

Human-Elephant Conflict Around Pu Mat National Park, Vietnam

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Abstract. The elephants living in Pu Mat National Park and Anh Son Watershed Forest, often move out to adjacent areas and cause severe human-elephant conflict (HEC). The main reasons for the HEC are, reduction and degradation of natural forest, human disturbance of elephant habitat, not taking elephants into account in land-use planning and poor HEC management. Local communities are very poor and have little experience in HEC prevention. HEC significantly impacts their livelihoods, threatens their lives and induces significant psychological stress, resulting in decreased support for elephant conservation.

Introduction

The Asian elephant (*Elephas maximus*) is threatened by illegal hunting, trade, habitat loss/ degradation and ever-increasing human-elephant conflict (HEC) (AsESG 2017). In many countries, HEC causes significant economic damage and psychological impacts on communities. Consequently, killing of elephants has been increasing. Thus, resolution of HEC is a major concern and a high priority for conservation of elephants (Fernando *et al.* 2008; Desai & Riddle 2015). In Vietnam, the Asian elephant population in the wild has decreased from about 1500–2000 individuals in 1990 to only 100–130 in 2013 (Nguyen 2015; Vietnam Forestry Department 2018). Currently they live in small isolated groups, mostly below 5 individuals (Nguyen 2015). Threats to their survival are widespread. In order to save the existing Asian elephants in Vietnam, the Government has designated 3 priority areas for elephant conservation, consisting of the Pu Mat National Park region, Cat Tien National Park – Dong Nai Cultural & Nature Reserve Region, and Yok Don National Park – Ea Sup District Region.

The elephant population in the Pu Mat NP region consists of 3 groups with a total of 13–14 individuals (Nguyen *et al.* 2020a, b). The group in Con Cuong District was thought to consist of

7–8 individuals. However recent observations found only a single adult female. They do not cause much HEC. The group in Tuong Duong District has 4–5 individuals. They occupy an area next to the Laos border and also cause little HEC. The third group is located in Anh Son District and consists of 8–9 individuals. As this is the largest group, it is the most important for elephant conservation in the Pu Mat NP region. However, the elephants cause severe HEC including economic damage, human deaths and injuries. In 2011 an adult male was killed in retaliation. The aim of this study was to assess HEC in Pu Mat NP region and develop strategies for its management.

Methods

Study area

The Pu Mat NP region is situated in the Southwest of Nghe An Province (18°46' - 19°12' N; 104°24' - 104°56'E), on the border with Laos. It covers the administrative territories of Anh Son, Con Cuong, Tuong Duong and Thanh Chuong districts (Fig. 1). The Pu Mat NP has a core zone of 94,715 ha and a buffer zone of 86,000 ha. The region is intersected by mountains with steep slopes and narrow valleys, with the elevation ranging from 100 to 1841 m a.s.l. About 90% of the area is below 1000 m. Level areas

