File No.FWLD-D1/82/2020-FWLD

പതിനാലാം കേരള നിയമസഭ

പത്തൊമ്പതാം സമ്മേളനം

നക്ഷത്രചിഹ്നമിടാത്ത നിയമസഭാ ചോദ്യം നം.2385 12.03.2020-ൽ മറുപടിയ്ക്ക്.

കുറുവ ദ്വീപിലെ സന്ദർശകർ

ചോദ്യം		ഉത്തരം	
ശ്രീ.ഒ. ആർ. കേളു :		അഡ്വ. കെ.രാജു (വനവും, മൃഗസംരക്ഷണവും, മൃഗശാലകളും വകുപ്പുമന്ത്രി)	
(എ)	മാനന്തവാടി കുറുവ ദ്വീപിലെ സന്ദർശകരുടെ എണ്ണം നിശ്ചയിക്കുന്നതിനായി വനം വകുപ്പ് ഏതെങ്കിലും തരത്തിലുള്ള പഠനങ്ങൾ നടത്തിയിട്ടുണ്ടോ; അറിയിക്കുമോ;	(എ) യും	ഉണ്ട്.
(ബി)	എങ്കിൽ പഠനം നടത്തിയ ഏജൻസിയുടെ പേരും പഠന റിപ്പോർട്ടും ലഭ്യമാക്കാമോ;	(ബി) യും	കോയമ്പത്തൂർ ആസ്ഥാനമായുള്ള ഇൻസ്റ്റിറ്റ്യൂട്ട് ഓഫ് ഫോറസ്റ്റ് ജനിറ്റിക്സ് & ട്രീ ബ്രീഡിങ് (IFGTB) എന്ന സ്ഥാപനമാണ് പഠനം നടത്തിയിട്ടുള്ളത്. പഠന റിപ്പോർട്ട് അനുബന്ധമായി ചേർത്തിട്ടുണ്ട്.
(സി)	പഠന റിപ്പോർട്ടിന്റെ അടിസ്ഥാനത്തിൽ വനം വകുപ്പ് സ്വീകരിച്ച നടപടികൾ വ്യക്തമാക്കാമോ?	(സി)	പഠന റിപ്പോർട്ട് അംഗീകരിച്ചിട്ടുണ്ട്. എന്നാൽ, കുറുവ ദ്വീപുമായി ബന്ധപ്പെട്ട് 'വയനാട് പ്രകൃതി സംരക്ഷണ സമിതി' എന്ന സംഘടന ബഹു.ഹൈക്കോടതിയിൽ റിട്ട് ഹർജി ഫയൽ ചെയ്തിട്ടുണ്ട്. ടി വിഷയം ബഹു.ഹൈക്കോടതിയുടെ പരിഗണനയിലായതിനാൽ റിപ്പോർട്ട് സംബന്ധിച്ച് തുടർനടപടികൾ സ്വീകരിച്ചിട്ടില്ല.

സെക്ഷൻ ഓഫീസർ

CONTENTS

Foreword

Kuruva Island has been promoted as an ecotourism destination by the Government of Kerala and tourists visit the Island every day during the season. In order to assess the visitor carrying capacity of the ecotourism site, the Kerala Forest and Wildlife Department, Government of Kerala invited proposals from research institutes. Accordingly, the research proposal submitted by the Institute of Forest Genetics & Tree Breeding (IFGTB) was approved. The visitor carrying capacity was estimated based on the primary data collected through field inspection, discussions and interactions with officials of Forest Department and various stakeholders of Pakkom - Kuruva Ecotourism site in South Wayanad Division, Kerala. The visitor carrying capacity estimated based on the selected limiting factors can be used to take administrative decisions to regulate the number of visitors per day to the Kuruva Island, and may be reviewed on a yearly basis based on a rapid impact assessment of ecotourism site to ascertain sustainable ecotourism.

Dr. Mohit Gera, IFS
Director

ACKNOWLEDGEMENTS

I express my deep sense of gratitude and grateful thanks to the Kerala Forests and Wildlife Department, Thiruvananthapuram for providing financial assistance to carry out the project.

I thank Shri. P.K. Kesavan IFS, Principal Chief Conservator of Forests & Head of Forest Force, Shri.A.K. Dharni IFS, Principal Chief Conservator of Forests (Vigilance), Shri. K. A. Mohammed Noushad IFS, Principal Chief Conservator of Forests (WP&R), Shri. Bennichen Thomas IFS, Principal Chief Conservator of Forests (Forest, Land and Resources) & Custodian of EFL, Shri.V.V. Shajimon IFS, Addl. Principal Chief Conservator of Forests (FMIS), Shri. Rajan Sehgal IFS, Addl. Principal Chief Conservator of Forests (Finance, Budget & Audit), Shri. S. Gopalakrishnan IFS, Addl. Principal Chief Conservator of Forests (IHRD), and Smt.Padma Mahanti, IFS for their valuable inputs to assess the visitor carrying capcity of Kuruva.

I thank Honorable **Sh. O. R. Kelu, MLA, Sh. C. K. Saseendran, MLA** and other participants of the interaction meeting on assessment of visitor carrying capacity of Kuruva for sharing their views / suggestions regarding various issues and limiting factors to be considered for the study.

I wish to record my heartfelt thanks to **Dr. Mohit Gera, IFS**, Director, IFGTB for his encouragement and guidance throughout the project period. I am equally grateful to **Dr. S. Murugesan,** Group Co-ordinator (Research), IFGTB for his periodical review and encouragement for successful completion of the project.

I thank **Shri P. Ranjith Kumar, DFO** and other Forest Officials, South Wayanad Forest Division for providing all necessary facilities and arrangements to carry out the project in a successful manner.

I thank Mr. P. U. Das, District Soil Conservation Officer, Wayanad for sharing information on soil and soil erosion in the Kuruva ecotourism site.

I extend my sincere gratitude to **Mr. C. Jayarajan,** FDA, South Wayanad Forest Division and **Mr. Agin George Kurian,** Field Assistant for their assistance at various levels during the study.

Dr. A. Rajasekaran
Scientist - E
Principal Investigator

Summary

The present study on "Assessment of the Visitor Carrying Capacity of Kuruva Island, Wayanad, Kerala" is based on primary data collected through field inspection, discussions and interactions with officials of Forest Department and various stakeholders of Pakkom - Kuruva Ecotourism site in South Wayanad Division, Kerala. Already published documents and available reports also have been consulted. The information based on observations of the relevant stakeholders from the area was also considered. The visitor arrival statistics in Pakkom –Kuruva ecotourism site and other available data was collected from the DFO, South Wayanad Division. The possible impact of visitors in the Pakkom –Kuruva ecotourism site has been assessed through field survey in the area and discussion with local people and field staff. The draft guidelines provided by the Ministry of Environment and Forest, Govt. of India on 2nd June, 2011 for Ecotourism in and around protected areas have been followed for assessing the visitor carrying capacity of Pakkom – Kuruva ecotourism site. Visitor carrying capacity has been divided into the following three levels namely a) Physical Carrying Capacity (PCC), b) Real Carrying Capacity (RCC) and c) Effective Carrying Capacity (ECC).

The Physical Carrying Capacity has been estimated by assuming the area required by a visitor as $1m^2$ based on earlier studies carried out for similar assessment. Correction factors such as soil erosion, Elephant movement and human - elephant conflict, Mugger crocodile breeding time and Smooth coated Otter were considered as limiting factors for this study to ensure minimum ecological impact, biodiversity conservation and safety of the visitors. The study found that the present management capacity of area is optimum. Considering the above points, it is recommended that a total of 1150 visitors may be allowed to visit the island on daily basis during the season, when the park is open for the visitors subject to the variation in limiting factors. Based on the outcome of the study, it may be concluded that the number of visitors entering the area was high for the years 2014-15 to 2016-17 and it was well within the limits of carrying capacity for the last year, i.e. 2017-18.

1. Background

Kuruva or Kuruvadweep is a cluster 64 islets in the Kabini River with the total area of 146.3 ha. falling in Chedalath Range of South Wayanad Forest Division, Kerala. These islets were gradually formed by river-sediment deposits and can be accessed by rafts and boats. It is home to a wide variety of plants and animals and the major vegetation type found in the area include evergreen, semi-evergreen and moist deciduous forests. The forests in some part of the island are degraded (Sasidharan and Chacko, 1987; Vidyasagaran, 2001). The riverine forests are evergreen with association of *Hopea ponga - Calophyllum apetalum.* Kuruva Island falls in the middle of a traditional migratory route of the Asian Elephants which migrate from the Southeast Wayanad – Mudumalai - Bandipur areas to the northeast towards the Brahmagiri – Nagarahole - Kottiyoor forest areas.

Kuruva Island has been promoted as an ecotourism destination by the Government of Kerala and thousands of tourists visit Kuruva Island every day during the season from October to May. The ecotourism activities in Pakkom - Kuruva ecotourism site are managed by Vana Samrakshana Samiti (VSS). The island has bamboo walkways and bridges to help the visitor to traverse through the vegetation. The Pakkom - Kuruva ecotourism site is a part of the island and the entry for the site is through tickets available both in Pakkom - Kuruva (operated by the Pakkom-Kuruva Vana Samrakshana Samiti) and Palvelicham ticket counters (Operated by District Tourism Promotion Council). There are bamboo rafts at both the entry points to take tourists to the island.

The site experienced higher numbers of visitors in increasing order during 2014-15 to 2016-17. The average number of visitors visiting Kuruva during these three years was 1789 numbers. However, unplanned development and increased tourism activities can lead to land use changes, and adverse effect on the environment besides impacting forests and its biodiversity. Spread of mosquito vectors have been already reported in the area (Anees *et al.*, 2014). The World Tourism Organization (WTO) in 2005 declared that tourism operations in protected areas need to be carefully planned, managed and monitored to ensure their long-term sustainability. Further, there is a need to evaluate whether the ecotourism principles and practices are strictly followed in this site. In view of the above facts, it is essential to study the Visitor Carrying Capacity which is an environmental management tool needed to maintain the exploitation and conservation ratio of the

site. The State Forest Department attempted to estimate the visitor carrying capacity of the site during 2017-18 with the already available data and fixed a ceiling for the entry of visitors to the area. However, the ceiling arrived after the assessment was not acceptable to the sections of local people. In this scenario, considering the need for a comprehensive assessment of Visitor Carrying Capacity of Kuruva ecotourism site involving different stakeholders the State Forest Department invited proposals from research institutes (Annexure 1). Accordingly, the research proposal submitted by the institute on assessment of visitor carrying capacity of Kuruva was approved with revised scope by the State Forest Department (Annexure 2).

2. The scope of the study

As per the APPCF (Forest Management) letter no. E & TW3-765/17 dated 23.06.2018, the scope of the present study is;

(i) Evaluating the present level of ecotourism activities in the site

(ii) Interacting with different stakeholders in site by organizing workshops / seminar / meetings etc. with VSS, Peoples representative, staff etc. for assessing the parameters and limiting factors for carrying capacity study.

(iii) Estimation of Carrying capacity – keeping in consideration the draft guidelines and the formula provided in the Ministry of Environment, Forest Guidelines for ecotourism in and around Protected Areas (2nd June, 2011). The report shall, inter alia, provide the parameter values for each limiting factor and the situations / time horizon, on the occurrence of which the calculations would require to be recalibrated. The report shall finally arrive at effective permissible carrying capacity for each and every set of ecotourism activity carried out, and should appropriately resolve overlaps between / among activities. Entire gamut of activities – safaris, trekking, night halts, boating etc., if applicable will be covered within the scope of this study.

3. Review of literature

The present study collected literature regarding ecotourism, visitor carrying capacity and studies related to Wayanad and Kuruva. A review of already published information related to assessment of visitor carrying capacity is given in the following headings.

3.1. Ecotourism definitions

The term ecotourism is first coined in the year 1983 by Mexican Architect Hector Ceballos Lascurain. The preliminary definition of ecotourism emphasized as *"is traveling to relatively undisturbed natural areas with the specific object of studying, admiring and enjoying the scenery and its wild plants and animals, as well as any existing cultural manifestations found in these areas"* (Lascurain, 1987).

Some of the prominent definitions of ecotourism during the initial phase are:-

"Responsible travel to natural areas that conserves the environment and improves the well-being of local people." as per the International Ecotourism Society (TIES, 1990). *"Nature tourism that contributes to conservation, through generating funds for protected areas, creating employment for local communities and offering environmental education"* as per Boo (1991). *"Ecologically sustainable tourism that fosters environmental and cultural understanding, appreciation and conservation"* according to Ecotourism Association of Australia, (1992). *"Travel to enjoy the world's amazing diversity of natural life and human culture without causing damages"* (Tickell, 1994). *"Ecotourism is nature based tourism that involves education and interpretation of the natural environment and is managed to be ecologically sustainable"* Alison (1994).

Various stakeholders in Ecotourism include visitors, local communities, business people like tour operators, hotel and accommodation providers, restaurants and so on (Lindberg *et al.,* 1997). Hence all stakeholders are expected to adhere to the norms and regulations of ecotourism which have direct impact on ecotourism destinations (Liliane, 2012). According to Aref *et al.,* (2010) local community relates to group of individuals living or working within the same geographic area with some shared cultures or common interests. The advantage of involving local community in ecotourism creates livelihood security without compromising the ecological

balance of the destinations. Tourism can generate both positive and negative effects on the areas where visiting and leisure activities take place. It can be a positive element for the local economy of the tourist destination, but it can also generate some externalities (positive or, more frequently, negative) that are not included in the local economic balance and that can affect the quality of the visitors' experience (Casagrandi and Rinaldi, 2002; Gössling and Hall, 2005; Mathieson and Wall, 1982; Saarinen, 2006). Therefore, it is important that tourism planning, carried out by local decision makers, assures a good level of conservation of natural resources and mitigates the impacts that tourism necessarily entails.

3.2. Ecotourism in Kerala

Bijith, (2015) mention that ecotourism in Kerala is divided into three zones namely, i. South Zone comprising of Thiruvananthapuram, Kollam, Pathanamthitta and Allapuzha districts ii. Central Zone comprising of Kottayam, Idukki, Ernakulam and Thrissur districts and iii. North Zone comprising of Palakkad, Malappuram, Kozhikode, Wayanad, Kannur and Kasargode districts. The ecotourism activities like nature walk, tree top huts, bathing ghats, peddle boats, bird watching trail in the state are primarily managed by the Eco-Development committees (EDCs), Forest Department and the Vana Samrakshana Samithies (VSS) under the Forest Development Agency of Kerala. A geographical analysis on the scope of ecotourism in Kerala was undertaken by Haider-e-Karrar, (2014) to examine the potentiality and wide scope of ecotourism in the region. Only secondary data published in articles, news reports, journals etc. were collected. A study on growth of tourism industry in Kerala and need for sustainable tourism development was carried out by Aswathy (2016). The study reveals that as tourism growth is depended upon environmental quality, the concept of sustainability has greater importance. A careful management of tourism industry is essential in order to reap in the maximum benefits with the minimum negative impact and to make it more environmentally and socially sustainable.

3.3. Visitor Carrying Capacity studies in different parts of the world

Castellani, *et al.,* (2007) suggested a model for assessing the physical carrying capacity of tourism destinations, and how it was used as a tool to evaluate whether the current situation is

sustainable or not and to determine if a rise in visitor numbers would affect the quality of the environment, the resources available and the quality of public services. For the assessment, all environmental aspects were separately analyzed and the main environmental issues related to the daily life of residents and to tourism activities (air quality, water quality and disposability, waste management, soil use) were considered. The study undertaken by Tselentis, (2011) highlights the impact of tourism on environment of Crete, the largest island in Greece and to estimate the tourism products and services offered.

