality including plant community structure, phumdi thickness and invasive species in KLNP will be continued.

	<p>topics of interest include community structure and productivity of <i>phumdi</i>, water quality analysis and extent of pollutant load, disease and its impact on population, impacts of biomass extraction on the Park Ecology and the attitude of local people towards the Park.</p>	<p>Sangai deer using four individuals.</p> <p>7. Baseline information on the population trend of Sangai and associated species in KLNP, genetics, stress physiology, habitat condition and resource dependency has been generated, and further study is ongoing.</p> <p>8. The habitat use and occupancy of Sangai and Hog deer were derived based on pellet distribution in the Park.</p> <p>9. Socio-economic surveys were conducted in 354 households, covering all 36 fringe villages of KLNP. Further, the surveys were also carried out in seven villages (N=174 HH) around Pumlun Pat to assess the local communities' socio-economic status and dependency.</p> <p>10. Livestock population was estimated in the fringe villages of KLNP and investigated the prevailing diseases or any disease outbreak in these fringe villages.</p>	<ul style="list-style-type: none"> • Local people's dependence on the Park and the proposed reintroduction site will be continued. • An extensive household level socio-economic survey in the fringe villages of KLNP and at the reintroduction site and continued monitoring of resource dependency will be continued. • Wildlife health monitoring for Sangai & hog deer populations at KLNP and domestic livestock around the Park will be prepared and implemented.
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6. OUTPUTS AND OUTCOMES

- The Integrated Management Plan of Keibul Lamjao National Park has been prepared and released. Collaborative implementation of the Integrated management plan of KLNP by Manipur Forest Department and Wildlife Institute of India is in process.
- Development of Conservation Breeding Centre for Sangai is in process. Layout of the breeding centre has been prepared and landfilling activity is going on at the site for construction of enclosures.
- Development of conservation-development linkages through skill development and livelihood training, women Self-Help Group (SHG) formation and mass awareness on Sangai conservation. Convergence with the Manipur State Rural Livelihoods Mission (MSRLM) for long-term sustenance of the women SHGs. Further livelihood planning with different training partners is on-going.
- Information on population trend of Sangai and associated species in KLNP using advanced population estimation techniques is available. Assessment of genetics and stress physiology of Sangai and Hog deer has been conducted. Evaluation of nutritional and reproductive stress has also been initiated to evaluate the health of captive and wild populations of Sangai.

7. FINANCIAL STATEMENT

7.1. Financial statement (2015-2016)

Conservation of Manipur's Brow Antlered Deer of Sangai: An Integrated Approach			
Receipt & Payment			
From 09.12.2015 to 31.03.2016			
Receipt	Amount	Payment	Amount
Ist Grant Received from CAMPA	13000000.00	Investment (FDR)	10000000.00
Bank Interest for F.Y. 2015-16	38575.00	Advances (Outstanding Tour Advance & Forest Advance)	440000.00
		Total Expenditure	10440000.00
		Balance as on 31.03.2016 A/c No. - 55295	2598575.00
Grant Total	13038575.00	Grant Total	13038575.00

7.2. Financial statement (2016-2017)

Conservation of Manipur's Brow Antlered Deer of Sangai: An Integrated Approach			
Receipt & Payment			
From 01.04.2016 to 31.03.2017			
Receipt	Amount	Payment	Amount
Opening Balance	2598575.00	Manpower	1590280.00
Opening Balance of TA and FA	440000.00	Infrastructure and Equipment	1407655.00
Interest Received	79200.00	Research & Monitoring	1250718.00
FDR Interest	297406.00	Base Camp Expenses	59356.00
FDR Withdrawal	5000000.00	Advance to Management Unit	1691992.00
		Advance Outstanding	89245.00
		Total Expenditure	6089246.00
		Balance as on Date 31.03.2017 A/c No. 55295	2325935.00
Grand Total	8415181.00	Grand Total	8415181.00