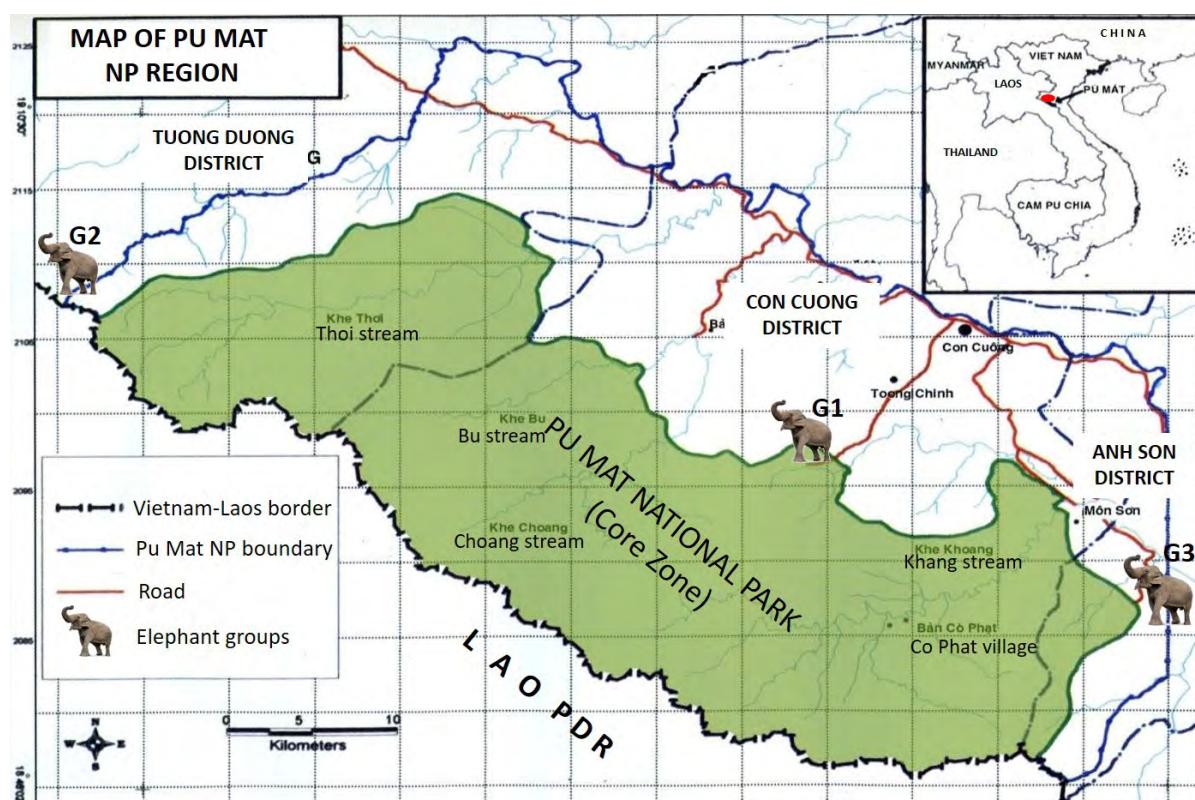


Figure 1. Location of Pu Mat NP region and elephant groups (G1 = Con Cuong elephant group, G2 = Tuong Duong elephant group, G3 = Anh Son elephant group).

are limited and are mostly occupied by settlements and agriculture. About 92,790 ha (97.8%) of the core zone is forested, with the vegetation comprising mostly of montane broad-leaf evergreen forests with bamboo forests occurring in lowland valleys. The buffer zone consists of secondary broad-leaf evergreen forests, restored forests, bamboo forests, commercial tree plantations, croplands and human settlements.

Data collection

The study was conducted in 2019–2020. Semi-structured interviews were used to collect information on HEC status, impacts and prevention/mitigation measures used. The interviews were conducted in different parts of the study area including the Pu Mat NP, the Anh Son and the Thanh Chuong watershed forests, local state rubber plantations and settlement centres. Field investigation was undertaken when information of recent HEC incidents were available (Fig. 2). In order to assess the attitude of local communities towards elephants and forest conservation, 300 questionnaires were sent to local households in Phuc Son and Thanh Duc com-

munes, of which 254 were completed and returned. Direct semi-structured interviews of 226 local households representing 40.2% of total households in the HEC area, were also conducted. One person from each household, aged 20 years or older was interviewed, usually the male head of the household. In each village, surveyors moved from house to house for interviews. The Human-Wildlife Conflict Rapid Safety Assessment System (Brooks 2015) was used to as-



Figure 2. Survey team interviews local village on elephant damage happening last night.

sess HEC mitigation. Consultations were held with representatives of villages, commune authorities, the Pu Mat NP management board, watershed forest management boards and state rubber farms. The level of safety in each component of the system, consisting of safety for people, safety for property, safety for elephants, safety for habitat, and monitoring effectiveness of management was determined and the strengths and weaknesses in the management of HEC by each group were identified.