The concept of ecotourism emerged to improve the living standards of the local population as it promotes employment opportunities, business opportunities for the local community without compromising on the use of green energy, use of biodegradable materials, eco-friendly accommodation and transportation, environmental friendly and responsible tourist behavior etc. are very significant to ensure sustainable ecotourism.

The estimation of physical and real carrying capacity with application on Egypt's tourist sites (Egyptian Museum and Saint Katherine Protected Area) was carried out by Nashwa (2015), to outline the importance of carrying capacity application and estimating it for two of the main tourist sites in Egypt. The results indicated that the tourists visiting Saint Katherine Protected Area are less than its potentials, whereas the actual numbers of tourists visiting the Egyptian Museum are higher than the estimated values of its physical and real carrying capacity. http://www.jotr.eu/index.php/volume12/114-egypt-carrying-capacity. Carrying capacity is often pragmatically, theoretically as well as purely intuitively considered as a concept in the context of tourism sustainability. The carrying capacity application has the greatest potential in protected areas, in frequently visited cultural and natural attractions, and in relation to sustaining of the lifestyle of the local community and tourism destination potential in general (Zelenka and Kacetl, 2014). Viñals, *et al.,* (2014) has brought a recreational carrying capacity assessment of the 16th century Spanish Fort of Santiago on the Island of Chikly, Tunisia, and the study reveals the greater fragility of the island in relation to the Fort of Santiago, and the need to control the visitor use level. Thus, they have arrived at one group of 20 people per day would be an acceptable volume of visitors.

3.4. Visitor Carrying Capacity studies in India

The study by Swagata, *et al.,*(2015) estimated tourism carrying capacity of four main beaches namely Bharatpur, Sitapur, Natural arch and Sunset point of Neil Island, South Andaman, India. Tourism capacity has been determined by means of Physical Carrying Capacity (PCC), Real Carrying Capacity (RCC) and Effective Carrying Capacity (ECC), which revealed the optimum range of Effective Carrying Capacity for Neil Island as 2134 visitors/day and 64020 visitors/month. A similar study was carried out by Jangra and Kaushik, (2017) on assessment of Physical Carrying Capacity for managing sustainability at religious tourist destinations. The study aimed to provide an examination of visitor thresholds and tried to estimate the carrying capacity of Braham Sarovar, a very famous Hindu religious destination in Kurukshetra, Haryana using methodology suggested by IUCN and IRC. An Evaluative Study on Kuruva Island in Wayanad, Kerala by Binoy (2017) evaluated the ecotourism activities and their impact in environmental sustainability and biodiversity protection. The presence of vector mosquitoes like *Aedes aegypti, Aedes albinopictus* and *Culex bitaeniorhynchus* is a serious issue that can cause vector diseases such as Malaria, Filariasis, Dengue fever, Chikungunya etc. as per the observation made by Aneesh, *et al.,* (2014). This is also an alarming issue in Kuruva Islands, as Kuruva Island is visited by ever increasing number of tourists from all over the world. The study revealed that out of total collected data on mosquitoes, the *Aedes* mosquitoes was predominant (50%) as they prefer clear water for their breeding. A study on host species preference of fig-wasps in south Wayanad Forest Division by Shilpa (2016) recorded 24 species of Ficus diversity with high ecological benefits. It is also highlighted in the study that most of the species undergo a rest phase of two weeks before next flowering to enable them to main a synchrony between the wasps communities associated with them. Thomas Ambalavayal, Secretary, Wayanad Prakruthi Samrakshana Samiti in The Hindu dated October 17, 2017 reported the increasing flow of tourists which affects the fragile eco-systems of the islets. Wayanad Prakrithi Samrakshana Samithi reported in the Times of India dated March, 6, 2018 that the ongoing tourism activities at Kuruva do not have the sanction of the Union Ministry of Environment and Forests and Climate Change (Badusha, 2018).

In view of the above fact, it is understood that the physical area required by a visitor and the limiting factors varies according to the type of ecotourism activities and the nature of area.

However, assessment of carrying capacity in other areas (Queiroz *et al.*, 2014; Wiyono *et al.*, 2018) for nature trail and trekking had considered $1m^2$ as the minimum area required by a tourist.

4. Methodology

The study is based on primary data collected and through discussions / interactions with Forest Departments and various stakeholders of Pakkom –Kuruva Ecotourism site in South Wayanad Division, Kerala. The methodological approach used for studying carrying capacity pertains to statistical and landscape data, already published documents / reports and information based on observations and discussions with the relevant stakeholders during the visits to the area.

4.1. Evaluating the present level of ecotourism activities in the site

The present level of ecotourism activities in Pakkom –Kuruva ecotourism site in South Wayanad Division, Kerala was assessed using the data collected from the Forest Department (Annexure 3), discussion with local people and members of VSS. The visitor arrival statistics in Pakkom – Kuruva ecotourism site for the period from 2008-09 to 2017-18 was collected from the DFO, South Wayanad Forest Division and the average number of visitors per day was calculated by dividing the total number of visitors with number of days the site is open for ecotourism.

The possible impact of visitors in the Pakkom –Kuruva ecotourism site was assessed through field survey in the area and by having discussion with local people. However, long term detailed studies are required for assessing the impact of visitors in the Pakkom –Kuruva ecotourism site. The impacts of tourism development on the land use and land cover changes in the area have been evaluated using geospatial technology. Although the subject of the carrying capacity assessment pertains to the Kuruva ecotourism site the incorporation and analysis of adjacent areas is considered necessary since these areas are functionally related. The Resourcesat LISS-IV satellite images for the year 2017 required for the study were procured from the National Remote Sensing Centre, Hyderabad. The land use and land cover in 10 km radius of Pakkom –Kuruva ecotourism site was assessed using the procured satellite images. Field survey was undertaken along with GPS and information on various land use categories were collected along with geographical coordinates. The collected information on sampling points was used as training sites for creation of land use and land cover map of the study area. The very high resolution images available in Google Earth for the year 2006 have been used as reference images. The

changes in Land Use and Land Cover between these two years (2006 & 2017) were assessed and the extent of changes in each Land Use category was estimated using ARCGIS.

4.2. Interaction with various stakeholders of Pakkom – Kuruva ecotourism site

Informal discussions with local people, VSS members, officials of tourism Department, field staff State Forest Department and local shop keepers regarding various issues related ecotourism in Pakkom – Kuruva ecotourism site were held during the field survey by the study team. Apart from the informal discussion, an interactive meeting with key stakeholders was conducted on 12th October, 2018 at Gaja Forest Inspection Bungalow, Sulthan Bathery for assessing the parameters and limiting factors for visitor carrying capacity study. The views and suggestions of the participants were considered for assessment of visitor carrying capacity of Kuruva. An interactive meeting with senior forest officials of State Forest Department was also organised to discuss about the physical area required by a visitor, the extent of various ecotourism sites and various limiting factors to be considered for assessing carrying capacity.

4.3. Visitor Carrying Capacity (VCC) of Pakkom – Kuruva ecotourism site

The general formula of visitor carrying capacity assessment for protected areas was first proposed by Cifuentes (1992), and further applied in different fields by many other authors (Cifuentes *et al.,* 1999; Munar, 2002; Nghi *et al., 2007*; Zacarias *et al.,* 2011). The draft guidelines provided by the Ministry of Environment and Forests, Govt. of India on 2nd June, 2011 for Ecotourism in and around protected areas have been followed for assessing the visitor carrying capacity of Pakkom – Kuruva ecotourism site. Visitor carrying capacity is divided into the following three levels namely a) Physical Carrying Capacity (PCC), b) Real Carrying Capacity (RCC) and c) Effective Carrying Capacity (ECC).

a) Physical Carrying Capacity (PCC)

Definition: PCC is the maximum number of tourists that can physically fit into or onto a specific area, over a particular time.

$$\text{Formula: } PCC = A/A_u, \times R_f$$

Where: PCC = Physical Carrying Capacity, A = Available area for tourist use; A_u = Area required per tourist; R_f = Rotation factor (number of visits per day)

$$R_f = \text{Daily open period / average time of visit}$$

b) Real Carrying Capacity (RCC)

Definition: The maximum permissible number of tourists to the specific site, once the Correction Factors (CF) derived from the particular characteristics of the site have been applied to the PCC.

$$\text{Formula: } RCC = PCC \times (Cf_1 \times Cf_2 \times Cf_3 \times Cf_4 \times - - - Cf_n)$$

Where: RCC = Real Carrying Capacity; PCC = Physical carrying capacity;
Cf = Correction factors

Correction factors are calculated using the following formula

$$Cf_x = 1 - Lm_x/Tm_x,$$

Where: Cf_x = Correction factors of variable x; Lm_x = Limiting magnitude of variable x;
Tm_x = Total magnitude of variable x.

Correction factors are so important for estimating the Real Carrying capacity. The correction factors are obtained by considering the biophysical, environmental, ecological, social and management variables. Tourism is dependent on nature, so some variables are considered as correction factors for this study.

c) Effective Carrying Capacity (ECC)

Definition: The maximum number of tourists that a site can sustain, given the management capacity (Mc) available.

$$\text{Formula: } ECC = RCC \times Mc$$

Where: ECC = Effective Carrying Capacity; RCC = Real Carrying Capacity; Mc = Management capacity

For assessing the visitor carrying capacity, primary and secondary information on physical characteristics of the area, flora and fauna were collated. The information on the extent of various areas in the ecotourism zone, data on fire occurrence, sighting of tiger, Human-Wildlife conflict, staff strength, number of VSS members involved in ecotourism and footfall of various visitors were collected from the DFO, South Wayanad Forest Division, Kalpetta, Wayanad. The information on infrastructure facilities in the area including parking area, signboards, resting places, hotels, souvenir shops, accommodation facilities, solid waste disposal and transportation were also collected.

5. Study Area

Kuruva Island falls in Wayanad District of Kerala State especially in Pathiri north section of Chedalath Range in South Wayanad Forest Division (Figure 1). It is one of the freshwater islands in the state. To enjoy the natural beauty of Kuruva and generating employment to local tribes, the forest Department has opened Pakkom-Kuruva Ecotourism site under the control of the Pakkom - Kuruva Vana Samrakshna Samithi, which was registered during the year 2002 by including two members from 137 families of Pakkom Cheriyamala and functioning under Kerala Forest and Wildlife Department. The Forest Department permitted the District Tourism Promotion Council (DTPC) to start an entry point on the banks of River Kabini adjoining Kuruva Island in 2004 at Palvelicham. Subsequently, the local inhabitants in the Palvelicham started to depend on the ecotourism activities in Kuruva for their livelihood.

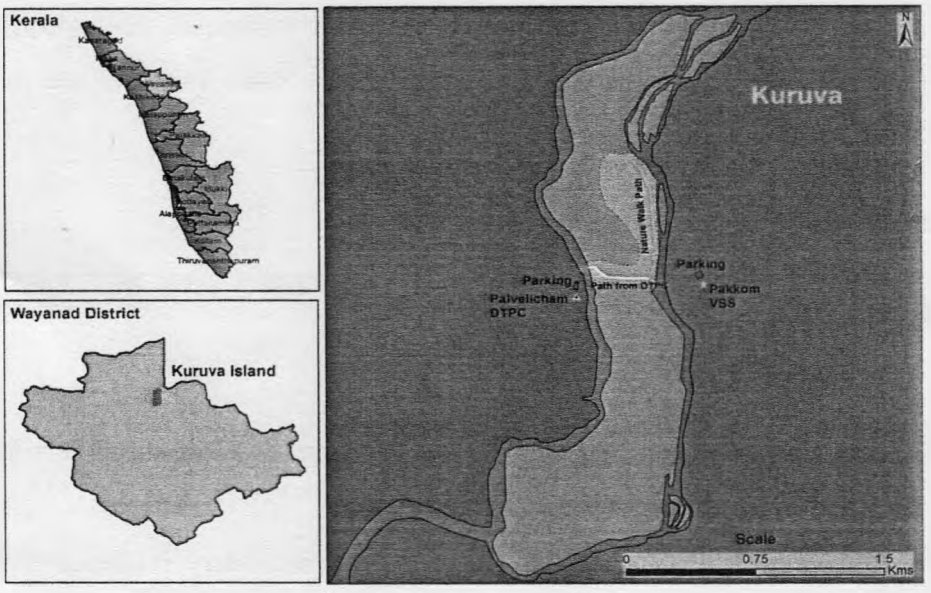


Figure 1. A map showing the location of Pakkom-Kuruva ecotourism site in Kerala

The entry points of Kuruva, the route of nature trail and the nature of land use in its surrounding are given in a Google Earth Map (Figure 2.).

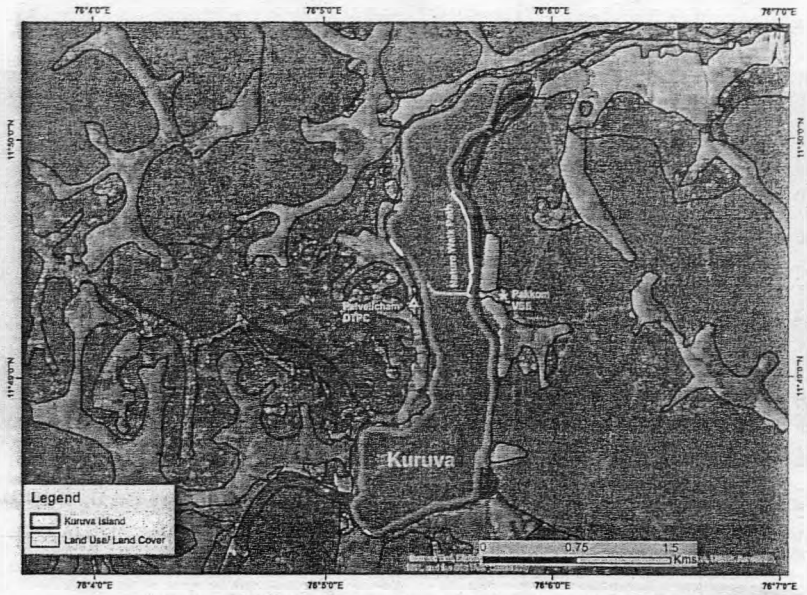


Figure 2. The location of Kuruva Island

5.1. Entry fee

The entry for the site is through tickets available both in Pakkom and Palvelicham ticket counters (Picture 1 & 2). The following entry charges are collected by the VSS from the visitors: -

Adults	-	Rs.80/-
Foreigners	-	Rs.150/-
Camera	-	Rs.50/-
Students	-	Rs.55/- **

** Students are given concession for entry. Visitors are cautioned against taking videos inside Kuruva, as it is totally prohibited.

The Forest Department has a Nature interpretation centre in Pakkom to educate the visitor about the significance of ecotourim site (Picture 3).

