

Identification of Distribution of *Lantana camera* (Exotic Invasive Species) and its impacts on Udawalawa National Park, Sri Lanka

G.M.T.S.Fernando¹, Nalaka Kodippili¹, P.A.C.N.B.Suraweera², B.H.G.K. Kumari²

¹*University of Sri Jayewardenepura
Gangodawila, Nugeogoda, Sri Lanka.*

²*Department of Wildlife Conservation
811A, Bodhiraja Mawatha, Jayanthipura, Battaramulla, Sri Lanka.*

dtsfernando@gmail.com

Abstract: The Exotic Invasive Species are spreading rapidly disturbing other native living organisms in a particular area. Especially this topic has been discussed often with the environmental disturbances arising due to climate changes and human activities. *Lantana camera* is a destructive exotic invasive plant that spreading rapidly in tropical countries destroying natural habitats. Udawalawa National Park of Sri Lanka is one of the world famous Asian elephant habitats that located in Dry zone of Sri Lanka. Elephants in this national park are often suffering from Malnutrition due to drought impacts. This situation has been worst as rapid distribution of the *Lantana camera*. This research planned to find an inexpensive method to identify the distributed area of *Lantana camera* in Udawalawa National Park to make a better plan for the clearing purposes. And this research secondly focused to identify the impacts of *Lantana camara* on natural habitats.

Landsat 08 satellite images were used for this research which can be downloaded free from USGS (United State Geological Survey) website. Resolution of this satellite image is 30m x 30m. Three handheld Global Positioning System (GPS) devices were used to get the accurate locations of 25 sampling sites. Arc GIS 10.4 software was used for the supervised classifications to identify the distribution of *Lantana camera* with reflectance values. Further verifications were done by observing selected locations by field visit. Major impacts of *Lantana camara* were identified by field observation and discussions with Wildlife officers. Total land extent of the Udawalawa National Park is 31067 ha. According to the result, *Lantana camera* has been invading the extent of 2,650 ha of the national park. Rapid spreading of *Lantana camara*, degradation of biodiversity, reduction of species richness and reduction of food productivity were the major impacts of this invasive plant that national park has been affected. Output of this research is very important to identify the invaded extent of the *Lantana camera* and its impacts on National Park. As a developing country Sri Lanka does not have a capability to use high resolution images for such studies spending big amount of money. Thus as an inexpensive method to identify the distribution of invasive plants, this research methodology is really applicable for such conditions in tropical developing countries as well.

Keywords: *Wildlife, Panicum maximum, Landsat 08, NDVI, Arc GIS*

Introduction: Exotic Invasive Species is one of major threats to natural ecosystem and the services they provide. These are spreading rapidly disturbing other living organisms which are native to a particular area. Especially this topic has been discussed often with the

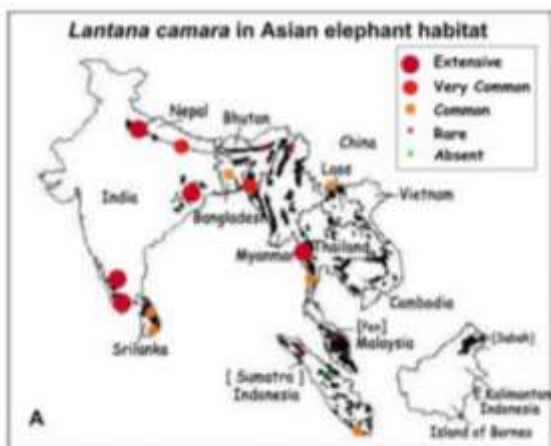
environmental disturbances arising due to climate changes and human activities. Damaging impacts of invasive species include decrease productivity, decrease carrying capacity of wildlife, decrease biodiversity and loss of native species.

Figure 01 *Lantana camara*



Lantana camara is a significant weed of which there are some 650 varieties in over 60 countries. It is established and expanding in many regions of the world, often as a result of clearing of forest for timber or agriculture. *Lantana camara* is a low erect or subscentent, vigorous shrub with stout recurved prickles and a strong odour of black currants; it grows to 1.2-2.4 metres (or even more). its root system is very strong, and it gives out a new flush of shoots even after repeated cuttings; Leaf ovate or ovate-oblong, acute or subacute, crenate-serrate, rugose above, scabrid on both sides; Flower small, usually orange, sometimes varying from white to red in various shades and having a yellow throat, in axillary heads, almost throughout the year; Fruit small, greenish-blue black, blackish, drupaceous, shining, with two nutlets, almost throughout the year, dispersed by birds. Seeds germinate very easily (Sastri and Kavathekar, 1990).

