Elephants beyond the Boundaries: A Geographical Assessment of Elephants' Movements outside the Udawalawe National Park

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Abstract:

Udawalawe National Park (UNP) in the Southern Wildlife Region (SWR) is not only very famous for its biodiversity and its elephants (*Elephas maximus maximus*) but also for the unfavourable Human-Elephant Conflict (HEC) prevalent around the park. Entry of elephants into the farming fields, damaging the crops and property, occasional injuries and death to both humans and elephants are common features beyond the UNP. The objective of this research is to identify how the push and pull factors contribute to elephants' invasion of villages, farmlands and HEC beyond the Eastern boundary of the UNP. UNP and the Eastern Udawalawe National Park (EUNP) have been selected as the study site for this research. Purposive sampling has been employed as one of the main techniques to collect data from targeted respondents. Particularly, a questionnaire survey, in-depth interviews with farmers using semi-structured questions, key informant interviews with park officers and with Safari Jeep drivers were conducted. Collected data were analyzed using Content Analyzing Methods, Microsoft MS Excel and GIS. High concentrated human activities (17%) play a major role as major push factors for elephants' entry into the farming fields. Besides, lack of carrying capacity inside the park (05%), the attraction of crops beyond the EUNP (28%), restriction of elephants' home range (30%), dangerous chasing techniques followed by the people beyond the EUNP (11%) and management related issues of the UNP (09%) acts as significant roles in pushing the elephants from the park beyond the EUNP and for HEC.

Keywords: Human activities, Elephants' invasion, Udawalawe National Park, Human-Elephant Conflict

Introduction

One of the most important purposes of declaring an area as a National Park is the conservation and management of biodiversity, especially wildlife, their habitats and the entire ecosystem from the unauthorized human activities and disturbances from immoral human behaviour inside the Parks (IUCN, 2015; IUCN, 2016). Sri Lankan Wild Elephants[1] are one of the most significant animals in the National parks in Sri Lanka (Department of Wildlife Conservation, 1998; De Silva and De Silva, 2007; Department of Wildlife Conservation, 2013). Sri Lanka without the elephants is difficult to be imagined as they are so much a part of our history, culture, religion, mythology, and lately, even politics (Santiapillai *et al*., 2010). It is considered as "*KeyStone Species*"[2], and "*Umbrella Species*"[3] in the context of biodiversity of the country. At present Sri Lankan elephants are considered as "*Flagship Species*"[4] for wildlife conservation and management in the country (Jayewardene, 1994; Fernando, 2015). However, the consequences of elephants‟ entry into the farmlands and villages as well as HEC beyond the boundaries of the parks are the most challengeable issues in the wildlife conservation and management of Sri Lanka (Bandara, 2005; Santiapillai *et al*., 2010; Fernando, 2015). UNP and Yala National Parks are not only very famous for elephants but also famous for HEC in and around the parks in the SWR (Department of Wildlife Conservation, 2011).

As a result of intensified, unfavourable human practices against the elephants in the UNP and due to the attraction of food and water beyond the Eastern border of the UNP, elephants enter the villages, raid crops and damage property. These have become very common beyond the Eastern border of the UNP. One of the most important livelihoods of the

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[1] Sri Lankan Wild Elephants *Elephas maximus maximus* is the subtype species of the Asian elephant, first described by Carl Linnaeus under the binominal system.

[2] *Keystone species'*, emphasize the vital role it plays in the structuring of natural communities.

[3] *Umbrella species* emphasize that its conservation will benefit all other sympatric species.

[4] *Flagship species',* which can capture the imagination of the public and induce people to support conservation measures.

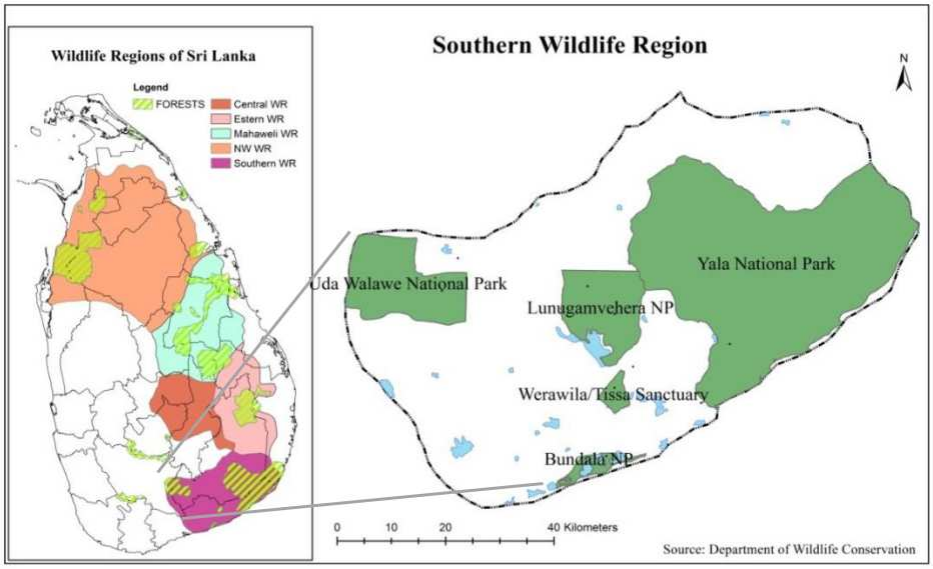
villagers beyond the UNP is agriculture. Seasonal high-risk crops[5] play a prominent role in agriculture as high profitable crops for farmers. Farmers are very much concerned about protecting farming fields and warehouses with the use of various crop protection as well as elephant chasing techniques. Erecting different types of fences including self-financed solar power fences in an irregular manner is very common as protection measures around the agricultural areas, settlements, hotels and restaurants outside the park. However, crop riding by the elephants is very frequent beyond the Eastern border of UNP. According to Santiapillai *et al*. (2010), farmers are in the practice of using hazardous chasing techniques. Killing and wounding elephants are also on the increase in attempts to protect crops, warehouses, properties and lives. Villagers' collective voice and expectation are that elephants should sustain in the park with effective measures or hard physical boundaries must be erected by the Department of Wildlife Conservation. However, according to Fernando (2015) driving or translocating elephants from village areas and restricting them in the park has almost become a failure. It is a challengeable assignment to recognize the root causes for elephants' invasion of the villages and HEC beyond the UNP and to find practical solutions.

