

HUMAN-ELEPHANT CONFLICT MITIGATION PROJECT

TA LAI & THANH SON
COMMUNE, DONG NAI,
VIETNAM

UNVEILING COEXISTENCE:

Tackling Human-Elephant Conflict through Cutting-Edge Monitoring and Local Collaboration. Discover how an innovative Ecological Niche Model and stakeholder engagement initiatives are paving the way for harmonious coexistence with majestic Asian elephants in Cat Tien National Park.



APRIL - 2024

HUMAN-ELEPHANT CONFLICT MITIGATION REPORT

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Section 1: Human-Elephant Conflict

EXECUTIVE SUMMARY

Cat Tien National Park, located in southern Vietnam, is home to a significant population of Asian elephants (*Elephas maximus*). According to the annual report of Cat Tien in 2020, the park was estimated to have around 30 individuals. This population is considered to be one of the largest in Vietnam, making Cat Tien National Park an essential area for elephant conservation efforts in the country. Despite the park's efforts to protect the elephants, Human-Elephant Conflict (HEC) remain a significant issue in local communities surrounding the park. Due to the expansion of agriculture and infrastructure development in the region, elephant habitats have been encroached upon, leading to more frequent encounters between humans and elephants. The conflicts often result in trampling crops and damaging the property of local people. With this project, we intend to make an effort to reduce human-elephant conflicts in the neighboring communities surrounding Cat Tien and ensure the long-term survival of these majestic creatures.

We therefore started with a spatial modeling approach to identify potential high-risk HEC locations, visited the modelled locations and engaged with local people via HEC-related survey questions, and asked them to provide geospatial input on elephant raiding locations. Moving forward we will use this input to install AI cameras as an early warning system, and begin developing elephant-focused ecotourism in the area as a co-existence HEC mitigation effort.



METHODS

Study Area Selection

In order to select survey sites, we ran an Ecological Niche Model (ENM) with records and signs of Asian elephants (visual observations, dung, footprints) within and surrounding the Cat Tien National Park protected area, and used biologically relevant environmental variables including several bioclimatic, terrain, and vegetation covariates to optimize the model. We removed any multicollinearity and variance inflation, and split the data into testing (75%) and training (25%) sets to assess model performance. The model was shown to perform well using the MaxEnt method. Providing an output with distinct paths where elephants were known to migrate and graze throughout the year. In order to model high-risk areas, we obtained an ESRI 10m 2022 global Land Use Land Cover raster. We then overlapped the subset layers to identify “High-risk” HEC sites (**Figure 1.1 – 1.2**).

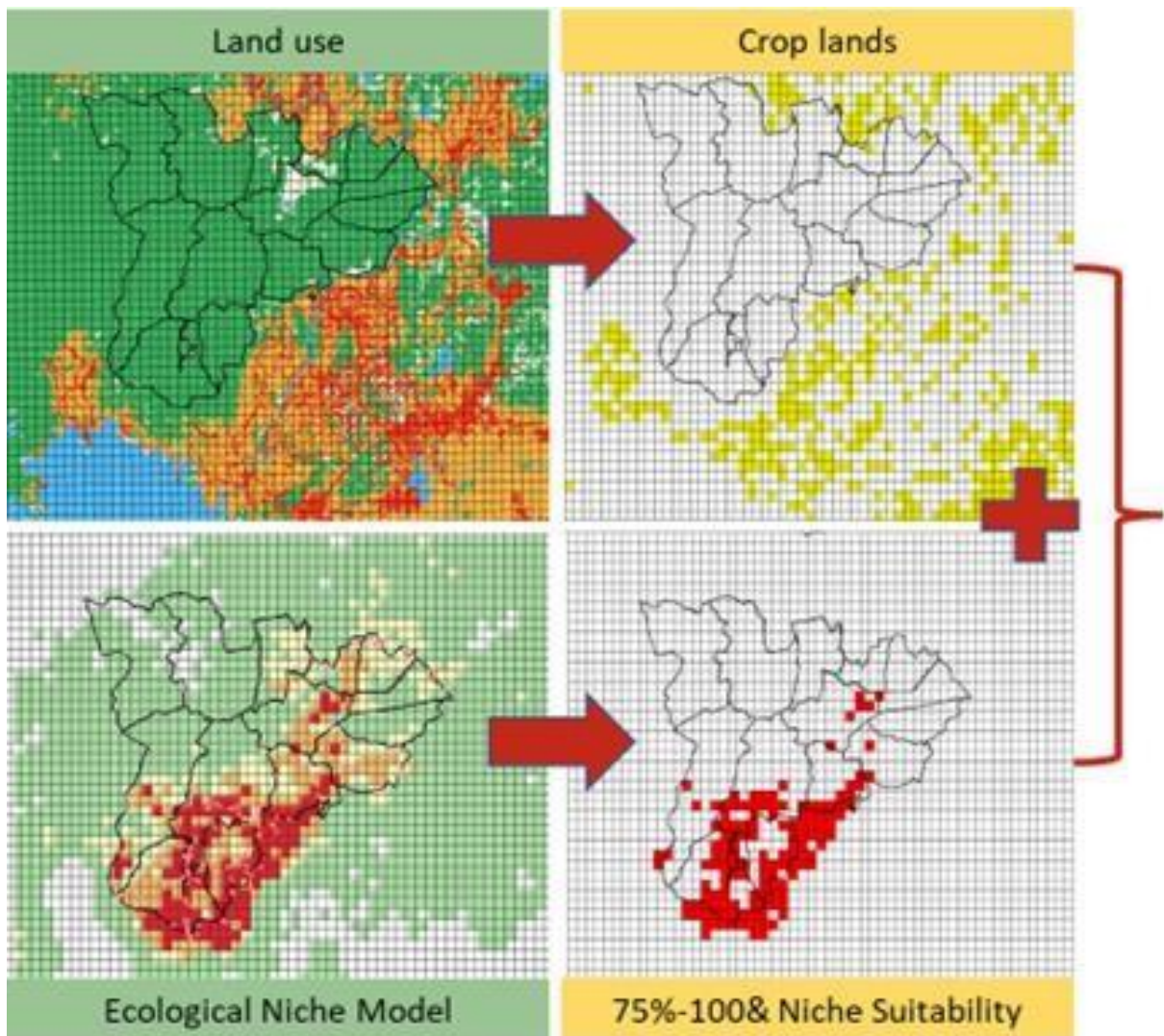


Figure 1.1. highly suitable elephant areas from an Ecological Niche Model (ENM) combined with agricultural land uses from remotely sensed LULC were used to extract potential HEC hotspots.

HEC Risk of *Elephas maximus* in and around Cat Tien National Park

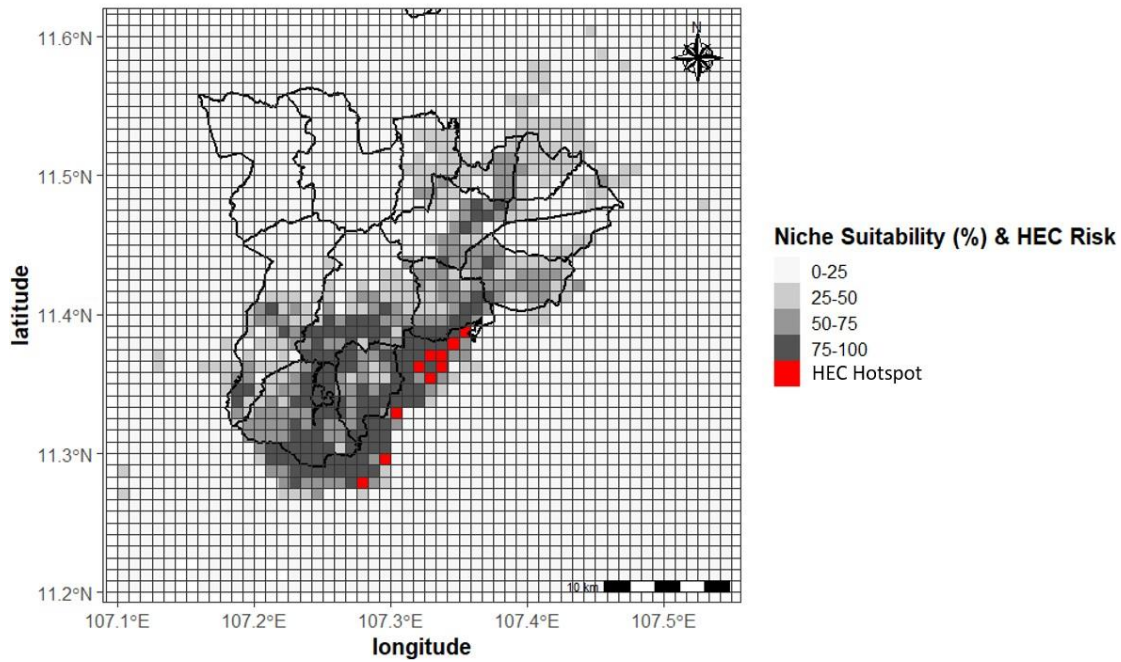


Figure 1.2. HEC hotspot map modelled from overlap of >75% ENM and cropland LULC.