7.3. Financial statement (2017-2018)

Conservation of Manipur's Brow Antlered Deer of Sangai: An Integrated Approach			
Receipt & Payment			
From 01.04.2017 to 31.03.2018			
Receipt	Amount	Payment	Amount
Opening Balance	2325935.00	Manpower	2928131.53
Opening Balance of Advance	89245.00	Infrastructure and Equipment	1020137.00
Interest Received	72160.00	Research & Monitoring	961998.00
FDR Interest	670674.00	Base Camp Expenses	97126.00
FDR Withdrawal	5000000.00	Capacity Building	771105.00
Loan from CAMPA GIB A/c No. 55292	2500000.00	Community Engagement	21960.00
		Conservation Education & Awareness	276267.00
		Establishment of Second Home	234613.00
		Habitat Recovery Plan at KLNP	929774.00
		Veterinary Action Plan	19275.00
		Total Expenditure	7260386.53
		Outstanding:	
		Forest Advance	40000.00
		Tour Advance	49496.00
		Advance to Management Unit A/c No. 55357	500000.00
		Balance as on Date 31.03.2018 A/c No. 55295	2808131.47
Grand Total	10658014.00	Grand Total	10658014.00

7.4. Financial statement (2018-2019)

Conservation Of Manipur Brow Antlered Deer of Sangai: An Integrated Approach			
Receipt & Payment			
For The Period Of 01 April 2018 to 31 March 2019			
Receipts	Amount	Payments	Amount
Opening Balance	28,08,131.47	Manpower	43,42,762.00
Grant Received	4,90,00,000.00	Infrastructure and Equipment	27,17,788.00
Opening Balance of Advances	22,81,488.00	Research & Monitoring	20,46,502.00
Interest Received	1,71,829.00	Base Camp Expenses	46,644.00
FDR Interest	1,68,418.00	Capacity Development	1,18,244.00
FDR Withdrawal	50,00,000.00	Community Engagement	39,689.00
		Conservation Education & Awareness	2,14,286.00
		Establishment of Second Home	57,090.00
		Habitat Recovery Plan at KLNP	2,52,920.00
		Veterinary Action Plan	1,88,974.00
		Total Expenditure	1,00,24,899.00
		Refund of Loan to CMAPA GIB A/c No. 55292	25,00,000.00
		Outstanding:	
		Forest advance	1,90,488.00
		Tour Advance	2,69,701.00
		Advance to Project Management Unit	31,91,992.00
		Investment in FDR	4,00,00,000.00
		Balance as on 31.03.2019 A/C No. 55295	32,52,786.47
Total	5,94,29,866.47	Total	5,94,29,866.47

7.5. Financial statement (2019-2020)

Conservation Of Manipur Brow Antlered Deer of Sangai: An Integrated Approach			
Receipt & Payment			
For The Period Of 01 April 2019 to 31 March 2020			
Receipts	Amount	Payments	Amount
Opening Balance	32,52,786.47	Manpower	53,72,122.00
Advances for Expenses	36,52,181.00	Infrastructure and Equipment	10,73,708.00
Interest Received	1,08,907.00	Research & Monitoring	51,08,354.00
FDR Interest	8,30,661.00	Capacity Development	2,12,794.00
FDR Withdrawal	1,00,00,000.00	Conservation Education & Awareness	2,19,166.00
		Habitat Recovery Plan at KLNP	3,96,914.00
		Veterinary Action Plan	6,24,247.00
		Total Expenditure	1,30,07,305.00
		Outstanding:	
		Forest advance	6,15,751.00
		Tour Advance	2,99,107.00
		Advance to M/s Ashish Chandola	13,11,750.00
		Balance as on 31.03.2020 A/C No. 55295	26,10,622.47
Total	1,78,44,535.47	Total	1,78,44,535.47

