Identifying Impressive Landscape Objects and Important Places using Visitors' Geotagged Photos and GPS Tracking

(July, 2017)

Graduate School of Horticulture - Chiba University

Department of Environmental Horticulture

Environmental Science and Landscape Architecture Course

Akhmad Arifin Hadi

Chiba University Doctor of Philosophy Dissertation

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Abstract

Visitors' preferences towards landscape they see are important considerations in managing landscapes effectively. One method for identifying visitors' preferences in a landscape is photo-based research, which assesses people's engagement with landscape scenes as objects and the vantage points, or locations from which people see the impressive elements. This research used visitor-employed photography (VEP), which allowed the participants to select and take photos of preferred or impressive landscape objects unprompted on the site. This method was combined with global positioning system (GPS) tracking to detect the participants' actual geo-positions while they were taking photos to monitor their movements. Those methods were possible and easily implemented given the prevalence of smartphones with cameras and GPS locators in the recent era.

The research was conducted in Bukit Kucing Forest (BKF) and Bogor Botanical Garden (BBG) Indonesia. Those study sites were selected because they are protected areas located in the middle of cities in Indonesia and open to the public. There were 61 participants who were university students invited to BKF along with 35 random visitors, and 51 university students who were invited to BBG as research participants. All participants were asked to walk inside the site study and asked to capture impressive landscape features during walking. Owing to differences in the availability of information about the sites, the procedure for participants in both sites was not the same. In BKF, participants were asked to follow a fixed trail to ensure their safety because maps and information about the site were not available. In BBG, where the information was available, participants could walk freely in any direction. All participants used their own smartphones or digital cameras to take photographs and carried a researcher-supplied

GPS logger to record their actual geo-positions of vantage points. The data obtained from participants were geotagged photos and GPS tracking data which were exported into ArcGIS for analysis. In ArcGIS, those data were read as points features.

The Getis-Ord Gi* Hotspots analysis in ArcGIS was used to identify hotspots of geotagged points and GPS tracking points. Owing to the two different walking patterns, the hotspots-analysis approach in BKF was line based whereas in BBG it was polygon based. In the line-based approach, the study used 5-meter segments to project the nearest points along the fixed trail. In the polygon-based approach, the study used 20-by-20-meter square polygon cells covering the site, and counted points that fell inside each cell. A segment or cell was deemed a hotspot if the number of points near the segment or inside the cell had a z-score higher than 1.96, indicating 95% confidence hotspots.

The results showed that there were landscape elements that the participants considered impressive enough that they were frequently captured by multiple participants in those two sites. These included photos with focused objects of plants, human-made structures, and open areas. The photo hotspots and GPS tracking hotspots indicated places where impressive objects were visible. The results from both sites showed that there was a dependency between the variables of photo hotspots and GPS tracking hotspots ($p<.0001$), showing that impressive scenes or objects visible along the trail influenced participants to sometimes stop to enjoy the view and take photos. The novelty of this research is the inclusion of self-portrait or "selfie" photos among participants' photos that included impressive objects and viewing places in addition to similar shots without self-portraits. From the chi-squared analysis, there was seen a dependency between the variable of selfie photo hotspots and ordinary photo hotspots ($p<.0001$). It showed that in the places where impressive landscape objects were visible, in addition to ordinary photos

with impressive objects as target, participants took a lower but still significant number of selfie photos with the same objects visible in the frame.

In conclusion, participants' photos and GPS tracking data were important as research objects in landscape preference research to give actual and accurate data about visible impressive objects and vantage point clusters.

Keywords: landscape, preferences, geotagged photos, selfies, GPS, hotspots, Colonial

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Chapter 1

Introduction

1. Introduction

1.1 Background

Visitors' experiences, needs, and preferences are important considerations for researchers and landscape managers to manage landscapes effectively (Taylor, Czarnowski, Sexton, & Flick, 1995). People's landscape preferences are influenced by internal factors such as psychology and personality (Abello & González Bernáldez, 1986) and external factors such as landscape visual quality. Therefore, landscape preferences are very subjective; they differ among individuals and groups as well as among casual observers and landscape professionals (Ozguner & Kendle, 2008). In landscapes that involve public visitors, such as in Bukit Kucing Forest and Bogor Botanical Garden, landscape managers should be aware of which landscape elements and vistas are of greatest interest to their visitors and of the most common viewing locations, or vantage points, for these attractions (Daniel & Boster, 1976). By considering them, landscape managers will have references to manage visitors' needs.

Photo-based landscape research is one method for identifying visitors' visual preferences in a landscape open to the public. In recreation or tourism activities, photographs are an important component (Markwell, 1997). Photographs not only record what people have seen and how something appeared, but also provide insights into how they know and understand the objects and sights (Albers & James, 1988). Research using visitors' photographs can clarify evaluations of resources, visitors' perceptions, and experiences, providing valuable input for management and visitor data collection efforts (Dorwart, Moore, & Leung, 2007).

There are three basic types of photo-based research: photos combined with questionnaires or interviews, subject-employed photography, and photo-sorting

procedures (Jacobsen, 2007). Visitor-employed photography (VEP), sometimes known as subject-employed photography, was introduced as a landscape and recreation research method for the first time by Gabriel Cherem in 1970s (Heyman, 2012). Assessing and quantifying scenic elements has always been a challenge for land management planning, but Cherem's method helped researchers analyze visitors' perceptions and responses. In VEP, researchers instruct participants at a site to photograph elements of the landscape (Hull & Revell, 1989). This method is the most revealing of the three photo-based research methods because the subjects of the research photographs are chosen by the participants, not the researchers. The advantage of using VEP in landscape preference research is that VEP is able to show a more accurate interpretation of the attractions of the landscape (MacKay & Couldwell, 2004).

The weakness of VEP as it was first implemented, before the advent of digital cameras, was the high cost of the research (Brian Garrod, 2007; Hull & Revell, 1989). Researchers had to budget for buying disposable cameras, film processing and printing, and mailing costs for sending printed photos from participants to researchers (MacKay & Couldwell, 2004). Today, nearly everyone has a cell phone with a built-in digital camera that can time- and date-stamp photos. Smartphones with high-definition cameras have become common, and most people are familiar with using either dedicated or in-phone digital cameras. Some researchers have succeeded in using this modern technology to conduct VEP research by asking participants to take photos using their own digital cameras (Sugimoto, 2011, 2013) and smartphones with cameras (Mizuuchi, Son, Kang, & Furuya, 2015). The Internet has been beneficial, too, acting as a supporting medium to transfer selected photos from participants to researchers (Mizuuchi et al., 2015).

Understandably, the constraints related to the high cost of VEP can be avoided given the prevalence of smartphone and Internet use in Indonesia.

Another issue that once hampered VEP was in tracking the exact locations where VEP participants took their photos. The locations where participants position themselves to view particular objects or vistas are called "vantage points" (Hull & Revell, 1989). Vantage points are related with spatial data to each photo captured by participants. VEP researchers aim to identify similar photo subjects and common vantage points (B. Garrod, 2008). There have been many methods of tracking vantage points on sites among researchers (Hull & Revell, 1989). Today, accurate, handled GPS technology is readily available. The use of GPS technology to detect accurate vantage points is very important for landscape preference analysis. It is not only useful for presenting the location of photos taken, but also for deeper analysis such as the density analysis of participants' tracking points (Hallo et al., 2012; Kienast et al., 2012).

Similar to the increasing popularity of phones with cameras, more people are also at least passingly familiar with the use of GPS tracking technology. Beeco et al. (2014) suggested combining the use of GPS tracking and maps in VEP to obtain actual visitor navigation patterns in recreational management. Research using GPS tracking in various case studies has increased since around 2005 (Shoval & Ahas, 2016). The applications for GPS tracking in various landscape research are diverse, and have already expanded to include the following: defining destinations; route and track types for urban planning and design purposes (van der Spek, van Schaick, de Bois, & de Haan, 2009); identifying people's experiences in time and space (Pettersson & Zillinger, 2011); measuring carrying capacity in tourism management (Beeco & Brown, 2013); and identifying

participants' spatial-behavior of the type once gathered by analyzing participants' travel diaries or through post-travel surveys (Edwards, Dickson, Griffin, & Hayllar, 2010).

At present, GPS tracking receivers available in the market are small and easy to carry by hand. One such popular tracking receiver is a GPS logger, which is able to record the device's actual geolocation over time. The time stamps produced by this particular GPS logger could be matched with EXIF metadata for time-stamping photos, meaning that the two sets of data could be combined into geotagged, time-stamped photos. This data is valuable for VEP as it can be used in identifying vantage-point locations for each of the participants' photos, checked against the participants' photo logs, and then cross-checked and corrected on-site by experts. By using this GPS logger, the geolocations of vantage points can be directly detected on the spot with reasonable accuracy. The digital photos that combined the metadata time stamp and the geolocation of the people taking the photos were called "geotagged photos."

The integration of GPS visitor tracking and VEP creates a set of geographically referenced images that are very useful for identifying visitors' experiences and interests at destinations (Shoval & Ahas, 2016). The GPS logger and VEP methods have been successfully combined to investigate people's preferences within a visited landscape based on visitors' geotagged photos (Mizuuchi et al., 2015; Sugimoto, 2011). Similarly, this research investigated visitors' preferences using VEP method and GPS tracking. However, this study differs from previous research (Mizuuchi, et al, 2015; Sugimoto, 2011) in its type of research objects and its locations. One, it was conducted in Indonesia, where the landscape has the characteristics of a tropical landscape, at two separate locations: a forest and a botanical garden in Indonesia. Two, this research used selfie

photos as research tools. Finally, it includes a deeper analysis of the GPS tracking data and geotagged photos.

1.2 Objectives

The objective of this research was to use the VEP method, combined with GPS tracking, to identify landscape objects and views on site studies that were perceived as most engaging or impressive by the study participants. The other objective is to investigate vantage points' locations of each part of walking trail where participants captured photos more frequently among all part of walking trail. Photos that overcome from VEP method represented the objects that participants looked at and impressed on the site. The locations where participants took photos more frequently were detected by GPS tracking method. The data obtained from VEP method combined with GPS tracking method were analyzed by using Getis-Ord Gi* hotspots analysis in ArcGIS. Related to analysis method, this research also aimed to investigate the efficiency of using Getis-Ord Gi* hotspots analysis if this method can perform important locations where vantage points significantly clustered which means participants took photos most.

In many city landscapes in Indonesia such as in Bogor Botanical Garden, colonial features such as buildings and its surrounding landscape are exist and still preserved. By VEP method and GPS tracking method, this research was aimed to identify landscape in BBG that its style was Colonial look according to Indonesian participants' perceptions. On the other hand, this method also aimed to identify landscape that its style was Indonesian look according to participants' perceptions. The Indonesian look landscape style were also identified in order to investigate if there are differences of photos contents and vantage points' hotspots locations among those landscape styles.

This was the first use of VEP method combined with GPS tracking method implemented in landscape preference studies in a case study in Indonesia with Indonesian participants. The increasing popularity of smartphone culture in Indonesia made it possible to investigate whether VEP and GPS tracking could be combined and employed in Indonesia to reveal results that would contribute to the development of landscape preference research.

1.3 Thesis Structure

This research was divided into 6 chapters:

1. **Chapter 1, Introduction.** This chapter consists of background and objective.
2. **Chapter 2, Research Method.** This explains the method used at each study site, including analysis method, survey method, sites descriptions, participants, and survey procedures.
3. **Chapter 3, Identifying Impressive Landscape Objects Based on Geotagged Photographs (A Case Study of Selfie Photos and Ordinary Photos)—Bukit Kucing Forest, Tanjungpinang City, Indonesia.** This chapter explains the research conducted in Bukit Kucing Forest, Tanjungpinang City, Indonesia. It also explains the importance of selfie photos in landscape preference research.
4. **Chapter 4, Identifying Visitor Preferences for Locations and Features in Bogor Botanical Garden, Indonesia, Using GPS Tracking and Geotagged Photos.** This chapter explains the research used in identifying important places based on geotagged photo hotspots and GPS tracking point hotspots.
5. **Chapter 5, Identifying Colonial and Indonesian Styles in the Landscape of Bogor Botanical Garden.** This chapter explains the use of visitors' photos

combined with geotagged technology to identify the Colonial and Indonesian landscape preferences of Indonesian visitors.

6. **Chapter 6, Discussion and Conclusion.** This chapter discusses the similarities and differences of impressive landscapes and participants' patterns of behavior in two sites in Indonesia.

Chapter 2

Research Method

2. Research Method

This research used an experiential paradigm approach (Zube, Sell, & Taylor, 1982) in which the research subjects were participants; all of them took a walk at one of the two study sites to get direct visual impressions about the landscape elements. We used the visitor-employed photography (VEP) method to get photos that represent participants' impressive objects or scenes, combined with GPS tracking method to track participants' movements and Getis-Ord Gi* hotspots analysis tool in ArcGIS to analyze important place where vantage points and GPS tracking points significantly clustered. The integration of GPS visitor tracking and photos created a set of geographically referenced images that were very useful in identifying visitors' experiences and interests at destinations (Shoval & Ahas, 2016).