Figure 2 Distribution of *Lantana camara* in Asian elephant habitat



This plant is a native shrub of South America (probably West Indies) and now widely distributed throughout the tropic. *Lantana camara* has been a critical threat to the Asian elephant habitats. According to the IUCN, figure 02 shows the distribution of this plant in Asian elephant habitats. The elephant habitats in India, Nepal, Bangladesh, Myanmar, Bhutan, Laos, Thailand and Sri Lanka have been more vulnerable with the distribution of this invasive plant.

Source: IUCN

Lantana camara was introduced to Sri Lanka in 1926 through the Royal botanical garden as a gardening plant. Since then, the species has spread rapidly into both agricultural and forest lands, and it has been one of the most widespread, terrestrial invasive species in Sri Lanka today. *Lantana camara* is considered by IUCN as one of the world's 100 most invasive species, and world's 10 worst weeds. *Lantana camara* grows on all types of well-drained soils and in a wide rainfall range, and also very drought-resistant. It rarely invades undisturbed, closed-canopy forest but rapidly colonizes gaps, edges and disturbed or logged habitats. It produces lots of seeds that are dispersed by birds and the seeds germinate rapidly. Under conditions of high light, soil moisture and soil nutrients *Lantana camara* is a very efficient competitor against native species. It can become the dominant understorey species in infested areas blocking natural succession processes, and reducing biodiversity (Ayesha, 2006). It is named as GandaPana/Rata Hinguru in Sri Lanka. It is very common in wastelands, open areas in forests, abandoned Chena cultivations and disturbed lands. *Lantana camara* has been a major threaten to the national parks in the country especially for the elephant habitats in dry zone.

Study Area:

Figure 03 Location of the Udawalawe National Park

The Study area, Udawalawe National Park is located in 6.609518° , 80.761488° and 6.4131510 , 81.0104830 decimal degrees and belongs to Ratnapura and Moneragala Districts in the Southern Part of the Sri Lanka. It is just south of the Central Highlands, of which escarpment brings about an enrapturing backdrop. The extend of the park is 31,067 hectares and was set up in the year 1972 to protect the catchment area of the man-made Rainwater Reservoir (Udawalawe Tank) located at the south end of the River Walawe. At the center of the park lies the Udawalawe Reservoir. Before the designation of the national park, the area was used for shifting cultivation (Chena farming). The farmers were gradually removed once the national park was declared. Udawalawe is an important habitat for water birds and Asian elephants. It is a popular tourist destination and the third most visited park in the country.



It is situated in the dry and intermediate zones and the drought period of the park coincide with the southwest monsoon that extends from May to October, and the mean annual rainfall is 1524mm. Altitude of Udawalawe National Park ranges from about 100m on the plains to the 373m at top of Ulgala (the pointed Rock) highest point within the park. The Figure 03 shows the location map of the Udawalawe National Park.

The average annual temperature is about 27–28 °C (81–82 °F), while relative humidity varies from 70% to 82%. Well-drained reddish-brown soil is the predominant soil type, with poorly drained low humic grey soils found in the valley bottoms. Mainly alluvial soils form the beds of the watercourses. Species recorded from the park include 94 plants, 21 fish, 12 amphibians, 33 reptiles, 184 birds (33 of which are migratory), and 43 mammals. Additionally 135 species of butterflies are among the invertebrates found in Udawalawe.

Figure 04 Udawalawe elephant habitat

Udawalawe National Park is one of the world famous Asian elephant habitats. But elephants in this national park are often suffering from Malnutrition due to drought impacts. This situation has been worst due to rapid distribution of the *Lantana camara*. Thus it is very necessary to plan a mechanism to remove and control the rapid spreading of this invasive species before invading whole national park. Identification of distributed area is the main challenge to plan such mechanism.



As a big National Park, it is very difficult to identify the distribution of invasive species by field survey. High resolution satellite images can be used for such studies to get an accurate outcome. But these images are very expensive, and it is an incapable amount for the government institutions in developing countries. As a large national park, it is unpractical to purchase such images for whole area. As well as spending a big amount of money per image that representing only one day data is very useless. Because mitigating mechanism needs temporal data series for monitoring purposes until completely control the situation. Thus it is very important to identify the inexpensive method to derive the distributed area of invasive plants for controlling activities. Thus this research aims to identify the distribution of *Lantana camara* using freely available Landsat 8 satellite data and to identify the impacts of *Lantana camara* on National Park.