7.6. Financial statement (2020-2021)

CONSERVATION OF MANIPUR BROW ANTLERED DEER OF SANGHAI AN INTEGRATED APPROACH			
FOR THE PERIOD OF 01 APRIL 2020 TO 31 MARCH 2021			
RECEIPT & PAYMENT			
RECEIPT	AMOUNT (In Rs.)	PAYMENT	AMOUNT (In Rs.)
Opening Balance	2610622.47	Manpower	4634679.00
Advance for Expenses	914858.00	Infrastructure and Equipment	626184.00
Interest Received	97532.00	Research & Monitoring	1777669.00
FDR Interest	1570776.00	Capacity Development	170871.60
FDR Withdrawal	10000000.00	Conservation Education & Awareness	64713.00
Advance to M/s Ashish Chandola	1311750.00	Habitat Recovery Plan at KLNPN	304511.00
		Veterinary Action Plan	183298.00
		Refund of Interest to MoEF&CC	939568.00
		Total Expenditure	8701493.60
		Outstanding:	
		Forest advance	1121896.00
		Tour Advance	168535.00
		Advance to M/s Ashish Chandola	1311750.00
		Balance as on 31.03.2021 A/C No. 55295	5201863.87
Total	16505538.47	Total	16505538.47

7.7. Financial statement (2021-2022)

CONSERVATION OF MANIPUR BROW ANTLERED DEER OF SANGHAI AN INTEGRATED APPROACH			
RECEIPT & PAYMENT			
FOR THE PERIOD OF 01 APRIL 2021 TO 31 MARCH 2022			
RECEIPT	AMOUNT (In Rs.)	PAYMENT	AMOUNT (In Rs.)
Opening Balance	5201863.87	Capacity Development	56000.00
Advance for Expenses	2602181.00	Community Engagement	11870.00
Interest Received	1101998.00	Conservation Education and Awareness	24248.00
FDR Encashment	5000000.00	Establishment of Second Home	878975.00
		Habitat Recovery Plan at KLNP	372988.00
		Infrastructure and Equipment	466638.00
		Manpower Engagement	4157636.00
		Research & Monitoring	3056151.09
		Veterinary Action Plan	101932.00
		Consumables	39976.00
		Advance for Expenses	1296184.00
		Total Expenditure	10462598.09
		Balance as on 31.03.2022 A/C No. 55295	3443444.78
Total	13906042.87	Total	13906042.87

7.8. Financial statement (2022-2023)

CONSERVATION OF MANIPUR BROW ANTLERED DEER OF SANGAI AN INTEGRATED APPROACH			
RECEIPT & PAYMENT			
FOR THE PERIOD OF 01 APRIL 2022 TO 31 MARCH 2023			
RECEIPT	AMOUNT (In Rs.)	PAYMENT	AMOUNT (In Rs.)
Opening Balance	3443444.78	Capacity Development	544009.00
Grant Received	41075000.00	Consumables	103039.00
Advance for Expenses	1296184.00	Community Engagement	-
Interest Received	2790417.00	Conservation Education and Awareness	-
FDR Encashment	10000000.00	Establishment of Second Home	1172782.00
		Habitat Recovery Plan at KLNP	-
		Infrastructure and Equipment	1277918.00
		Manpower Engagement	3304580.00
		Research & Monitoring	1112569.00
		Refund of Interest	4268568.00
		Advance for Expenses	1937540.00
		Total Expenditure	13721005.00
		Balance as on 31.03.2023 A/C No. 55295	44884040.78
Total	58605045.78.00	Total	58605045.78.00

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ANNEXURES

(Reports of post-mortems conducted for different animals encountered inside the Park)



POSTMORTEM REPORT

A dead hog deer was reported by the forest guards on the night of 19/01/2023 and as requested by the forest department, the WII team accompanied by forest guards visited the site to examine the carcass in the morning of 20/01/23 around 07:00am.

The carcass was located at N 24°29'12", E 93°49'24", near Thangbirel Yangbi watch tower at Keibul Lamjao National Park. On arrival, the body was observed as halfway decayed and unfit for post-mortem. The presence of fully grown/developed antlers on the carcass indicates that the individual encountered was an adult male Hog deer (*Axis porcinus*). The body was transported to the range forest office KLNP for anatomical structural study and dentition pattern.

Conclusion:

Cause of death could not be identified due to the decayed condition of the carcass.



Fig: Carcass of Hog deer encountered inside Keibul Lamjao National Park.