Results and discussion

HEC area

The home range of the Anh Son elephant group was about 18,000 ha (Fig. 3). It comprised of the Cao Veu sector of Pu Mat NP, Anh Son watershed forest, Thanh Chuong watershed forest,

state rubber farms and agricultural lands of Phuoc Son, Thanh Duc and Thanh Son communes in Anh Son and Thanh Chuong districts.

The elephants mainly stayed in the Anh Son watershed forest. They moved out during January to March and November to December when young bamboo shoots and crops were abundant outside. During these periods they often went back and forth spending 2–3 weeks at a time in each habitat. The elephants stayed in the Anh Son watershed forest probably because the terrain was better with comparatively low earth mountains of about 200–600 m height and steepness of 20–35°. In contrast in the Cao Veu sector, the terrain consisted of limestone mountains, soil mountains and deep narrow valleys with elevations reaching above 1400 m and steepness over 45°. The Anh Son watershed forest also had high surface water availability

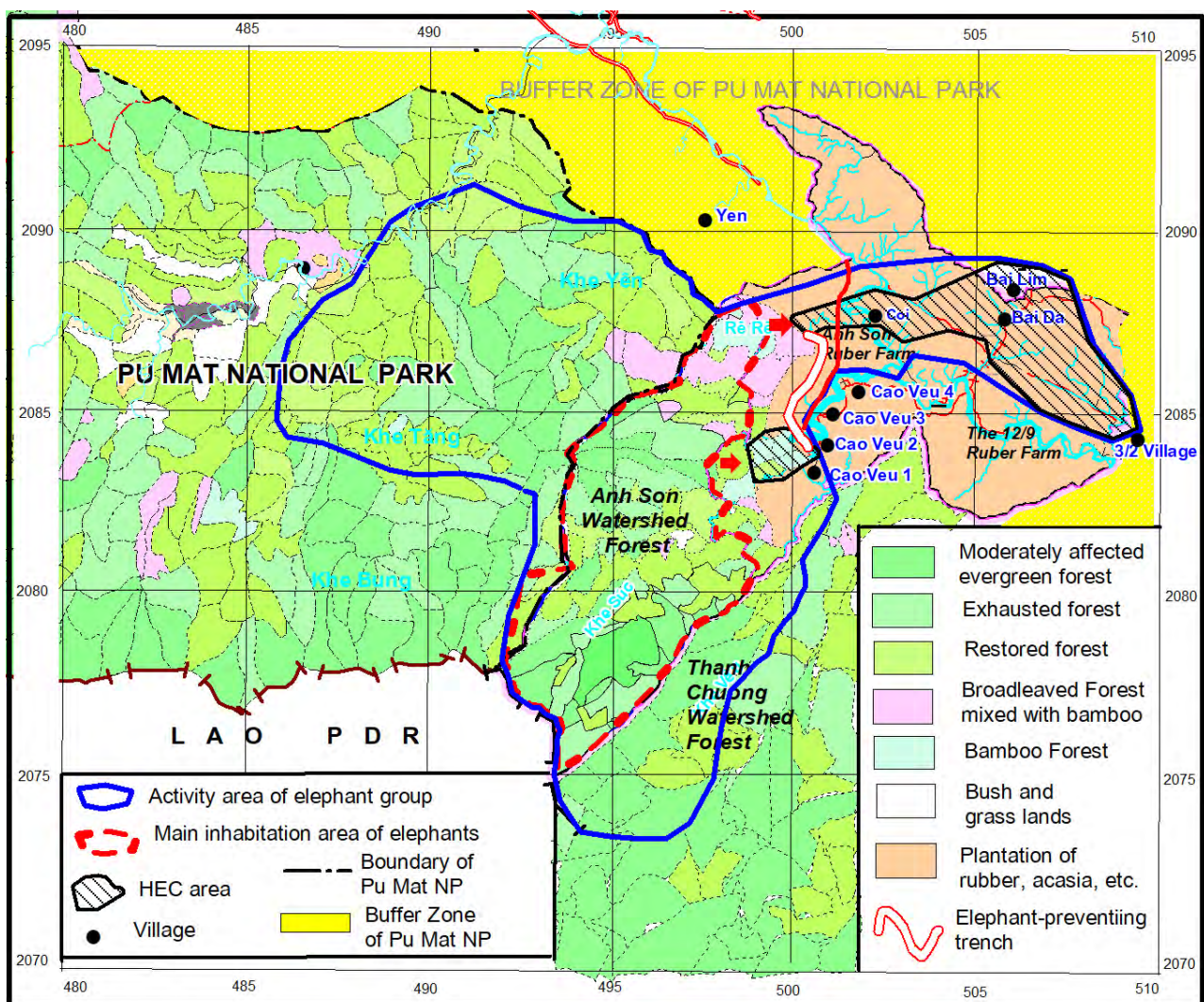


Figure 3. Activity area of the Anh Son elephant group and HEC area.

Table 1. Cultivated plant species affected by elephants and the type of damage caused.

No.	English name	Scientific name	Type of damage
1	Maize	<i>Zea mays</i>	Consumption, trampling
2	Manioc	<i>Manihot esculenta</i>	Eating, trampling
3	Rice	<i>Oriza sativa</i>	Eating, trampling
4	Banana	<i>Musa</i> spp.	Eating, breaking
5	Bamboo	Bamboo spp.	Eating young shoots, breaking
6	Small bamboo	<i>Schizostachyum dulloua</i>	Eating young shoots, breaking
7	Met bamboo	<i>Dendrocalamus barbatus</i>	Eating young shoots, breaking
8	Acacia	<i>Acacia auriculaeformis</i>	Breaking
9	Acacia	<i>Acacia magnum</i>	Breaking