We then selected the center of each hotspot grid to survey local people within a 500m range of the point location within the Ta Lai and Thanh Son districts of Dong Nai province (**Figure 2**)

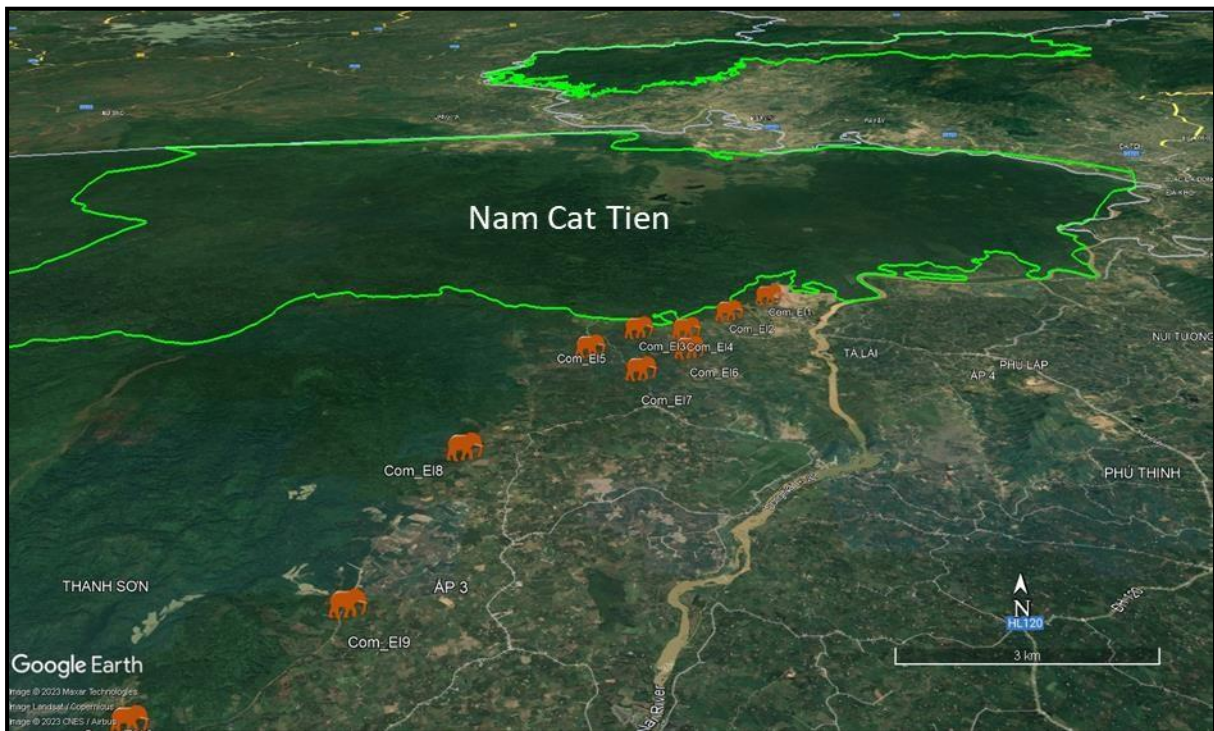


Figure 2. Location of focal areas to conduct local surveys in Ta Lai and Thanh Son Communes.

Permissions & Procedures

We worked in collaboration with the science department of Cat Tien National Park to discuss surveying locals with help from with ranger stations in the targeted areas. We then coordinated with the director of the commune to introduce our project and goals, and obtain information about the village leaders and individuals responsible for providing information about human- elephant conflict. We also requested the assistance of a representative to guide us to farmers whose crops had been damaged for interviews. We utilized a semi-structured interview approach, which involved asking a core set of questions but also allowing participants to provide additional information as needed. This method proved to be effective in eliciting detailed information and insights from the participants. Furthermore, we focused on individuals who had direct experience with human-elephant conflict and requested them to show us evidence of elephants in the farms, such as dung, footprints, damaged plants or farming equipment. In addition, we conducted ground surveys, which involved walking or driving through the targeted area to visually count elephants on foot or from a vehicle. Although this method was more time- consuming, it provided a more comprehensive understanding of elephant behavior and habitat use, including the trails that elephants typically take to reach the farms.

Software Methods

We used survey123 to collect primary data from interview, and using Google Earth Pro to draw a polygons, spatial points, and lines according to local knowledge of elephant activity areas when it came to the local farms. By engaging with locals surrounding the areas of heightened HEC, we were able to show them their current position on Google Earth Pro, and reference a few landmarks to confirm they knew their location and direction. We asked them to assist us to draw a point on the map where elephants often emerge from the forest, and a polygon on the map where they often see the elephants visiting and raiding crops. Each time a new respondent was engaged, the previous respondent's spatial data was hidden to reduce potential biases in reporting geospatial boundaries where elephants are often seen.

We used R Statistical Software to analyze spatial data and create a heat map by overlapping all the polygons we collected from farmers to find out the hotspot of elephant activity

RESULTS

We travelled around Ta Lai and Thanh Son communes in the predicted HEC hotspots and interviewed 84 local farmers. According to survey elephant active through the whole year, but month elephant most active are in the rainy season from July to November, also in rainy season, active area of elephant more likely to be wider than dry season (**Figure 3**).

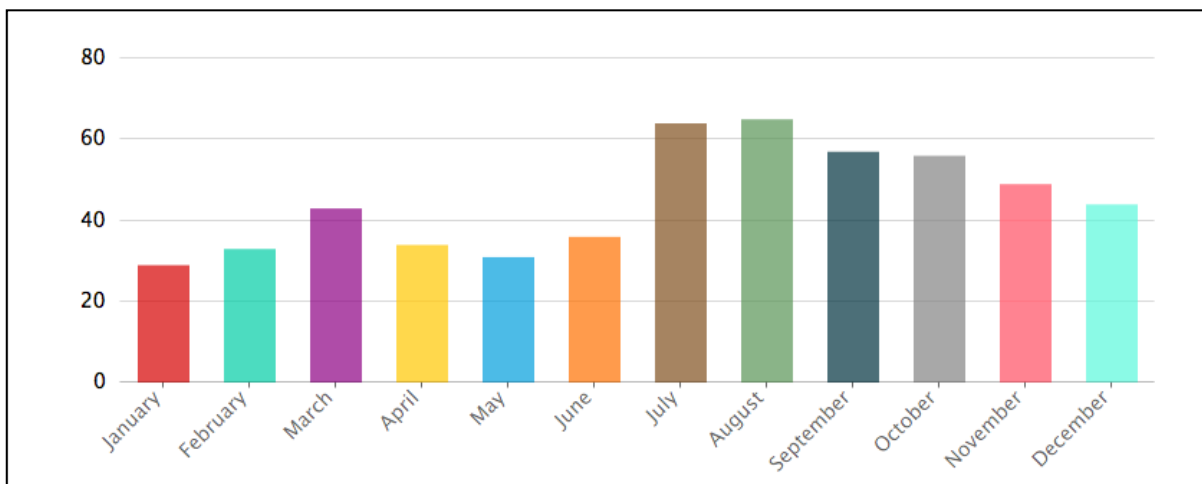


Figure 3. Column graph showing months that HEC often occurs in Ta Lai and Thanh Son commune

Elephant were said to primarily target banana, jackfruit, rice, corn, cashew (**Figure 4**) beside these crops, elephant also prefer to look for salt, and grain that store in farmer’s storage, with citrus plants elephant only destroy the plant but don’t eat the fruit