Gabriel J. Cherem conducted the VEP method technique for the first time in 1970s to analyze landscape preferences through participants' photos. In this method, researchers provide cameras to participants and ask them to take photographs to illustrate their personal views or capture their experiences (Heyman, 2012). VEP in this research was used to obtain samples of impressive landscape photos that captured on-site experiences by participants. Since they selected the subjects of the photos, the participants landscape preferences were not biased by directions from researchers.

The global positioning system (GPS) is a satellite-based tracking system that can provide geolocation and time information for a ground-based receiver (Chadil, Russameesawang, & Keeratiwintakorn, 2008). The GPS receiver device gets signals and information of actual geoposition from one or more satellites. The receivers used for this

research were small, portable individual GPS loggers, one per participant, to enable the actual geoposition and movement of the participants to be detected and recorded.

An additional method (discussed in Chapter 5) was implemented at one of the sites. This was the cognitive approach, used to elicit participants' perceptions of the Colonial and Indonesian landscape styles in Bogor Botanical Garden. The participants were interviewed after on-site visits using an online chatting application. However, although the cognitive approach was used, the questions in the interview and the expected data were still based on participants' on-site experiences.

2.1 Study Flow

The research was divided into three phases: pre-survey, survey, and post-survey. The pre-survey phase involved preparation for doing the survey. In this phase, researchers prepared the GPS logger devices, recruited participants, and explained procedures. GPS logger preparation include erasing old GPS logger data, charging the devices' batteries, and setting each GPS logger's time to local time (GMT+7) and the current, correct date. Recruitment of participants was implemented through in-field recruitment (see BBG Research, Chapter 4) and inviting participants (see BKF Research, Chapter 3). Before participants did actual walking inside the sites, all participants received an explanation about survey procedures.

During the survey phase, the participants walked following fixed trail (in BKF) or in free direction trail (in BBG). By walking the course in the site study, participants experienced many natural and human-made objects and sights. They were asked to select what they considered to be impressive landscape objects from these visual experiences and capture those objects into photos. From this phase, researcher gathered two types of

data: photos, which were captured by participants' cameras; and GPS logger data, which tracked the participants' movements.

The post-survey phase comprised activities after participants finished walking the courses in one of the two sites: the participants filled out a questionnaire and answered a post-walk online interview, and researcher performed data analysis. The online interview was a post-survey phase used only with Bogor Botanical Garden participants (see Chapter 5). The data obtained in this phase were analyzed by using supporting GIS and statistics software.

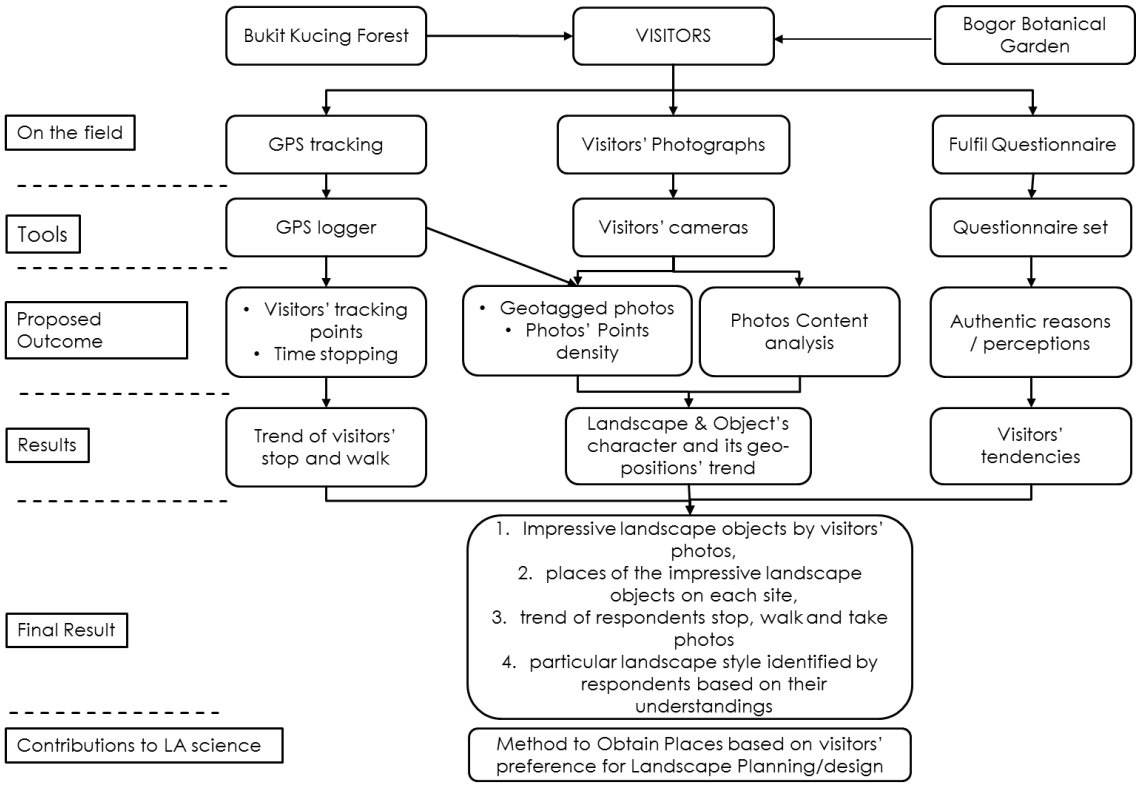

Figure 1. Study flow.

2.2 Study Sites

The study took place in 2 protected areas in the cities of Indonesia, include: Bukit Kucing Forest, Tanjungpinang city and Bogor Botanical Garden, Bogor city. Both sites

were located in Indonesia. The reason to choose those places as study sites based on Indonesian situation where protected areas in urban area in Indonesia are decreased. Therefore, it is important to do research about landscape preference research in protected areas in the cities in Indonesia to support conservations and preservations of those areas.

Figure 2. Study sites' locations

Source of map: http://3.bp.blogspot.com/-tL32I3OWTv0/VUzAZgT9d-I/AAAAAAAAIoE/VeIlBEo9Cr0/s1600/gambar%2Bpeta%2Bindonesia%2B(1).gif

2.2.1 Bukit Kucing Forest. Bukit Kucing Forest is a protected area in the middle of Tanjungpinang City, capital of Riau Island Province, Indonesia. The province comprises 2,408 islands, and Bukit Kucing Forest is located on Bintan Island (Figure 6), 462 meters south of the coastal line. The site is influenced by the coast in terms of biodiversity. The total area of the forest is 54.4 hectares that are surrounded by settlements. The area has been well preserved since the Johor-Riau-Lingga Kingdom era. The forest is open for visitors' recreation and local people's activities, such as bathing, collecting water, and washing clothes. The types of recreation activities include sightseeing, trekking, and camping. The established infrastructures are looped paved track, two

bridges, four gazebos, one monumental sculpture and wooden benches (Figure 3). Forest guards employed by the city government protect the site from illegal logging, forest fires, hunting, and other illegal activities.

As the main green open space in Tanjungpinang City, Bukit Kucing Forest serves numerous functions, including water catchment and wildlife conservation. It provides a habitat for various birds, including the predatory eagles that fulfill an important role in the ecosystem. A large variety of unique vegetation rarely found in other places on Bintan Island also grows in the forest.

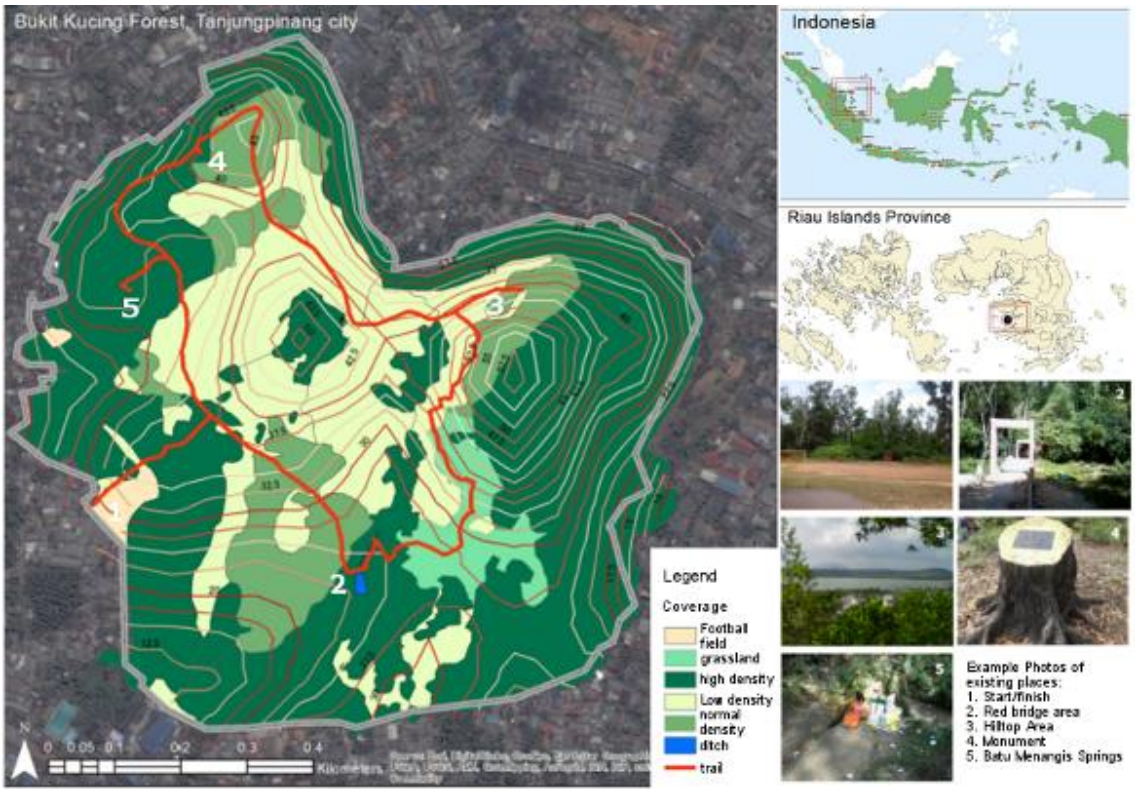

Figure 3. Study site of Bukit Kucing Forest Tanjungpinang City, Indonesia.

The local weather is influenced by the coastal climate. With a daily temperature range of 23–34°C and its location near the coast, the forest tends to be hot and humid.

During the survey phase for the current research, the temperature ranged from 32°C to 34°C, with a humidity level of 77–94%.

2.2.2 Bogor Botanical Garden. The second study site was Bogor Botanical Garden, located in Bogor City in the West Java Province of Indonesia (Figure 4). The survey phase for the current research took place April 19–25, 2016. The BBG has an area of 87 hectares with various destinations and facilities. According to the BBG's website (http://www.krbogor.lipi.go.id/id/Jumlah-Koleksi-Kebun-Raya-Bogor.html), the garden boasts flora from 218 families with 3,301 species and 13,061 specimens. These are grouped into five main collections: palm trees, medical plants, water plants, fruit plants, and climbing plants. Along with the plant collections, the BBG has thematic gardens that highlight specific types of plant collections, such as the Mexican Garden, Teijsmann Garden, Medical Plants Garden, Water Garden, Soedjana Kassan Garden, and Araceae Garden. Other buildings and structures are destinations on their own, such as the Orchid House, Zoological Museum, Lady Raffles Memorial, Reinwardt Monument, Teijsmann Monument, Red Hanging Bridge, and Dutch Tomb. The Bogor Presidential Palace is not a part of the BBG, although its back side and yard can be seen near Srigunting Pond. This pond, as well as the Lotus Pond and the Ciliwung River, are themselves destination places within the BBG.