Methodology: Landsat 8 data (image date is on the 27th January 2016) was used to identify the distribution of the *Lantana camara*. Resolution of this satellite image is 30m x 30m.

Thus, one pixel represents the 900sqm on the actual ground. But according to field observations, most of the distributed sites of *Lantana camara* could be identified as highly dense areas. Thus, resolution of the image was not a problem to identify the *Lantana* distribution. Randomly collected 25 sample sites and four GPS points of each site were obtained to improve the accuracy. Three handheld Global Positioning System (GPS) devices (accuracy 2-5meters) were used to collect coordinates, and Arc GIS 10.4 software was used to do classify the satellite image. Mainly, two types of raster analyses were done to identify the distribution of *Lantana camara*. Digital Numbers (DN values) of Blue, Green, Red and Near-Infra-Red bands were converted into Reflectance using the below equation.

BAND SPECIFIC REFLECTANCE_MULT_BAND X DN VALUES + REFLECTANCE ADD

The supervised classification was used for Blue, Green, Red and NearInfraRed bands. According to the each band, the Red band provides more accurate results than the other bands. Further the Normalized Difference Vegetation Index (NDVI) calculation and compared NDVI ranges with the results of the supervised classification. The below mentioned equation was used for the NDVI calculation.

$$\text{NDVI} = (\text{RNIR} - \text{RRed}) / (\text{RNIR} + \text{RRed})$$

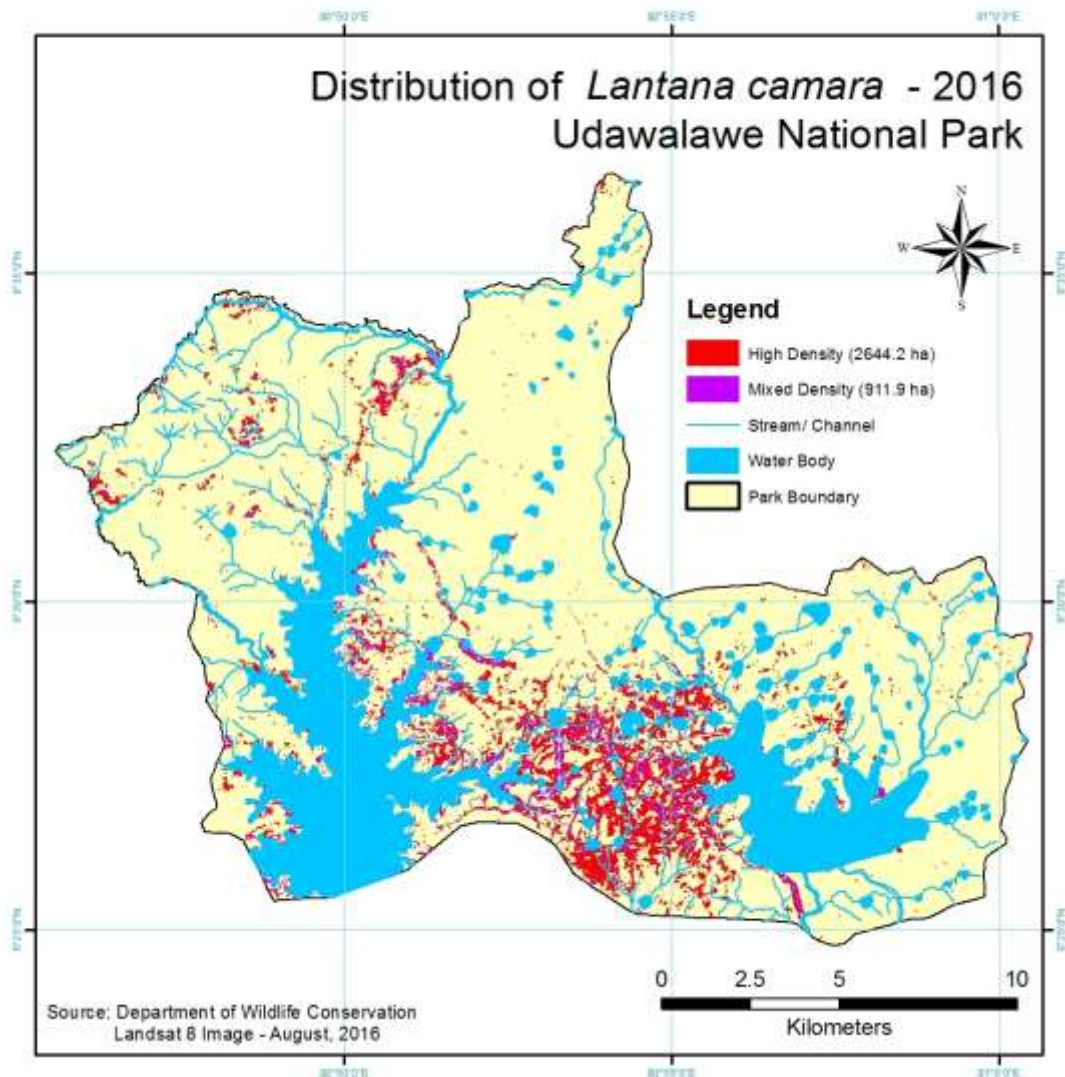
In order to do that, the distribution map of the *Lantana camara* was created. A field survey is done to validate 25 sample locations randomly, and the accuracy assessment was at about 92%. It was difficult to identify the mixed sites with other species using above images, because of the imagery resolution. But mixed *Lantana* sites that covered approximately 60 percent of the area were identified by the supervised classification. Randomly sampled 10 locations which were taken from mixed *Lantana* sites and they were used to derive mixed patches. But the assessment of *lantana* area would be more than the result due to the imagery resolution. The impacts of *Lantana camara* were investigated by the methods of field visit and discussions with the Wildlife officers.