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Veterinary Officer
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POSTMORTEM REPORT

The frontline staff of Keibul Lamjao National Park reported a dead Sangai individual encountered in Thangbirel yangbi during their routine patrolling on the morning of February 13 2023. As requested by the Forest Department, the CAMPA Sangai project team of Wildlife Institute of India accompanied by forest guards visited the site to examine the carcass around 11:00 AM.

The carcass was located at N 24°28'45", E 93°49'54", at Hiramphatpi inside Keibul Lamjao National Park, Manipur. On arrival, only intact head with hides and scattered bones was observed, making the carcass unfit for post-mortem. The presence of fully grown/developed antlers on the carcass indicates that the individual encountered was an adult male Sangai deer.

External examination:

Oral cavity: On examination of the oral cavity, no missing tooth was observed. The ridges of the tooth were sharp, indicating that the carcass belongs to an adult individual. Dentition pattern observed was I 0/4, C 1/0, Pm 3/3, M 3/3×2=32 i.e. total number of teeth is 34.

Antler measurements:

Diameter of pedicles (right & left) = 5.41cm & 5.73 cm

Distance between right and left pedicle = 2.75 cm

Distance between tine and beam tips (right) = 21 cm

Distance between tine and beam tips (left) = 23 cm

Length of left antler = 93 cm

Length of right antler = 97 cm

Examination of scattered bones:

On examination of the scattered bones, signs of chewing or eating were observed indicating eating of carcass by other carnivore(s) inside the park, most probably wild pig(s), as several wild pig nests and scats were observed near the carcass.

Conclusion:

Cause of death could not be concluded due to the decayed condition of the carcass.



Fig.1: Carcass of Sangai deer encountered inside Keibul Lamjao National Park.



Fig.2: Signs of chewing observed on the carcass.

Jim

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POSTMORTEM REPORT

The frontline staff of Range II at Keibul Lamjao National Park reported a dead hog deer fawn encountered during their routine patrolling on 17th February 2023. As requested by Forest Department, the CAMPA Sangai project team of Wildlife Institute of India examined the carcass for post-mortem.

The carcass was located at 24°30'12.948" N, 93°51'5.826" E nearby an open water body at a distance of approximately 200 m from the carcass. In the presence of forest guards and Wildlife Institute of India project team, post mortem of the dead fawn was carried out at 03.30 PM at the Range Forest Office.

External examination:

- 1) The body was wet.
- 2) No external wound or signs of injury were observed.
- 3) No discharge from the natural orifices was observed.
- 4) The carcass belongs to a male Hog deer fawn as evident from the external genital organs.

Internal examination:

- 1) Oral cavity: no abnormalities observed. Dentition pattern includes I 0/4, C0/0, P M2/2, M1/1
- 2) Thoracic cavity: emphysemic lungs, presence of foam in the bronchial tree, congested heart.
- 3) Abdominal cavity: absence of any foreign material in the rumen and gastrointestinal tract, no macro-pathological changes in liver, pancreas and kidney was observed.

Body measurement:

Body length: 65 cm, Chest girth: 40 cm, Shoulder height: 30.9 cm, Height of hip joint: 50 cm

Conclusion:

No abnormal post-mortem gross lesions were observed. Cause of death may be concluded as acute drowning indicated by the presence of foam in the bronchia, lungs and wet body.

A) External observation



Fig.1: The carcass of the Hog deer fawn encountered in the Park.

B) Internal observation:

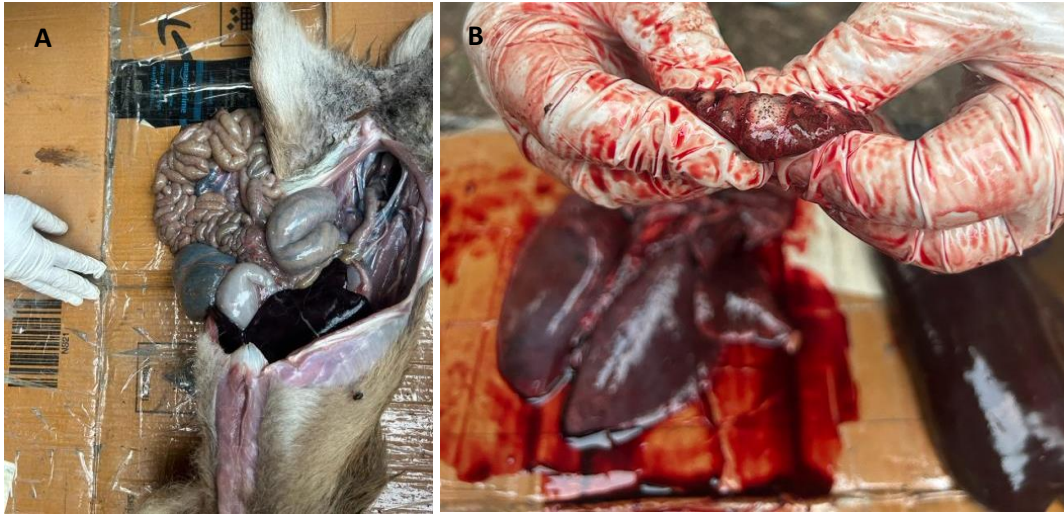


Fig.2: (A) Internal organs showing no pathological changes (B) Presence of foam in the lungs and bronchea.



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POSTMORTEM REPORT

The frontline staff of Keibul Lamjao National Park Range-I reported a dead Sangai deer encountered during their routine patrolling in Thangbirel Yangbi on March 2nd 2023. As requested by the Manipur Forest Department, CAMPA Sangai project team of the Wildlife Institute of India examined the carcass for post-mortem.

The carcass was located at 24°28'26.934" N, 93°50'19.92" E at Gourahari Yangbi. As reported by the staffs, the limbs of the carcass were found entangled in the phumdi vegetation.

In the presence of forest guards and Wildlife Institute of India project team, post mortem was carried out at 04:10 pm. The carcass was identified as male indicated by the presence of antlers and male genital organs.

External examination:

- 1) The body was found in a lateral position with half drowned.
- 2) No external wound or signs of injury were observed.
- 3) No discharge from the natural orifices was observed.

Internal examination:

- 1) **Oral cavity:** No abnormalities were observed. Dentition pattern includes I 0/4, C1/1, P M3/3, M3/3.
- 2) **Thoracic cavity:** Presence of mud and vegetation remains mix with blood in the trachea, presence of mud in the bronchial tree, emphysemic lungs were observed.
- 3) **Abdominal cavity:** Absence of any foreign material in the rumen and gastrointestinal tract, no macro pathological changes in liver, spleen, kidney was observed.

Body measurement:

Body length: 153cm, **Chest girth:** 142cm, **Shoulder height:** 101cm, **Height of hip joint:** 110cm, **Approximate body weight:** 200-250kg.

Antler measurement:

Right antler: Full length: 103.4cm, main beam: 67.5cm, pedicle: 40.4cm.

Left antler: deformed which may be due fights during rutting season.

Conclusion:

Cause of death: Drowning due entanglement in the vegetation. Presence of mud and vegetation remains in the trachea and bronchi leads the lungs tissue damage leading to internal bleeding and death.



A) EXTERNAL OBSERVATIONS:



Fig.1: Carcass of Sangai encountered in the Park and deformed antlers



Fig.2: Image showing no signs of external injury on the carcass.



B) INTERNAL OBSERVATIONS:



Fig.3: (A) Coroded mucosal layers due to decomposition, phum/vegetation remains were also observed **(B)** Presence of blood mixed with mud in trachea bronchea and **(C)** Damaged lung tissue.