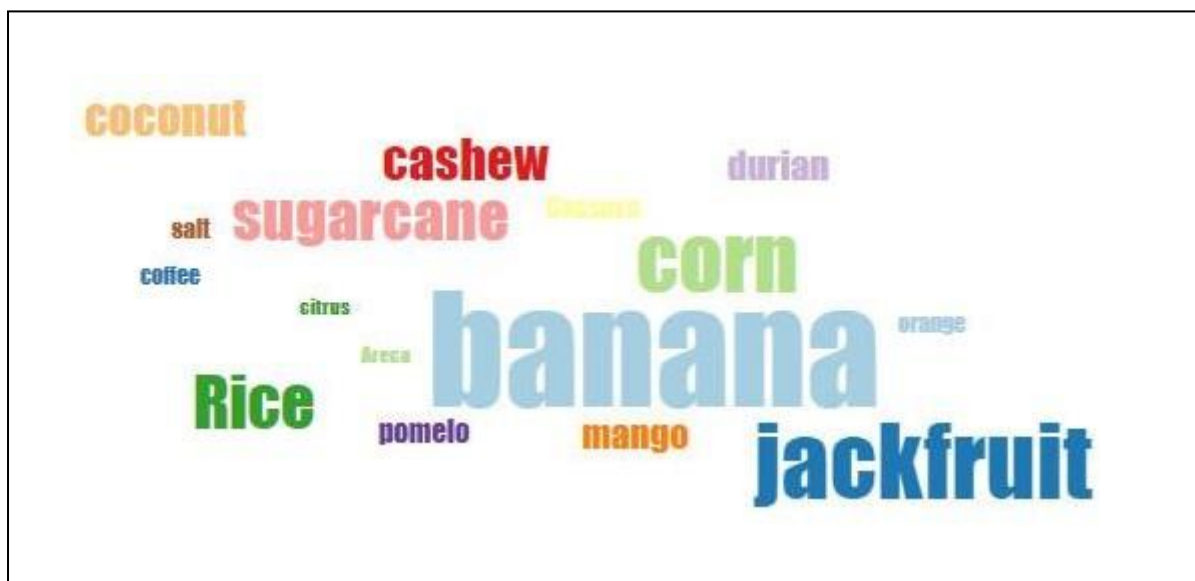


Figure 4. Word cloud of crops that elephant often targeted by elephants in Ta Lai and Thanh son include

When the incident happens, there were typically 1-2 males who came out first to scout (**Figure 5**), if there was enough food and no humans nearby to get chased away, the male or alpha female would lead the whole group about more than 20 elephants come out to the area. The commonly sighted male who comes to scout the croplands has been confirmed as the individual with the broken/uneven tusk or as farmer in the area gave his nickname as: Ông Ngà Lệch (which translates to “divergent/uneven tusks”)

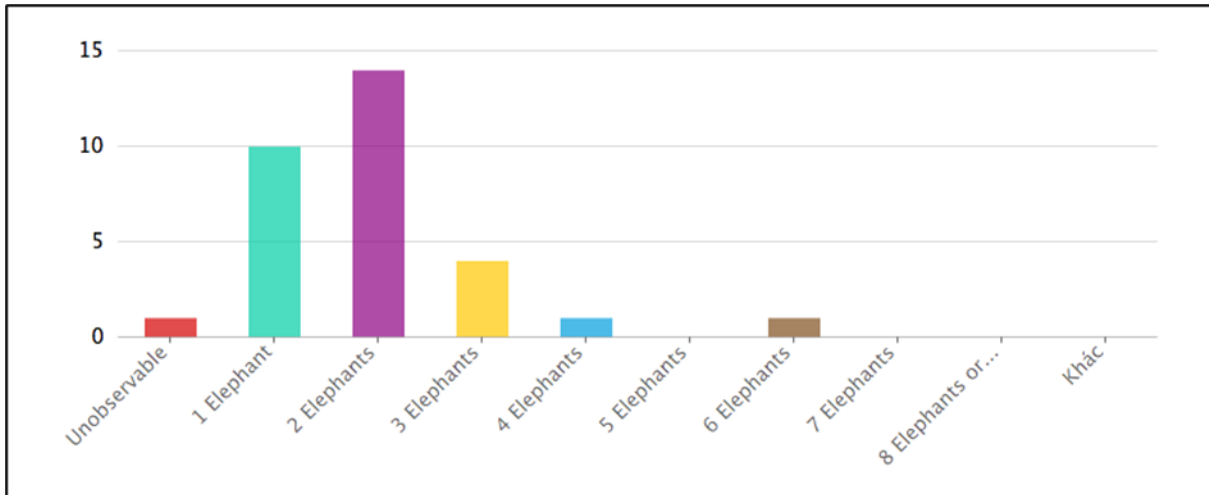
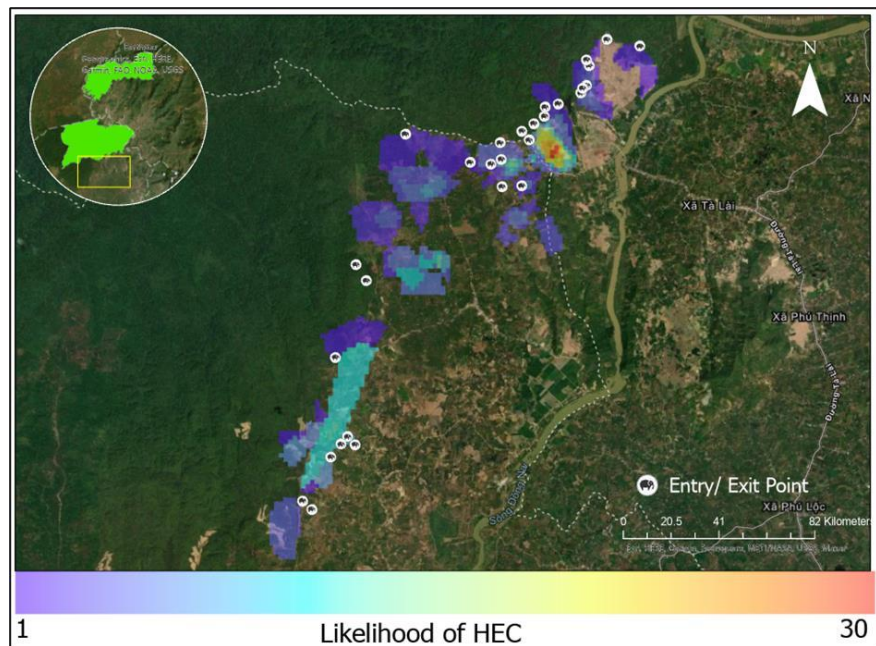


Figure 5. Quantity of elephants usually seen raiding crops in local villages.

Polygons drawn by locals produced a hotspot map of elephant activity in the village areas. The largest concentration of reported activity was in Ta Lai adjacent to a barren patch of land, abandoned by locals who used to grow rice (possibly due to constant elephant damages) (**Figure 6**).

Figure 6 Map showing the hotspots area of elephant activity by input from local people, the numeric quantity is equal to the total number of overlapping polygons in a given 500m x 500m grid area.



In order to identify potential pathways elephants often used to travel from place to place and raid croplands, we asked local people to draw lines of how elephants moved when they are seen in the nearby areas, as well as their entry and exit points from the forest (**Figure 7**).

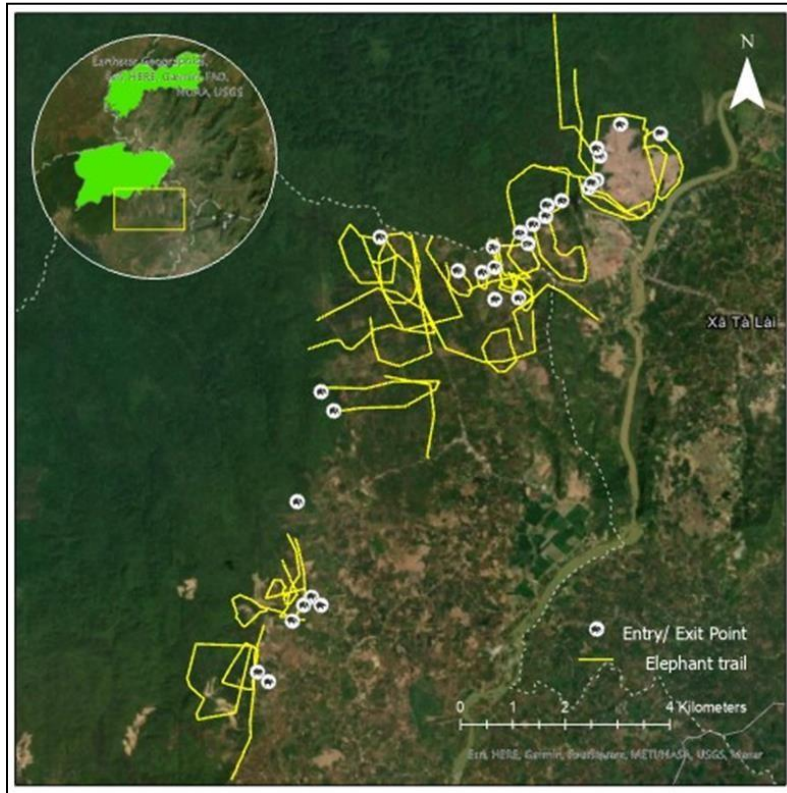


Figure 7. Map showing entry/exit point from the forest and trails of elephants used to reach the farms generated by input from local people.