Materials and Methods

The methodology has been applied for this research under the following subdivisions; justification of study site, data collection methods and analysis methods. According to the Department of Wildlife Conservation (2011), among six Wildlife Regions of the country, SWR is identified as one of the regions where elephants' invasions beyond the parks and HEC have become a serious problem. The Impacts of wild elephants on human environs are one of the most considerable factors around UNP, Yala National Park, Lunugamvehera National Park, and Bundala National Park in the SWR. Figure1 shows wildlife regions in Sri Lanka and the SWR.

[5] Highly attract to the elephants: paddy, banana, sugar cane, manioc, vegetables, corn and coconut.

Figure 1: Wildlife Regions in Sri Lanka and the Southern Wildlife Region.

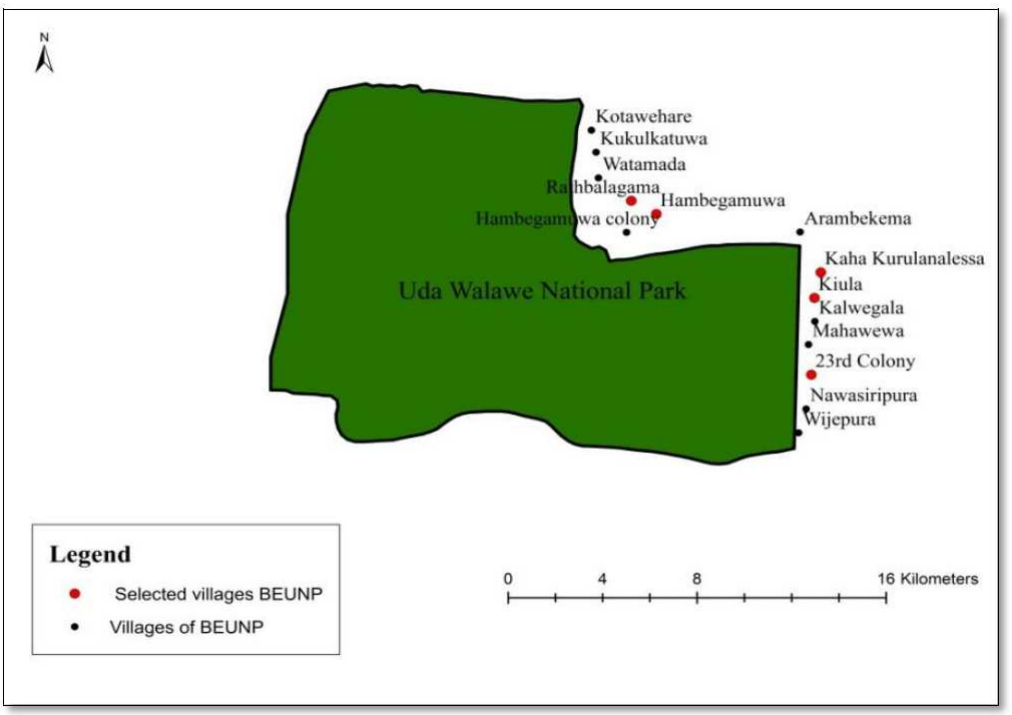


Source: The researcher, based on the Department of Wildlife Conservation (2016).

Study Site: Out of the15 villages beyond the Eastern border of UNP, five villages have been selected for this research. The elephants' invasion and events of conflict are very frequent in these selected 5 villages. The selected villages are Rathbalagama, Hambegamuwa, Kaha Kurulanpalasa, Kiula and the 23rd colony. These villages can be easily reached from Thanamanvila Junction. Figure 2 shows the existing and the selected villages beyond the Eastern border of UNP.

Existing and selected villages beyond the Eastern border of UNP

Figure 2: Existing and selected villages beyond the Eastern border of UNP



Source: The researcher based on GIS (2016).

Data Collection: Purposive sampling has been employed as one of the main techniques to collect data from targeted respondents in five villages above forty years of age who are involved in farming for more than twenty years. Among the selected farmers based on purposive sampling, 75 questionnaires were used for the questionnaire survey. Another set (06 officers) of the questionnaire was used to collect data from park officers. Besides, five (05) in-depth interviews with farmers using semi-structured questions, three (03) discussions with focus groups consisting of 4 to 6 farmers who were victims of elephants' invasions were conducted. Moreover, two (02) key informant interviews with park officers and three (3) interviews with Jeep drivers were conducted. A field survey has been conducted during August and December 2016 and April 2017. Particularly, the reasons for selecting the above-mentioned months were

that April is an inter-monsoonal season while August is dry and the rate of rainfall is high during December.

Semi-structured in-depth interviews were employed as key data collection tools to extract information from farmers who were victimized by elephants' invasion beyond the Eastern border of UNP. Principally, through questionnaire survey, in-depth interviews, focus groups discussions and the key informant interview the respondents provided in-depth information regarding experiences with elephants, their livelihood, mental agony, response, decisions, actions, behaviour and lifestyles of elephants and most importantly the main causes, the way and the views on elephants' invasions to the farmlands and villages including its' contribution to HEC. Further, the researcher was able to find detailed information regarding farming areas, seasonal crops, human practices in the park, grazing areas, elephant's entry to farmlands, crops raiding, elephant's attack, damages followed by elephant's attack and recommendations to stop the elephants' entry and to mitigate the conflict. Secondary data were also collected from related institutes as well as articles.

Analysis: Collected data were analyzed using Content Analyzing Methods, Microsoft MS Excel and GIS. Qualitative information such as opinions, views, narrations and experiences (psychological and emotional feelings of the villagers) on elephants' invasion and HEC were mainly analyzed using "Content Analysis Methods". The analysed qualitative findings were presented according to the main and sub contents with respondents' direct citations/quotes.

Results and Discussion

Identified factors for elephants' moments beyond the EUNP and HEC

In general, as well as in the SWR, elephants roam for many reasons; except for their genetic reasons[6], they roam about for their annual routine,

[6] Genetically, elephants need to roam about in large areas to find different food sources in different seasons as megaherbivores.

to feed on minerals from particular sources in the identified areas[7], to find their seasonal ecological niche and due to seasonal climatic variation. However, elephants are driven to roam about from one National Park /habitat to another National Park/habitat and enter into the farmlands and villages beyond the parks for some other reasons.