5.2. Parking Area

Parking area is available in both the entry points and the following parking fees are collected:-

Two Wheeler	-	Rs.10/-
Car / Jeep	-	Rs.50/-
Auto	-	Rs.20/-
Bus / Minibus	-	Rs.80/-

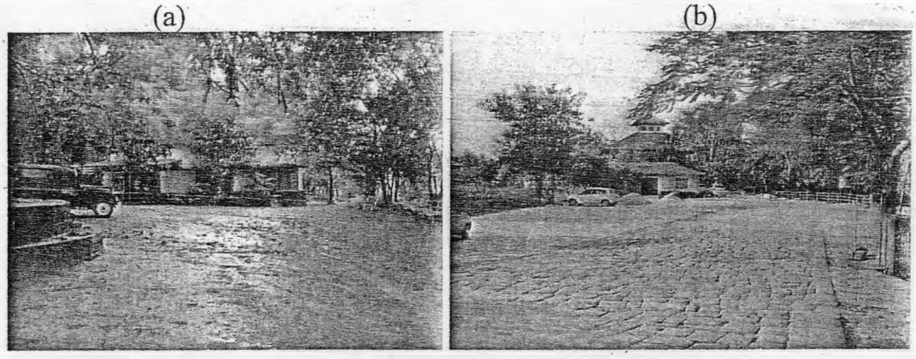
5.3. Bamboo Raft

From the ticket counters, bamboo rafts are available from both the side to take the visitor to the start of the nature trail (Picture 4).

(a) (b)

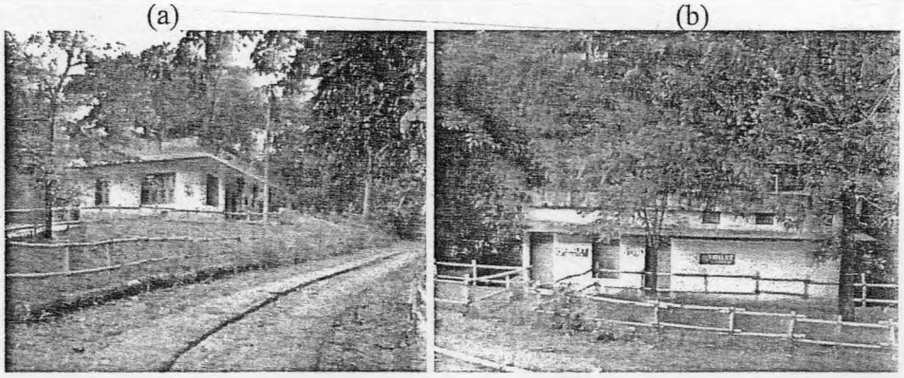
Picture 1. Ticket Counters in Pakkom (a) and Palvelicham (b)

(a) (b)



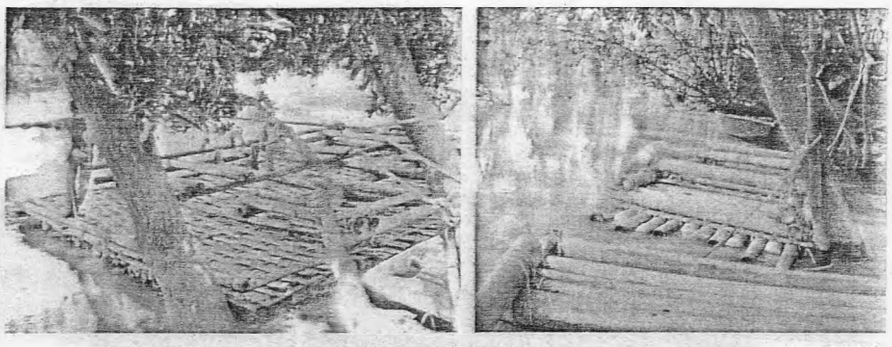
Picture 2. A view of part of Parking areas in Pakkom(a) and Palvelicham(b)

(a) (b)



Picture 3. Nature interpretation centre (a) and toilet facility in Pakkom (b)

(a) (b)



Picture 4. Bamboo rafts for transport of visitors in Pakkom(a) and Palvelicham(b)

5.4. Ecotourism zone and activities

Out of 146.3 total ha, 20 ha area has been allowed for various ecotourism activities in the area. The visitors from Pakkom and Palvelicham are allowed to go for a nature trail (900m x 3 m) inside the ecotourism zone. At the end of the nature trail (Picture 5), there are some small islets, resting places and bathing area (Picture 5). The island has bamboo walkways and bridges to help traverse through the vegetation. The total area being used by visitors is 5390m^2 and the breakup of the same is given in Table 1.

Table 1. The breakup of total area being used by visitors in Kuruva

S.No.	Location	Length (m)	Total area (m^2)
1	DTPC Changadakkadavu to Forest track path	300 x 3	900
2	Pakkom Changadakkadavu to Parakkoottam	900 x 3	2700
3	Parakkoottam to Resting place limit	100 x 5	500
4	Bathing area in the river	50 x 20	1000
5	Small islets	25 x 4.4 30 x 6	110 180
	Total		5390

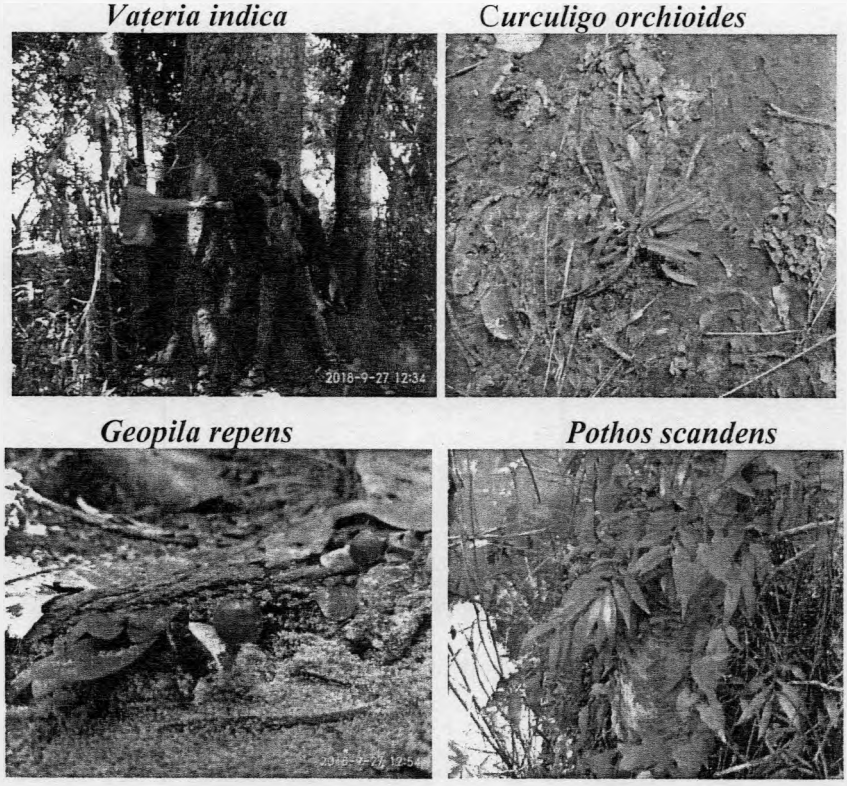
(a) (b)

Picture 5. A view of Nature trail (a) and Bathing area in Kuruva (b)

5.5. The vegetation

The major vegetation types found in the area include evergreen, semi-evergreen and moist deciduous forests. The forests in some part of the island are degraded (Sasidharan and Chacko, 1987; Vidyasagaran, 2001). The riverine forests are evergreen with the association of *Hopea ponga - Calophyllum apetalum.* A preliminary data on 198 species of flowering plants from Kuruva was reported by Safna, (2006). Some of the flora of the island is given in Picture 6.

Diospyros peregrina ***Scleropyrum pentandrum***



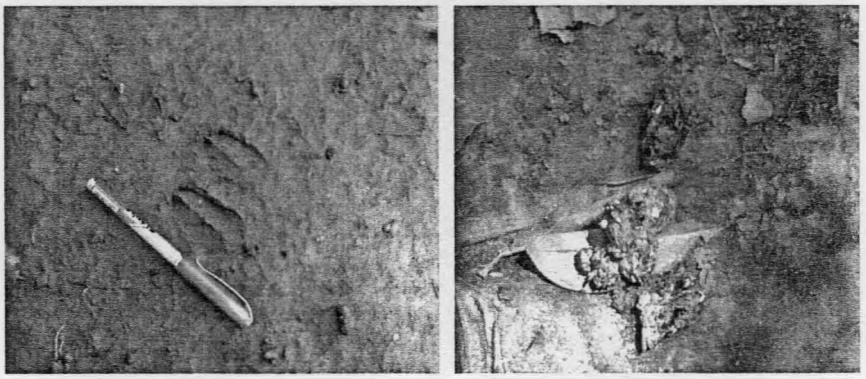
Picture 6. Some of the flora in the Kuruva

5.6. Fauna

During the field survey in Kuruva, Mugger crocodile (*Crocodylus palustris*) and Malabar giant squirrel (*Ratufa indica*) were sighted. Evidences for the presence of elephant (*Elephas maximus*), spotted deer (*Axis axis*) and smooth coated Otter (*Lutrogale perspicillata*) were collected (Picture 7). Other animals such as sambar deer (*Rusa unicolor*), mouse deer (*Moschiola indica*) and barking deer (*Muntiacus muntjak*) have been observed by local people. There are sightings of a tigress and two cubs recently near Kuruva and DFO, South Wayanad Division observed pugmarks of tiger near the carcass of an Elephant inside Kuruva on 30th December 2016. Some of the local people informed that animals such as Travancore flying squirrel (*Petinomys fuscocapillus*), Slender loris (*Loris lydekkerianus malabaricus*) and Asian small clawed otter (*Aonyx cinerea*) were observed near Kuruva Island, but their presence inside Kuurva could not be confirmed. Though birds and fish in the area was studied earlier, published information on birds and fish fauna of Kuruva was not available. Kuruva is identified as habitat which support a good resident population of wild mugger crocodiles and breeding ground. Apart from Kuruva,

Mugger crocodile are present only in Neyyar Wildlife Sanctuary and Parambikulam Tiger Reserve in Kerala.

(a) (b)



Picture 7. Indirect evidences Spotted deer footmark (a) and Otters scat(b)

5.7. Earlier Assessment of Visitor Carrying capacity of Kuruva

The visitor carrying capacity of Kuruva was assessed by the DFO, South Wayanad based on the draft guidelines provided by MoEFCC, GOI on 2nd June, 2011, and a report was submitted on 26th October 2017 to the APCCF (Eco-development & Tribal Welfare).

a) Physical Carrying Capacity (PCC)

For calculating the Physical Carrying Capacity (PCC), the following points were considered;

The length and width of the trail to be used by visitors by foot	:	950 m x 3m
Total area actually used by tourists	:	2850 m^2
Average time spent by visitors	:	2 hours
Area required per visitor for nature walk	:	1 m^2
The total hours open for visitors	:	7 hours

Therefore physical carrying capacity is calculated as

$$PCC = 2850\ m^2 / 1m^2 \times 7/2 = 9{,}975$$

b) Real Carrying Capacity (RCC)

Real carrying capacity is calculated with the following correction factors

1) Soil erosion for trail is taken as 50%. **Cf_1 = (1-50/100)**
2) Flood time is June to October (5/6 * 100) = 83.33 = 83% **Cf_2 = (1-83/100)**
3) Elephant movement is throughout the year. But it is reported highest during November to Mid December. Elephant movement (1.5/6*100) = 25% **Cf_3 = (1-25/100)**
4) Paddy harvesting in adjoining area is during November. Due to disturbance, the man-animal conflict is more during this time. Paddy harvesting (1/6 * 100) = 16.667 = 17% **Cf_4 = (1-17/100)**

So, Real carrying capacity is calculated as

RCC = 9975 x (1-50/100) x (1-83/100) x (1-25/100) x (1-17/100)
= 527.80

c) Effective Carrying Capacity (ECC)

The Management Capacity was calculated by considering the available staff strength of 49 against the sanctioned staff strength of 64 (49/64 = 0.76).

ECC = 527.80 x 0.76 = 404.10

Table 2. Visitor Carrying Capacity (VCC) of Kuruva calculated earlier

Available area of Kuruva Island (m^2)	Area required / tourist (m^2)	Rotation factor	Physical Carrying Capacity (PCC)	Real Carrying Capacity (RCC)	Effective Carrying Capacity (ECC)
		Daily open period / average time of visit (hrs)	(Visitors/Day)	(Visitors/Day)	(Visitors/Day)
2850.00	1.00	3.50	9975.00	527.80	404.10

Based on the visitor carrying capacity calculated (Table 2), only 200 visitors from each entry point were allowed during the starting of 2017-18 season (No. E &TW3-53128/17 dated 10.11.2017). There was a public protest especially local inhabitants of Palvelicham against the visitor limit implemented stating that the livelihood of local people who depend on ecotourism is getting affected.

5.8. Review of Visitor Carrying Capacity of Kuruva

In view of the increasing demand for allowing more number of visitors to the Kuruva, the assessment of visitor carrying capacity of Kuruva was reviewed. It was found that apart from the total nature trail area of 2850m^2 (950 m x 3m) the tourist also use parts of river bank and three small islets which comes to additional 2540 m^2 area. Thus, the actual area being used for various ecotourism activities is 5390m^2.

In view of the above points, the assessment of visitor carrying capacity of Kuruva was revised (vide Order No. E&TW3-53128/2017 dated 07.05.18) as follows;

The length and width of the nature trail used by visitors on foot : 2850 m^2
The additional area used in the river bank and 3 small islets : 2540 m^2
Total area actually used for ecotourism : 5390 m^2
Therefore, physical carrying capacity is calculated as

$$PCC = 5390\ m^2 / 1m^2 \times 3.50 = 18,865$$

The review followed all the limiting factors which were included in the previous study for calculating the Real Carrying Capacity. Therefore, the Real Carrying Capacity (RCC) for the revised total area available for ecotourism was calculated as

$$RCC = 18865 \times (1-50/100) \times (1-83/100) \times (1-25/100) \times (1-17/100)$$
$$= 998.19$$

The review also found that for calculating Effective Carrying Capacity (ECC), the 0.76 management capacity which was calculated by dividing the available staff (49) in the Chedalath forest Range by total sanctioned staff strength (64), is to be considered as 1 because all the staff

of Chedalath Forest Range is not involved in ecotourism and there is no limitation of staff for ecotourism in the area (Table 3). The revised ECC is calculated as

ECC = 998.19 x 1

= 998

Table 3. Visitor Carrying Capacity (VCC) of Kuruva with modified area and ECC

Available area of Kuruva Island (m^2)	Area required / tourist (m^2)	Rotation factor	Physical Carrying Capacity (PCC)	Real Carrying Capacity (RCC)	Effective Carrying Capacity (ECC)
		Daily open period / average time of visit (hrs)	(Visitors/Day)	(Visitors/Day)	(Visitors/Day)
5390.00	1.00	3.50	18865.00	998.19	998.19

The APPCF (E & TW) vide order No. E & TW3-53128/2017 dated 7th May 2018, temporarily decided to allow 950 number of visitor daily to Kuruva. However, there was an agitation by local people against the new ceiling of 950 visitors per day to enter the Kuruva Island. The District Collector, Wayanad has recommended for an appropriate decision to increase the number of visitors to Kuruva in view of the increased visitor arrivals.

The issue was considered carefully during the meeting held on 9th May 2018 with the Hon'ble Minister for Forests and Principal Secretary along with Head of Forest Force, APCCF (E&TW) and with Shri. C. K. Saseendran MLA and Shri. O. R. Kelu, MLA to discuss and review the numbers of visitors to be allowed in Kuruva island without compromising on the environmental aspects that have been highlighted by the Forest Department and Guidelines provided by Government of India for Ecotourism.

The Principal Secretary (Forests and Wildlife) directed the concerned Divisional Forest Officer (No.45/Prl. secretary (F&WLD)/2018 dated 11th May 2018) to increase the entry of visitors, if

necessary, subject to local factors, up to an additional 100 persons per day temporarily till the completion of comprehensive study on Visitor Carrying Capacity of Kuruva.