Local Stories about Elephant Conflict

Local who burned banana farm

A Vietnamese farmer named Thanh recently faced a conflict with a wild elephant that threatened his main source of income. Thanh owned a six-hectare banana field, which the elephant began to invade and eat the ripe bananas, causing Thanh to fear for his livelihood.

Initially, Thanh tried to scare the elephant away by making loud noises and shining bright lights, but to no avail. The elephant eventually grew accustomed to the noise and light and continued to raid the crop. Thanh then invested in building an electric fence around the field to keep the elephant out. However, the fence proved ineffective as the elephant learned to use nearby trees to push it down and enter the field.

With his crops continually being destroyed, Thanh took drastic measures to protect his livelihood. He set fire to his entire six-hectare banana field, destroying not only his crops but also the elephant's habitat.

The conflict between Thanh and the elephant highlights the challenges faced by farmers in the region, where wild animals encroaching on farmland is a common issue. It also underscores the need for sustainable solutions that protect both farmers' livelihoods and wildlife conservation efforts.



Figure 8. The 6-hectare banana field was burn because of the conflict between human and elephant



Figure 9. Photo of local man injured by elephant tusk

Man injured by elephant tusk

When he was a 16-year-old boy, Mr. Trung had a terrifying encounter with a wild elephant that left him severely injured. Trung was walking along a trail when he came across an elephant and decided to follow it out of curiosity. However, the situation quickly turned dangerous when Trung attempted to scare the elephant away by making loud noises.

The startled elephant turned around and caught Trung with its trunk, causing severe injuries to his throat and right eye. The villagers heard Trung's screams and rushed to his aid, pleading with the elephant not to hurt the boy. Remarkably, the elephant appeared to understand and put Trung gently on the ground before retreating into the forest.

The villagers were shocked by the incident and feared for Trung's life. They quickly transported him to the nearest hospital, where doctors worked tirelessly to save him. Although the recovery process was long and difficult, Trung ultimately survived the ordeal.

The incident highlights the dangers posed by wild animals in rural areas and serves as a reminder of the importance of exercising caution and respecting their habitat. It also demonstrates the resilience and bravery of individuals like Trung, who can overcome incredible challenges in the face of adversity.

Man who spoke to the elephant



Figure 10. Interview the local man who scared elephant

One night, after drinking too much, a local man named Minh fell asleep on his porch. To his surprise, he woke up to find an elephant rummaging through his rice and corn. Despite his usual fear, Minh felt an unexpected sense of courage and decided to confront the animal.

Speaking in a calm and assertive tone, Minh approached the elephant and said, "Hey, bro. Enough. Enough mess." To his amazement, the elephant seemed to understand him and stopped its destructive behavior. The animal turned around and walked back into the forest, leaving Minh unharmed.

The next morning, fully sober, Minh reflected on his unusual encounter and realized that perhaps the elephant was not as scary as he once thought. He shared his story with others in the village, and it quickly spread, earning him the reputation of a local hero. Minh learned a valuable lesson from the encounter: that wild animals could be understood and respected, and that fear was not always the best response.

This story serves as a reminder of the importance of respecting wildlife and learning to coexist with nature. Minh's newfound appreciation for elephants and all animals underscores the

need for humans to recognize the intelligence and worth of all living creatures, no matter how wild or unfamiliar they may seem.

Electric fencing for elephant prevention

Electric fences have been a popular solution to the problem of human-elephant conflict, particularly in areas where elephants frequently raid crops or cause damage. These fences work by delivering an electric shock to elephants that try to breach them, creating a barrier that elephants are unwilling or unable to cross. The fences are typically constructed using wires that are connected to an energizer or charger, which sends a pulse of electricity along the wires at regular intervals.

However, in some areas, elephants have learned how to cross these electric fences by using trees or logs to push the wires down and step through the fence. As a result, electric fences have become less effective at deterring elephants from entering farmland.

To address this issue, people in some areas have turned to other methods, such as using big lights and warning speakers with loud alarm noises. While these methods can be more costly than electric fences, they have shown to be more effective at deterring elephants and avoiding crop damage.

The problem of human-elephant conflict is a complex one, but it is clear that innovative solutions are needed to protect both farmers and elephants. As new approaches are developed and tested, it is important to consider the needs and perspectives of all stakeholders involved in order to find effective and sustainable solutions.



Figure 11. People showing how to use the alarm speaker.



Figure 12. High voltage flash light that farmers use to scared elephant. People noted that smaller flashlight wouldn't scare elephant so they have to use the big one. They also said that elephants stay away the machines that have the smell of motor oil)



Figure 13. Fence with electric wire that a farmer installed to prevent elephants, but was destroyed

Living on the edge

In hamlet 4 of Ta Lai village, right beside the electric fence corner, a farmer named Mr. Can lived with his durian orchard, which was situated near the path frequently used by elephants. Whenever the elephants passed by to approach village, they would enter Mr. Can's orchard to savor the delicious ripe jackfruit.



Figure 14. Jackfruit farm raided by elephants with broken trees and jackfruit on the ground

According to Mr. Can, every elephant preferred his orchard as their first stop upon appearing in the village. As the jackfruit trees began to bear fruit, the elephants would always target the large and ripe ones. Because the jackfruit garden was next to the banana garden, he was afraid that the elephants would come and eat the jackfruit and would destroy his neighbor's banana garden, so he cut down all the jackfruit trees to keep himself and his neighbors safe. Hence, he had to cut off jackfruit orchard and switched to cultivating durian, knowing that elephants do not favor this particular fruit.



Figure 15. Jackfruit farm has been cut down completely and the local people built electric fences themselves to protect their remaining crops.

Each time the elephants made their way through, Mr. Can and his family would prepare wine, snacks, and light incense, pray and hoping the elephants would not disturb their plantation. To deter the elephants from entering, Can's family installed an electric fence and hung lights to illuminate the orchard. They also placed containers filled with pesticide at the entrance as elephants have an aversion to this odor. Despite frequent visits from the elephants, the family maintained a respectful and non-hostile attitude towards them. This reflects their reverence and peaceful coexistence between humans and nature.

DISCUSSION

Local Perspectives on Elephants

Farmers who live in areas where human-elephant conflict is common often face significant challenges, particularly when elephants come onto their land and destroy their crops. However, many farmers choose to approach these situations with respect for the elephants and a willingness to find solutions that benefit both humans and animals. They recognize the importance of elephants in their ecosystem and understand that they are intelligent and social animals with a right to exist.

Despite the fear of elephants, local people exhibit a great deal of respect towards them, often referring to them as "Ông" as a sign of reverence, also people bow and pray to the elephant when it comes not to take their crops. On certain days, people will bring bananas, rice, and salt to the elephant trail and leave it as an offering. Many farmers do not place blame on the elephants for crop destruction, as they recognize that humans have encroached upon their natural habitat, and they have little choice but to forage for food elsewhere. Although the damage caused by elephants can sometimes cause frustration and anger among farmers, people still hold a deep admiration for these majestic creatures and the vital role they play in the ecosystem.

Elephant crop loss insurance program

- The program to compensate losses caused by elephants is a support program directed by the provincial People's Committee to the most affected districts and communes.
- The commune People's Committee establishes a damage verification team to collect and make a record of all the damage caused by elephants in the commune area. This team is composed of designated persons from the offices of the district, commune, and village. They also coordinate with local FPD (Forest Protection Department) from the park, district FPD, and vice chairman of the commune to synthesize information and send it to the District Committee and District Finance Manager.
- After compiling all the information, the Commune Chairman will submit a report to the District Committee to make a list of affected households and balance the budget to support.
- The support budget is spent through the Disaster Prevention and Control fund of Dong Nai province, under the relevant regulations governing this fund.

FUTURE DIRECTIONS

- Improve collaboration mechanism between SVW and Humane Society International (HSI) to increase elephant conservation impacts
- Conduct thermal drone surveys and ground surveys to identify core-usage zones of local elephant population staying near the villages
- Set AI cameras at entry/exit sites so that elephants passing through will send
 - alerts to local people's phones as an early-warning system
- Set AI cameras in elephant "viewing areas" so that local ecotourism operators can
 - bring visitors to safely and ethically view the animals for a fee
- Provide training for local people on elephant viewing and elephant ecotourism by experts
- Identify ecotourism and cultural tourism opportunities in Ta Lai and Thanh Son that can be included in a tourism package for farm-stays, village-stays, etc.
- Identify capacity for elephant-based handicrafts that can be sold by local people (chocolate, snacks, carvings, paintings, clothes, etc.)
- Provide training on ecotourism/farm-stay startup, promotion, and online marketing (trip advisor, social media platforms, etc)
- Create information signs for elephant viewing areas including: info on status of Asian elephants, info on when (month and hours) they usually visit the area, information on HEC in the local villages.