According to the results of the analysis in the UNP and beyond the EUNP, restriction of elephants' home range, human activities inside the park, changes in resource availability in the park and attraction of farming fields, crops and ready-made foods[8] beyond the Eastern boundary of the UNP and lack of seasonal carrying capacity in the park are recognized as main factors for the raid of elephants in farmlands and villages beyond the Eastern boundary of the UNP from the park.

As a result of human practices in and outside the park, the elephants keep moving from the park to other habitats to find their ecological niche including food, water and other basic requirements. On their way, they happen to cross over the lands having paddy fields, other farming fields including Chena cultivation and tanks, waterways, settlements and roads. Therefore, they tend to trample on obstacles on their way and attack people who chase and meet.

According to the data analysis, the following factors have been recognized as collective factors that push the elephants from the park and pull them into the farming fields beyond the Eastern boundary of the UNP and regulate the HEC.

The human pressure inside the park resulting from human activities and visits of tourists was recognized as one of the main factors that force the elephants to come out of the park. High concentrated and continuous tourist visits and human activities to the UNP where elephants have been pocketed[9] as the last option by the administrators. Conversion of elephants' habitats into agriculture and choosing of crops termed as high-

[7] Elephants use to eat red soil available in the South-Eastern part of the Udawalawe National Park.

[8] Ripen/Matured vegetables, fruits and grains

[9] The National Parks are considered as habitat patches compared to elephants' size, their niche, other genetic needs as well as the size of their previous home ranges.

risk crops for cultivation in the neighbouring areas of the park are pretty much attractive to the elephants. These include paddy, banana, corn, vegetables and fruits, sugar cane, manioc and coconuts which are suitable for cultivation in the area spatially and seasonally[10]. This directs elephants to enter farmlands and villages. Therefore, the elephants become tempted to feed on crops in the field, ready-made food especially grains in houses and warehouses and also food remains from garbage disposing areas. Restriction of elephants' home range and their ecological niche[11] within the park and restriction for their seasonal movements by erecting numbers of administrative physical barriers highly disturb the elephants' natural way of life. In particular, electric fences have been erected surrounding the park. Besides, several varied community fences have been erected by farmers surrounding their farmlands and villages. Therefore, elephants meet physical barriers preventing them from crossing their traditional home range/habitats. Also, they are pushed to invade the farming fields and to behave rudely.

Moreover, the lack of seasonal carrying capacity in the park drives certain numbers of elephants to farmlands and villages beyond the EUNP. The dangerous techniques adopted by the villagers beyond the Eastern boundary of the UNP to chase elephants from crop fields, storehouses/warehouses and dwelling areas irritate the elephants who are tempted to attack villagers. Further, the limited capacity of human resources in the park for controlling conflicts, entry of the elephants outside the park, and temporary control management[12] practices provoke the intensity of the HEC.

[10] Farmers are also familiar with those so-called high-risk crops in the study site.

[11] Ecological Niches are either the role played by a species in a biological community or the total set of environmental factors that determine species dispersion, distribution and other biological needs.

[12] Formerly, the main strategy for elephant management and conservation was the limiting of elephants to Protected Areas (Fernando et al., 2008).

Analysis revealed that, restriction of elephants' home range[13], their ecological niche and movements within the park[14] by erecting electric fences as physical barriers, human activities in the park, over visits of tourists and the attraction of high-risk crops and ready-made food near the bordering areas of the park, play major roles in pushing the elephants from the park and pulling them into the farming fields beyond the Eastern boundary of the UNP and in regulating HEC. The following table shows the recognized factors for elephants' invasion beyond the EUNP and HEC.

Table 1: Recognized Factors for elephants' invasion beyond the EUNP and HEC

Recognized Factors for HEC	**BEYOND EP**	
	Numbers	Percentage
Human activities	13	17
Shortage of food in the park[15]	4	5
The attraction of crops outside the park	21	28
Restriction of home range	22	30
Dangerous chasing techniques	8	11
Management-related issues	7	9
Total	**75**	**100**

Source: The researcher, Field Survey, 2016 and 2017

[13] In the SWR, elephants' common as well as large home range has been fragmented into forest patches and numbers of parks, among those patches and parks farmlands and villages, are occupied conjunctionally.

[14] Under the 'National Policy for the Conservation and Management of Wild Elephants' which was developed in 2007, an effort has been made to integrate land-use planning with elephant conservation.

[15] Considered as lack of Carrying Capacity

According to the 75 questionnaires employed in the survey, 22 respondents beyond the EUNP were of the view that restriction of the home range is the major factor for regulating HEC in the study site. Next to the restrictions of the home range, 21 respondents beyond the EUNP thought that the attraction of the crops outside the park is the second influential factor for HEC. Next to the above, dangerous chasing techniques also play a major role in regulating HEC. But in comparison with the earlier influential factors, the chasing techniques are less influential. In regulating HEC, the management related issues and shortages of food and water in the park are prevalent at 5%. Thus, restriction of home range, human activities - over visits of tourists, habitat conversion and attraction of crops are the foremost factors prevalent in the site. Further, it is important to focus on the factors that regulate the HEC separately and in detail.

Human activities in the park

Human activities, continuous tourists' visits, a high concentration of Safari jeeps and unauthorized human activities inside the park have become challenges for the survival of species, their natural way of life and the management of the park as well. Over visits of tourists to the park are recognized as one of the main factors among human activities in the park which give high pressure on the elephants in the park. Besides, certain groups of villagers who live neighbouring the park enter the park both day and night daily without considering the rules and regulations of the park. This type of human practice directly disturbs the natural way of elephants' behaviour and pushes them out of the park. A respondent beyond the EUNP, expressed her views as follows:

> *"This is our land for generations, this land is our life, our parents and grandparents lived with wildlife but after the erection of the park boundary only we had to face so many problems. Despite erecting electric fences we can enter the park. Anyhow some of our people are still entering the park as usual"* (Sumanawathi, R, aged 55, Beyond the EUNP).

It was recognized that poaching inside the park is one of the main unauthorized human activities done by different categories of people, including the local villagers, and the outsiders from nearby and sometimes even from distant places. According to the narrations of the respondents, animal poaching[16] from the park provides them with food and income. Besides, people from distant places are used to hunt animals for selling, food and also for fun. According to the field survey, respondents narrated that; human activities are one of the most important factors in driving elephants beyond the EUNP. Following table 2 shows human activities that have been recognized as major factors of pushing elephants outside the UNP as well as for HEC:

Table 2: Human activities (pressures) on the elephants in the park

Human pressure on the elephants in the parks	**BEYOND EUNP**	
	Numbers	Percentage
Over visits of tourists	18	24
High concentration of Safari Jeeps	20	27
Visitors‟ immoral behaviour	6	8
Human encroachments	31	41
Total	**75**	**100**

Source: Researcher, Field Survey, 2016 and 2017.