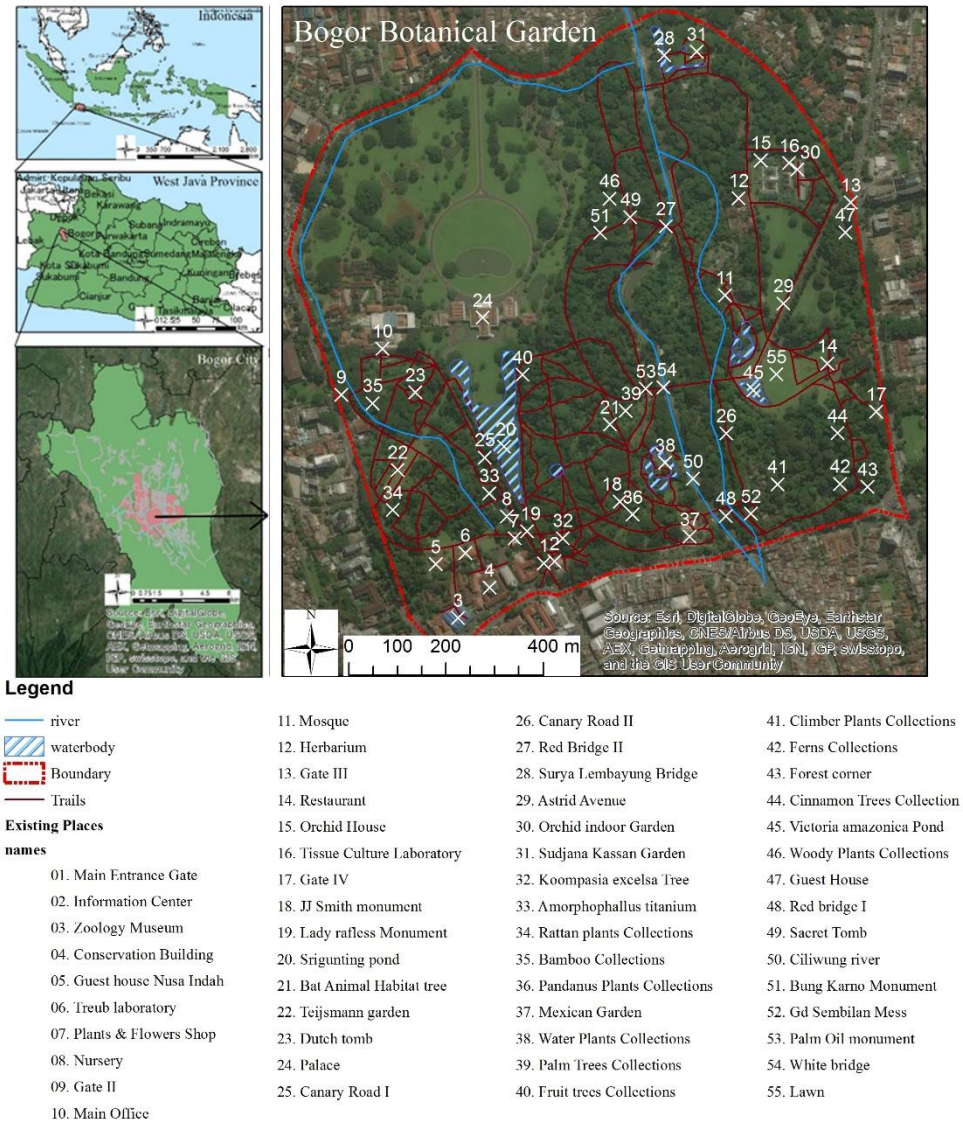

Figure 4. Study site of Bogor Botanical Garden, Bogor City, Indonesia.

2.3 Participants, Tools, and Materials

2.3.1 Participants in Bukit Kucing Forest survey. The participants in this part of the study were 61 university students in Tanjungpinang City: 56 students from University of Maritime of Raja Haji Ali (Umrah University), 10 from Sekolah Tinggi Ilmu Sosial dan Ilmu Politik (STISIPOL) Raja Haji Tanjungpinang, and 2 from Sekolah Tinggi Ilmu Ekonomi Pembangunan (STIEP) Tanjungpinang. University participants were selected based on assumption that the students would possess the appropriate

knowledge to offer objective evaluations of Bukit Kucing Forest. Regarding their educational background, none majored in landscape or forestry. In that way, the participants represented regular visitors to the forest.

Students who were interested joining as participants were invited to a short orientation meeting on March 23, 2015. The invitations were distributed with the help of Umrah University administration officials and the "Mahapala" nature conservation students' organization using the short message service (SMS). The on-site survey was conducted from March 24–27, 2015, and the number of students per day was limited to twenty because of the limited number of GPS logger units.

2.3.2 Participants in Bogor Botanical Garden survey. The participants of this part of the study were 94 BBG visitors who were invited to participate in the research. The participants comprised 60 females and 34 males with ages ranging from 10 to 38 years (median of 21 years old). Of the normal visitors, one was a housewife, 25 were professionals in various fields, 17 were high school students, and 51 were university students. The participants' frequency of previous visits to the BBG ranged from 1 to 30 times. All visitors who agreed to participate were given an explanation on the research procedure before entering the BBG gate and starting the survey. The tools used in this study were the participants' cameras or phones with cameras to capture landscapes or elements and GPS loggers to record actual geographic position information while they took photos inside the BBG.

2.3.3 Cameras. One of the two main tools in this research was the participants' cameras, which was used to capture impressive landscape objects found on the site. The camera device was either a digital camera or a smartphone with a built-in camera so that the photos could be transferred digitally to the researcher's computer (Figure 5). After

walking the survey course, each participant was asked to copy the photos to the researcher's laptop using a data cable.

Figure 5. Example of the participants' activities of taking photos

2.3.4 GPS logger. The GPS logger used was the I-gotU GT 120 GPS Logger from Mobile Action Technology, Inc., with an SiRF Star III Low Power chipset. This logger can auto-map the GPS location of photos captured with an accuracy of 10–20 meters. The dimension of the GPS logger is 44.5 x 28.5 x 13 mm and the weight is 20 grams, making it easy for participants to carry during walking (Figure 6).

Figure 6. The GPS Logger used by participants.

2.3.5 Questionnaire. A questionnaire sheet was used to obtain participants' demographic information and perceptions about the site. The main open question, for which participants could write more than one answer, asked what kind of landscape elements the participant expected to see on the site. The questionnaire sheets used in the research at Bukit Kucing Forest can be found in Appendix A; the questionnaire sheets used in the research at Bogor Botanical Garden can be found in Appendix B.

2.4 Procedure

2.4.1 Procedure in Bukit Kucing Forest. Participants were asked to photograph the landscape elements that impressed them in Bukit Kucing Forest. Participants came to the start/finish point in the Forest Guard base camp. Before they traversed the specified trail, the researcher explained the route, the procedure for capturing photographs, and the use of the GPS logger. Afterward, the forest guard explained rules to observe while walking in the forest. Subsequently, each participant was lent a GPS logger, which was placed in the participants' bag, hand, or trouser pocket. Participants were asked not to push the button of the GPS logger during the walk. The GPS loggers recorded their

positions on the trail when taking photographs according to the time setting. As the forest did not have a direction map, participants were divided into three groups, each guided by a forest guard. Although this procedure had the risk of participants being influenced by other people (MacKay & Couldwell, 2004), this option was deemed the best choice for safety reasons.

On site, participants were asked to take photographs of landscape elements that impressed them using their cellphone, smartphone, or camera device. As the Internet connection in Tanjungpinang City was weak, it was difficult to ask participants to send their digital pictures to the researcher online in real time. Therefore, all pictures captured by participants were transferred to the researcher's laptop after they had completed walking the entire trail.

At the finish point, students were asked to return the GPS logger, and the researcher copied the GPS logger file to a laptop. Each participant was given a transportation fee after the image and the GPS logger files were transferred to the researcher's laptop.

The predefined trail passes many recreation locations including the Red Bridge area, hilltop gazebo with a city view, historic inscriptions sculpture, and Batu Menangis Rock Springs. The trail runs a length of 2,700 meters counterclockwise in a loop, with a similar start and finish point at the Forest Guards' basecamp. In fair weather, given the various slopes, visitors would need at least 1 hour and 30 minutes to complete a loop on this trail without stopping to take pictures.

2.4.2 Procedure in Bogor Botanical Garden. The participants were asked to capture any impressive or attractive landscape features (e.g., surrounding views, scenery, or objects). The number of photos allowed was unlimited, based on Sugimoto (2011,

2013), to obtain a natural response from participants to the landscape they saw. No routes were predefined, so participants were free to decide which part of the BBG they wanted to visit and what direction they wanted to travel.

2.4.3 Procedure of identifying Colonial and Indonesian style elements. The participants were asked to "capture any impressive or preferred landscape or objects." The researcher did not ask the participants to take photos of what they deemed to be Colonial or Indonesian landscape styles to obtain spontaneous responses. One month after site observation day, participants were asked questions (via online chat applications such as Whatsapp, Line, and Blackberry Messenger) about what photos showed a Colonial landscape element and an Indonesian landscape element. Each participant was asked to select two photos each for Colonial and Indonesian landscape style elements or objects. The participants had the option to provide an explanation for selecting these photos. This part indicated the elements that the participants perceived as Colonial or Indonesian style. The participants were encouraged to give free answers in the chat session. The participants' explanations were tabulated and then analyzed for the photos' content analysis.

2.5 Data Sampling

Due to the objective, this research tried to identify impressive landscape objects and important places based on participants' sighting on the visited site. The participants' photos and GPS logger data were main data in this research, supported by questionnaire data and online interview data.

2.5.1 VEP method. Visitor-employed photography (VEP) is a method of taking samples of landscape scenes on-site by group of participants on-site. It was introduced for the first time by Gabriel Cherem in 1970s. In this research, participants used their own

cameras to take photographs of impressive landscape objects on-site. The selection of impressive landscape objects on-site was unprompted and without direction by researchers. The photos are media that record the view of impressive landscape objects as selected by participants. The photos captured by participants were copied to researcher's laptop as data of this research (Figure 7).

Each participant's photos were checked to delete duplicate photos or photos that captured the same feature twice, along with any accidentally captured or blurred photos.

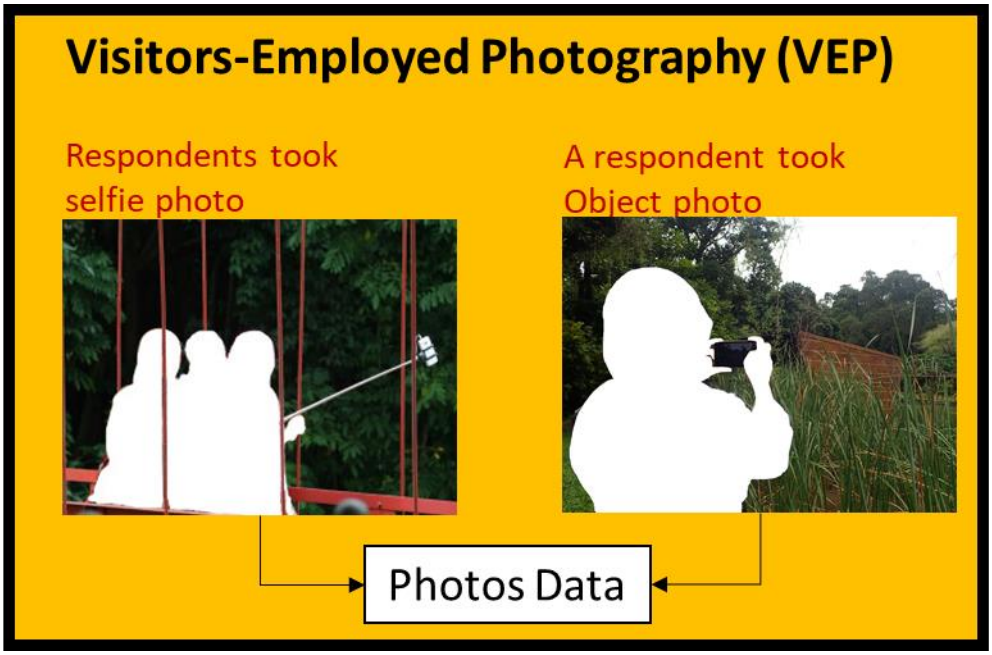

Figure 7. Illustration of VEP method implementation on-site.

2.5.2 GPS tracking method. While participants walked, selected impressive objects, and took photos, the actual geoposition of each participant was recorded by the GPS logger. The geoposition data were obtained automatically since the GPS logger was turned on. The GPS logger is a satellite-based signal receiver device that ensured the accurate location of each participant who held it. Each participant was lent a GPS logger, which had to be carried in such a way as to ensure that the satellite signals were not

blocked (Figure 8). Before distributing the GPS loggers, the time setting on the participants' cell phones, smartphones, or cameras was synchronized with the western Indonesian time zone system. These GPS loggers were hung on the participants' bag or clothes and were not covered, in order to properly receive the GPS signal.