10	Pagoda tree	<i>Styrax tonkinensis</i>	Breaking
11	Tea	<i>Camellia sinensis</i>	Trampling
12	Cow grass	<i>Penisetum purpureum</i>	Eating, trampling
13	Sugar cane	<i>Saccharum officinarum</i>	Eating, trampling
14	Rubber	<i>Hevea brasiliensis</i>	Breaking
15	Mandarin	<i>Citrus</i> spp.	Breaking
16	Pommel	<i>Citrus maxima</i>	Breaking
17	Jackfruit	<i>Artocarpus heterophyllus</i>	Breaking

due to abundant streams, and high food availability from secondary forests, bamboo forests, natural banana stands and grasslands.

From Anh Son watershed forest, the elephants sometimes came to the Yen village of Luc Da commune where they occasionally damaged cultivations, but did not cause severe HEC. In the northern direction, the elephants crossed the Re Re stream in the Anh Son watershed forest and moved to the Anh Son State Rubber Plantation, Cao Veu 4, Bai Lim, Bai Da and Kim Tien villages of Phuc Son commune in Anh Son district. Then, they moved further to the 12/9 State Rubber Plantation, the Third-February village (Thanh Duc commune) and the Dai Son village (Thanh Son commune) in Thanh Chuong district. In these areas, the elephants caused severe HEC. The elephants also crossed the Khe Suc stream and the Khe Da Mai stream and entered the Cao Veu 1 village where they caused some HEC, damaging crops and houses.

Impact of HEC

HEC has occurred in the Phuc Son area since 2004. However, it was not severe at first as there were only few crop damages and no human death and injuries. HEC increased, particularly after 2009 with more crop damages and the oc-

currence of human deaths and injuries, and elephant deaths.

Out of about 40 crop species cultivated in the area, 17 were damaged by elephants. The most commonly damaged crops were met bamboo, bamboo, rubber, Acacia, sugar cane, banana and maize (Table 1).