It was recognized that over visits of tourists play a major role in pushing the elephants out of the park which is 24% in UNP. The high concentration of Safari jeeps plays the second major part in pushing the elephants out of the park which is 27% in UNP. As far as the UNP is concerned, in the case of human activities that push the elephants outside the park, a high concentration of Safari jeeps stands out 03% more than over visits of tourists. Human encroachments inside the park play the

[16] Animal poaching including rabbits, deer, elks, iguanas, some certain birds and reptiles take place in the park.

most important role in pushing the elephants out of the park. 41% of human pressure on the elephants is due to human encroachments in UNP. Considering comparatively, various human practices/human encroachments inside the park play a major influential factor in pushing elephants out of the park in UNP. Thus, it is necessary to consider and separately analyze the human pressure on elephants in the park.

Over visits of tourists

In recent years especially from 2010 onwards, the number of foreigners visiting the National Parks is dramatically on the increase. According to the officers and the jeep drivers, comparatively, a higher number of foreigners visit the UNP from early November to late January. Visiting natural areas and National Parks has become a trend among the locals. In the SWR, pilgrims on their way to Thissamaharama, Kataragama and Sithulpawa visit the Yala National Park and UNP especially, during the school holidays in April, August and December and also during the Katharagama *Perahera* season which falls in July.

It was found out that the rate of visits to Yala National Park and UNP[17] is very high during December. This is a serious problem particularly in three parks, Yala Block-1, Minneriya and Horton Plains and also there are signs of it becoming a problem in parks such as Wilpattu, Udawalawe and Kawdulla also. It is worth mentioning that the elephants cannot sustain themselves in the parks with the over and continuous visits of tourists.

It has been confirmed that the years 2015 and 2016 have recorded the highest number of foreigners visiting UNP during all field visits. During the field survey, a jeep driver shared his views on the visits of tourists as follows:

> *"Nowadays visitors come here even on Poya days and weekends from early morning and we earn much money than earlier. We take safari jeeps even closer to the herds of elephants with full of*

[17] Among tourists, Yala B-1 is famous for leopards and elephants and UNP is famous for elephants.

> *people as we know some elephants would not do any harm to the people"* (Afras, aged, 24, nearby Kirinda)

The high possibility of viewing herds of elephants in UNP attract a large number of visitors to the park day in and day out (Senevirathna, and Perera, 2013). During the field survey it has been observed that it is possible to view elephants nearby the reservoir and in the flat grassland close to the reservoir in the UNP. A jeep driver in UNP shared his views on visits of tourists as follows;

> *If the visitors come to Udawalawe National Park, we take them very close to the elephants. These days, apart from the local and foreign tourists, lots of school children also come to the park. Visitors are higher in number than 3 – 4 years back.* (Anonymous, aged 26, UNP).

Due to easy access and the possibility to travel inside the park within 3 to 5 hours by safari jeeps, the UNP has a high potential for day visitors. According to the park officers and jeep drivers, almost all the visitors' target is to have a closer look at elephants and leopards. Therefore, most of the tourists visit the most popular National Parks like Yala B-1and UNP in the SWR.

It is obvious that during the twilight of the day, UNP is mobbed by visitors daily and is on the rise on holidays. Therefore, the haven has turned into a living hell that is unable to meet even the basic needs such as food for these elephants (Department of Wildlife Conservation, 2011). The main reason for over-visits to the UNP is the narrow wildlife viewing preference[18] especially targeted at the elephants. The previous studies pointed out that narrow wildlife viewing preferences of visitors are the main cause for higher visitor pressure in certain Protected Areas (Kerley et al., 2003; Prideaux, 2006; Duffiled et al., 2006 as cited in Senevirathna and Perera, 2013).

[18] Most of the visitors come to the park targeting to view closely at selected animals; therefore, those visitors concentrate on selected identified spots of the park.

According to the narrations of the respondents, elephants find food outside the limits of the parks but are victimized by villagers. As a result, elephants become vulnerable and motivated to be rude. According to the analysis, 24% of the respondents claimed that the over and continuous visit is one of the reasons for elephants to enter beyond the EUNP which leads to HEC beyond the UNP.

High concentration of safari jeeps

According to the field observation and findings, from dawn to dusk, more than 25 Jeeps full of local and foreign visitors, continuously circulate the hotspots of the elephants. At a stretch, around 05 to 08 jeeps enter the UNP. According to the entrance office of UNP, (2016 and 2017) 152 safari jeeps are registered in UNP at present.

As a result, elephants get annoyed and push themselves out of the park. The reckless behaviour of some jeep drivers and their desire for money cause threats to the wildlife in the park.

According to the analysis, 27% of the respondents claimed in the UNP that a high concentration of Safari jeeps in the park disturbs the elephants. This drives elephants out of the UNP beyond the EUNP and contributes to pushing out the elephants from the park hence become one of the main reasons for the HEC.

A front officer[19] of the UNP shared his views on visitors‟ behaviour as follows;

> *"Most of the visitors do not follow the rules and regulations of the park, and disturb the wildlife in several ways, there is a mobile service around the park and it displays several instructions on boards. But some try to feed though, while some others go against the regulation" (*Anonymous., aged --, UNP).

Elephants have been continuously disturbed by the camera flashes. However, repeating such behaviour drive elephants outside the park and

[19] The officer requested not to mention his name.

this directly paves the way for them to enter the crop fields and result in HEC.

Human encroachments into the Park:

35 out of 81 respondents in the UNP and beyond the EUNP, (both locals and officials) were of the view that human activities in the park, especially, poaching is the most influential factor for the conflict 19 respondents out 81 in UNP and beyond the EUNP were of the view that cannabis cultivation is the second influential factor. The following table and the figure show the respondents‟ views on human practices in the park.