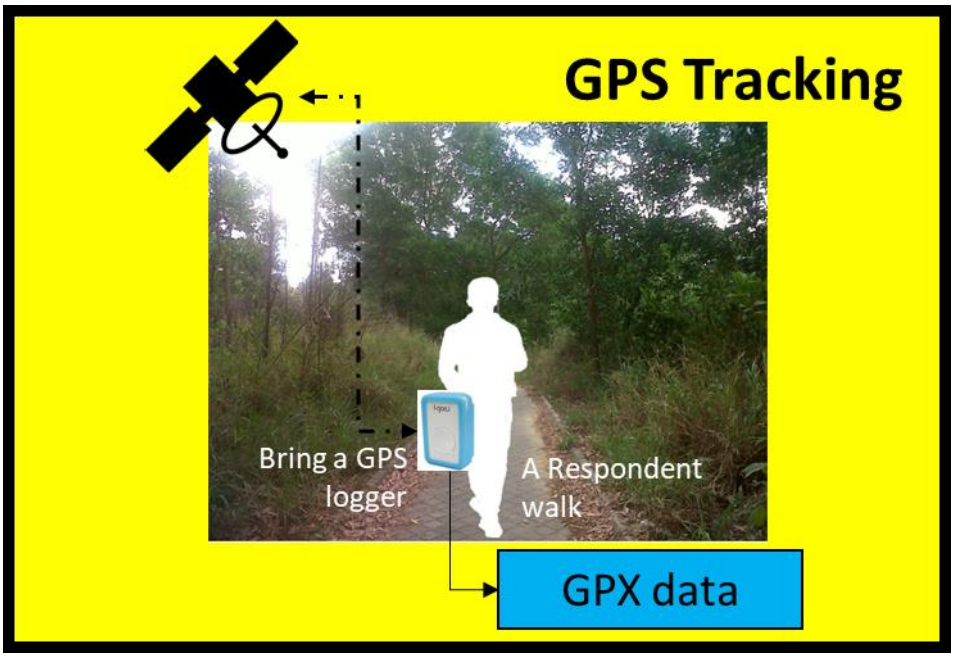

Figure 8. Illustration of GPS logger tracking visitors on-site.

The GPS logger recorded the actual position of longitude, latitude, altitude, and geopositional time of the GPS logger. In this research, the GPS logger was set to record the geoposition of the device every one second.

2.5.3 Producing geotagged photos and GPS tracking data. Each of the photos that were produced in digital format had metadata recording the time at which the photos were taken (Figure 9). On the other hand, the data obtained from GPS tracking the geoposition of the GPS logger device and thus the participant who held it consisted of latitude, longitude, altitude, and time for of each geoposition. The data from the GPS logger were downloaded into a computer with a Windows operating system using @trip

software. In @trip software, the time of the GPS logger and the time of participants' photos were matched to produce geotagged photos. The geotagged photos were saved in *jpg format. The GPS logger data itself were saved separately in *.gpx format to be GPS tracking data. These data, geotagged photos in *jpg format, and GPS tracking data in *.gpx format were exported to ArcGIS for further analysis.

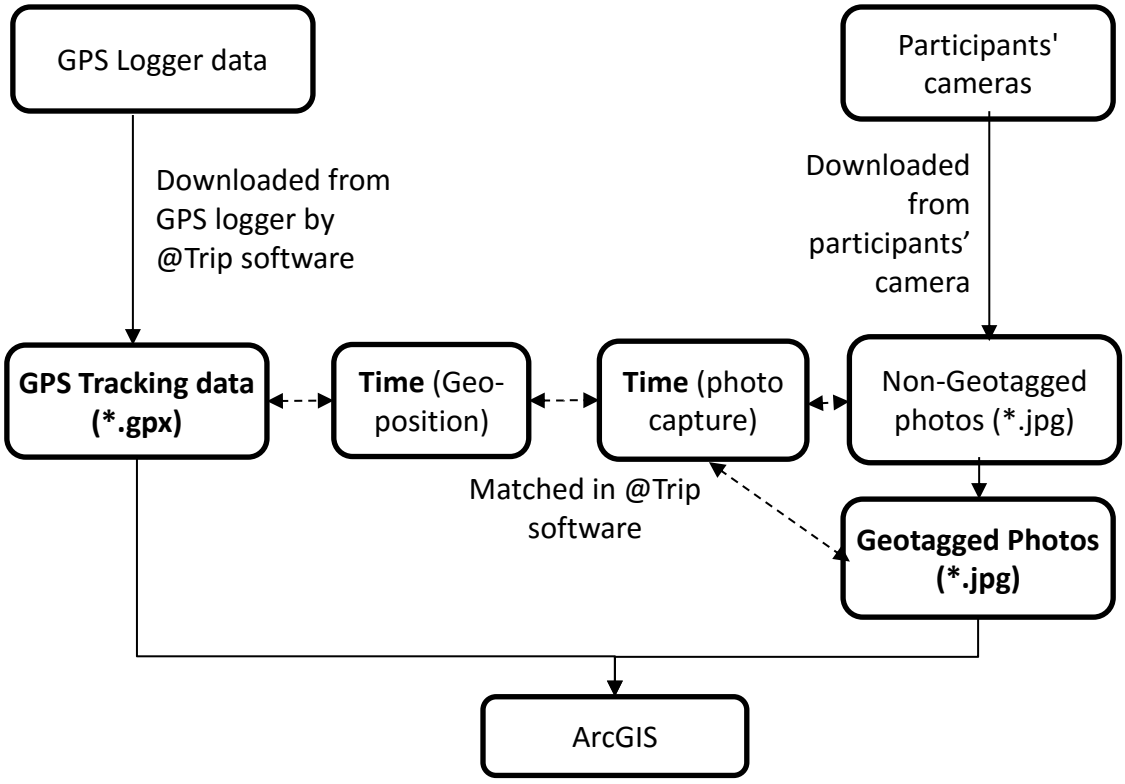

Figure 9. Flow of producing GPS tracking data and geotagged photos.

The geotagged photos and GPS tracking data were the main data exported into the ArcGIS software to obtain photo points and GPS tracking points on a map. The supporting data obtained from city government of Tanjungpinang included a geo-database file with site boundaries, contour lines with interval contours of 0.50 m, islands of the province, and city roads, and a .jpg file with an actual site plan. The points data and supporting data were matched using its coordinate system and the base maps were made. All points located outside the site's boundaries were deleted.

2.5.4 Online interview. The online interviews were implemented in research aimed at identifying participants' perceptions of Colonial and Indonesian landscape elements at Bogor Botanical Garden. The online chat applications used were Whatsapp, Line, and Blackberry Messenger. Before participants started to the walking phase in Bogor Botanical Garden, they were asked about any active accounts of online chat applications to ensure that they could be interviewed after on-site survey. The online interviews were conducted very well using the online chat application. The capability of online chat applications to transfer images was also very useful during the online interview to participants.

2.6 Analysis Method

2.6.1 Different study sites' character influenced method. There are similarities and differences in the characteristics of two sites in this study, as mentioned in table 7. The landscape character of the sites influenced the walking patterns and the analysis method of each study site. The walking procedure in Bukit Kucing Forest (BKF) was following fixed-trail where in Bogor Botanical Garden (BBG), participants could walk on non-fixed trail or free direction trail (Table 1). The main reason of this different procedure was related to availability of direction information where in BKF the information as not available. To ensure the safety of participants and to ensure that participants did not disturb the wildlife, procedure of participants walked on fixed-trail guided by forest guard was implemented. On the other hand, procedure in BBG was different from BKF that participants could walk on any direction and any trails due to availability of direction information and features information.

Table 1

Difference of Landscape Character of Study Sites

No	Characteristics	Bukit Kucing Forest	Bogor Botanical Garden
1	Area	54 hectares	87 hectares
2	Function	protected areas	botanical garden
3	Location	in the middle of city	in the middle of city
4	Availability of direction Information	not available	available
5	trail options	few	many
6	Landform	Hilly landform	relatively plain
7	resting facilities	less number (4 gazebos in 3 places)	more number (gazebos and benches in many points and 2 café)
8	water attraction	springs, small pond and view to seashore	large ponds with water plants and fountains
9	Buildings	one management building and one forest guard's camp	many colonial buildings, managements buildings and café
10	procedure	participants walked following fixed trail & took impressive landscape objects	participants walked in free direction of trail & took impressive landscape objects
11	Analysis method	Line-based Getis-Ord Gi* hotspots analysis in ArcGIS	Polygon-based Getis-Ord Gi* hotspots analysis in ArcGIS

Due to research procedures in BKF, each participant had the same opportunity to pass trails and see objects along the trail because they walked on fixed route. It was different with the BBG research, where participants could walk freely in any direction. This difference influenced the approach for the analysis method. In BKF, the line-based Getis-Ord Gi* hotspots analysis were implemented to analyze the significant number of points in each trail segment. The hotspots in BKF performed trail segments where participants took photos more frequently than other segments. In BBG, polygon-based hotspots analysis was implemented. The hotspots showed popular cells or places where more participants passed by or stayed longer and took photos

2.6.2 Line-based Hotspots analysis. The photos hotspots based on the polyline method was used for the Bukit Kucing Forest research (see Chapter 3). In this research, all participants followed a similar track and direction. Each part of the track had a similar chance to be passed by participants. This caused the photos points and GPS tracking points to be distributed along a similar trail. Therefore, the research used line-based analysis to analyze the points' hotspots in each part of trail.

The trail was divided into five-meter segments. In each segment, the nearest points of photos points or GPS tracking points were counted (see illustration in Figure 10). The number of nearest points became the value of each segment next to the values analyzed in the hotspots analysis.

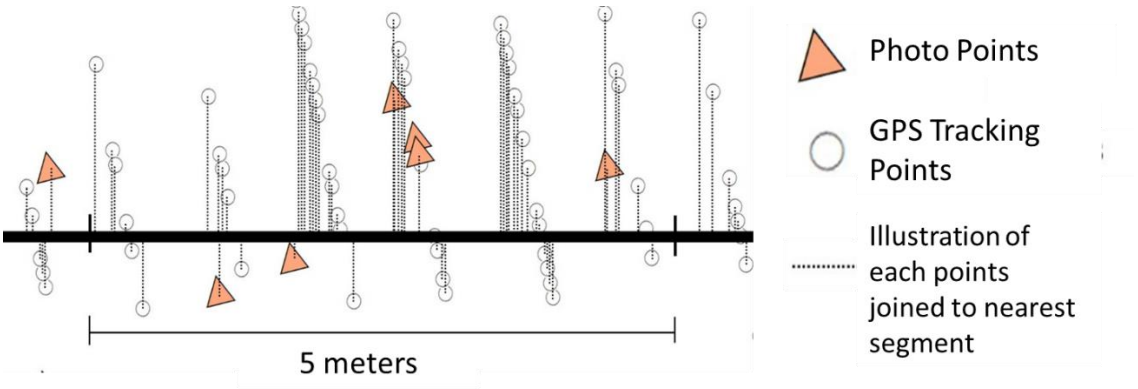

Figure 10. Illustration of nearest photos to each segment.

The hotspot analysis tool used was Getis-Ord Gi* in ArcGIS, which calculates the statistics of each segment, analyzing high or low values to identify cluster patterns in the spatial data. For each segment, the data included count numbers for the nearest points (selfie points, ordinary photos points, or GPS tracking points). The hotspots, or cluster patterns, were determined using the values fed into and calculated by the Getis-Od Gi* hotspots analysis formula (http://resources.esri.com/help, 2017). The spatial weight-

between-segments features were calculated by using fixed-distance analysis. The segment features that had at least one neighbor were weighted as one.

$$G_i = \frac{\sum_{j=1}^{n} W_{ij}X_j - \sum_{j=1}^{n} W_{ij}}{S\sqrt{\frac{[\sum_{j=1}^{n} W_{ij}^2 - (\sum_{j=1}^{n} W_{ij})^2]}{n-1}}}$$

Where:

X_j = Number of nearest points in each segments j (Chapter 3) or number of points that fell in each cell j (Chapter 4)

W_{ij}= Spatial weight between segment i to segment j (Chapter 3) or Spatial weight between cell i to cell j (Chapter 4)

n= Total number of segments (Chapter 3) or total number of cell (Chapter 4)

$$\overline{X} = \frac{\sum_{j=1}^{n} X_j}{n}$$

$$S = \sqrt{\frac{\sum_{j=1}^{n} X_j^2}{n} - (\overline{X})^2}$$

The Gi* is already the z-score therefore no further calculation needed.

In this analysis, the trail was divided into five-meter segments. Each segment feature was examined within neighboring features. If a segment had a high number of nearest points and had a neighbor with a high number of nearest points as well, and this cluster of segment was significantly higher than the total features, those segments were considered as segments where nearest point significantly clustered and deemed hotspots (Figure 11). In contrast, if a segment had a low number of nearest points and had a neighbor with a low number of nearest points as well, and this cluster of segment was significantly lower than the total features, those segments were not significant as hotspots. The significant of hotspots and coldspots can be seen from the Getis-Ord Gi* results.

The results of Getis Ord G_i* analysis report is represented in z-score, p-value and Bin. The Z-score is critical points of each segments that has nearest points. A segment

became a hotspot if the geotagged points had a G_i z-score (results of calculation) higher than 1.96, indicating 95% confidence (see illustration in Figure 11). The G_i p-value is significant of a segment decided as hotspots. If the segment if more than 1.96, then it is equal with more than 95% confidence hotspots. The G_i Bin is the resultant of z-score and p-value. If in a trail segment the z-score more than 1.96 and the p-value more than 95% confidence, then the G_i Bin will be scored as 2 and if z-score more than 2.58 and the p-value more than 99% confidence then the G_i Bin will be scored 3. The segment with G_i Bin 2 or 3 will be decided as hotspots.