Result & Discussion: According to the results 2,644.2 ha were identified as *Lantana camara* invaded (Figure 05). It represents 8.5% extent of total National Park area. This invasive species is more abundant in the middle part of the national park between Udawalawe and Mau-Ara reservoirs. Most of these areas were identified as often disturbing areas besides the road network in the national park. Some extent of *Lantana camara* was identified in the Western part of the Udawalawe Reservoir, and a few places in the Northern part of the reservoir as well. According to the Google earth temporal imageries, lot of these sites could be identified along the road network. As an example, the distribution of *Lantana camara* is very less in the Eastern part of the Mau-Ara reservoir. This area could be identified as an undisturbed area due to the exclusiveness of road network. Some lands of *Lantana camara* are cleared Teak (*Tectona grandis*) sites and after the clearance of Teak, *Lantana camara* has been spread rapidly.

Major impacts of *Lantana camara* were noted at the field observations. Rapid distribution is the major impact of this species. *Lantana camara* had been completely disrupting the succession process of disturbed sites. Native primary plants do not inherit a possibility to

grow in these areas due to its rapid growth. This caused to decrease the biodiversity in such places. As well as this caused to reduce the species richness and suppressed regeneration in native tree populations. Most of the sites were completely invaded and dominant by *Lantana camara*.

Figure 05 Distribution of *Lantana camara* in Udawalwe National Park



Reduction of the productivity of the habitat was identified as a major impact of the *Lantana camara*. Udawalwe is an important elephant habitat in the South Asia. There are minimum 750 elephant population dispersing in this habitat and this amount includes the migrating elephants from Lunugamwehera and Bogahapattiya as well. Normally, one elephant needs 250kg of food per day. But Udawalwe National Park does not have sufficient foods for these elephants. Especially, in the dry season this situation is converting to be more serious. Thus elephants in this national park are often suffering from malnutrition due to low productivity of the habitat. Elephants do not eat *Lantana camara* and its rapid distribution does not allow growing other plants in disturbed areas. Grasslands have been mostly common with this invasive plant disturbing grass species. Thus food production of the Udawalwe National Park has been decreasing rapidly making elephants more vulnerable.

Figure 04 *L.camara* in Udawalawe NP



Some controlling activities could be identified in Udawalawe National Park by the field survey. Some sites were investigated where *Lantana camara* had been removed by bulldozers. But most of these activities were unsuccessful due to poor planning. *Lantana camara* was removed and these removed plants had been collected into several places. But they had not taken any other attempt to destroy these plants using fire or any other method. Thus, after a few days lots of new plants germinate rapidly with undestroyed seeds. These new plants again produce lots of new seeds and they are dispersed by the birds easily. Thus, removing of *Lantana camara* should be done in a well-planned mechanism to prevent this rapid spreading.