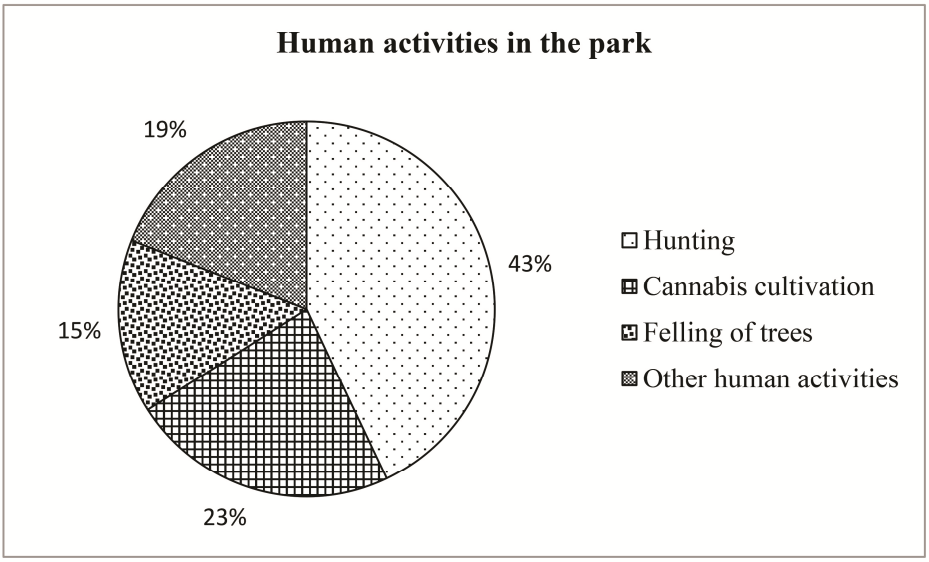
Table 3: Human activities in the park

Human activities in the park	**UNP** Numbers
Poaching	35
Cannabis cultivation	19
Illegal Logging	12
Other human activities	15
Total	**81**

Source: The researcher, Field Survey, 2016 and 2017.

From the views of the respondents, poaching is the most influential factor out of human activities. Cannabis cultivation and other human activities stand as the second and third influential factors and the falling/cutting down of trees are at the last in the list.

Figure 3: Human activities in the park, UNP



Source: The researcher, Field Survey, 2016 and 2017 **Poaching**

Out of the respondents in the UNP and beyond the EUNP, 52% answered that hunting takes place inside the park while 20% is of the view that hunting does not take place in the park, and 28% denied answering. It was identified that; chronic hunting practices are one of the main reasons to direct elephants to enter the farmlands and villages beyond the EUNP. Some instances that the elephants were hurt by the poachers in the park were recorded during the data collection. As a result, the elephants have developed a tendency to attack human beings upon seeing.

Cannabis cultivation

Regarding cannabis cultivation, 19% of the respondents from UNP and beyond the EUNP were of the view that cannabis cultivation takes place. But 81% of the respondents denied cannabis cultivation in UNP and beyond the EUNP. However, cannabis cultivation within the limits of the parks is confirmed during interviews with the officers.

It has been revealed that, in comparison with hunting, cannabis cultivation influences on HEC are lesser. When discussed, with one of the park officers at the front office of the UNP, he said that he did not know much about cannabis cultivation in the park. But, one of the guards revealed as follows:

> *"some people from the 23rd Colony, Hambegamuwa Colony, Mahawewa, Kahadurallan Palassa bordering the Eastern boundary of the park engage in cannabis cultivation in the park"* (Anonymous, aged 26, UNP).

According to the interviews and discussions, most of the cannabis cultivation in the parks is done nearby the water sources, the farmers reject elephant's access to the selected water sources. If wild animals enter the cultivation area, they are shot. However, encroaching to the park, setting the fire, clearing the forest cover and cultivating cannabis is liable to punishment, but it has been continued in the study site for years and has been playing a crucial role to drive elephants out of the parks.

Illegal Logging

Planting Teak under the reforestation and habitat enrichment programme is common in the National Parks. In UNP, teaks are an obvious feature. In the Southern part of the UNP, teaks stand tall in a regular pattern. Unfortunately, it can be noticed that some of the teak trees are missing. There are signs that some of these trees are being cut down. It was identified that the illegal cutting of trees is a usual practice of encroachers. In general, teak and other dry zone trees are in high demand in Sri Lanka[20]. As a result, the businessmen with the support of encroachers and other influential parties cut down such trees for money.

In particular, the riparian strip of Kuda Oya consists of dense forest cover. As a result, illegal cutting down of trees is frequent in this area. According to the discussions with the officers of the UNP, the local villagers of the area cut the timber and is transported using the lorries of the businessmen. It was revealed through analysis that quite a several

[20] As it is very well known, teak furniture is high priced and is being used by the elite.

families in the Kalwelgala village beyond the EUNP are regularly involved in the illegal cutting of trees. However, officers stressed that they do not have sufficient numbers of officers to prevent all the illegal activities underway in the park. Besides, those who engage in these illegal activities are ruthless ruffians.

According to the respondents in UNP and beyond the EUNP 42% were of the view that logging takes place in the park. According to the interviews with the officials, this was confirmed. This drives elephants out of the park and contributes to HEC in the area.

Other human activities:

In addition to the activities discussed earlier, some villagers were involved in firewood collection and gem mining in the park.

Lack of carrying capacity in the park

Elephants' carrying capacity inside the parks means replicating its complete ecological niche in the parks including water, food, space, shadow areas, security, necessary minerals which are available in barks of some trees, leaves, underground water and selected types of soils. According to the field survey, one of the reasons for elephants' raiding outside the park is the lack of food and water inside the park, especially during the drought seasons.

However, according to the analysis compared with the factors such as restriction of elephants' home range, over visits of tourists, human activities in the park and attraction of high-risk crops outside the park, the role of carrying capacity impact less on regulating HEC.

The study reveals that the villagers around the park now and then break into the park and set fire[21] to the grass and other plants for different purposes including illegal farming. The fire, during the dry seasons, may

[21] Under the concept of "disturbances regime" in ecology, natural fires/bush fires are considered natural events for the initial stage of the succession process.

make a successional process[22] the very slow and also sometimes successional process makes the change of grassland to shrubs which can be a great threat to the carrying capacity of wild elephants in the park. Furthermore, any species, besides the fire and its flames, would not tolerate it, nonetheless naturally they will try to be away from the fire. And they would try to shelter themselves in selected areas of the park. So, these practices reduce the carrying capacity in the park and drive the elephants out of the park.