Section 2: Stakeholder Engagement



Figure 16. Group photo of guests who attended the stakeholder meeting

Executive Summary

The Elephant Stakeholder Meeting on June 28th 2023 brought together local farmers affected by human-elephant conflict, village and commune leaders of Ta Lai and Thanh Son, law enforcement, Cat Tien National Park protected area managers and rangers, private sector ecotourism businesses, and local conservation NGOs including Humane Society International (HIS), and Save Vietnam's Wildlife (SVW).

Purpose

1. **Elephant Observation Network:** Introduce the newly established Elephant Observation Network (EIN) Dong Nai initiative for local people, rangers, and other community members living within the Dong Nai elephant population areas to report elephant sightings, stories, and elephant-related damages
2. **SVW project initiatives and community support:** Explain the initiatives of SVW elephant conservation project including the use of Artificial Intelligence (AI) cameras as an early warning system, thermal drone monitoring projects to track elephant groups, movements, and behaviors, and the intended initiative to build up an elephant ecotourism model to benefit local stakeholders affected by human-elephant conflict (HEC).
3. **Elephant information and safety training:** Provide stakeholders with information on the population size of elephants in Dong Nai, the extent of human-elephant conflict in the province, the extinction threshold for elephants in Vietnam, and to provide training on elephant behavior, safety protocols, and measures to help ensure property damages remain at a minimum.
4. **Elephant ecotourism planning:** Bring together local ecotourism operators to gather feedback from local stakeholders and elephant experts on how an elephant ecotourism model can be established In Dong Nai through a holistic, step-by-step process that takes advantage of the reports from the elephant observation network, connects with tourists, and established a benefit-sharing mechanism that pools financial support into the communities affected by HEC to reimburse crop damages by elephants and build local incentives to support conservation actions.

Results

Stakeholder Feedback

1. **Discussion Item 1: Who will connect with tourists to announce it is possible to see wild elephants?**
 - a. Information on elephant populations and individuals should be accurate
 - b. Rangers, local people, and others who come in contact with the elephants can inform about their arrival
2. **Discussion Item 2: What is the mechanism to inform visitors when an elephant is spotted**
 - a. Elephant viewing must be a tour provided by a professional unit to ensure safety, not a spontaneous service
 - b. Travel agencies should announce and promote this activity and inform visitors, since people who spot the elephants generally do not have contact with tourists
 - c. There should be an elephant viewing service and information dissemination service to visitors
 - d. Elephant spotted -> report to local commune -> reports to tourism agency -> reports to visitors
3. **Discussion Item 3: Who should bring visitors to see elephants?**
 - a. It takes a thorough research process and a methodical approach to ensure the safety of tourists when visiting.
 - b. Indigenous people will be the guide because they know the way, where elephants often appear. However, training is required to ensure safety
 - c. Depending on the location where the elephant appears, such as in the National Park or the land of the people to determine who will be the leader. And there should be flexible coordination between people, forest rangers and HDV
 - d. Consideration: Elephants are generally friendly toward rangers, possibly because they all wear the same uniform and they know not to see them as a threat. It may be beneficial for all guides who bring locals to see elephants to wear a standard, non-threatening uniform so over time elephants know they are safe, and will remain calm.
4. **Discussion Item 4: What should the payment mechanism be to ensure cost-benefit sharing?**
 - a. There should be a clear regulation mechanism with travel companies to ensure that the costs collected from elephant viewing services will be partially contributed to the development and livelihood support for local communities. Avoid travel companies asking for help from people but reaping benefits for the company without contributing to the local community
 - b. Whoever contributes the effort gets paid. But most of the profits should contribute to the community. This means that all involved personnel should get a percentage of payment
 - i. Tourism companies that promote and coordinate with tourists
 - ii. Rangers who join or stand by for protection, safety, and regulation
 - iii. Guides that bring tourists
 - iv. Locals who submit observation locations of elephants for people to view
 - c. A cooperative economic organization should be established with seven board members from CTNP, HEC affected households, Commune/Village leaders, and Ecotourism operators to ensure benefit sharing mechanisms and transparency.



Elephant Monitoring

5. Monitoring of elephants is currently being conducted by
 - a. **Humane Society International (HSI):** through camera trapping and survey projects
 - b. **Save Vietnam's Wildlife:** Through thermal drone and AI camera projects
 - c. **Local people:** through sharing observations of elephants when they visit the community areas

Human-Elephant Conflict Mitigation

6. Currently, some households have voluntarily built electric fences. This is a great sign of local people taking individual actions to ensure damage to their property is reduced.
7. It is possible to turn elephant conflict from a difficulty to an opportunity for tourism development and reimbursement for losses.
8. Chasing elephants with sharp objects and increase the level of aggressiveness when confronting to wild elephants would make elephants' reactions worse
9. HSI provided a protocol sheet on elephant safety to all stakeholders compiled from regional expert advice, as well as an ID key to various elephants in the local population.

Elephant Ecotourism Pilot Model

Based on all stakeholder feedback, the elephant ecotourism pilot model could function as follows:

1. **Data Collection and Reporting:** Local community members will contribute to the project by reporting elephant observations through platforms such as Facebook and Zalo group chats. Additionally, camera traps and AI camera alerts will be utilized to capture information about elephant movements and behavior.
2. **Coordination with Ecotourism Companies and CTNP:** Observations received from the community will be forwarded to ecotourism companies like Ta Lai Longhouse that will promote and coordinate elephant tours, and CTNP for monitoring and conservation needs and promotion of tours. Ecotourism companies and CTNP will facilitate the connection between tourists interested in observing elephants and the local guides.
3. **Ecotourism agencies and product development:** Ecotourism agencies (such as the Ta Lai Longhouse) will promote the elephant ecotourism activities to visitors and develop various programs that include village walks (through HEC affected communities), school programs that enable students to learn about elephants and conservation monitoring by finding elephant and measuring elephant footprints, or possibly observing wild elephants if present (in a safe setting), and by visitors or tour groups going out to see wild elephants.
4. **Guided Elephant Tours:** Trained guides, in collaboration with CTNP rangers, will lead visitors to areas with a higher likelihood of encountering wild elephants. The tours will be conducted in a safe, ethical, and environmentally responsible manner, ensuring minimal disturbance to the natural habitat.
5. **Cooperative Economic Organization:** A cooperative economic organization should be established to ensure fair benefit sharing and transparency. The organization will consist of seven board members representing CTNP, HEC affected households, Commune/Village leaders, and ecotourism operators.