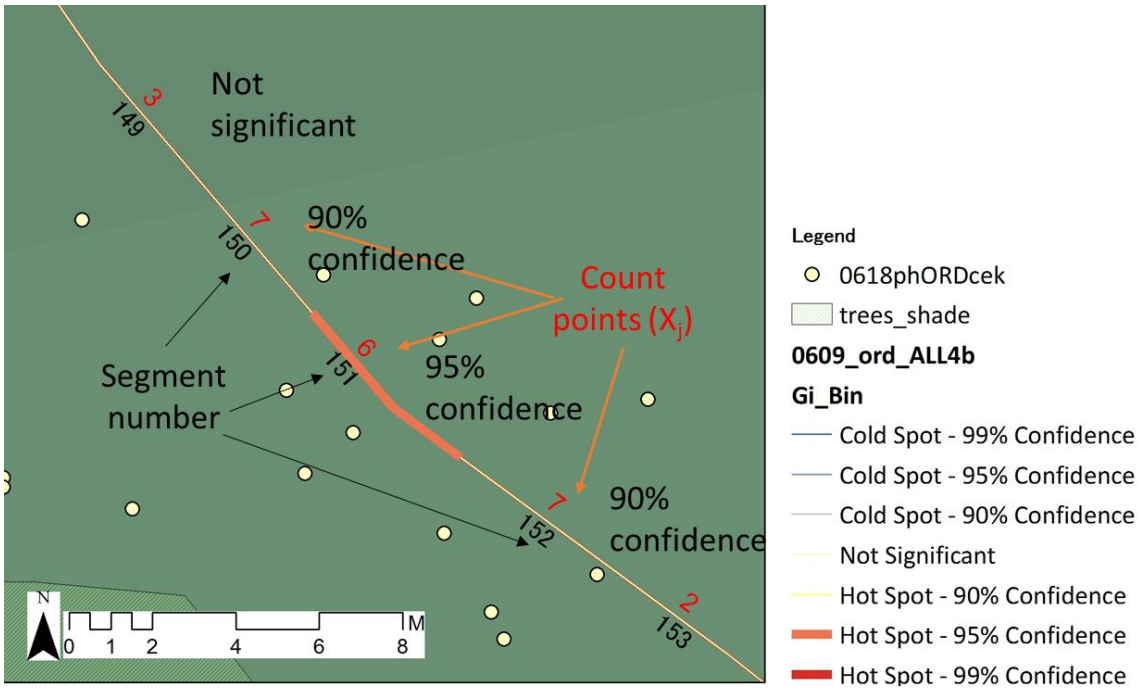

Figure 11. Illustration of Hotspots segments

In each hotspots clusters, the number of photos influenced hotspots were not only photos that near to hotspots segments but also the neighbors. Therefore, the neighbors of hotspots segments (one segment before and one segment after hotspots cluster) were also considered. In order to ease the neighbor segment explanations, the clusters' neighbors were called as "segments $\pm$ 1. The clustering of hotspots were based on the continuously of hotspots segments and segments $\pm$ 1. In those hotspots, there were various types of

landscape elements that impressed participants. The objects that impressed participants can be analyzed by participants' photos of each of the hotspot places.

2.6.3 Polygon-based Hotspots analysis. A hotspots analysis based on a fishnet cell was used for the Bogor Botanical Garden research (Chapter 4). Due to on-site survey procedure for participants, the participants could move freely in any direction in BBG. To count the points in each part of BBG territory, we used an overlay grid dividing BBG into fishnet cells 20 x 20 meters square, covering the entire BBG site inside the boundaries. The photo points and GPS tracking points were joined with the cell and the number of points that fell within in each cell was counted. Any cell that did not contain tracking points was classified as not passed by participants, and these were excluded from hotspot analysis. Cells with a number of points greater than or equal to one were analyzed.

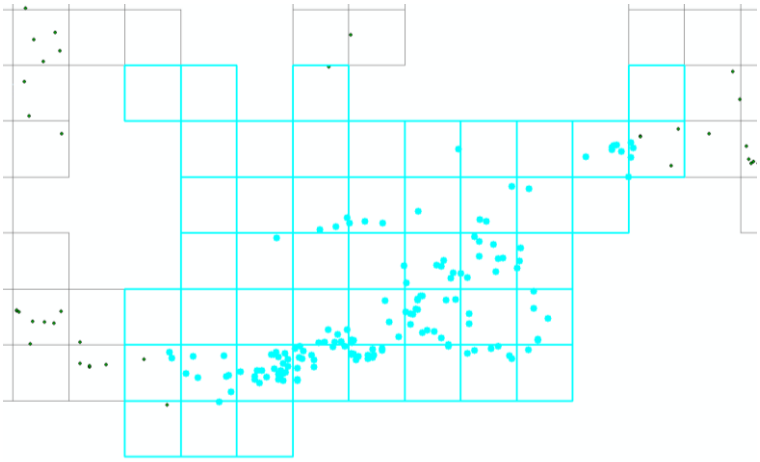

Figure 12. Illustration of points that fell within each cell.

All data obtained were analyzed in ArcGIS software to identify the positions of participants' photos' captured points and GPS tracking points. The Getis-Ord Gi* hotspots analysis was implemented to analyze the data. Of importance were those clusters in cells with high or low numbers of points that had a neighboring cell that also had a

high or low number of points. All values were compared with the sum of the total cells. The local sum of the number of points for a cell and its neighbors was compared proportionally to the sum of all cells. The resultant z-scores informed which cells with high or low values were clustered spatially within which cell and neighboring cell. A cell would have a high value z-score if the z-score was more than 1.96 and they will be stated as hotspots cell (see illustration in Figure 13). The hotspots cells show cells where points are significantly clustered in those hotspots cells.

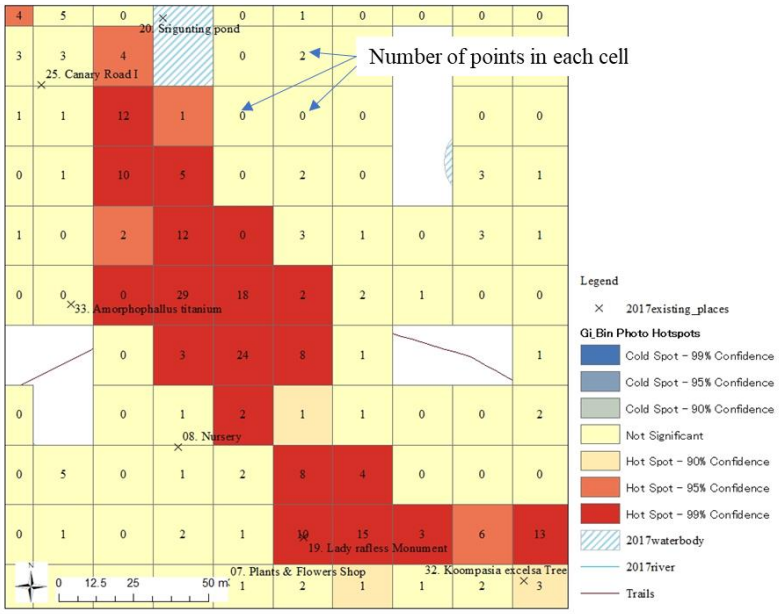

Figure 13. Illustration of hotspots cell

The concept of neighbor in this subchapter is different with concept of neighbor in previous subchapter, where the analysis used a line-based method. In this chapter, cells that shared an edge or corner were considered neighboring cells. Therefore, in the conceptualization of spatial relationships, in this subchapter we used contiguity edges and corners.

The locations identified by photo were assumed to be the popular vantage point locations with popular impressive landscape objects as views and tracking hotspots were assumed as location where participants stayed longer than in other locations.

2.6.4 Chi-squared test of photo hotspots and tracking hotspots. As mentioned in hotspots analysis above, each segment or each cell consisted of a count value of photo points and a count value of GPS tracking points. Any segment or any cell had the probability to become a significant hotspot or not for either photos or GPS tracking or both due to criteria of Getis-Ord Gi* hotspots analysis. The research tried to establish whether there was a relationship among selfie photo hotspots, ordinary photo hotspots, and GPS tracking hotspots (Chapter 3), or between photo hotspots and GPS tracking hotspots (Chapter 4).

A segment or a cell was given score of one if it became a selfie hotspot, an ordinary photo hotspot, or a GPS tracking hotspot. The not-significant ones were given score of zero. Those variables were tested by using a chi-squared test with a 2 x 2 matrix in JMP software. The tested variables were combinations of hotspot categories in each segment (not-significant/significant, selfie photos/ordinary photos, selfie hotspots/ordinary hotspots, selfie hotspots/GPS tracking hotspots, etc.). The test used Hotspots A and Hotspots B to represents tested variables—for example, hotspots of selfie photos (A) and hotspots of ordinary photos (B). The null hypothesis (H_0) was that the variables of Hotspots A and Hotspots B were independent. H_1 was that the variable of Hotspots A and Hotspots B were not independent or it means dependent. If p-value <.05 or less and number of cell which are hotspots of variables A and B more than expected value, the null hypothesis H_0 would be rejected and H_1 would be accepted.

2.6.4 Photos' focused objects analysis. In this research, each photo captured had information about the geolocation of the person taking the photo (vantage point). However, for each vantage point, it was still necessary to analyze what scenes or objects were the desired focus or subject (Hull & Revell, 1989). Therefore, each photo was examined and its focused objects subjectively studied by the researcher (Table 2). The focused objects are objects that mainly captured in photos and influence whole themes of photos. The criteria of focused objects in each photo are explained in table below. Each photo was scored one according to its focused objects' criteria. The number of photos-influenced hotspots according to its focused objects was counted in each hotspot's place.

Table 2

Criteria or Photos Categorization Based on Focused Objects

No	Focused Objects	Criteria
1	Plants	Any kind of plant with stem, both the root appear or not, with branch and leaves, include: trees, bushes, grasses, weeds
2	Opening area	Grassland or lawn without or less trees' shadings
3	Part of plants	Part of plants that captured in close distance (zoom in). part of plants can be still join with main plant or already dropped or separated with main plant. Example of part of plants: leaves, flowers, fruits, seeds, dropped leaves, roots, trunks, branch, etc
4	Animal	Animals or animals' nest and prints
5	Corridor	Corridor of trail, drainage or electric lines with spaces on the left an right side
6	natural elements	Non-man made elements that already exist on the site such as rocks, springs, water, sky
	structures	Man-made structures include buildings, recreation facilities and infrastructures, such as: any kind of buildings, gazebos, shelters, bridges, drainage, sculptures, benches, buildings, etc
8	Panoramic view	Long distance view. The objects on far can be captured in photos
9	others	Any objects that were not categorized above, such as garbage, vehicles, well, etc

The focused objects information from each photo was used to analyze the character of impressive landscape objects in each hotspot. The most number-focused objects captured in photos-influenced hotspots were assumed to be the most impressive landscape objects as seen by participants in that place.

2.6.5 Selecting Historical-Colonial and Indonesian landscape elements and styles. In the research of "Historical-Colonial look" and "Indonesian look" landscape style in Bogor Botanical Garden, we used a cognitive paradigm by asking participants to answer questions and select photos that they thought represented "Historical-Colonial look" and "Indonesian look." In online interviews, the researcher asked participants "Which photo shows Historical-Colonial look landscape and which photo shows Indonesian-look landscape?"

The photos were sent by the participants after their site survey via online chat. Each of the landscape elements that appeared in each photo was analyzed and tabulated. Elements appearing in each photo were scored as one, whereas absent elements were scored as zero. In addition, each photo was matched with the respective GPS logger's time-tracking data to obtain geoposition of each photos by using GeoSetter software.

The focused objects of each photo were then counted to get information about focused objects in "Historical-Colonial look" and "Indonesian look." The photos' point density in each cluster was also identified using point-density analysis in ArcGIS. The densest photo points revealed the most common observation locations in which visitors perceived either the "Historical-Colonial look" or "Indonesian look" in the landscape. The location of these points was assumed to be the best observation positions and the most common place for visitors to capture both Historical-Colonial and Indonesian styles in the landscape.

The points-density analysis is a tool in ArcGIS to calculate density of points. Points were determined in a circle area or cell, and their neighbors (other points) within were included in each points' circle area or cell and totaled and divided by the area. If there were no neighbor points within a cell, it was assigned as no data. The output of this analysis was raster data of points density. This is qualitative output but it can be used to inform the concentration of geotagged photos points or vantage points spatially.