In general, depletion of elephant's carrying capacity not only result in the depletion of food and water but also all other needs including space for roaming, security, and also safer places for their entire reproduction process. Therefore, the lack of carrying capacity in the park makes elephants nervous and stressed and drive them out of the parks. According to space and time variations, elephants often move out of the parks in search of food and fulfil their mineral requirements and all other needs in their previous habitats. But their previous habitats are now being highly occupied by humans.

Besides this, the rapid spread of exotic invasive species such as "Katukamaiya" or "Unni" and a large grove of *Sonneratia caseolaris* is replaced with forest in the Menik Ganga's estuary also makes lack of food in the UNP. The growth of invasive alien species such as *Lantana Camara*, *Opuntiadillenii*, *Chromolaena odorata* is posing a threat to the native plants. Elephants or other living creatures do not eat these plants or their fruits. According to the narrations of the officers, the exotic invasive species such as Lantana (Gandapana) and Eupatorium (Japan lantana or Podisingho-maran) take control of the grasslands[23]. These types of invasive plants are a serious problem for it poses a challenge to the trees and grass.

[22] According to Clement (1916), an ecological process in which communities of plant and animal species in a particular area are replaced over time by a series of a different and often more complex communities.

[23] Pulling shrubs out is the best solution. It has to be done regularly and systematically, which would be costly (Fernando, 2015)

Besides, it was found that there is a special kind of soil in various parts of the UNP, which attracts the elephants. They habitually eat it and even dust over their bodies as a natural skincare technique and maintain the body temperature but due to high concentrated human activities in the park, elephants get annoyed and avoid making use of that special soil. Moreover, illegal logging causes the lack of particular minerals for elephants and directs them outside the park.

Through interviews with the officials, it was identified that the lack of grass and grass buds for elephants during the dry seasons in the park due to livestock grazing in UNP drive away elephants from the parks. Elephants and other livestock have to compete for grazing which makes carrying capacity deplete. Annual drought, human pressures in the parks, spreads of invasive species allowing livestock for grazing is one of the major threats to the UNP. Based on the factors affecting the carrying capacity such as annual drought, human pressures in the parks, spreads of invasive species, make elephants enter the bordering villages and it acts as a factor to regulate HEC.

Converting forests into farming and dwelling areas

Most of the present SWR was covered with thick forests and natural corridors before the declaration of National Parks[24] including Yala, Udawalawe, Lunugamvehera and Bundala. During that period, the elephants did not face any obstacles when they roamed within their home ranges and they did not migrate out of the home ranges. However, after the declaration of National Parks and various development projects around the parks, hundreds of acres of elephants' traditional habitats were transformed into human utility areas in the bordering areas of the present National Parks, particularly around Yala and UNP.

In the bordering areas of the UNP, the forest is deforested for farming and human purposes making it difficult for the elephants to live in the traditional forests. It was discovered that poverty, lack of permanent livelihood, lack of water for agriculture and shortage of land have forced adjacent villagers to clear forests in the bordering areas of the park and

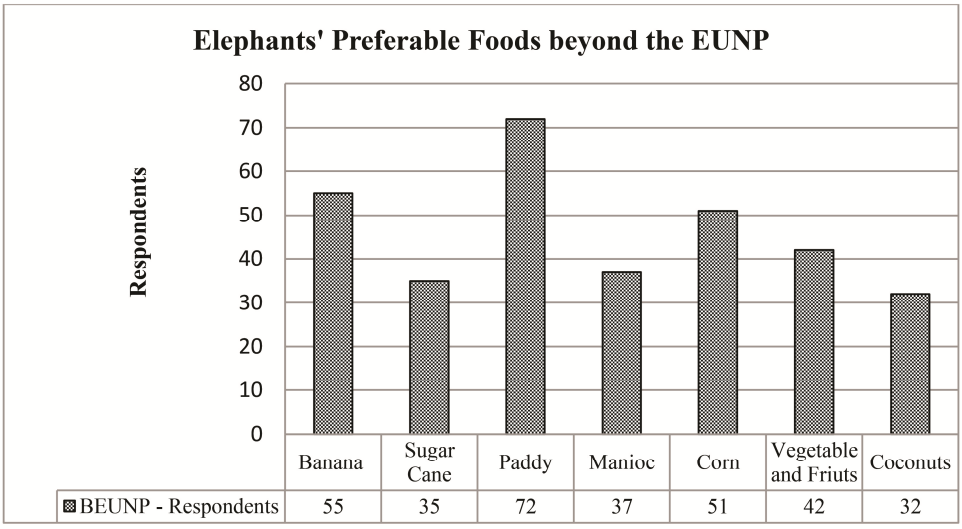
[24] Yala was declared as a National Park in 1938, UNP in 1972

engage in farming. Most of the crops cultivated by the farmers are attractive to the elephants. Elephants tend to cross over to the lands with paddy and crop fields, roads and tanks. During the discussion, it was stressed by the villagers that they had to struggle with the officers on and off because of the conversion of forest into farmlands.

The attraction of high-risk crops outside the park

According to the observation and data analysis, within 50 to 300 meters from the park's boundary[25] elephants can find food such as paddy *(Oryzasativa),* wood apple *(Limoniaacidissima),* maize *(Zea mays),* banana *(Musa paradisiacal),* sugar cane *(Saccharumofficinarum)*, manioc (*Manihotesculenta*) among other fruits and vegetables. According to the respondents, paddy is preferred by elephants more than the other fruits and vegetables. Figure 4 shows elephants' preferable food in numbers beyond the EUNP based on respondents' answers.

Figure 4: Elephants' Preferable Foods, beyond the EUNP



Source: The researcher, Field Survey, 2016 and 2017

[25] Several fruits and vegetable stalls are also located within 30 meters distance from the park boundary

According to the analysis, 72 of the respondents thought that paddy is preferred by elephants while 55 of the respondents thought that bananas are preferred by the elephants beyond the EUNP. According to the respondents, they prefer the following food in order beyond the EUNP; corn (51), vegetables and fruits (42), manioc (37), sugar cane (35) and coconut (32) next to paddy and banana. A woman shared her opinion on the food consumed by the elephants as follows:

> *"We involve in crop cultivation such as kurakkan, cowpea, maize, tomatoes, peanuts, ladies' fingers, capsicum, green beans and manioc, elephants come and taste crops, they prefer, cowpea, kurakkan and manioc"* (Sumanawathi, R., aged 55, beyond the EUNP).