6. Results and Discussion

The present study on assessment of Visitor Carrying Capacity of Kuruva was carried out during July – October 2018. The study evaluated the present level of ecotourism activities in the site including the footfall of visitors, impacts of visitors and the changes in Land use and Land Cover in the 10km radius of the area.

6.1. The present level of ecotourism activities in Kuruva Island

Kerala is one of the most sought tourist destinations in Asia due to secluded beaches, palm-fringed back waters, mist clad hill stations, lush green tropical forests, water-falls, wildlife, historical monuments, diverse art forms and festivals. It is also India's number one state in literacy with 100 percent literate people and highest life expectancy rates. The climate and the rich art and culture of the state are main factors that help to foster its tourism development. In the world scenario, Kerala comes under "**must see destinations**" at the global level. Hence, the state experiences an increasing flow of international tourists as well as domestic tourists on yearly basis.

Kuruva Island is no exception to this and the data collected as shown in the Table 4, confirms the emerging trend. With the available data, it is observed that the total number of visitors visiting Kuruva varied from a minimum of 65,233 to a maximum of 3,35,488 (Table 4). The period between 2007-08 and 2013-14 experienced a yearly visitor flow between 362 to 1630 numbers, however, no clear trend has been observed. The following years 2014-15, 2015-16 & 2016-17 experienced higher number of visitor in increasing order. It is observed that the average number of visitors visiting Kuruva during these three years averaged 1789 numbers. This increasing trend has abruptly come down to 145,565 annual visits in 2017-18 due to regulation as per the decision of the Government of Kerala (Figure 3).

Table 4. Pakkom - Kuruva Ecotourism visitor statistics – South Wayanad, Forest Development Agency

Year	Adults	Students	Foreigner	Total	Average visitor per day**
2007-08*	-	-	-	97,091	539
2008-09*	-	-	-	159,070	884
2009-10*	-	-	-	265,911	1477
2010-11*	-	-	-	65,233	362
2011-12	1,44,955	47,913	469	1,93,337	1074
2012-13	2,03,749	88,589	1,060	2,93,398	1630
2013-14	1,29,778	64,674	1010	1,95,462	1086
2014-15	2,43,178	62,573	1,269	3,07,020	1706
2015-16	2,59,352	63,622	670	3,23,644	1798
2016-17	2,49,771	85,029	688	3,35,488	1864
2017-18	1,34,212	11,177	176	145,565	809
Total	13,64,995	4,23,577	5,342	17,93,914	**1203**

*Data on Adults, students and foreigners not available

**Average number of visitors per day for the six month period

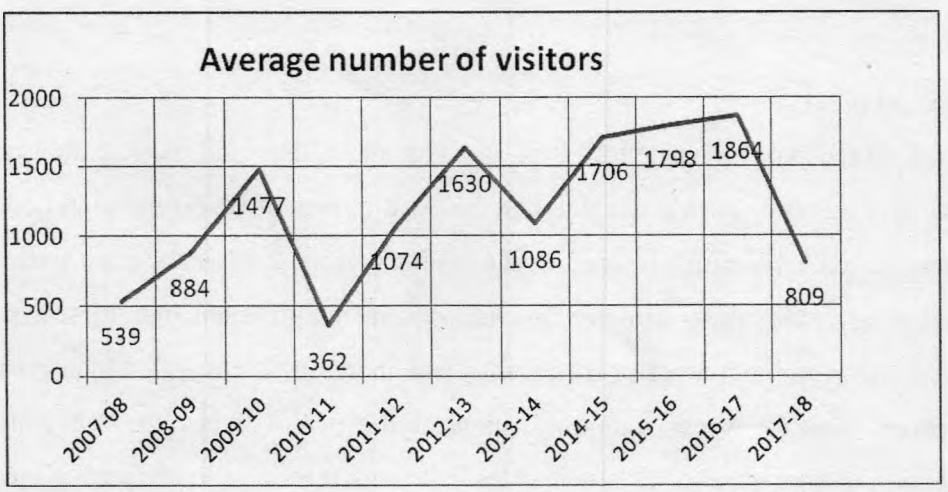


Figure 3. Average number of visitors in Kuruva per day in different years

6.2. Impacts of ecotourism

According to Patterson (2002), characteristics of an ecotourism should have a low impact on a protected areas; should involve stakeholders (individuals, communities, eco-tourists, tour operators and government institutions) in the planning, development, implementation and monitoring phases; should limit visit to areas, either by limiting group size and/or by the number of groups taken to an area in a season etc. If ecotourism is not maintained properly, it will lead to a major threat to biodiversity, natural habitats, disharmony among various stakeholders, livelihood of local residents, and misuse of natural resources.

Impacts of related ecotourism can be divided into (a) Impacts due to the presence of visitors and, generally, to their activities in the area and (b) Impacts due to the building infrastructural facilities for the production of goods and services for visitors in the nearby areas. Impacts due to ecotourism activities in the area can generate solid waste and waste waters. In the Kuruva, the visitors are allowed to carry only essential items which have been monitored by VSS members. So, the amount of solid waste generated from the site is negligible. As per the various Forest Acts, no new tourist facilities are to be constructed on the forest lands, so there are no lodging and toilet facilities in the ecotourism site, so generation of wastewater is also negligible. However, the following indirect impacts of ecotourism in Kuruva have been observed during the study:

- Trampling

  If the tourists use the same trail over and over again, they will trample the vegetation and soil, and thereby causing damage that can lead to loss of biodiversity and other impacts. Damage will be much more, if the visitors stray off established trails. Similarly, trampling could affect soil by loss of organic matter, reduction in soil porosity and decrease in air and water permeability and increase in run off which result in faster erosion. Due to excess trampling, parts of the turf will be removed which result in creation of bare ground. This in turn leads to colonization of less vigorous species.

- Injuries to root system of trees (due to floods & trampling) and hindering natural regeneration of trees in the walking path. Some impacts on vegetation could be breakage and bruising of stems, reduced plant vigour and regeneration and loss of vegetation ground cover and vegetation diversity.

- Disturbance to fauna

  The visitor movement may affect the movement of wild fauna including birds.

- Aiding spread of Invasive Alien Species

  The visitor will indirectly involve in spread of Invasive Alien Species. Some of the Invasive Alien species like *Mikania, Eupatorium* etc. can spread due to the disturbances.

However, a long term monitoring study covering all the physical and biological aspects of Kuruva need to be taken up for effective management of the site, and such studies can address the impacts of visitors on the ecotourism site also.

Impacts due to the building infrastructural facilities for the production of goods and services for visitors in the nearby areas were observed. The local inhabitants of Palvelicham have constructed several tourist facilities like restaurants, Souvenir shops, etc. The current land use and land cover in the study area is shown in Figure 4. Changes in Land use and land cover of the 10 km radius of Kuruva Island between 2006 and 2017 were assessed, and there were no changes in the extent of forest but changes in agriculture and plantation crops were observed (Figure 5). However, such changes in Land use and land cover in the study area could also be due to other developmental activities.

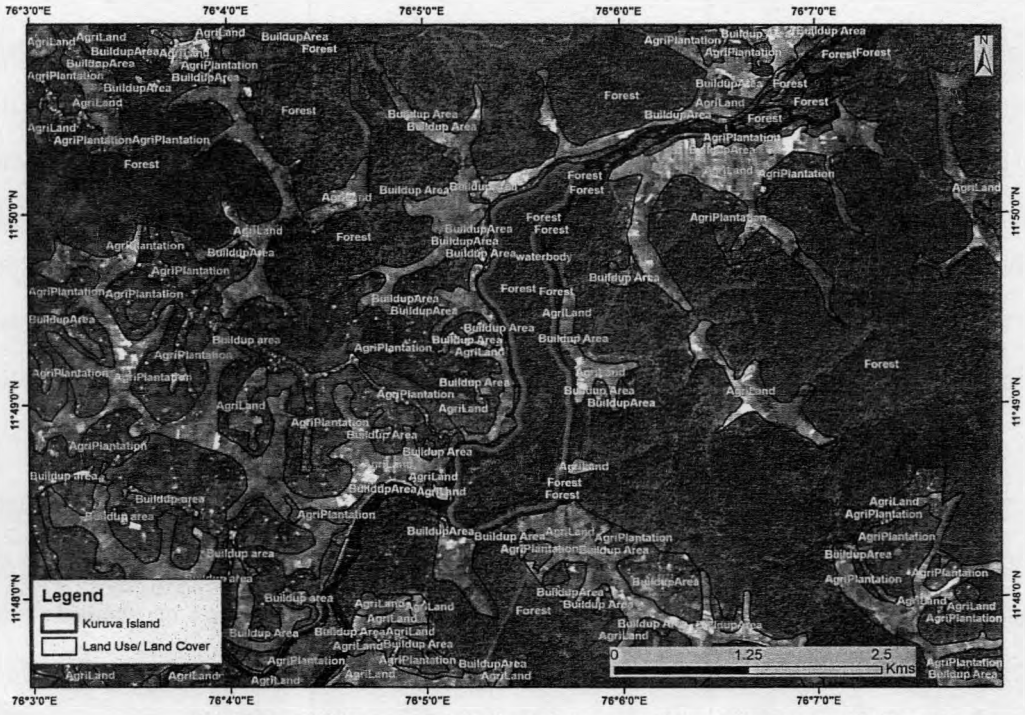
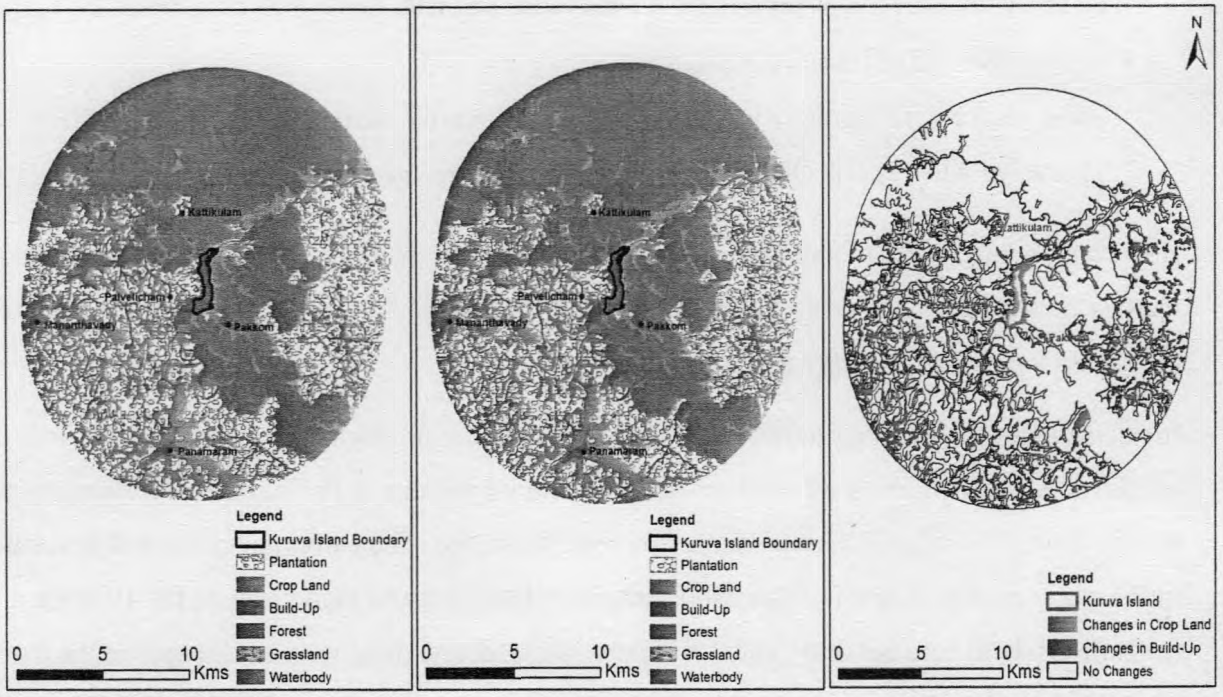


Figure 4. The present Land use and Land cover of the area



LULC 2006 LULC 2017 LULC Changes

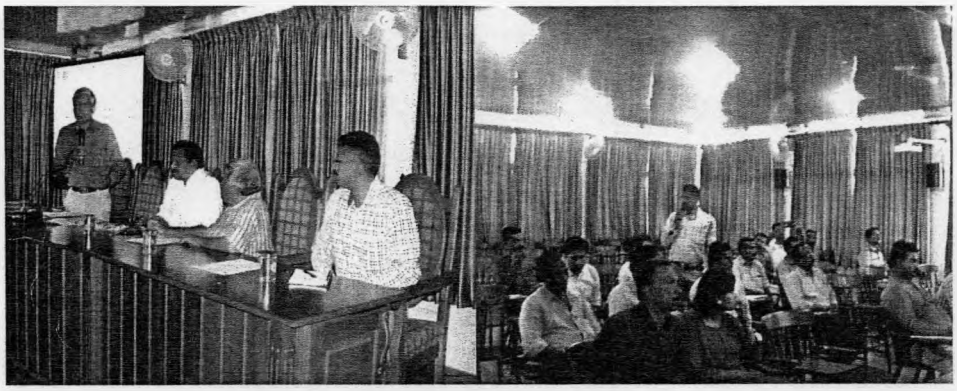
Figure 5. Land use and Land cover changes of the area between 2006 and 2017

6.3. Interactive meeting with stakeholders for assessment of Visitor Carrying Capacity

Interactive meeting with key stakeholders such as people's representatives, VSS members, Tourism Department officials and field staff of state forest department was conducted on 12th October, 2018 at Gaja Forest Inspection Bungalow, Sulthan Bathery for assessing the parameters and limiting factors for visitor carrying capacity study. A total of 23 persons attended the meeting which includes Honorable MLAs from Mananthavady and Kalpetta, DFO, South Wayanad Forest Division, DFO, North Wayanad Forest Division, Forest Range Officers, Officials from DTPC, Manager DMC, VSS members, NGOs and Field staff from Forest Department.

Participants have expressed their opinion on various issues like presence of rare/endangered flora, presence of rare/endangered birds, physical area required for a tourist, average time spent, waste management, local livelihood etc. During the discussion, deliberations were made about the limiting factors which can affect the ecotourism in Kuruva, other issues of ecotourism like waste disposal, environmental impact etc. number of field staff and VSS members,

infrastructural facilities, area available for parking on both sides and so on. Since the ecotourism activities of Kuruva Island are managed by Vana Samrakshana Samiti in association with the District Tourism Promotion Council, respective representatives had also opined about Kuruva (Picture 8). The proceeding of the interaction meeting with key stakeholders along with the list of participants of the interactive meeting is enclosed in Annexure - 4.



Picture 8. View of Interaction meeting with key stakeholders

6.4. Interaction meeting with Senior Forest officials

Apart from the interaction meeting with various stakeholders, a meeting with senior forest officials of state forest department was held on 24th October 2018 at Kerala Forest Head quarters, Trivandrum. A brief presentation on assessment of carrying capacity of Kuruva was presented. Shri. P.K. Kesavan, IFS, Principal Chief Conservator of Forests & Head of Forest Force, Shri.A.K. Dharni, IFS, Principal Chief Conservator of Forests (Vigilance), Shri. K. A. Mohammed Noushad, IFS, Principal Chief Conservator of Forests (WP&R), Shri. Bennichen Thomas, IFS, Principal Chief Conservator of Forests (Forest, Land and Resources) & Custodian of EFL, Shri.V.V. Shajimon, IFS, Addl. Principal Chief Conservator of Forests (FMIS), Shri. Rajan Sehgal, IFS, Addl. Principal Chief Conservator of Forests (Finance, Budget & Audit), Shri. S. Gopalakrishnan, IFS, Addl. Principal Chief Conservator of Forests (IHRD), and Smt.Padma Mahanti, IFS were present during the meeting. The issues related to physical area required by a visitor, the extent of various ecotourism sites and various limiting factors to be considered for assessing carrying capacity were discussed.