Chapter 3

Identifying Impressive Landscape Objects Based on Geotagged Photographs (A Case Study of Selfie photos and Ordinary Photos) – Bukit Kucing Forest, Tanjungpinang City

3. Identifying Impressive Landscape Objects Based on Geotagged Photographs (A Case Study of Selfie Photos and Ordinary Photos)—Bukit Kucing Forest, Tanjungpinang City

In any tourism activity, the visitors' inspiration and willingness to capture photographs could change from "looking at," in which people capture objects they see, into "involvement in," in which people want to be captured as photo objects (Markwell, 1997). The concept of "involvement in" is expressed in the current participants' self-portrait photographs (selfies) captured on site, with people as the foreground and the landscape as the background. A selfie is a type of photograph in which the main object is the human whose face stares at the camera. Selfies are identified as photos captured by individuals using their arm to extend the camera as far away as possible but with the lens still pointed toward the face. The selfie, the popularity of which is reflected in the term's addition to the *Oxford Dictionary* in 2013, is a photographic object that initiates the transmission of human feeling to others (Senft & Baym, 2015). Selfies show that the person taking the photo "was there" and witnessed certain events in a particular time and space (Koliska & Roberts, 2015). Taking a selfie is an expression of one's self in a place and time; vacation spots, landmarks, and recreational destinations are commonplace elements for selfies (Hess, 2015).

For Indonesians, taking selfies is a widespread social phenomenon (Simatupang, 2015). Selfies dominate the profile pictures and albums of Indonesians' social media pages. The importance of selfies for Indonesian people can be seen in any Indonesian forest or park, where it is a common to see visitors taking selfies (see example in Figure

14). The selfie phenomenon in Indonesia is related with the expansion of the smartphone market: in 2013, the number of cellphones sold reached 55 million units, 28% of which were smartphones. Several reasons have been identified for the Indonesians' love of the selfie: to maintain their existence in social media, to record important moments in their life, and to engage in a hobby (Siregar & Kurniadi, 2015). As regards the third reason, selfies are captured anywhere, including in recreation areas. Selfies with a natural open space as background are one of the most common types of social media profile picture preferred by university students in Indonesia (Franzia, 2015).

Figure 14. Example of selfie behavior of Indonesian people in a forest or park. Source: Participant's photo.

GPS technology and research using GPS tools to track visitors has been conducted since around 2005 (Shoval & Ahas, 2016). Since then, the use of GPS tracking has contributed to photo-based landscape research. Through GPS tracking, it is possible for researchers to track the location of visitors' captured photos, assign geotagging information to photos, and use GIS technology to detect trends and hotspots of locations captured in photographs (Mizuuchi et al., 2015; Sugimoto, 2011). By integrating GPS

loggers into this study, the researcher was able not only to analyze the photos produced by participants, but also to investigate the walking and stopping patterns of participants.

The objective of the research described in this chapter was to identify impressive landscape objects based on visitors' geotagged photos captured while participants walked in Bukit Kucing Forest. The geotagged photos included both selfie photos and non-selfie photos (ordinary photos). This research also aimed to determine if the selfie photos can be used as research objects for VEP research.

3.1 Participant Demographics

The average age of the study participants in this portion of the research was 20 years, and the age range was 18 to 31 years. Regarding gender, 48.21% of the participants were male and 51.79% were female. More male participants reported having previous knowledge and awareness of the site before the site survey. However, only nine male and two female participants had visited the site before the site survey. Participants mostly came from other cities (67.86%). In total, 64.29% of the participants who came from cities other than Tanjungpinang city had never visited the site.

3.2 Participants' Geotagged Photos

From the 61 participants, 1,647 geotagged photographs were collected. The geotagged photographs were separated into two categories, namely selfie photos and non-selfie photos. The non-selfies will be called "ordinary photos." A photograph was categorized as a selfie photo if it featured human face staring at the camera. The selfie photos could be photos captured by participants' holding their own camera (selfie photos) or taken by other people (assisted self-portrait). In contrast, the ordinary photos were those photos without humans as a main object.

In this research, the geotagged photographs were useful to identify locations of where photographs were taken or from which vantage points. According to the procedure of taking photographs in this research, the geotagged photographs captured by participants was a record of the locations and landscape objects that impressed participants along fixed trail. This is consistent with other geotagged photo-based research (Mizuuchi et al., 2015) in which geotagged photographs indicated relevant places and preferred objects on particular sites.

The researcher's instructions did not mention selfie photos at all, so participants were not influenced to take or not take self-portraits. Not all participants captured self-portraits at the site. Nine participants (14.76%) took no selfie photos at the site. In all, 292 selfie photos were produced by the 52 participants (85.24%) who captured selfie photos during their walk.

The vantage points of each participant's photographs were detected by the ArcGIS software. In the figures of hotspots of trail segments; those indicated by thicker red lines were more significant than other segments.

3.3 Ordinary Photograph Hotspots

From a total of 1,712 participants' photos, there were 1,300 ordinary photos captured by participants. The ordinary photos' vantage points were distributed along trail (Figure 15). From Getis-Ord Gi* hotspots analysis of the geolocation of those participants taking ordinary photos on the site, there were 8 hotspot places as indicated by 484 ordinary photographs (35.72% of total photos) (Figure 16 and Table 3). As explain in Getis-Ord Gi* hotspots analysis in chapter 2, a segment will be decided as hotspots if the segment feature has high number of nearest points and its neighbors also have high number of nearest points, performed by Gi Z-score more than 1.96 and p-value more than

0.950. The results of Getis-Ord Gi* analysis of each hotspots segment and neighboring segment were written in Appendix C.

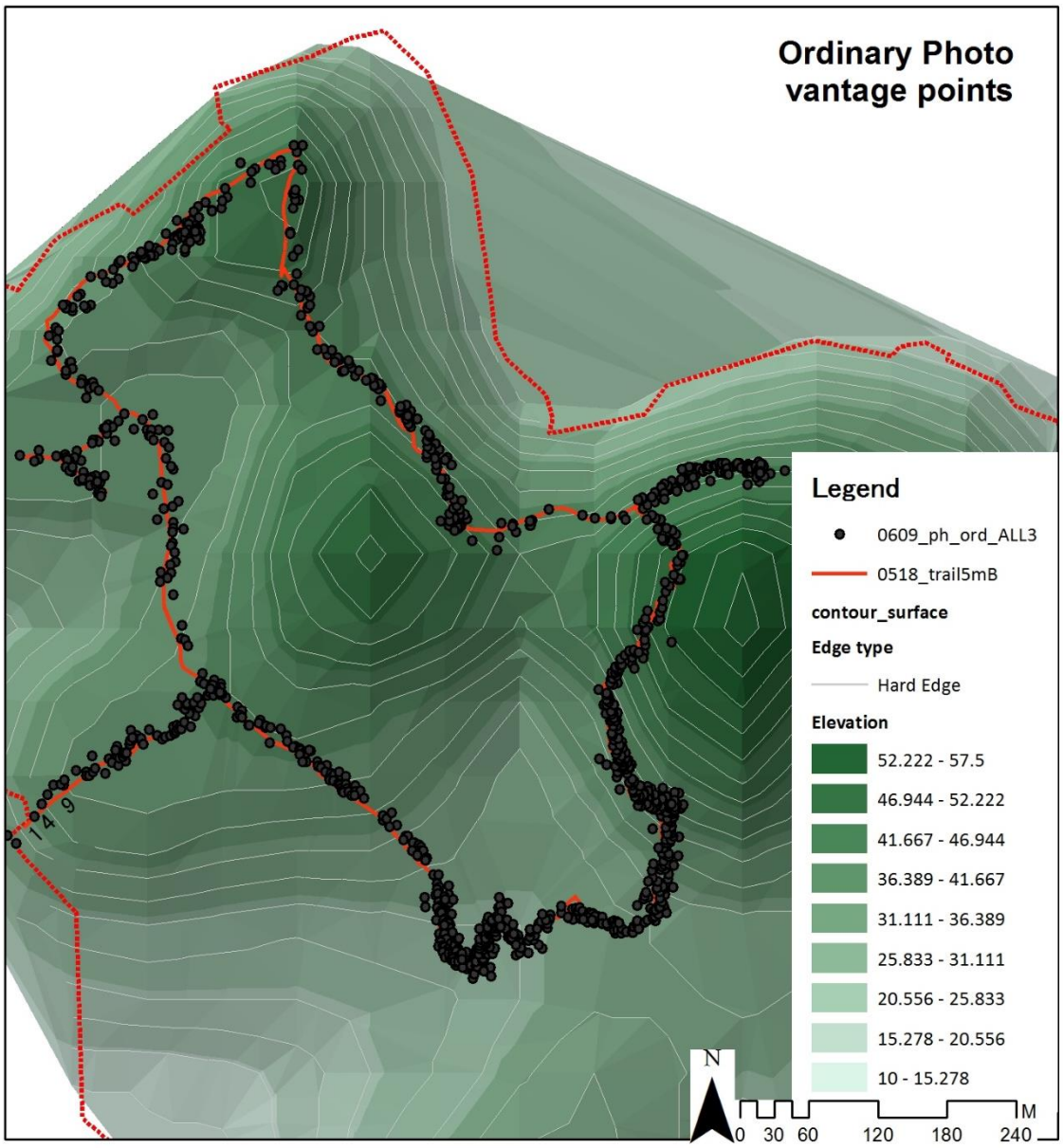

Figure 15. Vantage Points of Ordinary Photos Hotspots

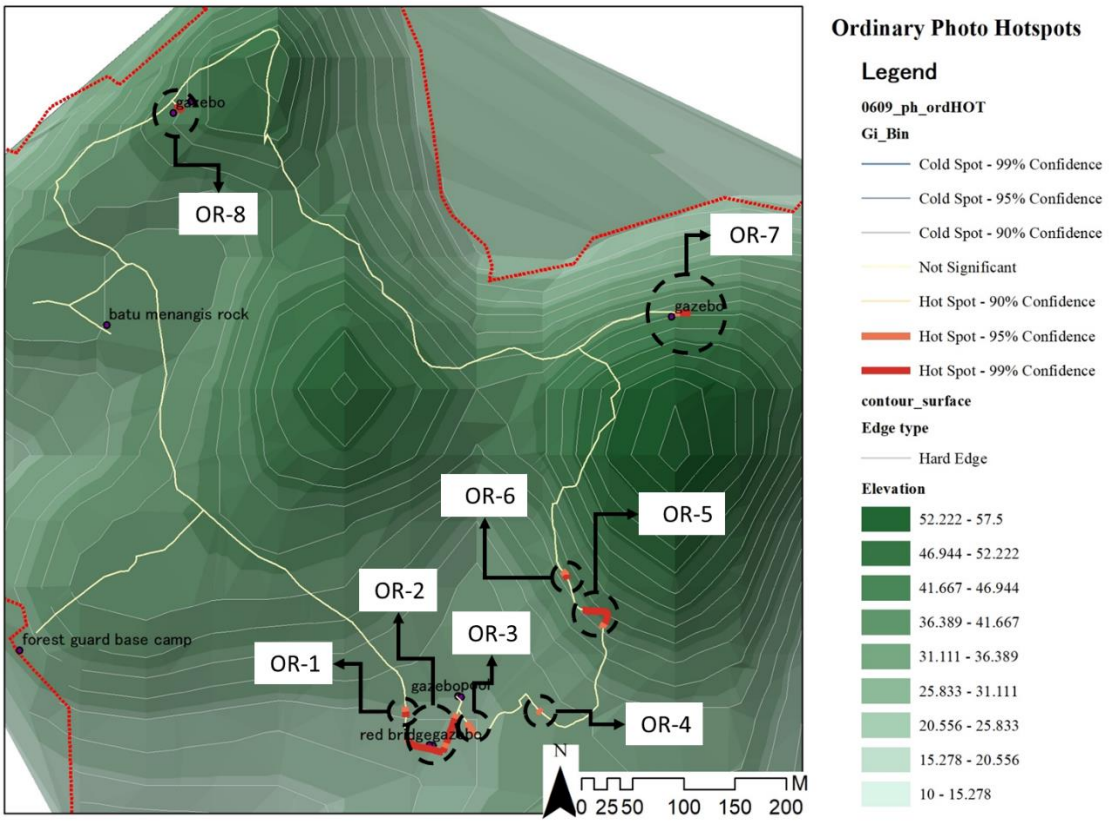

Figure 16. Hotspots map of ordinary photographs.