A respondent beyond the EUNP shared her views as follows;

> *"Elephants enter the villages and raid crops during the dry season which falls from July-August to September due to lack of water. In both maha and Yala seasons, elephants usually raid the crops. The season is not a matter for them, they even come daily"* (Nelka, aged 36, beyond the EUNP).

The attraction of crops, harvested sugar cane and other grains in the warehouses as well as fruits and vegetables in the stalls outside the park contribute to the invasion of elephants.

When the area is dry from May to September, elephants drink water from the reservoir in UNP. Quite a several elephants enter the UNP from neighbouring National Parks and forests especially via Lunugamvehera National Park targeting water in the reservoir. On their way and back, farmlands and properties beyond the EUNP are raided annually.

The attraction of high-risk crops such as paddy, banana, sugar cane, manioc and corn are playing a dominant role in the raid of elephants in the farmlands. During the rainy season from late October to February, paddy is the dominant crop beyond the EUNP. Even during the rainy

season, elephants raid the fields in December, January and February[26] before harvesting the crops.

Beyond the EUNP, elephants' raid is high, especially from the beginning to the end of the rainy season in October and February. Further, during the harvesting seasons and school holidays in April, August and December, elephants ' raids are comparatively a little high. It is very clear that elephants raid the farmlands and villages outside the park mainly because of human pressure, lack of carrying capacity within the park, the aroma of crops and readymade foods outside the park but it varies according to the seasons.

According to the results of the analysis, between 15 to 20 elephants come from 19.00 to 03.00, to the surrounding area of the park to feed and most of them are adult males. Once they come to the farming area, chasing them into the park is very difficult and it ends up with clashes between humans and elephants. This situation is obvious during the dry season from March to early September and rises in May, June and July. In the same way, between 08 to 15 elephants feed on fruits and foods from visitors, restaurants and fruit and vegetable stalls outside the UNP. Further, according to the observation during the field survey, 2 to 3 elephants are very frequently seen inside the park close to the electric fence in the Southern boundary expecting fruits especially bananas, sugarcane and pineapple from the visitors. In the vicinity of the Eastern boundary of UNP, 5 to 6 elephants feed on prepared rice and curry and they stay near the dwelling areas. These types of feeding behaviour make elephants come out of the park to sustain outside the park. It is stated that, if they did not get any food at night they enter the kitchens of the houses and small hotels to find food. The addiction of elephants to food is also identified as one of the reasons for the HEC.

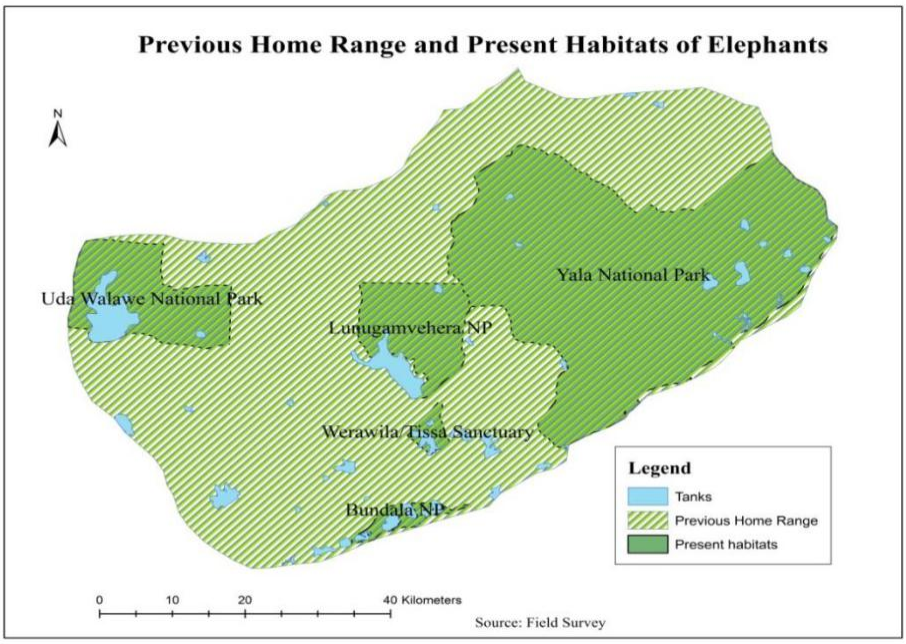
[26] It is common in the HEC areas of the country too; paddy is preferentially eaten by wild elephants when the plants are ripe and ready for harvesting (Santiapillai, 2010)

Restriction of elephants' movements in their previous home range

According to the results of the analysis, up to 1970[27], the elephants travelled between Yala via Lunugamvehera National Park to UNP and Yala to Bundala National Park and Weeravila Sanctuary and through some other forest areas. Their home range was broad and they found their ecological niche in their home range. However, from the 1970s, the elephants were directed and restricted in the parks under elephant management programs. According to the Department of Wildlife Conservation (2011), in particular, around 150 elephants were electric fenced in the Yala National Park in 2005 and it prevented them from accessing their dry season home range. In 2006, 250 - 300 elephants were driven into the Lunugamvehera National Park from the adjacent Mattala area and were electric fenced and an additional 100 elephants were driven into Lunugamvehera National Park from the Pellawatte area in 2007 and were electric fenced (Fernando, 2015). These elephants completely lost their home ranges. Accordingly, parks have become small patches of forestry for elephants compared to their previous broad home range and they are being pocketed continuously. The following figure 5 (Map) shows the previous home range and the present habitats in the SWR.

[27] At this time, the only National Park was Yala National Park in the SWR and the rest were covered under the forest.

Figure 5: Previous Home Range and Present Habitats of Elephants



Source: The researcher, Field Survey, 2016 and 2017.

According to the officials of the park, elephants are forced to be re-pocketed in these parks with the increased human activities against them and the elephants are now vulnerable and their natural routine has been disturbed, dispersed and blocked. However, elephants have found alternative ways to fulfil their needs. Further, the elephants use the corridors and move freely among National Parks and other forest areas in the SWR. During the dry season, quite a several elephant herds come from other parks and forests through the corridors to the Eastern and Northern of UNP. On the Eastern side, there is a narrow link between the Lunugamvehera National Park and, and the Yala National Park. Besides, there are also links with the elephant habitats in the Kalhota, Koslanda and Haldumulla areas in the Northern part of the UNP. To the North-East lies a large habitat, in the Kuda Oya basin (Krindi Oya system).