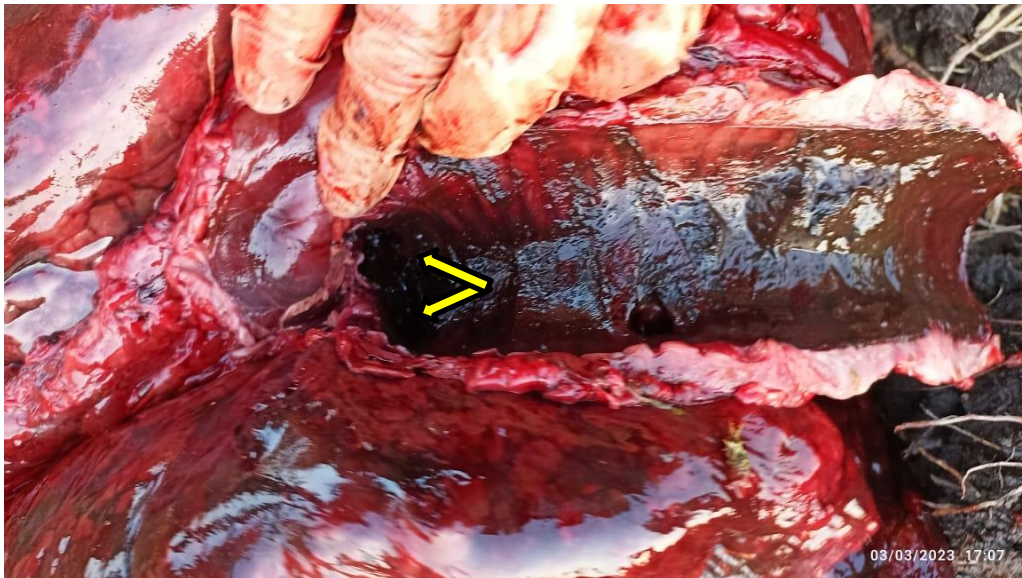


Fig.4: Image showing presence of mud in the bronchea.



Fig.5: No abnormalities observed in liver and no abnormalities/foreign bodies observed in the stomach.



Fig.6: No abnormalities observed in small or large intestines and the mucosal layer and image showing large intestinal contents.

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POSTMORTEM REPORT

Forest guards of Keibul Lamjao National Park reported a dead hog deer encountered during their routine patrolling on the evening of 22/03/2023. As requested by the forest department, WII team accompanied by forest guards visited the site to examine the carcass on 23/03/23 morning around 09:00am.

The carcass was located at N 24°30'30.59", E 93°49'54.22", at Nashik houbi inside Keibul Lamjao National Park. On arrival, scattered bones and half decomposed skull with antler was observed making the carcass unfit for post-mortem in order to determine the cause of death.

External examination:

Skull examination: the upper jaw showed presence of i:0, c:0, preM:3, m:3 dentition. The lower jaw was missing. The presence of fully grown/developed antlers on the carcass indicates that the individual encountered was an adult male hog deer.

Antler measurement:

Height of right antler:38.6cm, diameter: 3.75cm, height of 1st pedicle:9.1cm

Height of left antler:37cm , diameter: 3.56cm, height of 1st pedicle:9.8cm

Examination of scattered bones:

On examination of the scattered bones, signs of chewing or eating were observed indicating eating of carcass by other carnivore(s) inside the park most probably wild boar(s).

Conclusion:

Cause of death could not be concluded because only remnants of the carcass were found.



Fig: remnants of hog deer scattered at different locations inside Keibul Lamjao National Park.



Fig: trails of scattered bones indicating predation inside Keibul Lamjao National Park(KLNP).

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POSTMORTEM REPORT

On field visit inside Keibul Lamjao National for sample collection, remnants of hog deer was encountered on the way between Khordak Range Office and Khangandong on the morning of 12/04/2023. The carcass was located at N 24°30'0.8784", E 93°51'7.5132".

Only scattered bones and hides attached with skull observed making the carcass unfit for post-mortem in order to determine the cause of death.

Examination:

Skull examination: dentition pattern of the carcass was i:0/0, c:0/0, preM:3/3, m:3/3 dentition. The presence of fully grown/developed antlers on the carcass indicates that the individual encountered was an adult female hog deer.

Examination of scattered bones:

On examination of the scattered bones, most of the body parts or bones were missing which may be due to scavenging.

Conclusion:

Cause of death could not be concluded because only remnants of the carcass were found.



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Fig: encountered carcass/remnants of female hog deer inside Keibul Lamjao National Park (KLNP).



Fig: dentition pattern of the carcass inside Keibul Lamjao National Park(KLNP).

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