Table 3

Number of Focused Objects Captured in Each Ordinary Photo Hotspots' segment

NO	Hotspots		Number of nearest photos according to focused objects*									trees shade	Elevation (m)
	name	Segment	1	2	3	4	5	6	7	8	sum		
1	Melalueca trees	99**	2		1		2				5	Yes	25.753
	(OR-1)	100	4		1		1		3		9	No	25.530
		101	4		2		1				7	Yes	25.292
		102**	6		1				1		8	No	24.951
	Sum (OR-1)		16	0	5	0	4	0	4	0	29		
2	Red-bridge area	105**	5		1				4		10	Yes	24.259
	(OR-2)	106	1						3		4	Yes	24.054
		107			1				5		6	Yes	23.928
		108	2		1		1		9		13	Yes	23.818
		109	1		1		1	1	16		20	Yes	23.765
		110	1				1		11		13	Yes	23.716
		111	3				7		8		18	Yes	23.706
		112	1				8	1	11		21	Yes	23.856
		113	2	1	3		3	2	3		14	Yes	24.049
		114					1		2		3	Yes	24.233

		115	1	1			1		3		6	Yes	24.411
		116	2		2		2	1	3		10	Yes	24.589
		117	1		1		1	3	3		9	Yes	24.767
		118	3	1			2	1			7	Yes	24.941
		119	5				1	3	1		10	Yes	25.000
		120	3		2		1	2	2		10	Yes	25.003
		121	3		1		1	2	2		9	Yes	25.125
		122**					1	2			3	Yes	25.308
	Sum OR-2		34	3	13	0	32	18	86	0	186		
3	Transition area 1	128**	1		4						5	Yes	25.011
	(OR-3)	129			2						2	Yes	25.000
		130	5		8						13	Yes	25.000
		131	1		2		1				4	Yes	25.000
		132**	3				1				4	Yes	25.023
	Sum OR-3		10	0	16	0	2	0	0	0	28		
4	Transition area 2	150**	4		2			1			7	No	26.780
	(OR-4)	151	4				1	1			6	No	26.902
		152**	4	1				2			7	No	27.044
	Sum OR-4		12	1	2	0	1	4	0	0	20		
5	Grassland 1	180**	2	1				1			4	No	35.082
		181	1	2							3	No	35.730
		182	5	1	2	1				3	12	No	36.520
		183	5	19	1	3				1	29	No	37.272
		184	4	11	1	3					19	No	37.560
		185	4	10	1	1					16	No	37.242
		186	7	5							12	No	36.721
		187	4	6	2	1					13	No	36.161
		188	4	4	1						9	No	35.660
		189**		2	1						3	No	35.156
	Sum OR-5		36	61	9	9	0	1	0	4	120		
6	Grassland 2	195**	3	1	3						7	No	35.957
		196	4		3			1			8	No	36.070
		197	1	1	7						9	No	36.081
		198**	1	0	2						3	No	35.950
	Sum OR-6		9	2	15	0	0	1	0	0	27		
7	Hilltop gazebo	272**	2							2	4	Yes	41.519
	(OR-7)	273	1				1			6	8	Yes	41.747
		274	1						1	6	8	Yes	41.887
		275	1		1				2	20	24	Yes	41.959
	Sum OR-7		5	0	1	0	1	0	3	34	44		
8	Historical Sculpture	414**	1								1	Yes	38.944

	(OR-8)	415							8		8	Yes	39.478
		416	3		3		1		14		21	Yes	40.003
	Sum OR-8		4	0	3	0	1	0	22	0	30		

*:

1. Plants
2. Opening area and Grassland
3. Part of Plants
4. Animals
5. Corridor of trail and drainage
6. Natural Features
7. Man-made Structures
8. Panoramic views

**: One segment before and one segment after hotspots segments (segment $\pm$ 1)

Hotspots “OR-1” included segments number 99 to 102 (Table 3). There were total 29 photos influenced hotspots along those segments. The location of these segments are in a corridor before Red-bridge area where many Melaleuca trees were exist (Figure 17). The bark of melaleuca trees are soft texture and some trees were half burned caused the trunk looked darker than surrounding trees. These trees are visible from trail corridor. There were 16 photos consist of Melaleuca trees as focused objects in these hotspots segments.

Figure 17. Example photos of Hotspots OR-1: Melaleuca trees area

Hotspot "OR-2" was the most popular hotspot place, as the vantage point for 186 ordinary photographs. It included trail segments number 105 to 122 (Table 3). Most of the photographs at this hotspot area consisted of physical structures (86 photos), any kind of plants (34 photos), corridor (32 photos), parts of the plants (13 photos), and natural features (18 photos), with the rest being open area without trees' canopy (3 photos). the example of participants' photos in OR-2 hotspots area can be seen in Figure 18. In this hotspot area, the bridge was the most frequently captured physical structure in participants' photos. The hanging style and red color of the structure makes the bridge easy to spot from a distance and breaks the monotonous green color of the surrounding trees and shrubs. Here, "contrast" as a landscape design principle is prominent in the design of the bridge and influences its composition, all of which attracts visitors' attention. The design of the Red Bridge is also unique compared to other bridges in Tanjungpinang City. The bridge was not only captured as a target object of photographs, but was also used as a

vantage point that enabled participants to capture surrounding objects. This is similar to results found by (Sugimoto, 2013) in which a bridge served not only as an impressive focal object but also became a sightseeing resource for viewing the surrounding space.

Figure 18. Example photos of Hotspots OR-2: Red-Bridge area

Hotspots “OR-3” included trail segments number 128 to 132 (Table 3). It was called as transition area because it is a transition between Red-bridge area and grassland area. In this place, the Red-bridge was not visible anymore and the grassland still not visible too. In these segments, there were 28 nearest ordinary photo’s points. These segments were located along corridor after Red-bridge area. In this place, participants were attracted to Passiflora plants (climber plants) with its red-flowers (Figure 19). There were 16 photos captured by participants with focused objects of the red-flowers of Passiflora plant.

Figure 19. Example photos of Hotspots OR-3: Transition I area

Hotspot “OR-4” included trail segments number 150 to 152 (Table 3). It was called as transition area because it is an open area with less of trees’ canopy but the grassland was not yet visible. It was an area before the opening grassland area. In this place, there were ferns as ground cover plants and trees as background. In this place, participants feel opening area of forest after on the previous trail segments they feel experiences walking under trees’ canopy. The changing of under trees’ canopy to opening area with view to wider scenes and ferns as ground cover influenced participants to take photos more in this area. The example of participants photos captured in Hotspots OR-4 can be seen in Figure 20. There were 20 photos influenced hotspots in this area with 12 photos consist of ferns as foreground and trees as background with situation less of trees’ canopy.

Figure 20. Example photos of Hotspots OR-4: Transition II area

Hotspot "OR-5" consisted of 120 ordinary photographs (Table 3). The photographs mostly featured an open area of grassland (61 photos), with the next most common being any kind of plants (36), parts of plants (9 photos), and animals and animals' imprints (9 photos); the rest featured corridor panoramic views (4 photos), (1 photo) and natural features of sky (1 photos). The grassland forms a wide bit of scenery that makes it possible for participants to see trees in the far distance as background. From this opening area, participants were able to see a tree with Eagle's nest and sometimes the Eagles were visible flying on the sky. Unlike in other parts along the predefined trail, the trees in the area offer less canopy coverage and provide full sun that reaches the forest floor (Figure 21). Therefore, it offered a wide landscape scene that attracted participants to stop and document the view. The parts of plants and animals that were captured in other hotspots were captured more in this place. Those objects are potential objects that need to be more explored as attraction in ecotourism programs of Bukit Kucing Forest.

Figure 21. Example photos of Hotspots OR-5: Grassland Area I

Hotspots “OR-6” included trail segments number 195 to 198 (Table 3). These segments were also located on grassland area. However, many attractive trees such as a tall pine tree and drought trees attract participants’ attention (Figure 22). There were also more part of shrubs plants such as flowers and seeds. There were 9 photos consist of unique shape of trees and 15 photos consist of part of plants captured by participants in this hotspots place.

Figure 22. Example photos of Hotspots OR-6: Grassland Area II

Hotspot "OR-7" consisted of 44 ordinary photographs (Table 3). Similar with the trend of selfie photos background, the focused objects of the photographs of these hotspots mostly consist of panoramic view of Tanjungpinang city (34 photos). The panorama of the city in lower elevation can be seen from this hilltop (Figure 23). A 9.50 m^2 gazebo is located on the hilltop, which became a resting point for participants after they walked up the ascending slope. While resting, participants enjoyed a panoramic view of Tanjungpinang City and took photographs.

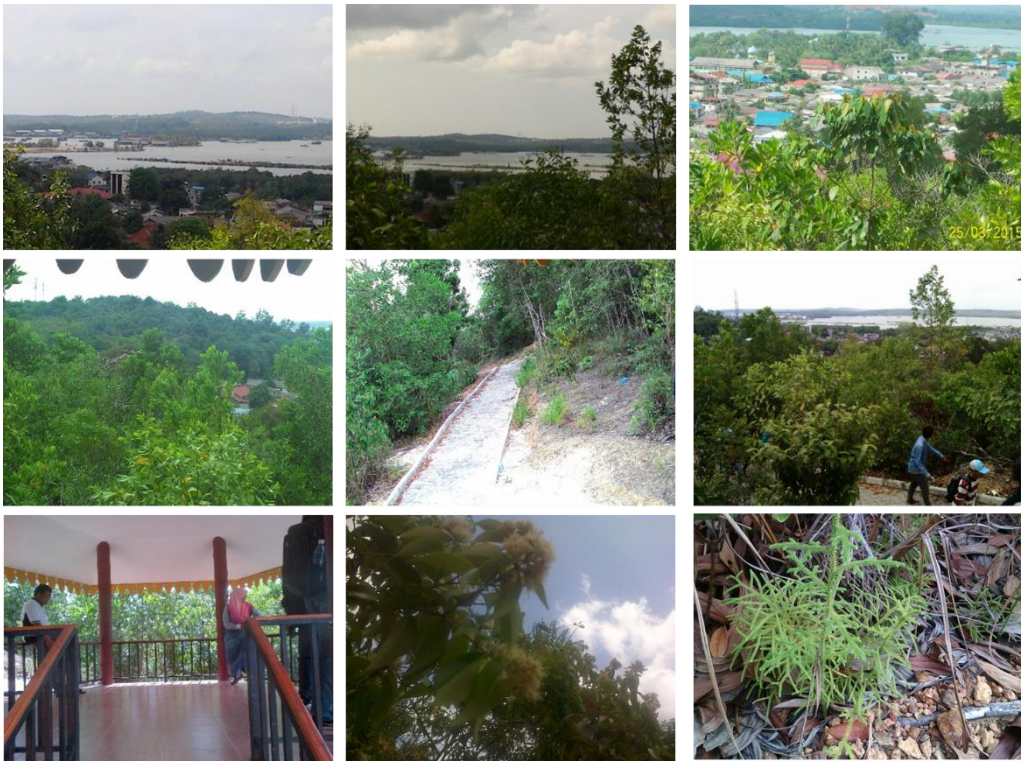

Figure 23. Example photos of Hotspots OR-7: Hilltop Gazebo area

Hotspot “OR-8” consisted of 30 photos (Table 3). The photographs in this hotspot mostly consisted of the Historic Inscription Sculpture as the focused object (22 photos). The sculpture looks regular, but on the logged part, there is a historic inscription noting replanting activities in 1989 as supervised by City Major of Tanjungpinang City (Figure 24). Participants were interested in the history of Bukit Kucing Forest; therefore, they captured it in photographs.

Figure 24. Example photos of Hotspots OR-8: Historical Sculpture area

3.4 Selfie Photo Hotspots

The total number of selfie photos captured by participants at BKF was 412 selfie photos from 35 participants. the vantage points of selfie photos were distributed along the trail (Figure 25). From the total photos, there were 108 photos influenced by the appearance of seven hotspots along the trail (Figure 26). The Getis-Ord Gi* analysis results that shows the significance of hotspots segment and segment $\pm$ 1 of Selfie Photos hotspots is available in Appendix D. The number of selfie photos in each hotspot segment differed (Table 4).