However, at present, most of the corridors have disappeared[28] with human practices along with high concentrated fences as physical barriers within elephants' homes range in administrative boundaries. Electric fences play a dominant role as physical barriers in administrative boundaries. There are no biological corridors as conceptualized by the 'Concept of Biological Corridors' among National Parks in the SWR.

It was recognized that one of the most unfortunate but significant facts is that, except for two corridors in the Eastern UNP, there are no wild strips with particular width and length due to human encroachments. As a result, elephants are forced to adapt themselves to move in a twist and turn pattern. However, they tend to move regardless of any obstacles. When elephants roam in their previous home ranges and move through corridors, they raid crops and violently destroy them by trampling. In return, these circumstances directly regulate HEC. Moreover, it was identified that it is one of the main factors to regulate HEC, beyond the EUNP.

Villagers' dangerous chasing techniques

It has been found that the villagers beyond the EUNP chase the elephants by shouting, lighting elephant thunder crackers ('Ali rathinjya' / 'Alidoam'), throwing stones and other objects, flashing lights, waving objects, raising canes. Besides, farmers sometimes show artificial guns at them and also make noise using sound instruments to keep the elephants away and protect their crops, residences and their lives. The farm-based methods include making noise, throwing firecrackers and guarding fields from tree huts, however, these proved to be insufficient and it aggravates the problem. Table 4 shows the methods used by the villagers to chase the elephants in the site.

[28] People around the parks are not that much happy to maintain corridors as some of the previous corridors are through their present farmlands and villages but cannot find any signs of them.

Table 4: The methods used by the villagers to chase the elephants in the site

Methods used by villagers to chase elephants	Beyond EUNP	
	Numbers	Percentage %
Setting firecrackers	74	98
Shouting	72	96
Making noise	67	90
Flashing lights	66	88
Waving objects	56	74
Shooting	6	8

Source: The researcher, Field Survey, 2016 and 2017

Beyond the EUNP, 98% of the villagers use firecrackers while 96% of the villagers shout and 90 % makes noise to chase the elephants. Beyond the EUNP 80% of the villagers use the mixed bag of shouting, firing crackers, making noise as well as waving objects as a team or family to chase the elephants. It was recognized that almost all the respondents on the site, are of the view that chasing elephants is not a simple, easy and quick task but it sometimes takes more than 3 to 5 hours even as a team. When an adult elephant starts to run away, then the herd follows the adult. According to the respondents, chasing a single male adult is more difficult than chasing a herd and expressed that elephants get more aggressive against people's chasing attitude in turn they react to chase the people. It is a baffling task to control the elephants and make them come back to normalcy when they are irritated and aggravated by the chasing methods. A respondent expressed her experiences on elephant chasing as follows;

> *"If they get annoyed they won't go but they trumpet out loudly rotating for some time and trample the ground which makes the dust rise above and then chase the people by running after them with their tails straight up and their ears steady by the sides"* (Amitha Kumari, R., aged 26, beyond the EUNP).

In the study site, most of the villagers chase the elephants by making a kind of noise with coconut shells and by Elephant Thunder Crackers (ETC) which are provided free of charge by the Department of Wildlife Conservation. According to a farmer beyond the EUNP, some elephants react when the people shout: 'go away' (*heiyanava*) and so on. It was observed and queried in the field survey that in some areas, the farmers put up barbed-wire fences without electrification around their lands. Since the elephants have had bitter experiences with the electric fences on the boundary of the UNP, mistaking this fence for an electrified barbed wire fence, they dare not get closer to it.

It was revealed by the respondents that, every dry season, some selected 5 to 6 rude elephants beyond the EUNP destroy large areas of farmlands and tend to damage houses, warehouses, walls, fences, gates and even large trees. In such unpleasant situations, villagers shoot at them without the intention of killing them and inform the officers of the park. In such circumstances, officers come and shoot the elephants with anaesthetic bullets and take them to the park before they regain consciousness.

According to the results of the analysis, It was known, when the villagers flop in their effort to chase the elephants away, they shoot at the back of the elephants and it is indirectly agreed that when the elephants cause great damages or when they are uncontrollable and determined to kill people, the villagers shoot at them wherever they want; when the elephant dies, the officers of the UNP recognize this and remove the body within a few days. According to the respondents, nobody in the village

will give any evidence on the person that shot the elephant, no matter how much they are cross-examined by the officers[29] of the park.

During the field survey, some respondents said (8%) of villagers beyond the EUNP shoot the elephants especially because of fear of their attacks and to save their lives. Giving poisoned fruit or vegetables as well as using "*Hakkapatas*" to kill elephants is common in Sri Lanka. But beyond the EUNP, none of the respondents was of the view that they use such mechanisms. The above-mentioned chasing techniques, directly and indirectly, provoke HEC. However, it is very unfortunate that those dangerous techniques are still in progress. However, most of the chasing techniques influence regulating factors for HEC.

Management Related Issues

According to the key informant interviews, the following facts were identified as major management related issues which also play as regulating factors of HEC in and around UNP: lack of officials, top-level influences, pocketing elephants in the parks and other management related issues.

Conclusion

The major factors for elephants' invasions beyond the EUNP and HEC are recognized as continuous high concentrated human activities in the park, over visits of tourists to the park and high concentration of safari jeeps in the park and lack of carrying capacity inside the park. In addition, attractions of seasonal crops outside the park, restriction of elephants' home range, dangerous elephant chasing techniques practised by people, and management related issues of the park were also identified as major factors for elephant invasions and HEC beyond the UNP. In particular, the seasonal attraction of crops outside the Eastern boundary of the park, feeding habits in the crop field, grains in warehouses and their usual seasonal routine are identified as main factors for elephants'

[29] During the field survey, none of the respondents said that people purposely kill elephants, but during the long discussions, they indirectly said that some shoot. They do not have any intention to kill elephants.

seasonal invasion beyond the Eastern boundary of UNP. In particular, human activities inside the park and the attraction of seasonal crops outside the park contribute as major push and pull factors for the elephants' invasion of the villages and HEC. The invasion is very obvious during the dry season from March to early September. Besides, it has been identified that invasion is high in May, June and July. It is important to find a solution for the foregone continued invasion and conflict through practically implementable, long term, multi-dimensional and sustainable measures.

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