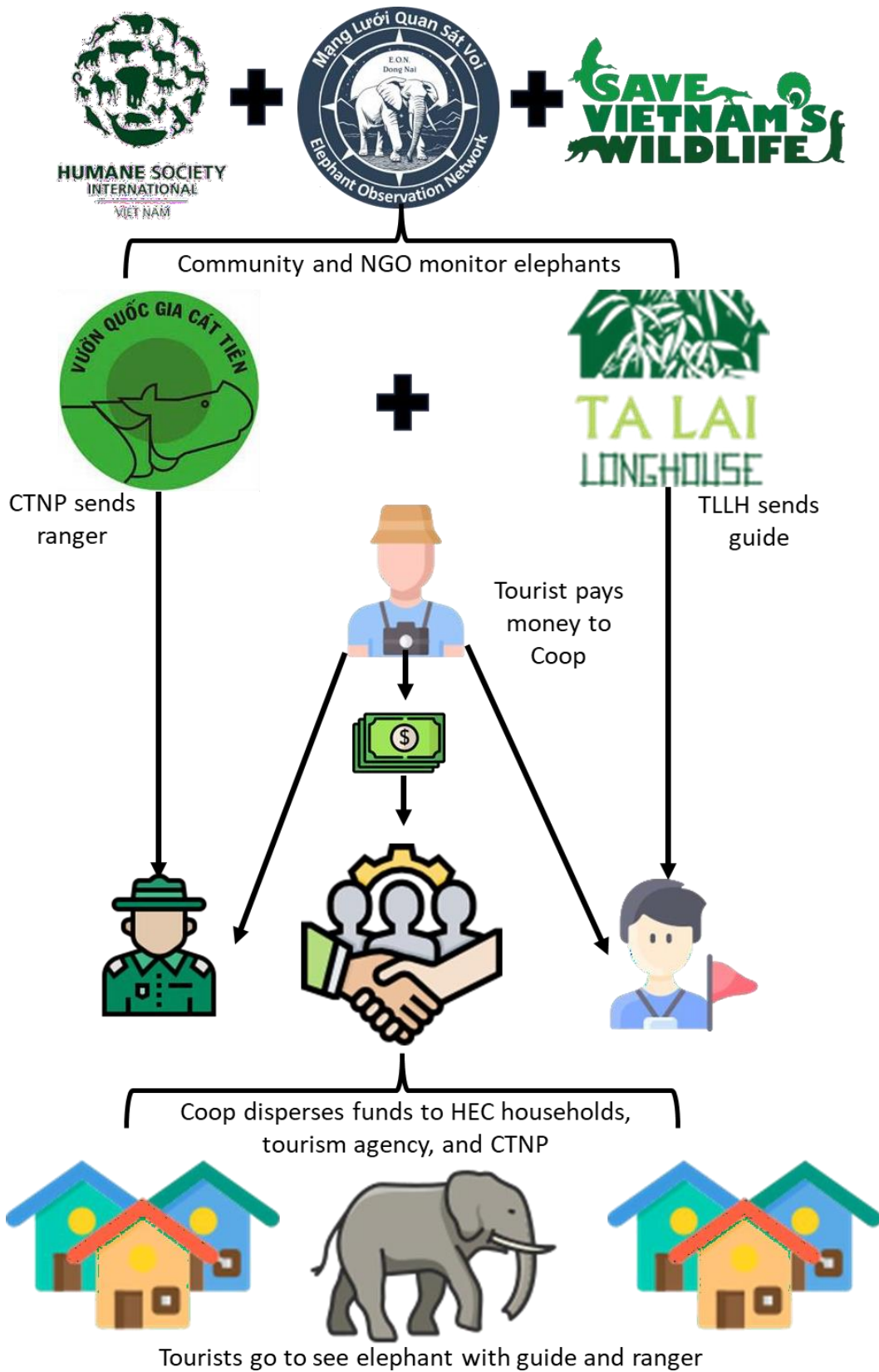


Figure 17. Ecotourism and collaboration structure as recommended by various stakeholders

Section 3: Elephant Monitoring

Elephant Observation Network

We started and promoted a new initiative in Dong Nai called the “Elephant Observation Network” (Figure 18) (<https://www.facebook.com/profile.php?id=61552242155582>) in which local stakeholders who often observe elephants or have elephants damaging their property can share and report their observations on both a designated Zalo and Facebook group. These groups will have commune leaders, rangers, elephant rapid-response teams, and conservation researchers so the benefit is wide reaching. In the future, we plan to incorporate alerts from the AI cameras into the network as an early warning system for locals and for ecotourism operators to take advantage of the opportunity for elephant ecotourism.

We provided QR codes to link stakeholders to the EON platforms during our stakeholder meeting, and only hours after the meeting, the network platforms became active. Two people reported elephants on their property including one with crop damages, and another watching a large male walking down the road near their house. Another member showed a downed portion of the electric fence that may have otherwise gone unnoticed by managing authorities.

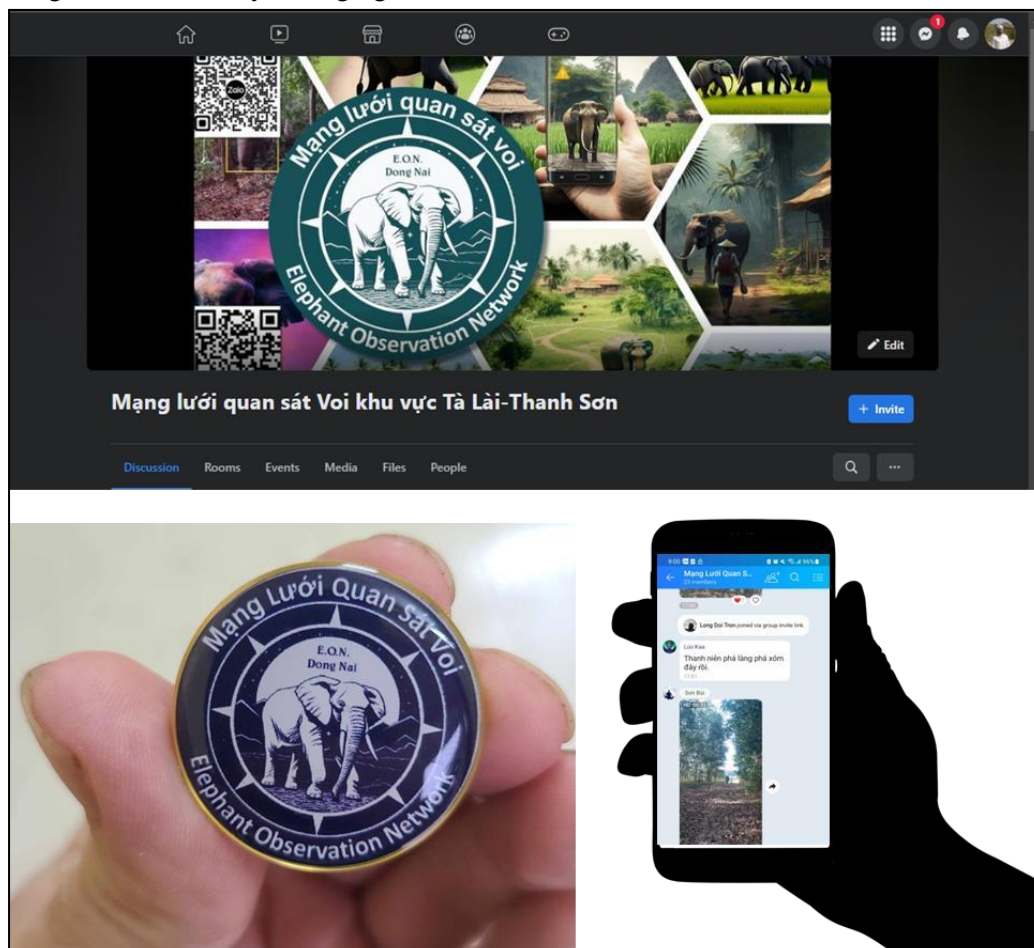


Figure 18. Elephant Observation Network Facebook page, Zalo group, and promotional pins handed out to stakeholders at our meeting.

Thermal Drone Monitoring

In June, our team established a network of 18 flight routes for thermal-drone surveys. The drone used is a Mavic 3 Thermal. This system is employed to search for, identify, and monitor the movement, group size, and behaviors of elephant herds in Dong Nai. Additionally, we implemented rapid response operations upon receiving information from the community regarding elephant presence in the area. To ensure long term sustainability of these monitoring efforts in the future, and prompt responsiveness, we organized technical training sessions on drone utilization for the forest ranger forces stationed at various stations as well. Thermal drone monitoring of elephants is beneficial because they can be monitored at night during their active periods with minimal disturbance. It also reduces the safety risks for monitoring teams, as they do not have to get close to the animals to make observations.

So far, we have carried out 60 systematic flights. However, most of them were unsuccessful in detecting elephants. Only two flights so far were successful in monitoring an elephant that remained close to the community areas and the periphery of the forest. However, 11 Elephant individual detected as a result of flights, ground surveys, and rapid responses flights. There have been reports lately of a group of 10 individuals (and possibly a new baby) that has been visiting sites along our flight routes. We are hopeful for the coming months and assuming a potentially seasonally variation in movement behaviors that may allow us to obtain more detections. We also carried out ground survey for 3 days a week to record active and sign of elephant active.

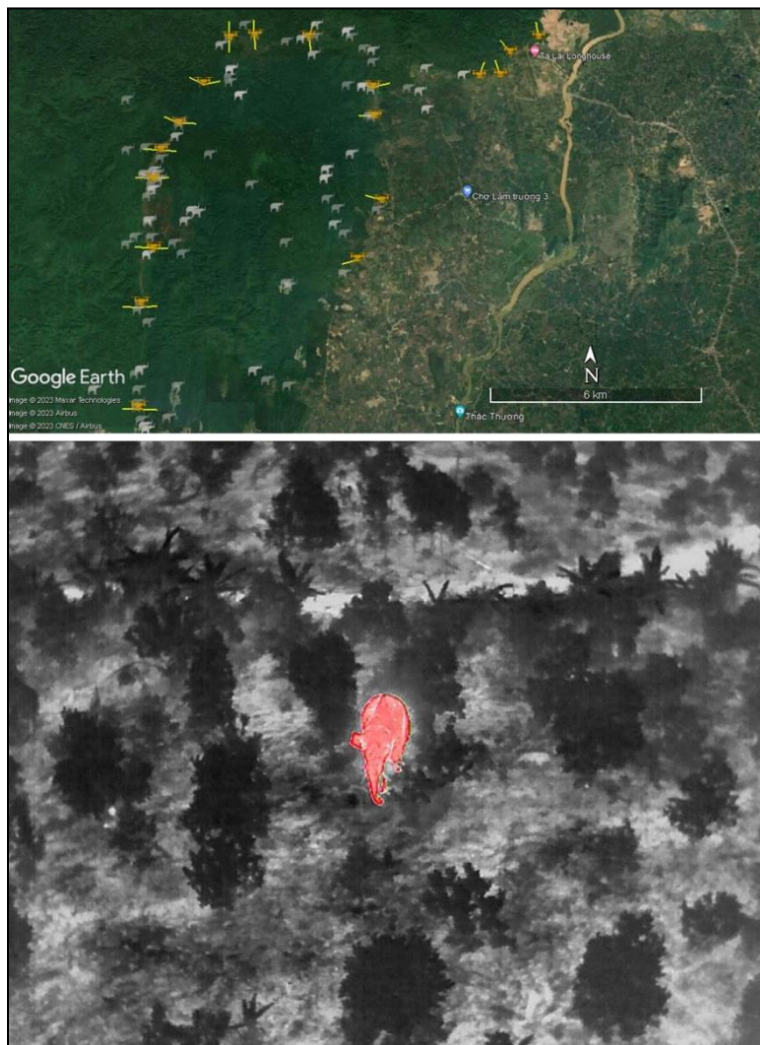


Figure 19. Elephant flight transect plans, and a large male elephant detected via thermal drone inside a cashew plantation.