6.5.The assessment of Visitor Carrying Capacity (VCC) of Kuruva as per present study

Based on field visits to the area, informal discussion with local people and interaction meeting with key stakeholders, the parameters to be considered as limiting factors of ecotourism were identified and accordingly the visitor carrying capacity of Kuruva has been assessed. A stepwise assessment of effective visitor carrying capacity is given as:

a) Physical Carrying Capacity (PCC) as per the present study

The present study considered the following points for calculating the PCC:

Formula: $PCC = A/A_u \times R_f$

The total area allowed for ecotourism by the Forest Department (A)	= 5390 m^2
Physical area required by a visitor * (A_u)	= 1m^2
Total time open for ecotourism (9.00 am to 4.00 pm)	= 7 Hours
Average time spent by a visitor**	= 2 Hours 20 Minutes
Number of visits per day (R_f)	= 3 visits/day

*In the present study, the area required by a visitor is kept as 1m^2. Also conducted a review on similar studies on assessment of carrying capacity in other areas (Queiroz *et al.*, 2014; Wiyono *et al.*, 2018) and found that 1m^2 can be taken as the minimum area required by a tourist for nature walk. It may be mentioned that the earlier assessment of visitor carrying capacity of Kuruva calculated by the State Forest Department also considered 1m^2 as the minimum physical area required by a visitor.

**Presently the Kuruva Island is open for ecotourism activity from 9.00 am to 4.00 pm. It was informed that the above duration is followed presently mainly for the safety of the visitors and to avoid human - wildlife conflict. Thus, a total of 7 hours (420 minutes) is available for the ecotourism activity and the average time spent by a visitor has been taken as 2 hours (120 minutes) which means that a maximum of 3.5 visits can be made to the area in a day. However, orientation programme on the ecological values and significance of flora & fauna of Kuruva Island as well as the do's and don'ts of the ecotourism for about 20 minutes need to be organized in the Kuruva Island for each group of visitors to guide the visitor towards responsible and sustainable ecotourism. Hence, each visit will involve spending of 2 hours 20 minutes time. This will result in a maximum of 3 visits per day.

Hence, PCC = $5390m^2/1m^2$ x (420 minutes /140 minutes) = 16170
= 16,170 visitors / day

b) Real Carrying Capacity (RCC) as per the present study

Ecotourism activity in Kuruva is dependent on some limiting factors such as flooding in the area, vulnerability to soil erosion, presence of fauna, human-wildlife conflict etc. These variables have been considered as correction factors for this study to ensure minimum ecological impact, biodiversity conservation and safety of the visitors. This correction to the physical carrying capacity also helps in ensuring sustainable ecotourism for a given area. These, correction factors are also known as limiting factors of ecotourism as they limit the number of visitors entering the given area.

Calculation of correction factors for different limiting variables based on the field observation is described below:

(i) **Monsoon and floods in Kabini River**

During the South-West monsoon, the entire state of Kerala including the Kuruva Island witness high amount of rainfall. The high monsoon rainfall increases the water level in the river and its tributaries and it is not possible to the visit the area. So, the Kuruva Island is closed for about 6 months (generally May-June to October) depending upon the monsoon in a year for repair and maintenance of the area. Since the area is already closed during monsoon and flood time for ecotourism activity, it is not included as a limiting factor for the present study.

(ii) **Soil erosion**

Soil erosion which is the process of detachment, transportation and deposition of soil particles from land surface is mainly due to abiotic factors like water, wind and biotic factors like human beings and animals. The Kuruva Island is surrounded by Kabini River and it is prone to soil erosion. The recent excessive rainfall and floods also caused damage to the bamboo bridges, resting places and erosion of soils in Kuruva. The property of local people in the surrounding area also got damaged due to the floods and most of the agricultural areas are deposited with sand. The floods in the river cause soil erosion in Kuruva leading to exposure of roots of many tree species including some of the endangered tree species such as *Hopea ponga* and

Calophyllum apetalum. Such exposure of roots may affect the tree species adversely, and it can pose a threat to the visitor unless some management measures are taken. Further, the movements of higher number of visitors also aggravate the level soil erosion in Kuruva.

Discussion with expert from District soil conservation department revealed that the sandy loam soil in Kuruva ecotourism site is prone to erosion due to rainfall and erosion can be further aggravated by the movements of visitors. It was also informed that the slope category of the area is <5% and the present soil erosion is estimated to be 40% due to recent high rainfall and flood in the ecotourism site. However, it may be noted that amount of soil erosion may vary in different places in the area and in various years which may have to be monitored during different seasons/year. During the present study, the length of the nature trail affected due to soil erosion was studied (Picture 9) and found that 25% of the nature trail is affected due to soil erosion. Discussion with the VSS members revealed that this year the area experienced more flooding and inundation due to extreme rain events. In view of this observation and interaction a value of 25% has been taken as limiting factor on account of soil erosion.

Formula for limiting factor is $Cfx = 1 - Lm_x/Tm_x$,

- Cf_l = Correction factors of Soil erosion;
- Lm_x = Limiting magnitude of Soil erosion (25%)
- Tm_x = Total magnitude of Soil erosion (100%)

Hence, Correction factors of Soil erosion is $Cf_l = (1-25/100)$ **.....(1)**

Picture 9. Root system getting exposed due to soil erosion on the walking trail

(iii) **Elephant movement and Paddy Harvest**

Asian Elephant (*Elephas maximus*) movement has been reported throughout the year in the study area. It may be informed that it is an **'Endangered'** animal as per the IUCN red list (Choudhury *et al.,* 2008). Direct sighting and indirect evidences (Picture 10) for the movements of elephants have been collected from the Kuruva Island. The geographical coordinates of direct sighting and indirect evidences for elephants were also collected in the ecotourism zone of Kuruva with the help of GPS. The Kuruva Island falls in the traditional migratory route of the elephants which migrate from the Southeast Wayanad – Mudumalai - Bandipur complex to the northeast towards the Brahmagiri – Nagarahole - Kottiyoor forest complex. The ecotourism guides in the area ensured that no human-elephant conflict happened in ecotourism zone of the area by not allowing visitor to enter the area during elephant movement and sometime whole day elephants will be in the Kuruva Island so it will not be opened for visitors on that particular day.

Picture 10. Elephant dung inside the Kuruva Island

During the discussion with local people, it was reported that continuous presence of visitors in the Kuruva Island force the elephant to move towards adjacent Paddy growing areas in the nearby places which result in human-elephant conflict during Paddy harvesting time (November – December). The incidences of human-elephant conflict reported in Chedalath Range of South Wayanad Forest Division has been given in Annexure – 5 and the amount of compensation paid to the people due to human-animal conflict in South Wayanad Forest Division has been given in Annexure – 6. Hence, the movement of elephant in Kuruva and associated human –elephant conflict in adjacent areas is considered as a limiting factor.

The Elephant movement in Kuruva may be throughout the year but information from various resources reveal that it is more during March to May. Hence, elephant movement during this period (3 months) is taken as a limiting factor. In addition, the human – elephant conflict during the paddy harvesting season (45 days) in adjacent areas of Kuruva is also taken as a limiting factor.

Formula for limiting factor is $Cf_x = 1 - Lm_x/Tm_x$,

- Cf_2 = Correction factors of Elephant movement and Paddy Harvest;
- Elephant movement in the study area (3 months) and the human – elephant conflict during the paddy harvesting season (45 days) are considered as Limiting magnitude of the variable (Lmx) = 4.5 months
- Tmx = Total magnitude of variable (6 months visiting period of the site)

Hence, Correction factors for Elephant movement and Paddy Harvest is

$Cf_2 = 1-(4.5/6 \times 100) = 75\%$

$\mathbf{Cf_2 = (1-75/100)}$ ***.....(2)***

(iv) **Smooth-coated Otter (*Lutra perspicillata*)**

The Smooth-coated Otter is occurring in most of the Indian subcontinent and South East Asia. Indirect evidences for the presence of this species have been observed by the study team near the walking trail of Kuruva. The local people and the field staff of the area have sighted the species frequently in the area. The breeding time of the Otter in India is for about 5 months (August-December,) and it will be more sensitive around the birth of young ones. However, detailed studies on its population and their life history need to be studied for a longer duration in Kuruva to arrive at the exact duration of limiting period. The species currently reported as **'Vulnerable'** in the IUCN red list due to an inferred population decline because of habitat loss and exploitation (De Silva *et al.*, 2015).

In the present study, the first month of young ones of Otter is taken as a limiting factor for ecotourism

Formula for limiting factor is $Cfx = 1 - Lm_x/Tm_x$,

- Cf3 = Correction factors for young ones of Smooth-coated Otter
- The first month of young ones of Otter is taken as a limiting factor (Lm_x) = 1 month
- Tm_x = Total magnitude of variable (6 months visiting period of the site)

Hence, Correction factors for young ones of Otter is

$$Cf_3 = 1-(1/6 \times 100) = 16.6\%$$

$$\mathbf{Cf_3 = (1-16.6/100)} \qquad \text{.....(3)}$$

(v) **Mugger Crocodile (*Crocodylus palustris*)**

Mugger Crocodile (*Crocodylus palustris*) is primarily restricted to the Indian Sub-continent found in fresh water habitats. It is currently reported as **'Vulnerable'** in the IUCN red list (Da Silva and Lenin, 2010). Mugger crocodile has been sighted during the field visit of the study in Kuruva and the local people have informed that during flood time it was found in nearby agricultural areas also. The population status and nesting ecology of Mugger Crocodile in Kuruva Island has been studied by Sophia (2016). The said study has reported that the population size of Crocodile in the area is 45 individuals and breeding activities of Crocodile were observed during March to May. Mugger crocodiles are known to conflict with humans and cattle resulting in injuries and sometime death. However, in Kuruva island, only minor incidents of such negative interaction with Crocodile have been reported by Sophia (2016). Jayson and Padmanaban (2002) have reported Human – Mugger conflict in Neyyar reservoir of Kerala. As per the said study, the breeding activities of Mugger is reported during March to May, during which the animal is sensitive, and it can cause negative interaction especially around the bathing area and other parts of river banks.

In view of the above observations and support from the existing studies, three months of breeding time (March to May) of Mugger is considered as a limiting factor for ecotourism.

Formula for limiting factor is $Cfx = 1 - Lm_x/Tm_x$,

- Cf4 = Correction factors for Mugger crocodile breeding time

- Three months of breeding time (March to May) of Mugger is considered as a limiting factor for ecotourism (Lm_x) = 3 months
- Tm_x = Total magnitude of variable (6 months visiting period of the site)

Hence, Correction factors for young ones of Otter is

$$Cf_4 = 1\text{-}(3/6 \times 100) = 50\%$$

$$\mathbf{Cf_4 = (1\text{-}50/100)} \qquad \mathbf{.....(4)}$$

(vi) **Forest fire**

The occurrence of fire could be one of the limiting factors in any ecotourism site. However, as per the records of the forest department, the incident of fire was observed only once on 14th March 2011 during the last many years in Kuruva which affected 1.5 ha of the area. Since the fire in this area is rare, and has occurred only once during the last many years, it is not being considered as a limiting factor.

(vii) **Reported incidence of presence of Tiger**

Tiger (*Panthera tigris*) is an **'Endangered'** animal species as per the IUCN red list category (Goodrich *et al.,* 2015). The presence of Tiger has not been reported inside the Kuruva except once where the DFO, South Wayanad Forest Division has reported the pug marks of Tiger near a carcass of an Elephant on 30th December 2016. However, the presence of animal has not been reported afterwards in the area and it might have come to the Kuruva Island in search of prey from other forest areas. Matter was discussed with field staff during stakeholder interaction meeting held on 12th and meeting with PCCF & HoFF and other senior officials of KFD held on 24th October 2018, respectively and it has been decided not to consider just one incident as a limiting factor.

Detailed study in Kuruva during different seasons using camera traps may provide evidences for the presence of other wild animals including nocturnal species. If any such evidences for the presence of other animal are collected, the same may be evaluated for considering as a limiting factor, in future.

So, Real carrying capacity is calculated as

$$RCC = PCC \times (Cf_1 \times Cf_2 \times Cf_3 \times Cf_4 \times - - - Cf_n)$$

$$PCC = 16170$$

$$Cf_1 = (1\text{-}25/100) \text{ .....(1)}$$

$Cf_2 = (1\text{-}75/100)$ .....(2)
$Cf_3 = (1\text{-}16.6/100)$ ...(3)
$Cf_4 = (1\text{-}50/100)$.....(4)

On substituting the values of correction factors as mentioned above the Real Carrying Capacity is calculated as

RCC = 16170 x (1-25/100) x (1-75/100) x (1-16.6/100) x (1-50/100)

Hence Real Carrying Capacity of the area = 1264 visitors/day

c) Effective Carrying Capacity (ECC)

The effective carrying capacity is the maximum number of visitors that should be allowed according to the capacity of the regulatory agency to manage them in the area. The Management Capacity (Mc) is defined as the sum of conditions that the Protected Area administration requires if it is to carry out its functions at the optimum level. Limitations in management like lack of staff, fund availability and infrastructure limit the real carrying capacity of an area. Hence, measuring management capacity involves assigning value to variables like infrastructural facilities, amenities, staff (both number and competency), available budget, legislation and commitment.

The following variables were taken into consideration for calculating Management Capacity:-

(i) **Manpower**

The DFO South Wayanad Forest Division informed that Kuruva Island comes under the administrative control of Pulpally Forest Station of Chedalath Forest Range and there is shortage of field manpower in the Range. The DFO further informed that the existing field staff also has to be deployed for pressing issue like human-wildlife conflict, fire management, protection, etc. The sanctioned staff for the Range is 64 which include 57 field staff and 7 ministerial staff. Of the 57 field staff sanctioned, only 47 incumbent are in position and the remaining 4 are on leave / training/Leave without allowance (LWA). Considering this, the management capacity of Chedelath Range for field activities works out to be 0.82 (47 in position / 57 sanctioned) (Annexure 3). However, the Mc of Pulpally Forest Station of Chedelath Range which manages the Kuruva needs to be calculated as per the sanctioned strength and actual staff in position. The

staff sanctioned for Pulpally forest station is 26 and against which 24 number of staff are in position.

Hence, Mc = 0.92 (24 staff in position / 26 staff sanctioned)

Further, in addition to the sanctioned field staff, VSS members assist the ecotourism activities in Kuruva. Currently, the section forest officer who is the VSS secretary manages the ecotourism along with 39 VSS members who act as tourist guides. VSS members monitor the tourists from the entry point of Kuruva Island till completion of the visit and guide the visitors in ecotourism and ensure safety of the visitors.

(ii) **Maintenance of ecotourism zone**

The ecotourism site is closed for six months during monsoon season and most of the management activities like repair of bamboo bridges, maintenance of nature walk, repair of bamboo rafts etc. are carried out before opening of ecotourism zone during November month.

(iii)**Bamboo Raft**

The bamboo rafts in both the side of entry point are available to ferry the visitors to the Kuruva Island. The members of VSS reported that about 15-20 minutes are required for the transport of visitors to the site and back for a raft and so far it has not limited the eco-tourism. They also reported that the bamboo rafts and safety jackets are maintained and sufficient funds are available for the same.