In 2014, damage to a sugar cane plantation in the Cao Veu 1 village (Phuc Son Commune) was over 200,000,000 VND (22,000 US\$). In 2018, damage to crops in Bai Da village (Phuc Son commune) was around 786,000,000 VND (40,000 US\$). During 2018–2019, elephants damaged approximately 2000 rubber trees of the 12/9 Rubber Farm and destroyed two field houses, and the damages were estimated to be about 2 billion VND (220,000 US\$). They also damaged about 400 rubber trees of the Anh Son Rubber Farm, valued at about 600,000,000 VND (330,000 US\$). Total economic loss in 2019 and 2020 was estimated to be about 200,000 USD. Therefore the economic loss caused by elephants in the Anh Son area was very high and significantly impacted the livelihood of local communities, which were already very poor as their annual income was about 400 US\$ per person.

Indirect impacts caused by the elephants included the fear of elephants, restriction of people's movements to and fro from their fields and villages, reduced school attendance and interference with the collection of fuel wood, thatch grass, wild fruits and other non-timber forest products, which supplemented household income.

When elephants came to their lands, farmers and their families had to guard crops and property, leading to loss of sleep and employment opportunities, increased exposure to vector borne diseases such as malaria and dengue, and psychological stress. In Bai Da and Bai Lim villages, when elephants approached the village, 30–40 men were mobilized to guard crop fields and houses. They had to be awake the whole night, keeping watch and chasing elephants. This guarding lasted 3–10 days until the elephants moved away.

In Boc Chau Tam settlement of Cao Veu 4 village (Phuc Son commune), there were 13 families who did not have land for crop cultivation and they earned their living by collecting non-timber forest products (young bamboo shoots, vegetable, fruits, medicinal plants, etc.) from forests close to the village and working as wage-workers. In high HEC seasons, they could not enter the forests because of the fear of elephants and thus lost their income.

The survey found that 110 of 226 households suffered economic loss from HEC in Phuc Son and Thanh Duc communes. In response to the question regarding meeting elephants, 29.2% expressed 'high', 14.2% 'medium' and 56.6% 'low' levels of fear. Of 110 households suffering economic loss by HEC, the number expressing a high level of fear was 72.7% and a medium level was expressed by 6.3%. The findings indicate a high indirect negative impact of HEC in the Anh Son area.

Measures for HEC prevention and mitigation

The main method used was to chase away raiding elephants. Households in Cao Veu 1 village turned on electric lamps hung around the houses, to discourage elephants from coming

close. When the elephants approached houses, the people tried to chase them away by shouting, burning tires, making loud noises by beating on metal and lighting bamboo stems to create explosions. These attempts had low success because the elephants got used to it after 3–4 times of being chased using these methods.

In 2015, Pu Mat NP constructed a 5-km long concrete lined trench along the hill slope in Phuc Son commune (Figs. 3 & 4). The trench has been effective in preventing elephants entering populated areas of Cao Veu 1, Cao Veu 2, Cao Veu 3 and Cao Veu 4 villages, but has not eliminated HEC. The elephants used new routes to enter Cao Veu 1 and they also enter Bai Lim, Bai Da and Kim Tien villages (Phuc Son commune) and the Third-February village (Thanh Duc commune) where they continue to cause severe HEC.

In 2018, two HEC Response Teams, each consisting of 10 residents, was established by Pu Mat NP to help local communities in HEC prevention and mitigation. The teams were not full time employees and became activated only when elephants came. They had no monthly salary but received an allowance for subsistence when working in the forest. They were provided training on chasing away elephants by simple techniques and received very limited funds for the operation of the team (about 1,000 US\$ per month for two teams). The support that could be provided to the local communities by the two teams was inadequate to address HEC effectively.



Figure 4. Elephant-preventive concrete trench in Anh Son District (Pu Mat NP).