Thermal Drone Training

In Thanh Son and Ta Lai Communes, we have taken the initiative to train rangers in the critical task of monitoring elephants using thermal drones from four different ranger stations which patrol and monitor an approximately 120 km² area (**Figure 18**). Our flights are conducted under 5657/TC-QC issued by Department of Operations of General Staff of Vietnam and project permission no. 360/VCT-KH&HTQT from Cat Tien NP. This initiative aims to ensure the long-term sustainability of monitoring efforts so that the continuation of these activities can be sustained after we exit the project.



Figure 20. Images of our team members providing in-field training on how to operate and interpret the functions and visual outputs of the thermal drone.

Drones and potential for HEC management

In one instance of flying our thermal drone within 30m of a large male elephant to collect video footage. We realized if we got closer than 30m altitude, the individual would calmly walk in the opposite direction. We would like to explore this behavior further to assess a thermal drone's use as an ethical active HEC mitigation tool. Since thermal drones can see elephants at night when they are active, they allow a safe way to approach and visualize them. Currently, locals use spotlights to drive elephants in the opposite direction. Our drones are also fitted with a spotlight, so this may be a potential tool that can be used to guide elephants safely away from human settlements.

Drone Limitations & Good News

Other than rainy and windy conditions, one of the major limitations of flying drones in Vietnam are the strict policies and permissions required to do so. In order to fly drones in a protected area, one must first contact the Vietnam Ministry of Defense, and pay a large fee (between \$300 – \$700 USD) to get a permit for a pre-determined flight plan (with dozens of restrictions that must be discussed before flight plans are established). This means that your flight days are not compensated for in the permissions regardless of weather-events that permit you from carrying them out.

Fortunately, in July the government of Vietnam passed a new regulation loosening the permissions necessary for researchers, conservationists, and managers to fly drones if it is for forestry management purposes (<https://www.qdnd.vn/xa-hoi/tin-tuc/duoc-phep-su-dung->

[thiet-bi-bay-khong-nguoi-lai-trong-quan-ly-bao-ve-rung-734740](#)). The new policies have been written under Official Letter No. 3917/VPCP-QHDP dated May 30, 2023 and amended to Decree No. 36/2008/ND-CP dated March 28, 2008.

AI Cameras

In late May 2023 we obtained 3 Reolink Go Plus cameras to test our AI system in collaboration with Conservation AI. The cameras unfortunately did not work with Vietnamese SIM cards, and were therefore not used for the project. Fortunately, we had several Panthera PoacherCams on hand that were not in use by our anti-poaching teams. Both SVW and Conservation AI were uncertain whether or not the cameras could be used with the system, but after a day of trial and error, we found a way to make them operate and speak to their website.

We have since set three AI cameras in early July in locations that were determined to be high value for elephant monitoring and community benefit as an early detection system. Our team visited each entry/exit points reported by locals during our HEC surveys and scored them based on:

- Evidence of elephant activity (footprints, dung, direct observations)
- Proximity to crops often raided by elephants (banana, mango, jackfruit, durian, cashew)
- Whether or not there was a viable area to put the cameras
- Was it clear of vegetation
- Was it a bottleneck point where only one entry/exit was present (easier to detect this way)
- Is there a tree or post to secure the camera out of reach
- Is there a location where a solar panel can collect sunlight (open area)



Figure 21. Poster that we hang under the AI cameras to ensure locals understand the benefit and purpose of them being there.

These cameras AI have been strategically placed at the entry and exit points where elephants usually traverse whenever they appear on the farmland side. The initial results have been promising; the cameras have been functioning effectively. Upon detecting an elephant passing by, the cameras promptly identify the animal and generate alerts, ensuring the timely notification of the community about the elephant's movement. Through the early warning system, the local community will be aware of the timing of elephant appearances. This will enable them to notify neighboring households and take protective measures to safeguard their crops, thus avoiding potential conflicts that might arise.



Figure 22. Elephant travelling to local's farm though known trail recorded by AI camera. **Note:** Conservation AI only has a robust African Elephant model (hence the species name), but it works effectively for Asian elephants (although with some elephants being classified as rhinos and hippos). In the cases of misclassifications, we simply add them to our alert system collectively.

Section 4. Elephant database

We collaborate with several sources to aggregate and standardize data obtained from elephant observations. This data is compiled into a comprehensive dataset, incorporating information sourced from Cat Tien National Park, SVW-SMART patrol data, HSI data, and SVW-Research team data. The dataset encompasses diverse information, including direct observations of the animals or their tracks, status and numbers, as well as specific individual characteristics noted. This compilation of ~700 records hold significant value in delineating the elephants' habitats, ascertaining their status, monitoring their movements, and recording the times of observations. This information provides a comprehensive understanding of the behavior, movement patterns, and preferences of the elephant population in the region. By analyzing this data, conservationists and authorities can identify crucial habitats, determine migration routes, and understand the specific needs and behaviors of the elephants. This knowledge aids in the formulation of effective conservation strategies, facilitating the creation of protected areas, mitigation plans to prevent human-elephant conflict, and targeted initiatives to ensure the well-being and preservation of the elephant population in Dong Nai.

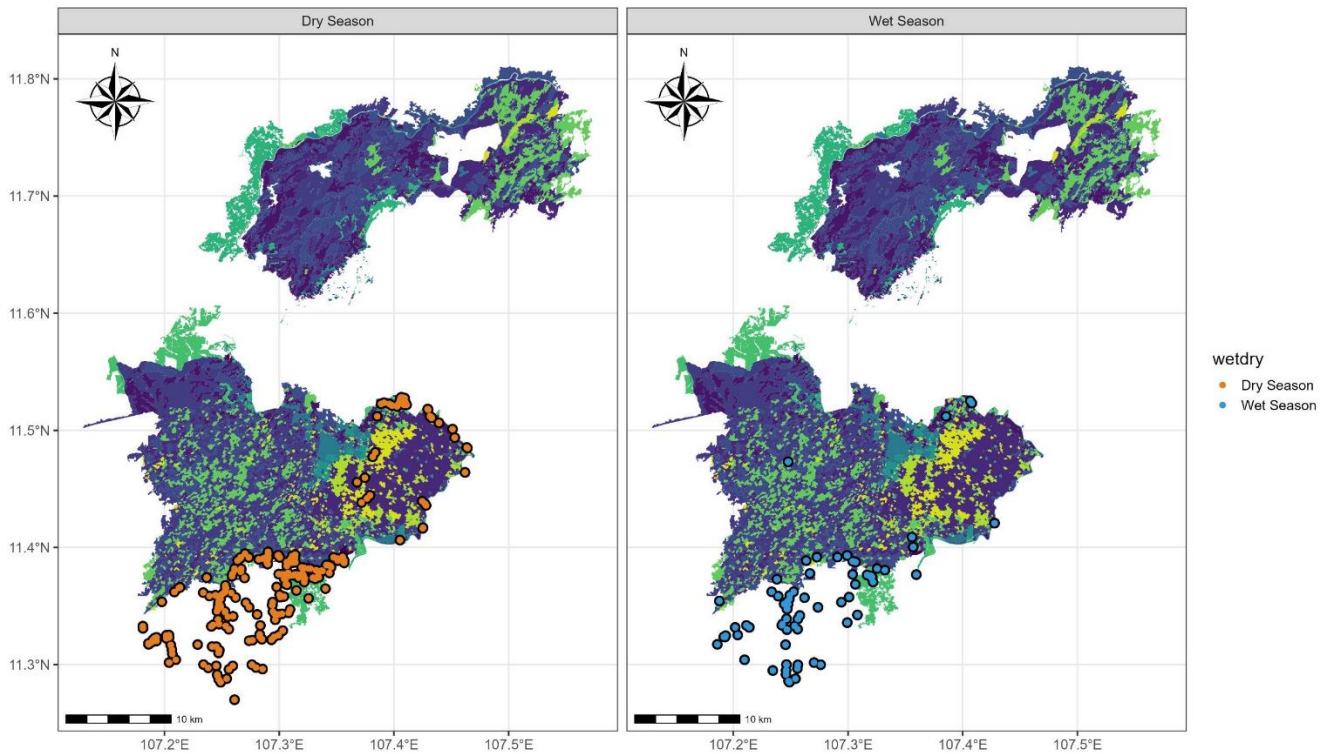


Figure 23. Mapped data from the elephant database showing seasonal variation in movement patterns during wet and dry season that were previously unknown. This new database has already served to make recommendations to park managers on “Elephant season” inside the park area to raise awareness of visitors and potentially promote viewing of the elephants when they come through the park (primarily from November – February)

Section 5. Population Viability Analysis

Methods and parameter input

We conducted a simple, tentative Population Viability analysis (PVA) using Vortex 10 software (<https://www.cpsg.org/our-approach/science-based-tools/vortex>).