(iv)**Parking area**

Presently, all the visitors' vehicles are allowed to park in parking area available in both the entry points and visitors are taken to the eco-tourism site by bamboo rafts. However, the existing parking area may not be sufficient for peak days such as holidays and weekends. The maximum number of vehicles that can be parked at the two entry points have been calculated as per Jangra and Kaushik (2017) based on Indian Roads Congress (IRC) norms which shows that at Pakkom entry point 120 Cars/Taxis can be parked whereas at Palvelicham entry point, a total of 71 Cars/Taxis can be parked. This necessitates that the existing parking areas at both the entry points may not be sufficient requiring additional parking areas during peak days. To ensure smooth and steady flow of traffic on the road, parking on road sides obstructing the traffic needs to be discouraged, use of private vehicles may be discouraged and public transport may be encouraged.

(v) **Toilet facilities**

Limited numbers of toilets are available on either side for the visitors to make use of it. As such, it doesn't pose any hindrance in arrival of visitors to the island. But during peak period more such facilities are required.

(vi)**Solid waste management**

The visitors are allowed in ecotourism zone only with essential materials and plastic materials are not allowed in the Kuruva. The visitors carrying water bottle with them have to pay a security amount and the water bottles are tagged and recorded so that while returning, the tourists can handover the tagged plastic bottles and get refund their security amount. So, solid waste management is not the issue in ecotourism zone.

Considering all the above parameters, the present management capacity of area is limited due to shortage of field manpower and limited infrastructure and it can limit the ecotourism. Hence, taking into account the available field staff (Annexure 3) of Pulpally Forest Station, Mc is calculated as follows :

Mc = 24 field staff in position/26 field staff sanctioned

Mc = 0.92

ECC = RCC x Mc

1264 x 0.92 = 1163

Table 5. Effective Carrying capacity

Available area of Kuruva Island (m^2)	Area required / tourist (m^2)	Rotation factor	Physical Carrying Capacity (PCC)	Real Carrying Capacity (RCC)	Effective Carrying Capacity (ECC)
		Daily open period / average time of visit (hrs)	(Visitors/Day)	(Visitors/Day)	(Visitors/Day)
5390.00	1.00	3	16,170	1264	1163

= say 1150 visitors / day

Hence, an Effective Carrying Capacity of 1150 numbers of daily visits can be recommended.

6.6. Various scenario of Visitor Carrying Capacity

The present study assessed the Visitor Carrying Capacity considering $1m^2$ physical area is required by a visitor during the nature trail. However, the present value of physical carrying capacity will change if more physical area per visitor is required in future. Further, it may be noted that area required by a visitor/ tourist for taking bath in the river may exceed $1m^2$. Likewise, it will also be different for tourists on the beach site where they may swim, surf or relax. Accordingly the time taken for visits will also vary. One can understand the impact of these variables on the Physical Carrying Capacity which is calculated and shown in tabular form for the study area (Annexure 8).

6.7. Limitations of the study

The perception of visitor / tourist regarding physical area required and time duration to be spent for various ecotourism activities may also be taken into consideration for assessing the physical carrying capacity of the area. In the present study such views of visitor could not be considered due to the prevailing off-season and closure of the ecotourism site during the short study period. Similarly the impacts of ecotourism activities in the area require dedicated studies to ascertain role of different correction factors. As per the principles of ecotourism, the ecotourism activities in Kuruva should be low-impact, educational, and conserves the environment while directly benefiting the economic development of local communities. The role of VSS members and the forest department field staff in educating the visitors about the ecological significance of Kuruva and the responses of the visitors for forest conservation etc. could not be ascertained due to the limited study time.

6.8. Recommendations of the study

Based on the present study, the following recommendations are made:

1. The impacts of ecotourism on flora and fauna, soil, river system etc. need to be studied long term for better estimation of carrying capacity of Pakkom – Kuruva ecotourism site.
2. The tourists who visit the Kuruva Island may be encouraged to associate with the conservation efforts of the management.
3. Education, natural and cultural interpretations are the most important objectives for the Ecotourism activity. Experienced and trained guides, naturalists, interpreters etc. may be engaged to educate the tourists about the ecosystem and biodiversity conservation. An

audio-visual interpretation centre may be established at the entrance to provide interpretation and awareness to the tourists.

4. The VSS members associated with the destination may be well trained and educated about the significance of biodiversity conservation. They must be able to guide the tourists towards responsible and sustainable tourism.
5. The local community participation needs to be ensured at all levels.
6. To avoid human-wildlife conflict in the area regular precautionary measures needs to be taken by the Forest and Wildlife Department by involving other stakeholders especially the VSS members.
7. Public transport facilities to the ecotourism site may be encouraged and new parking area for the tourist vehicles may be developed towards Pakkom side near the main road. This will reduce ecological impacts due to the private vehicles going upto the ticket counter. In addition, this will also provide livelihood opportunity to the local community.
8. To carry out maintenance activity, the ecotourism site may be closed for ecotourism activities once in a fortnight, preferably on Mondays.
9. The visitor carrying capacity of the ecotourism site may be reviewed on a yearly basis. The review may be based on the new limiting factors identified, change in the limiting magnitude of existing limiting factors such as soil erosion, breeding time of fauna, etc. A rapid impact assessment of ecotourism site may also be carried out on yearly basis to ascertain sustainable ecotourism.

7. Conclusion

In any protected area, the PCC, RCC & ECC varies according to the environmental conditions, as well as the management capacity of the area. The visitor carrying capacity estimated based on the selected limiting factors can be used to take administrative decisions to regulate the number of visitors per day to the Kuruva Island. Based on the outcome of the study, it may be concluded that the number of visitors entering the area was high for the years 2014-15 to 2016-17 and it has been well within the limits of carrying capacity for the last year, i.e. 2017-18. As per the present study, wherein the area available to the ecotourist in Kuruva Island was taken as 5390 m^2 and the calculated Physical Carrying Capacity of 16,170 numbers was subjected to limiting factors of soil erosion, elephant movement and human – elephant conflict, Mugger crocodile breeding time, Otter breeding time and management capacity of Forest Department and Effective Carrying

Capacity of 1163 has been estimated. Hence, it is recommended that a total of 1100 to 1150 visitors may be allowed to visit the island on daily basis during the season when the park is open for the visitors.

8. References

Alison Allcock (1994). The National Ecotourism Strategy, Canberra: Commonwealth Dept. of Tourism, Australia.

Aneesh, E. M., Thasia, C., and Laksmi, H. (2014). Diversity and vectorial capacity of mosquitoes in Kuruva Island, Wayanad District, Kerala, India. *Journal of Zoology Studies*, *1*(4), 16-22.

Aref F., Gill S.S. and Farshid A. (2010). Tourism development in local communities: As a community development, approach. *Journal of American Science*, 6:155 – 161.

Aswathy M.J, (2016). A study on growth of tourism industry in Kerala and need for sustainable tourism development. *International Research Journal of Multidisciplinary Studies*, Vol. 2(3), 1-12.

Badusha, N. (2018). Move to ease visitor curbs at Kuruva islands decried, *The Times of India*, 6th March, 2018.

Bijith George Abraham, (2015). Community participation in Ecotourism: An inclusive development option for Kerala. Ph.D Thesis submitted to Cochin University of Science and Technology, Kochi.

Binoy, T. A., (2017). An Evaluative Study on Kuruva Island in Wayanad, Kerala. *Atna-Journal of Tourism Studies,* Vol. 12, No. 1, 65-83.

Boo, E. (1991). "Ecotourism: A tool for Conservation and Development", *Ecotourism and Resource Conservation: a collection of papers*, 1, 54-60.

Castellani, V. S. Sala and D. Pitea (2007). A new method for tourism carrying capacity assessment, *WIT transactions on Ecosystems and sustainable development*, Vol.106: 365 - 374 (ISSN 1743-3541).

Choudhury, A., Lahiri Choudhury, D.K., Desai, A., Duckworth, J.W., Easa, P.S., Johnsingh, A.J.T., Fernando, P., Hedges, S., Gunawardena, M., Kurt, F., Karanth, U., Lister, A., Menon, V., Riddle, H., Rübel, A. and Wikramanayake, E. (IUCN SSC Asian Elephant Specialist Group) (2008). *Elephas maximus*. *The IUCN Red List of Threatened Species* 2008: http://dx.doi.org/10.2305/IUCN.UK.2008.RLTS. T7140A12828813.en.

Cifuentes, M.A., (1992). Determinación de capacidad de carga turística en areas protegidas. Biblioteca Orton IICA/CATIE, Costa Rica.

Cifuentes, M.A., Mesquita, C.A.B., Méndez, J., Morales, M.E., Aguilar, N. and Cancino, D., (1999). Capacidad de carga turística de las áreas de Uso Público del Monumento Nacional Guayabo, Costa Rica. WWF Centro America, Costa Rica.

Da Silva, A. and Lenin Janaki (2010). Mugger Crocodile Crocodylus palustris Pp. 94-98 in Crocodiles, Status Survey and Conservation Action Plan. Third Edition, ed. by S.C. Manolis and C. Stevenson. Crocodile Specialist Group: Darwin.

De Silva, P., Khan, W.A., Kanchanasaka, B., Reza Lubis, I., Feeroz, M.M. & Al-Sheikhly, O.F. (2015). *Lutrogale perspicillata*. The IUCN Red List of Threatened Species 2015: e.T12427A21934884.http://dx.doi.org/10.2305/IUCN.UK.20152.RLTS.T12427A21934884.

Goodrich, J., Lynam, A., Miquelle, D., Wibisono, H., Kawanishi, K., Pattanavibool, A., Htun, S., Tempa, T., Karki, J., Jhala, Y. and Karanth, U. 2015. *Panthera tigris. The IUCN Red List of Threatened Species 2015*: e.T15955A50659951. http://dx.doi.org/10.2305/IUCN.UK.2015-2.RLTS.T15955A50659951.en.

Haider-e-Karrar, (2014). "Scope of ecotourism in Kerala" – A geographical analysis, Scholarly *Research Journal for Interdisciplinary Studies* (ISSN 2278-8808).

Jangra, Ravinder and Kaushik, S.P. (2017) "Assessment of Physical Carrying Capacity for Managing Sustainability at Religious Tourist Destinations," International Journal of Religious Tourism and Pilgrimage: Vol. 5: Iss. 1, Article 5.

Jayson and Padmanabhan (2002). Evaluation of the problems of captive/natural population of crocodiles in Neyyar Wildlife Sanctuary and suggestions for their management with special emphasis on reduction of human - animal conflict, Kerala Forest Research Institute Peechi-680 653, Kerala, India.

Josef Zelenka and Jaroslav Kacetl (2014): The concept of Carrying Capacity in Tourism. *Amfiteatru Economic*, 16(36), 641-654, ISSN 1582 – 9146.

Lascurain, H. (1987). The future of 'Ecotourism'. *Mexico Journal* 13-14.

Liliane, P. (2012), "Towards Sustainable Ecotourism through Stakeholder Collaborations in Tanzania", *Journal of Tourism Research & Hospitality*.

Lindberg Kreg and Mccool Stephen F. (1997). A critique of environmental carrying capacity as a means of managing the effects of tourism development. *Environmental Conservation* Volume 25, Issue 4, pp. 291-292.

Munar, F.X.R., (2002). Análisis de capacidad de carga en los espacios litorales, calas e playas, situados en áreas naturales de especial interés de la Isla de Menorca. Universidad de Almería, Spain.

Nashwa F. Attallah (2015). Tourism Studies Department, Faculty of Tourism and Hotels, Alexandria University. The estimation of physical and real carrying capacity with application on Egypt's tourist sites (Egyptian Museum and Saint Katherine Protected Area).

Nghi, T., Lan, N.T., Thai, N.D., Mai, D. and Thanh, D.X., (2007). Tourism carrying capacity assessment for Phong Nha-Ke Bang and Dong Hoi, Quang Binh Province. *VNU Journal of Science, Earth Sciences* 23, 80 -87.

Queiroz Rose Emília, Maria Anunciação Ventura, José Angelo Guerreiro and Regina Tristão da Cunha (2014). Carrying capacity of hiking trails in Natura 2000 sites: a case study from North Atlantic Islands (Azores, Portugal), *Journal of Integrated Coastal Zone Management* 14(2):233-242.

Safna, K.M. (2006).The preliminary investigation on the flowering plants diversity of Kuruva Island, Wayanad district (MSc. Dissertation), University of Calicut, Kerala.

Sasidharan, N. and Chacko, K.C. (1987). A note on the Kuruva Reserved Forest, *Evergreen* Trichur (19): 24-28.

Shilpa K Satheesan (2016). A study on host species preference of fig-wasps in south Wayanad forest division. M.Sc. Thesis, Kerala Veterinary and animal science university, Pookode, Wayanad.

Sophia Joseph, V. (2016). Population status and nesting ecology of Mugger Crocodiles (*Crocodylus palustris*. Lesson, 1831) in Kuruva Island, Wayanad, Kerala (MSc. dissertation), Kerala Veterinary and animal science university, Pookode, Wayanad.

Swagata Bera, Dipanjan Das Majumdar and Ashis Kumar Paul (2015). Estimation of Tourism Carrying Capacity for Neil Island, South Andaman, India. *Journal of Coastal Sciences*, Volume 2 Issue No. 2 - 2015 Pages 46-53.

The International Ecotourism Society (TIES), 1990, Washington, DC, USA.

Tickell, C, (1994). Foreword, "In Carter, E & Lowman, G, Ecotourism: A sustainable option?" Chichester, pp. ix-x.

Tselentis (2011). Tourism carrying capacity assessment and environment: the case of Crete, *WIT transactions on Ecosystems and sustainable development*, Vol.144 (ISSN 1743-3541).

Vidyasagaran, K., Pramod, G.K. and Gopikumar, K. (2001). Ecological studies in a highland riverine island forest ecosystem of Kuruva, Wayanad. Tropical forestry research: challenges in the new millennium *Proceedings of the International Symposium*, Peechi, India, 2-4 August, 2000: 50-55.

Viñals M. J., I. Martínez, A. Abdennadher and L. Teruel, (2014). A recreational carrying capacity assessment of the 16th century Spanish Fort of Santiago on the Island of Chikly, Tunisia.

Wiyono K H, Muntasib and Yulianda F (2018). Carrying capacity of Peucang Island for ecotourism management in Ujung Kulon National Park, *IOP Conf. Series: Earth and Environmental Science* 149: 1-11.

Zacarias, D.A., Williams. A.T. and Newton, A., (2011). Recreation carrying capacity estimations to support beach management at Praia de Faro, Portugal. *Applied Geography* 31, 1075-1081.

Annexure –1

ANIRUD KUMAR DHARNI IFS

PRINCIPAL CHIEF CONSERVATOR OF FORESTS (FOREST MANAGEMENT)

Mob-No.9447979004

Vana Lekshmi
Forest Headquarters,
Thiruvananthapuram
Pin -695 014
Ph- 0471 2529210

pccf-d.for@kerala.gov.in

No. PCCF-FM/2018

Dated: 18/06.2018

To

Dr. Mohit Gera
Director,
IFGTB,
Coimbatore

Sir,

Sub:- Research proposals submitted by IFGTB

Ref:- Your E-mail dated 14.06.2018

We have received 7 project proposals from IFGTB that will be processed shortly. However, the following research proposals are of immediate concern to us and I request you to inform whether they can be taken up urgently.

1. **Visitor Carrying capacity study of Eco tourism site- Kuruva Island**. A separate note is attached to give the location details of the site and the issue involved. The study can be completed within 1 month by relying on past data about the foot falls. It is expected that the cost of the study should be about Rs.2 lakhs.