If the authorities can plant *Panicum maximum* (Guinea grass /Ginithana) in cleared and disturbed areas, that can be used to provide foods for elephants and other grazing animals. *Panicum maximum* is also an invasive plant and, it could be a good competitor against to the *Lantana camara*. The rapid spreading of *Panicum maximum* will be controlled by elephants and other grazing animals. According to Sampson (2013), the relative elephant abundance is at the highest in grasslands, specifically in areas with *Panicum maximum*. He had used Udawalawe National Park and Hurulu Forest reserve as the study areas for his research. Thus, that research also provides good evidence about the importance of spreading *Panicum maximum* that cause to increase the elephant abundance. This method will be very useful as a controlling mechanism of the *Lantana camara* as well as to increase the food production of the habitat. According to discussions which we had with Wildlife Range Assistant, Mr. Anil Jayantha Vithanage, *Panicum maximum* had been abundant in the Udawalawa National Park before 15-20 years. But at present even one acre is very difficult to find with *Panicum maximum*, and whole ecosystem of the Udawalawe National Park has been changed. This situation is a big threat to the elephant habitat due to very less food productivity.

Conclusion: 2,650 ha was identified as completely invaded areas of *Lantana camara* in the Udawalawe National Park. But this extent could be more than the resulted extent. Identification of *Lantana camara* mixed areas was difficult to identify due to the low

resolution of satellite data. *Lantana camara* dominant areas should be controlled as the first step. Thus, this result is important to identify the *Lantana camara* dominant areas for removing programs.

As a developing country, Sri Lanka does not have an ability to use high resolution images spending a huge amount of money for such studies. This money can be allocated for clearing purposes and that is the solution for the major problem. Thus as an inexpensive method to identify the distribution of invasive plants, this research methodology is really applicable for such conditions in tropical developing countries as well.

This invasive plant had been spreading rapidly in the Udawalawe National Park and it has directly impacted to reduce the food production of the elephant habitats. Especially grasslands had been invaded by this invasive plant. Grasslands are the main food resource of the elephant habitats. Thus, this situation has made the elephant habitats more vulnerable. *Lantana camera* had caused to reduce the biodiversity of the National Park. Some areas had been completely invaded by this plant. Species richness in such areas had been reduced rapidly. It directly caused to degrade the biodiversity of the National park.

According to the field observation controlling programs of *Lantana camara* had not been done with a better controlling plan. Thus, those activities were useless. Therefore removing and destroying removed plants by fire is very important to prevent their regrowth. As well as growing of *Panicum maximum* (Guinea grass /Ginithana) in disturbed and cleared areas in the National Park can be proposed to control the rapid spreading of *Lantana camara*. *Panicum maximum* is a good food resource of elephant habitats and this grass will be useful to increase the food production of the National Park as well.

References

Ayesha E.P. (2006) “*Impact of Lantana camara, a major invasive plant, on wildlife habitat in Bandipur Tiger Reserve, southern India*” Nature Conservation Foundation, India. Available at <http://www.rufford.org/files/17.09.06%20Detailed%20Final%20Report.pdf>

Dhobal P. K., Kohli R. K. and Batish D. R. (2010) “Evaluation of the impact of *Lantana camara* L. invasion, on four major woody shrubs, along Nayar river of PauriGarhwal, in Uttarakhand Himalaya” *International Journal of Biodiversity and Conservation* Vol. 2(7), pp. 155-161, July 2010. Available at http://www.academicjournals.org/article/article1380190683_Dobhal%20et%20al.pdf

Sampson, C. (2013) "Conserving the Land of the Giants: Critical threats to Asian elephant habitat in Sri Lankan protected areas" (2013). *All Theses*. Paper 1789. Available at http://tigerprints.clemson.edu/all_theses/1789/

Sastry CST, Kavathekar YY (1990). Plants for reclamation of wastelands. Publications and Information Directorate, New Delhi pp. 317-318.

Soumya P. & Christy W. “Extent and Distribution of some invasive species in Asian Elephant Habitats”, IUCN. Available at http://www.asesg.org/PDFfiles/IUCN%20AsESG%20report%20on%20invasive%20plant%20species%20in%20ele%20habitats_LE.pdf

Veitch, C.R., and M.N. Clout. 2002. Turning the Tide: The Eradication of Invasive Species Occasional Paper of the IUCN Species Survival Commission No. 27. IUCN, Gland, Switzerland and Cambridge, UK.