We used general input parameters with modification from He et al. (2020), and set the parameters under three scenarios “Best scenario” (no HEC, discontinued land conversion, and no poaching) indicating the elephants had no external population threats, “Realistic Scenario” (HEC threats) in which the elephants encounter HEC which may lead to occasional retaliatory killing in some years, and “Worst Case Scenario” (HEC/land conversions + Poaching) which represents a coupling of HEC-related mortality events amplified by further land conversions and poaching threats.

We set the current population size to 27 individuals following the recent population report by Humane Society International (HSI) Vietnam with 9 adult females and 16 adult females; there are two young of undetermined sex so we split 1 young female and 1 young male. We set the carrying capacity to 100 individuals, and the timeframe to 100 years.

Results

Results indicate an increase and stabilization of the population under the Best-case Scenario, a gradual decrease in the HEC Scenario, and rapid decline in the HEC/Land Conversion + Poaching scenario (**Figure 24**).

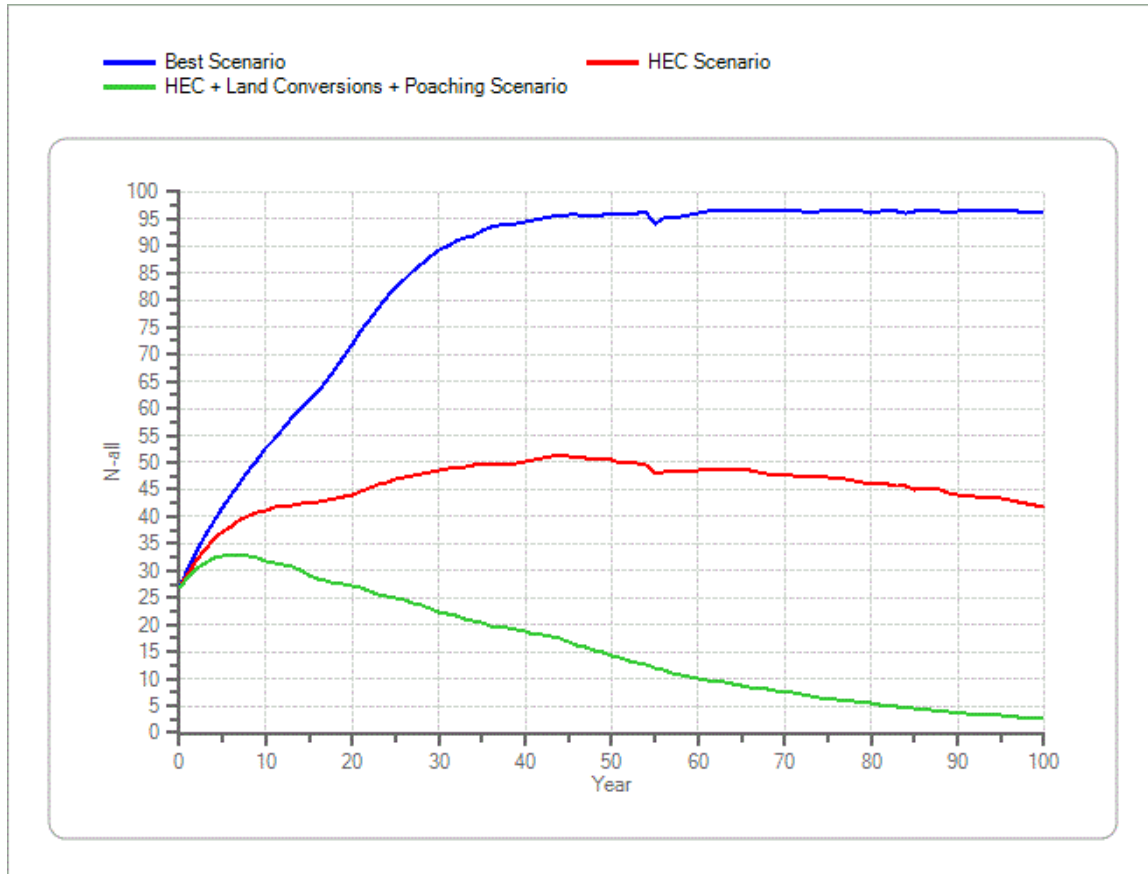


Figure 24. Population viability analysis for the Asian Elephants in Dong Nai indicates their best-case scenario has 0% probability of extinction over time, the Current HEC Scenario has 8% probability of extinction, and the Worst-Case Scenario (all major threats to elephants in Vietnam for the past 3 decades) has 83% probability of extinction over time. Therefore in order to maintain the population, HEC must be entirely mitigating and retaliatory killings cannot occur, and elephants must be protected from rapid land conversions and poaching threats throughout Vietnam.

References

He, C., Du, J., Zhu, D., & Zhang, L. (2020). Population viability analysis of small population: A case study for Asian elephant in China. *Integrative Zoology*, 15(5), 350-362.

Discussion

The study aimed to address human-elephant conflict (HEC) by employing an Ecological Niche Model (ENM) to analyze Asian elephant records and relevant environmental variables. The ENM demonstrated promising performance, providing distinct migration and grazing paths for elephants within the Cat Tien National Park protected area and its surroundings. By identifying high-risk HEC sites using ESRI Land Use Land Cover data, targeted surveying was conducted in the Ta Lai and Thanh Son districts of Dong Nai province.

To gather essential information, the research team collaborated with local stakeholders, including farmers, village leaders, and park rangers. Semi-structured interviews and ground surveys were utilized, resulting in the involvement of 84 farmers sharing their experiences and insights regarding elephant activity and crop damage. The data revealed that elephants remained active throughout the year, with heightened activity during the rainy season (July to November). Banana, jackfruit, rice, corn, and cashew were primary crop targets, while elephants also sought salt and grain stored by farmers. Moreover, the study shed light on unique local stories of human-elephant encounters, illustrating the challenges faced by farmers and their respect for these majestic creatures.

The stakeholder meeting played a pivotal role in facilitating communication and collaboration among diverse groups. Participants included local farmers, conservation organizations, village and commune leaders, law enforcement, and ecotourism businesses. The meeting addressed critical aspects of elephant monitoring, safety, and community involvement. The introduction of the Elephant Observation Network (EON) provided a platform for local stakeholders to report elephant sightings and damages, contributing to an early warning system. Furthermore, the utilization of thermal drones and AI cameras exhibited potential for efficient and non-intrusive elephant monitoring, with training provided to local rangers for long-term sustainability.

Conclusion

In conclusion, the study's findings and stakeholder engagement demonstrated the significance of community involvement in addressing human-elephant conflict. The successful application of the ENM, thermal drones, and AI cameras enabled the identification of HEC hotspots and better understanding of elephant behavior. Local perspectives showcased the farmers' deep respect for elephants, despite the challenges they face.

The stakeholder meeting proved instrumental in fostering collaboration and co-creating solutions for elephant conservation and ecotourism. The establishment of the Elephant Observation Network allowed for real-time reporting of elephant activities, facilitating timely responses and enhanced safety measures. The future direction for the study encompasses strengthening collaborations between conservation organizations and expanding AI camera deployment, thermal drone surveys focusing on rapid-response events, and sustainable ecotourism practices.

Overall, this research contributes to the broader efforts of conserving Asian elephants and promoting harmonious coexistence between humans and wildlife. By bridging scientific knowledge with local wisdom, we aim to develop effective strategies that protect both the livelihoods of farmers and the natural habitats of these magnificent animals.