Dr. Rajasekaran

2. **Master plan for mitigation of Man Animal Conflict**

   Kerala is having frequent Man Animal Conflict especially with reference to wild elephants. An expert committee recommended a master plan covering site specific, socially acceptable and scientifically sound human wildlife conflict mitigation plan for all forest areas. The plan should consider the intensity of conflict in each area, the animal involved, the mitigation measures

in place and their effectiveness. It would also address relocation of human habitation from protected areas, land use /cropping pattern and securing corridors of elephants and other wildlife.

3. **Wood balance study in Kerala.**

There are nearly 9000 wood processing units in Kerala. Kerala Forest Department wishes to understand the supply and demand of various timber species, total consumption of various types of wood by different wood based industrial units, surplus/deficiency of various timber species etc..

While the third study can be taken up leisurely, the first two are to be conducted urgently. Please let me know the willingness of IFGTB in this regard.

Yours faithfully,

Sd/-

ANIRUD KUMAR DHARNI

Encl:

1. Note on Kuruva Island
2. Note on Maser Plan for mitigation of Man animal conflict.
3. Note on Wood balance study.

Note on Kuruva Island

Kuruva Island is a cluster of 64 islets in fresh water, which is situated in the Chedalathu Range of South Wayanad Forest Division. The islets are in the Kabani River which is the important tributary of river Kaveri. The total area of the islets comes to 146.3 Ha. This is one of the most crucial wildlife corridors and the traditional migratory path of the Asian Elephants which migrate from the South-East Wayanad to Muthumalai - Bandhipur and also to the North-East towards Brahamagiri, Nagaragolai and Kottiyoor forests. The Pakkom-Kuruva eco-tourism site is part of the above said islands which is having an approximate area of 20 Ha. The area can be accessed from Pakkom-Kuruva and Palvelicham for the tourists. There are two ticket counters for entering into the eco tourism area. The ticket counter at Palvelicham is operated by DTPC and the counter at Pakkom- Kuruva is operated by the Pakkom-Kuruva VSS. The eco tourists coming from the area enter into the forest area by crossing the Kabani River on rafts. The average annual number of visitors in Kuruva is about 2.5 lakhs. This is actually too heavy and we doubt it is beyond carrying capacity. The site is open only for six months in a year when the flood level in the Kabani River is low. Hence it is absolutely necessary to access the carrying capacity of the area after proper scientific study.

Annexure –2

A.K.DHARNI IFS
PRINCIPAL CHIEF CONSERVATOR OF FORESTS
(FOREST MANAGEMENT)

FOREST HEADQUARTERS
THIRUVANANTHAPURAM
KERALA - 695 014
Phone: Off : 0471 - 2321994
0471 - 2529210
Fax : 0471 - 2337022
Mobile :9447979004
e-mail : pccf-d.for@kerala.gov.in

E&TW3-765/17 Dated 23..06..2018

To

The Director,
Institute of Forest Genetics and Tree Breeding (IFGTB)
Coimbatore, Tamil Nadu.

Sir,

Sub: Assessment of Carrying Capacity in Ecotourism sites of Kerala - reg.
Ref: Your proposal for conducting carrying capacity study in Pakkam - Kuruva Ecotourism site.

The proposal submitted from your office by Dr.A.Rajasekharan as Principal Investigator for assessing the carrying capacity of Pakkam - Kuruva Ecotourism site in South Wynad Division is acceptable to the department with slight modification in the budget provided by you as below.

1.	Procurement of maps etc.	-	0.30 lakhs
2.	Salary to Project fellow	-	0.42 lakhs
3.	Consumables	-	0.35 lakhs
4.	Travel expense	-	0.60 lakhs
5.	Contingencies	-	0.25 lakhs
	Sub Total	-	1.92 lakhs
	Overheads (15%)	-	0.288 lakhs
	Total	-	**2.208 lakhs**

The study involves

(i) Evaluating the present level of ecotourism activities in the site.

(ii) Interacting with different stake holders in site by organising Workshops/seminars/meetings etc with VSS, Peoples' representatives, staff etc. for assessing the parameters and limiting factors for carrying capacity study.

(iii) Estimation of carrying capacity, keeping in consideration the draft guidelines and the formula provided in the Ministry of Environment & Forests' Guidelines for Eco Tourism in and around Protected Areas (2nd June, 2011). The report shall, inter alia, provide the parameter value for each limiting factor and the situations / time horizon, on the occurrence of which the calculations would require to be re calibrated. The report shall finally arrive at effective permissible carrying capacity for each and every set of eco tourism activity carried out, and should appropriately resolve overlaps between / among activities. Entire gamut of activities - safaris, trekkings, night halts, boatings, etc. if applicable will be covered within the scope of this study.

The outcome of the carrying capacity study should be

(i) A preliminary report for carrying capacity assessment, will be given within a period of two months, covering the basic aspects (like present status of utilisation such as over/under/optimal utilisation, vis-a-vis ecological health of the area, Present annual footfall and its impact on ecotourism sites) as well as the corrective factors identified for calculating real carrying capacity, etc.

(ii) The final report should be submitted within 3 months from the date of undertaking the activities.

If the above conditions are acceptable, please take up the study so that the same can be completed within the time proposed by you.

Yours faithfully,

Principal Chief Conservator of Forests
(Forest Management)

Annexure –3

Information on Kuruva received from DFO, South Wayanad Forest Division

1) **Split up area**

A) DTPC Changadakkadavu to Forest track path – 300mx3m =900 m^2

B) Pakkom Changadakkadavu to Parakkoottam – 900mx3m = 2700 m^2

C) Parakkoottam to Resting place limit – 100mx5m = 500 m^2

D) Bathing area in the river –50m x 20m =1000 m^2

E) Small islets –

1) 25 m x4.4m = 110 m^2
2) 30mx6m= 180 m2

2) **Details of Fire incidents**

Sl No	Date	Area	GPS	Govt. loss
1	14.3.2011	1.5 Ha	N11^{0}48'364'' N76^{0}06'043''	Nil

3) **Report on sighting of tiger**

Pugmarks of tiger were seen near the carcass of an Elephant inside Kuruva on 30.12.2016.

4) **Details of human - wildlife conflicts (Elephant, Tiger, Leopard, Mugger, Otter etc.) and compensation paid if any for last 10 years exclusively for Kuruva Island.**
Nil

5) **No of sanctioned and available field staff of Forest Department posted**

Staff strength in Chedelath Forest Range, South Wayanad Forest Division

Sl No	Designation	Sanctioned	Present	Vacancy	Remarks
1	Range Forest Officer	1	1	Nil	
2	Deputy Range Forest Officer	3	3	Nil	
3	Section Forest Officer	9	9	Nil	
4	Beat Forest Officer	27	19	8	Vacant -6 LWA -1

					Training -1
5	Tribal watcher	16	14	2	authorized absent -2
6	Forest watcher	1	1	Nil	
7	Clerk	3	3	Nil	
8	Driver	3	1	2	
9	OA Cum PTS	1	1	Nil	
		64	**52**	**12**	

Staff strength in Pulpally Forest Station, South Wayanad Forest Division

Sl No	Designation	Sanctioned	Present	Vacancy
1	Deputy Range Forest Officer	1	1	0
2	Section Forest Officer	4	4	0
3	Beat Forest Officer	12	10	2
4	Tribal watcher	8	8	0
5	Forest watcher	1	1	0
		26	**24**	**2**

6) **No of VSS members involved in Tourism activity**
39 Nos (Tourism Guides)

7) **Foot fall of Visitors to Kuruva**

Year	Total visitors	Monthly Average
2007-08	97091	12136
2008-09	159070	19884
2009-10	265911	33239
2010-11	65233	8154
2011-12	193337	24167
2012-13	293398	36675
2013-14	195462	24433
2014-15	307020	38378
2015-16	323644	40456
2016-17	335488	41936
2017-18	145565	56400

Hereby submitting the above details for favour information and further proceedings.

Chief Executive Officer
South Wayanad FDA

E:\Sunitha\FDA\2018\Pakkom\Eng\B3-6298.08 dated 31.10.2018 Pakkom.docx

Annexure – 4

Proceeding of the interactive meeting with key stakeholders for assessment of Visitor Carrying Capacity

An interactive meeting with key stakeholders such as people's representatives, VSS members, Tourism Department officials and field staff of state forest department was conducted on 12th October, 2018 at Gaja Forest Inspection Bungalow, Sulthan Bathery for assessing the parameters and limiting factors for visitor carrying capacity study. A total of 23 persons attended the meeting.

The interaction meeting started with formal introduction of participants. Dr. C. Kunhikannan, Scientist-F and Head, Forest Ecology and Climate Change Division, IFGTB, Coimbatore welcomed the participants. After the welcome address, a brief overview of the assessment of visitor carrying capacity, Kuruva Island was given by Dr A. Rajasekaran, Scientist-E, IFGTB, Coimbatore. After the presentation, all the participants were given time to share their views on assessment of visitor carrying capacity.

During the interaction Honourbale Sh. Kelu, O.R. MLA - Mananthavady informed that the recent flood in the district has caused extensive damage to agricultural lands which affected the livelihood of the local people. Keeping in view of the livelihood of the local people and VSS members, all the required facilities for allowing more number of visitors to Kuruva should be improved. Further, he also pointed out that the impacts due to more number of visitors in Kuruva are negligible.

Honourable MLA further added that Forest Department had already put lots of restriction like closure of the site during monsoon, summer (fire season), whenever elephants present in that area etc. Further he mentioned that so far no Human-Wildlife conflict happened inside the Kuruva and no negative impacts on plants, animals and soil reported from the area. Keeping in view of the above, the number of visitors should not be reduced. He also mentioned that the Human – wildlife conflict is increasing due to increasing population of wild animals. The study should look into all the aspects and a balanced stand need to be taken up.

Honourbale Sh. Sasindran C. K., MLA – Kalpetta informed that the carrying capacity study based on existing guidelines need to be undertaken and a suitable decision to be taken up safeguarding the interest of both local people and environment. The study should also look into the number of visitors in the earlier years and accordingly the number of visitors in the area

needs to be increased. He added that in the present situation of Wayanad after the flood, tourism is the only solution. Thus, it has to be fixed as 3000 visitors per day and study the impact after allowing 3000 people per day.

Mr. Radhakrishnan K. N., The Deputy Director, Department of tourism, Civil Station, Kalpetta, Wayanad informed that already needed restrictions were taken to maintain Kuruva as ecotourism centre and no commercial activities are allowed inside and all the rules and regulations of ecotourism will be followed and so far no negative impacts were noticed in the area. Necessary accommodation and parking facilities will be improved in Palvelicham area.

Mr. Vijayan K., President, Pakkom-Kuruva VSS informed that the number of visitors to Kuruva should not be increased to 1050 numbers as mentioned by honourable MLA, but a reasonable number i.e 1050 to be retained.

Mr. Anand B., Secretary – DTPC Wayanad, Kalpetta mentioned that as per the existing guidelines 15% of total 146.3 ha of Kuruva can be permitted for ecotourism. He also mentioned that actually people visit 8 hours during a day and more number of limiting factors should not be added. He added that the area is being closed for about 153 days due to flood and the period of closure should be reduced to 3 months. He also mentioned that all necessary precaution is being taken to reduce solid waste and the tourist were involved in tree plantation activities.

Mr. Johny Mattathilani from Mattathilanickel emphasized that the tourist visit the area for enjoying the beauty of the environment and we need to protect the same. Considering the reduction in forest cover of the state, the Kuruva Island need to be conserved, which also have some threatened orchids. So, he questioned about the increase of visitor carrying capacity.

Mr Sugathan K., Chairman, Kuruva Samsashana Samithi emphasized that it is the responsibility of the people to conserve the Kuruva. Earlier people were allowed to go up to swamp areas in the Island and now ecotourism is allowed only inside the fenced areas. The visitors follow all the rules and regulations of the ecotourism and there is cooperation between DMC and VSS. He added that Monkeys are creating more problem when compared to elephants in this area. People had helped the department in fire protection. He requested that the number of visitors to Kuruva should not be reduced and about 1000 people should be allowed from each side.

Mr. Badusha N. President, Wayanad Prakrithi Samrakshana samithi informed that he has helped in assessing the visitor carrying capacity of Kuruva earlier. He reported that Kuruva is Reserve Forest notified by the Britishers during 1835 and the entire area surrounding Kabini River is the forest area. As forest is listed in the concurrent list and no tourist should be allowed inside Kuruva. He mentioned that all the activities in the area should be as per the Working Plan of the

area which is approved by the Central Government and presently without the approval of Central Government, ecotourism activities are being conducted in the site. He also reported that the area is prone to Human – Wildlife Conflict as it fall in traditional migratory path of elephants and the forests areas are connected. He mentioned that DTPC cannot involve in ecotourism. He further added that the State Government has prepared detailed guidelines for ecotourism and all the rules and regulations related to ecotourism need to be followed. He informed that Kuruva area support threatened species such as tiger, otter and several such species. He suggested that human interference to be reduced maximum in Kuruva.

Mr. Shiju V. J., Manager, Kuruva Destination Management Committee (DTPC Wayanad) informed that earlier about 2,20,000 people visited the area and now it is reduced to 35,000 people. The local people including restaurant and shop owners, people associated with transportation and other people are affected due to this reduction in tourist inflow. Presently no food is allowed to be carried inside the Kuruva and so far no negative effects have been observed. So about 3000 people should be allowed to visit the area.

Mr. Balakrishnan M. informed that as per the earlier study, only 400 people were allowed to visit the area but more people were allowed to visit the area recently. So, a comprehensive visitor carrying capacity study of the area should be conducted and the outcome of the study to be followed strictly.

Mr Sasidharan K. N., Kuruva Samsashana Samithi mentioned that the number of tourist are increasing which will lead to more Man – Animal conflict and already lot of damage to agricultural crops are reported due to elephants. He further warned that precaution is always better. Thus, precaution to be taken before happening any such incident. Some of the area in Palvelicham side also have disturbance from elephants. Such area to be kept under the control of Forest Department.

Mr. Ranjith Kumar P., DFO, South Wayanad Forest Division reported that the riverine forest in Kuruva is unique and the area is notified as RF during 1835. He mentioned that VSS was formed in the year 2002 as per the guidelines of National Forest Policy and only VSS is allowed to carry out ecotourism activities in the site from the year 2005. All the management of the area is as per the working plan approved by the Government. He told that about 107 tribals are members of VSS and it is an elective body. Visitor carrying capacity was initially fixed as 400 people and later on the capacity was revised as 950 people per day. He mentioned a variety of flora and fauna including elephants, tigers, otter etc. are reported to occur in the area. He informed that due to strict vigilance and precautionary measures taken by the department and VSS no Human – Wildlife conflict happened inside the Kuruva.

Ms. Keerthi, R, DFO, North Wayanad Forest Division requested that a realistic carrying capacity of Kuruva based on existing guidelines need to be estimated.

The meeting concluded with Vote of Thanks by Dr A. Rajasekaran, Scientist-E, Principal Investigator of the study.