Reasons for HEC

Habitat loss and degradation

Elephant habitat in the area has been significantly reduced and degraded due to conversion of natural forests into tree plantations and cultivated lands. Before 2009, almost the entire area (about 45,000 ha) of the Anh Son and the 12/9 Rubber Farms was covered by natural forest and served as habitat for elephants. In 2009, the natural forests in the area were converted to rubber plantations and other tree plantations such as *Acacia* spp., met bamboo (*Dendrocalamus barbatus*) and bo de (*Styrax tonkinensis*), and agricultural fields such as sugar cane and bananas. According to Pu Mat NP Management Board, before 2010, Phuc Son commune had about 43,000 ha of natural forests but from 2010 to 2018, about 12,000 ha of forests was converted into rubber plantations. The elephants are now confined to an area of about 18,000 ha, of which only 11,300 ha is natural forest. The loss of habitat may have led to decrease of food resources and movement paths for elephants.

Human disturbance

Current elephant habitat in Anh Son is much disturbed by local residents through cultivation activities in the forest, harvesting non-timber forest products such as fuel wood, bamboo, rattan, medicinal plants and bee honey and fishing and hunting/trapping wild animals. These activities may disturb the elephants and make them more aggressive towards people.

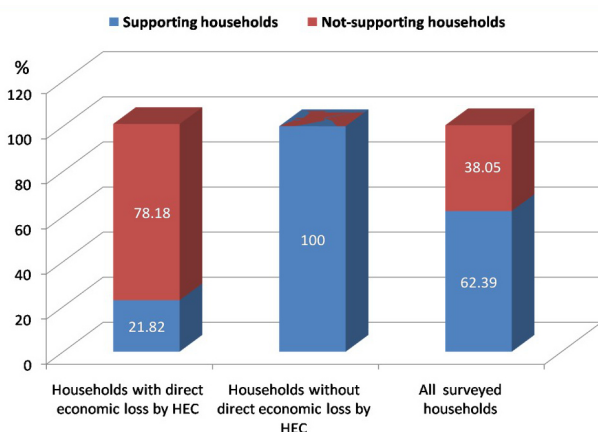


Figure 5. Support for elephant conservation.

Lack of proper land-use planning

The presence of elephants has not been taken into account in setting up settlements and cultivations. Villagers constructed houses and grew crops very close to or even within the forest. As a result, seasonal movement routes of elephants outside the forest were obstructed. In addition, most crops in the area such as rice, manioc, maize, sugar cane, banana, papaya, bamboo and fruit trees, were very attractive to elephants.

Poor HEC management

Local communities had little knowledge of HEC prevention and mitigation measures and lacked the financial capacity to implement such measures. The current governmental HEC management system merely consists of a 5-km trench, a few awareness programs on wildlife conservation and poorly-operational HEC Response Teams. There are no HEC prevention/mitigation interventions such elephant monitoring for warning local communities of elephant encroachment. Financial support is lacking for local communities to apply HEC preventive/mitigation measures such as watchtowers, elephant-preventive trenches, bee-hive fences, etc. and for elephant-friendly livelihood development schemes.

People's attitude towards elephant conservation

Out of 110 households with direct economic loss by HEC, only 24 had a positive attitude to elephant conservation (Fig. 5). In contrast, all 116 households without direct economic loss by HEC had a positive attitude. This clearly indicates that HEC caused significant decrease of local community support to elephant conservation. Local communities are very poor and the HEC significantly impacted their livelihood, threatened their lives and induced significant psychological stress on them, leading to the observed decrease in support for elephant conservation.

When households supportive of elephant conservation were questioned about their reasons, all stated that it was because elephants were an endangered species and were protected by gov-

ernment laws. In addition, 46.8% expressed support because elephants were a government asset, 23.4% because elephants had lived there for a long time as close friends of the people and 1.4% because elephants can help local economic development. The percentage of people supporting elephant conservation because they cared for elephants was lower than we expected. Possibly, this is because conservation education has focused too much on laws, neglecting the socio-cultural aspects of elephant conservation, and because of the negative impacts of HEC in the area. The fact that very few saw an economic value in elephants, reflects the lack of livelihood development measures associated with elephant conservation.

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