List of participants of interactive meeting on 12.10.2018 at Sulthan Bathery, Wayanad

S.No.	Name of the participant	Address & Email	Contact Number / Mobile Number
1.	Kelu O. R.	Honorable MLA, Olanchery Puthenmittom, (17-Mananthavady - ST) Kattikulam P.O., Nila Block 31&32. Wayanad -670 646.	9446545761
2.	Sasindran C. K.	Honorable MLA, Ponnada, Chandragiri Block 201. Maniyankode P.O, Kalpetta North, Wayanad - 673 122.	9446891227
3.	Ranjith Kumar P.	DFO, Wayanad Pinangode Road Kalpetta PO, Wayanad 673121(South). dfosouth@gmail.com	9447979075
4.	Keerthi R.	DFO, Wayanad (North), Mananthavady PO, Wayanad 670645.	9447979074
5.	Ratheesan V.	Range Forest Officer, Chedlath Range ratheesanb@gmail.com	8547602737
6.	Sasikumar T.	Deputy Range Forest Officer, Pulpally sasinabhas@gmail.com	9447204695
7.	Jayarajan C.	South Wayanad Forest Division, Kalpetta	8547602721
8.	Chandran M.	Secretary, Pakkom-Kuruva VSS Section Forest Officer, Pulpally Forest Station	8547602751
9.	Ajay Ghosh V.	AWW (M), Muthana Range awwmuthanga@gmail.com	8547603487
10.	Vijayan K.	President, Pakkom-Kuruva VSS	9946597461

11.	Manoj V. N.	Member – Kuruva VSS	9744497325
12.	Satheesh Kumar	Member – Kuruva VSS	6238195767
13.	Rajan T. R.	Member – Kuruva VSS	9744807481
14.	Shiju V. J.	Manager, Kuruva Destination Management Committee (DTPC Wayanad)	7025513791 9947280503
15.	Anand B.	Sectretary – DTPC Wayanad, Kalpetta anand@dtpcwayanad.com	9446336788
16.	Subin Phililp	Marketing Coordinator – DTPC Wayanad, Kalpetta subin@dtpcwayanad.com	9940709151
17.	Radhakrishnan K. N.	The Deputy Director, Department of tourism, Civil Station, Kalpetta, Wayanad.	9495759670
18.	Ajithkumar K.	TIO, Tourism, Kalpetta ddwyd@keralatourism.org	9539777725
19.	Johny Mattathilani	Mattathilanickel, P.O. Porur-Wayanad, Yavanarkulam	9544946647
20.	Sugathan K.	Chairman, Kuruva Samsashana Samithi, Kunnath House, Palvelichem, Bavali (PO) – 670646	9447849574 9747364724
21.	Sasidharan K. N.	Kuruva Samsashana Samithi, Kodungukudy House, Payyampally (PO), Muttanikara	9562756067
22.	Badusha N.	President, Wayanad Prakrithi Samrakshana samithi, Naikatty Post, Sulthan Bathery. arulbadsha@gmail.com	8547590222
23.	Balakrishnan M.	Secretary, AIKSM Taluk, AITUL Office, Mananthavady, 670645 manathavadybalakrishan@gmail.com	9447325439

Various views of Interaction meetings

Annexure – 5

Details of Human – Wildlife conflict un Chedalath Range of

South Wayanad Forest Division

Date	Place	Animal Involved	Start date of the issue	Date when resolved	Possible reason for trespass	Remarks
06-04-2017	Veetimoola	elephant	06-04-2017	06-04-2017	water and food scarcity	habitual crop raiders
25-04-2017	Thazhasseri	elephant	25-04-2017	25-04-2017	water and food scarcity	habitual crop raiders
26-04-2017	Gruhannoor	elephant	26-04-2017	26-04-2017	water and food scarcity	habitual crop raiders
30-04-2017	Pulanna	elephant	30-04-2017	30-04-2017	Elephant Attack (Maasthi)	MAC
30-04-2017	kakkodan block	elephant	30-04-2017	30-04-2017	Crop raiders	habitual crop raiders
01-05-2017	Channakolly	elephant	01-05-2017	01-05-2017	water and food scarcity	habitual crop raiders
03-05-2017	Vandikkadav	elephant	03-05-2017	03-05-2017	Jackfruit, Mango Season	habitual crop raiders
04-05-2017	Nelliyambam	elephant	04-05-2017	04-05-2017	Jackfruit, Mango Season	habitual crop raiders
10-05-2017	Neikuppa, Thazhe Pathiriyambam, Ammani, Orkkotmoola	elephant	10-05-2017	10-05-2017	Jackfruit, Mango Season	habitual crop raiders
22-05-2017	Neervaram, Ammani	elephant	22-05-2017	22-05-2017	Jackfruit, Mango Season	habitual crop raiders
28-05-2017	Punjavayal, Neervaram, Pariyaram	elephant	28-05-2017	28-05-2017	Jackfruit, Mango Season	habitual crop raiders
31-05-2017	Neervaram, ammani, Pariyaram, Thazhae Pathiriyambam Manalvayal	elephant	31-05-2017	31-05-2017	Jackfruit, Mango Season	habitual crop raiders
05-06-2017	Ammani	elephant	05-06-2017	05-06-2017	Elephant Attack (Thambi)	MAC
18-06-2017	Moozhimala, Kaapikunnu, Ammani, Neervaram	elephant	18-06-2017	18-06-2017	Jackfruit, Mango Season	habitual crop raiders

19-06-2017	Moozhimala	elephant	19-06-2017	19-06-2017	Jackfruit, Mango Season	habitual crop raid
23-06-2017	Dasanakkara	elephant	23-06-2017	23-06-2017	Jackfruit, Mango Season	habitual crop raiders
08-07-2017	Kaithakkal	elephant	08-07-2017	08-07-2017	Jackfruit, Mango Season	habitual crop raiders
24-07-2017	Veliyambam	elephant	24-07-2017	24-07-2017	Jackfruit, Mango Season	habitual crop raiders
28-07-2017	Kolavally	elephant	28-07-2017	28-07-2017	Jackfruit, Mango Season	habitual crop raiders
13-08-2017	Padiri	elephant	10-08-2017	10-08-2017	Jackfruit, Mango Season	habitual crop raiders
14-08-2017	Madal	elephant	14-08-2017	14-08-2017	Jackfruit, Mango Season	habitual crop raiders
20-10-2017	Kandamala	Unknown	20-10-2017	20-10-2017	cattle killed	MAC
03-10-2017	Forest vayal	Unknown	03-10-2017	03-10-2017	cattle killed	MAC
01-11-2017	Chekadi	Tiger	01-11-2017	01-11-2017	cattle killed	MAC
05-11-2017	Pulpally town	wild boar	05-11-2017	05-11-2017	Animal Attack (Haris)	MAC
26-11-2017	Chamappara	Tiger	26-11-2017	26-11-2017	cattle killed	MAC
06-12-2017	Vettathur	Tiger	06-12-2017	06-12-2017	cattle killed	MAC
14-01-2018	Ammani, Manalvayal	elephant	14-01-2018	14-01-2018	water and food scarcity	habitual crop raiders
15-01-2018	Seetha Mount	elephant	15-01-2018	15-01-2018	water and food scarcity	habitual crop raiders
19-02-2018	Neervaram, Ammani, Punjavayal,	elephant	19-02-2018	19-02-2018	water and food scarcity	habitual crop raiders
19-02-2018	Srambi, Pakkom	Tiger	19-02-2018	19-02-2018	cattle killed	MAC
21-02-2018	Punjavayal, Neervaram, Panamaram, Pariyaram	elephant	21-02-2018	21-02-2018	water and food scarcity	habitual crop raiders
25-02-2018	Aaloorkunnu	elephant	25-02-2018	25-02-2018	Elephant Attack (Kalan)	MAC
17-03-2018	Madal	elephant	17-03-2018	17-03-2018	water and food scarcity	habitual crop raiders
21-03-2018	Nelliyambam	elephant	21-03-2018	21-03-2018	water and food scarcity	habitual crop raiders
15-04-2018	Manalvayal, Ammani	elephant	15-04-2018	15-04-2018	water and food scarcity	habitual crop raiders
20-04-2018	Kandamala	elephant	20-04-2018	20-04-2018	water and food scarcity	habitual crop raiders
10-05-2018	Vellippadi	elephant	10-05-2018	10-05-2018	Jackfruit, Mango Season	habitual crop raiders
16-05-2018	Vilangadi	elephant	16-05-2018	16-05-2018	Jackfruit, Mango Season	habitual crop raiders

19-05-2018	Chekadi	elephant	19-05-2018	19-05-2018	Jackfruit, Mango Season	habitual crop raiders
20-05-2018	Kurichipatta	elephant	20-05-2018	20-05-2018	Jackfruit, Mango Season	habitual crop raiders
20-05-2018	Kurukkanmoola	elephant	20-05-2018	20-05-2018	Elephant Attack	MAC
21-05-2018	Basavakolly	wild boar	21-05-2018	21-05-2018	Animal Attack (Bomman)	MAC
29-05-2018	Nelliyambam, Punjavayal, Panamaram	elephant	29-05-2018	29-05-2018	Jackfruit, Mango Season	habitual crop raiders
01-06-2018	Chekadi	elephant	01-06-2018	01-06-2018	Jackfruit, Mango Season	habitual crop raiders
04-06-2018	Dasanakkara, Koolivayal	elephant	04-06-2018	04-06-2018	Jackfruit, Mango Season	habitual crop raiders
09-06-2018	Palakolly, Madal	elephant	09-06-2018	09-06-2018	Jackfruit, Mango Season	habitual crop raiders
10-06-2018	Kolavally, Marakkadavu	elephant	10-06-2018	10-06-2018	Jackfruit, Mango Season	habitual crop raiders
16-06-2018	Madal	elephant	16-06-2018	16-06-2018	Jackfruit, Mango Season	habitual crop raiders
23-06-2018	Dasanakara	elephant	23-06-2018	23-06-2018	Elephant Attack (jollys gate destroyed)	MAC
25-06-2018	Palakolly, Pallichira, Padiri, Udayakkara	elephant	25-06-2018	25-06-2018	Jackfruit, Mango Season	habitual crop raiders
26-06-2018	Panamaram, Punjavayal, Pathiriyambam	elephant	26-06-2018	26-06-2018	Jackfruit, Mango Season	habitual crop raiders
30-06-2018	Marakkadav, Vandikkadav, Pannimukku	elephant	30-06-2018	30-06-2018	Jackfruit, Mango Season	habitual crop raiders
02-07-2018	Koodalkadavu	elephant	02-07-2018	02-07-2018	Jackfruit, Mango Season	habitual crop raiders
06-07-2018	Padiri	elephant	06-07-2018	06-07-2018	Jackfruit, Mango Season	habitual crop raiders
07-07-2018	Manalvayal	elephant	07-07-2018	07-07-2018	Elephant Attack (Girish)	MAC
09-07-2018	Kolavally, Madapallykunnu, Seetha Mount	elephant	09-07-2018	09-07-2018	Jackfruit, Mango Season	habitual crop raiders

10-07-2018	Kallickal	elephant	10-07-2018	10-07-2018	Jackfruit, Mango Season	habitual crop raiders
12-07-2018	Kolavally, Chamappara, Madampally	elephant	12-07-2018	12-07-2018	Jackfruit, Mango Season	habitual crop raiders
13-07-2018	Veliyambam	elephant	13-07-2018	13-07-2018	Elephant Destroyed Gate (Augustin, Veliyambam)	MAC
17-07-2018	Valambadi	elephant	17-07-2018	17-07-2018	Elephant Attack (Santhosh)	MAC
19-07-2018	Palakolly, Changambam	elephant	19-07-2018	19-07-2018	Jackfruit, Mango Season	MAC
22-07-2018	Bhoodanam	elephant	22-07-2018	22-07-2018	Jackfruit, Mango Season	habitual crop raiders
28-07-2018	Vandikkadav, Vilangadi	elephant	28-07-2018	28-07-2018	Jackfruit, Mango Season	habitual crop raiders
29-07-2018	Manikkod	elephant	29-07-2018	29-07-2018	Elephant destroyed Electric Post	MAC

Annexure – 6

Details of compensation paid due to human-animal conflict in South Wayanad Forest Division

Year	Human Death		Human Injury		Destruction of House		Cattle lifting		Agricultural crop damage		Total compensation paid	
	Application disposed	Amount paid (in lakhs)	Application disposed	Amount paid (in lakhs)	Application disposed	Amount paid (in lakhs)	Application disposed	Amount paid (in lakhs)	Application disposed	Amount paid (in lakhs)	Application disposed	Amount paid (in lakhs)
2006-07									507.00	20.38	507.00	20.38
2007-08									419.00	21.77	419.00	21.77
2008-09									505.00	16.20	505.00	16.20
2009-10	3.00	3.62							632.00	22.53	635.00	26.15
2010-11	6.00	4.00	2.00	0.10			4.00	0.31	501.00	15.58	513.00	19.99
2011-12	4.00	7.00	11.00	0.50			8.00	0.62	1573.00	78.80	1596.00	86.92
2012-13	1.00	3.00	7.00	0.35	2.00	0.10	16.00	2.40	945.00	51.90	971.00	57.75
2013-14	Nil	0.00	13.00	0.76	3.00	0.48	25.00	3.24	1573.00	97.51	1614.00	101.99
2014-15	2.00	6.00	15.00	1.95	5.00	1.69	42.00	10.37	1763.00	75.54	1827.00	95.55
2015-16	3.00	11.00	14.00	1.45	3.00	0.53	49.00	9.92	1107.00	39.10	1176.00	62.00
2016-17	4.00	16.00	10.00	1.42	12.00	2.62	41.00	7.14	1562.00	63.25	1629.00	90.42
2017-18	1.00	1.00	17.00	4.27	69.00	2.41	58.00	10.47	539.00	23.79	634.00	41.94

Annexure –7

Estimation of parking of different vehicles

Types of parking space	Parking standard / norms in metres				Parking space of Kuruva				Total vehicle
	Length	Width	Minimum headroom	Total LxW	Pakkom_Kuruva VSS		Palvelicham DTPC		
					Area (m^2)	Carrying capacity	Area (m^2)	Carrying capacity	
Private cars and taxis	5	2.5	2.4	12.5	**1505**	120	**884**	71	191
Light goods vehicles	7	3.5	3.6	24.5		61		36	97
Medium / heavy goods vehicles	11	3.5	4.7	38.5		39		23	62
Coaches and buses	12	3.5	3.8	42		36		21	57

Based on : Jangra and Kaushik, 2017

Annexure – 8

Visitor carrying capacity of Pakkom-Kuruva ecotourism site in different scenarios

Area required / tourist (m^2)	Physical Carrying Capacity (PCC) (Visitors/Day)					Real Carrying Capacity (RCC) (Visitors/Day)					Effective Carrying Capacity (ECC) (Visitors/Day) (modified)				
	3 hours	2 hr 30 m	2 hours	1 hr 30 m	1 hour	3 hours	2 hr 30 m	2 hours	1 hr 30 m	1 hour	3 hours	2 hr 30 m	2 hours	1 hr 30 m	1 hour
1	12577	**16170**	18865	25153	37730	983	**1264**	1475	1967	2950	905	**1163**	1357	1809	2714
1.5	8384	10780	12577	16769	25153	656	843	983	1311	1967	603	775	905	1206	1809
2	6288	8085	9433	12577	18865	492	632	738	983	1475	452	582	679	905	1357
2.5	5031	6468	7546	10061	15092	393	506	590	787	1180	362	465	543	724	1086
3	4192	5390	6288	8384	12577	328	421	492	656	983	302	388	452	603	905
3.5	3593	4620	5390	7187	10780	281	361	421	562	843	258	332	388	517	775
4	3144	4043	4716	6288	9433	246	316	369	492	738	226	291	339	452	679
4.5	2795	3593	4192	5590	8384	219	281	328	437	656	201	258	302	402	603
5	2515	3234	3773	5031	7546	197	253	295	393	590	181	233	271	362	543