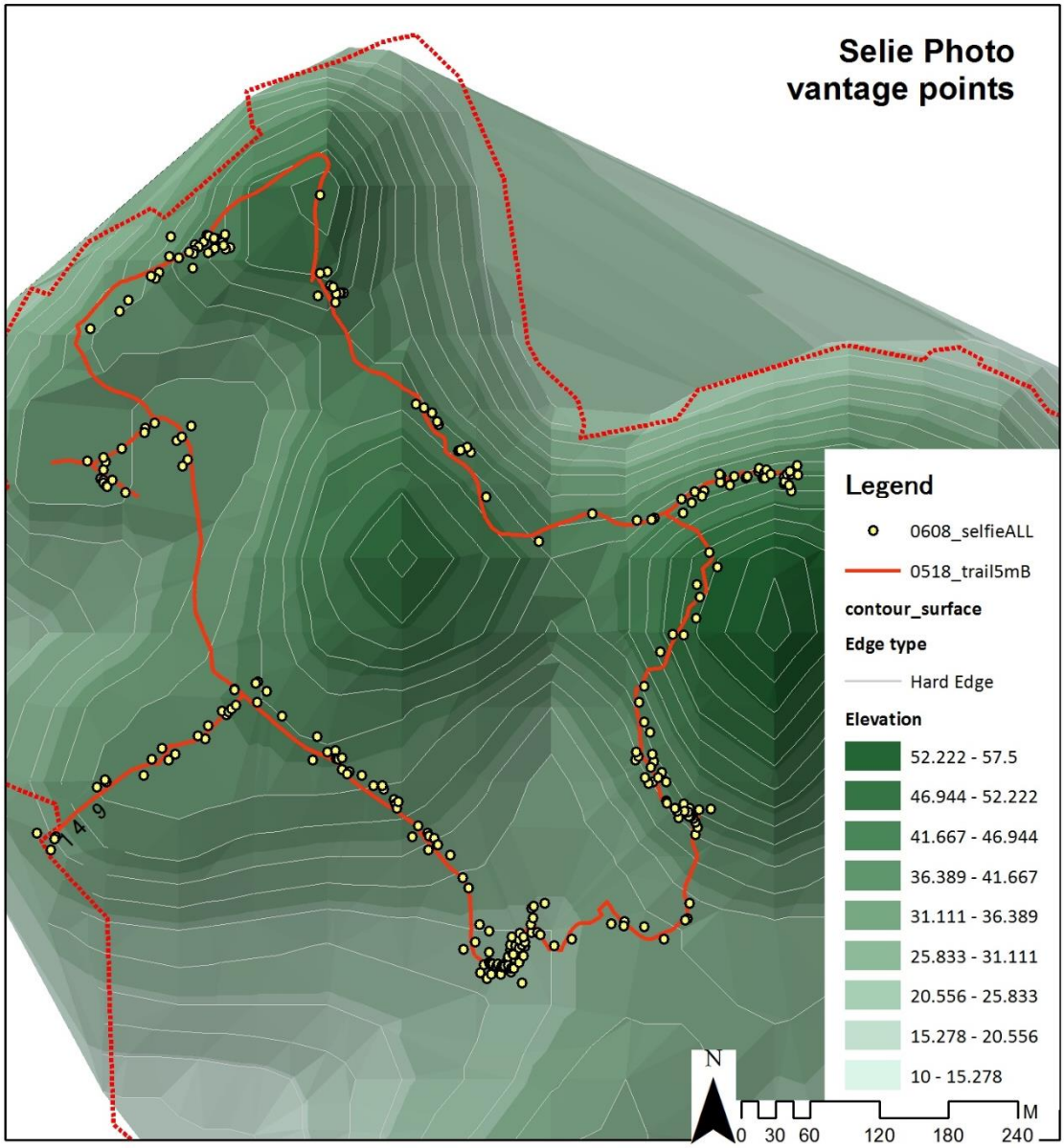

Figure 25. Vantage points of Selfie photos

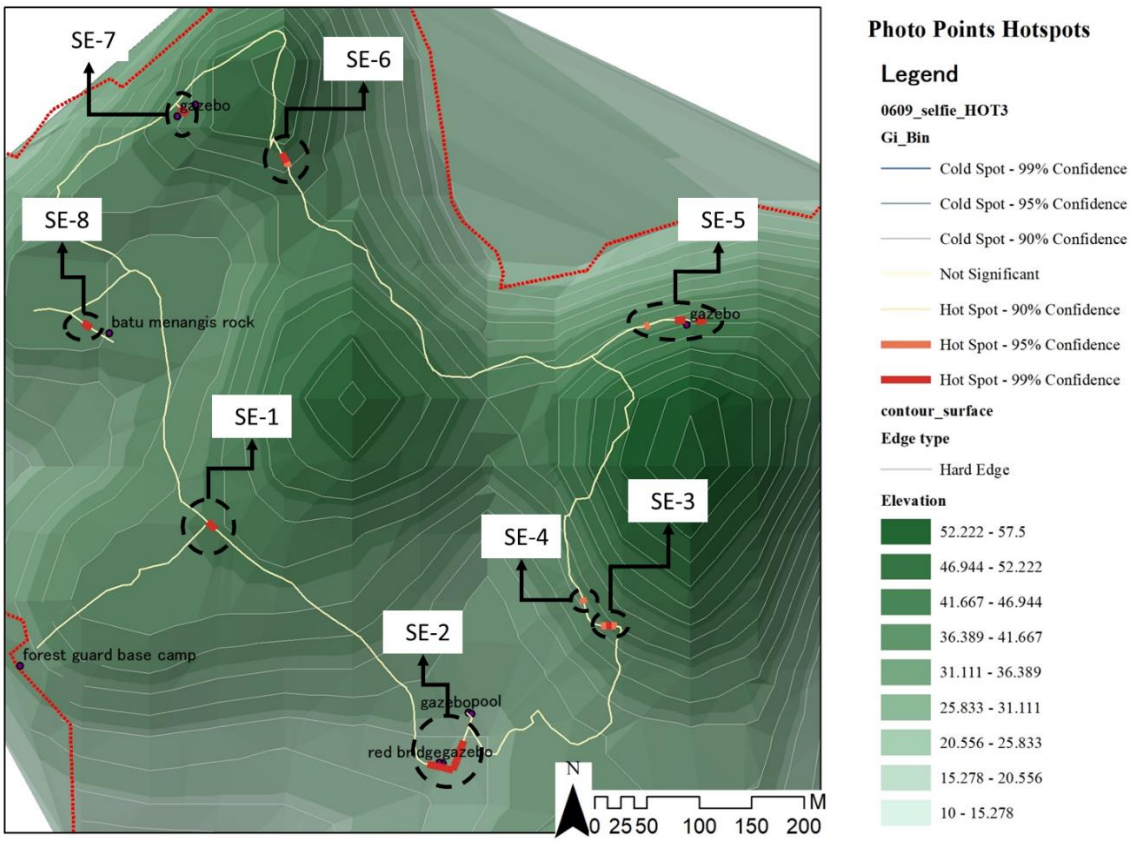

Figure 26. Hotspots map of selfie photos.

Table 4

Number of Background Scenes Captured in Each Selfie Photo Hotspot

No	Hotspots		Number of photos based on Selfie background*									trees shading	elevation
	Name	Segment	1	2	3	4	5	6	7	8	Sum		
1	First intersection	43	1				3				4	Yes	37.015
	(SE-1)	44	2								2	Yes	37.152
		45**	3								3	No	37.205
	Sum (SE-1)		6	0	0	0	3	0	0	0	9		
3	Red-bridge area	108**							2		2	Yes	23.818
	(SE-2)	109							3		3	Yes	23.765
		110	1						7		8	Yes	23.716
		111							3		3	Yes	23.706
		112							8		8	Yes	23.856
		113					2		3		5	Yes	24.049
		114						1			1	Yes	24.233
		115							3		3	Yes	24.411
		116							4		4	Yes	24.589
		117	1						2		3	Yes	24.767
		118	1						4		5	Yes	24.941
		119						1	1		2	Yes	25.000
		120**	2								2	Yes	25.003

	Sum (SE-2)		6	0	0	0	2	2	40	0	50		
6	Grassland I	184**		1							1	No	37.560
	(SE-3)	185		2							2	No	37.242
		186	2	1							3	No	36.721
		187		2							2	No	36.161
		188**		1							1	No	35.660
	Sum S-3		2	7	0	0	0	0	0	0	9		
7	Grassland 2	193**		1							1	No	35.484
	(SE-4)	194	1	1							2	No	35.733
		195**		1							1	No	35.957
	Sum (S-4)		1	3	0	0	0	0	0	0	4		
8	Hilltop gazebo	263**					1		1	2	4	No	40.339
	(SE-5)	264					1				1	No	40.358
		265**					1				1	Yes	40.216
		269**									0	Yes	40.564
		270	1				1			1	3	Yes	40.858
		271	3							1	4	Yes	41.185
		272								1	1	Yes	41.519
		273									0	Yes	41.747
		274	2							2	4	Yes	41.887
		275	1						3	4	8	Yes	41.959
	Sum (SE-5)		7	0	0	0	4	0	4	11	26		
9	Corridor	358**									0	Yes	39.920
	(SE-6)	359	1	1							2	Yes	40.449
		360	4								4	No	41.060
		361		1			2				3	No	41.485
		362**									0	No	41.808
	Sum (SE-6)		5	2	0	0	2	0	0	0	9		
10	Historical	414**					1				1	Yes	38.944
	(SE-7)	415	1						3		4	Yes	39.478
		416	3				2		4		9	Yes	40.003
	Sum (SE-7)		4	0	0	0	3	0	7	0	14		
11	Batu menangis Rock Springs	539**	1				1				2	Yes	32.500
	(SE=8)	540	3								3	Yes	32.500
		541	3				1				4	Yes	32.500
		542**									0	Yes	32.500
	Sum (SE-8)		7	0	0	0	2	0	0	0	9		

*:

1. Plants
2. Opening area and Grassland
3. Part of Plants
4. Animals
5. Corridor of trail and drainage
6. Natural Features

7. Man-made Structures
8. Panoramic views

**: One segment before and one segment after hotspots segments (segment ± 1)

Hotspot “SE-1” is including segment number 43, 44 and 45 (Table 4). It is located in the first intersection after starting points, consisted of four photos. Participants took selfie photos of any kind of trees as and corridor as selfie background (Figure 27). In this place, participants more to wait for friends and forest guard to make sure that they took correct trail. This situation happened because there were no information about direction in BKF.

Figure 27. Example Selfie photos of Hotspots SE-1: First intersection

Hotspot “SE-2” included segments number 108 to 120 (Table 4). It was a similar location to hotspot “OR-1” in ordinary photographs. There were 50 selfie photos taken at the Red Bridge area. The most frequently captured object as a selfie photo’s background

was man-made structures, include: Red Bridge, gazebos, drainage ditch and pond structures, with totally 40 photos (Figure 28). The rest of photos consist of any kind of plants (6 photos), corridor (2 photos) and water as natural features of pond and drainage (2 photos).

Figure 28. Example Selfie Photos of Hotspots SE-2: Red-Bridge Area

Hotspot “SE-3” included segments number 184 to 188 (Table 4). It was a similar location to hotspot “OR-5” in ordinary photographs, which was characterized by an open area consisting of grassland and low density of trees (Figure 29). There were nine selfie photos taken in this area. Most participants took photos with the grassland as the selfie background (6 photos).

Figure 29. Example Selfie Photos of Hotspots SE-3: Grassland I

Hotspots “SE-4” included segments number 193 to 195 (Table 4). This place is similar location with hotspots “OR-6” in ordinary photographs where the unique grass flowers. Many participants took photos with background and foreground of grasses with flowers (Figure 30).

Figure 30. Example Selfie Photos of Hotspots SE-4: Grassland II

Hotspots “SE-5,” which was a similar location to hotspot “OR-7” in ordinary photographs, included 20 photographs of the hilltop area (Table 4). The panoramic view of Tanjungpinang city was captured most frequently in the selfie photos’ background (8 photos), followed by any kind of plants as selfie photos’ background (7 photos). The example of participants’ selfie photos with its background scenes can be seen in Figure 31.

Figure 31. Example Selfie Photos of Hotspots SE-5: Hilltop Gazebo

Hotspot “SE-6” was refers to selfie hotspots that shared common features but not common locations on the trail. There were nine selfie photos captured by participants in this segment area (Table 4). The selfie photo backgrounds consisted of tall shrubs on the left and right side of trail corridor (any kinds of plants) as background (5 photos), open areas (2 photos), and the trail corridor (2 photos) (Figure 32).

Figure 32. Example of Selfie Photos of Hotspots SE-6: Corridor

Hotspot "SE-7" was a similar location to hotspot "OR-8" in ordinary photographs. There were 13 selfie photos captured in this hotspot area (Table 4). The Historical Inscriptions Sculpture is a human-made structure that attracted participants to take selfie photos with the sculpture as background (Figure 33).

Figure 33. Example of Selfie Photos of Hotspots SE-7: Historical Sculpture

Finally, for hotspot "SE-8," which was the least common of the selfie hotspots with 7 selfie photos (2.40%) of total selfie photos, the Acacia trees' trunks were the most popular background for participants (Figure 34).

Figure 34. Example of Selfie Photos of Hotspots SE-8: Batu Menangis Springs area

Some hotspots for selfies—"SE-1," "SE-6," and "SE-8"—were not also hotspots for ordinary photographs. Although the number of selfie photos and ordinary photographs was different, the overall numbers suggest that the selfie photos were valuable indicators of impressive or attractive landscape elements, and able to show more numbers of popular places than ordinary photographs.

Selfie photos with understory spaces as background were mostly taken in hotspots "SE-1" and "SE-8." The selfie photos in hotspot "SE-1" were taken under tree canopies on the first intersection after starting point. In this intersection or T-crossing, participants had to stop to wait for forest guard, who walked some distance behind them, as they were

unsure about the direction they had to walk due to unavailability of information about the site. During the wait, they took many selfie photos under the trees' canopy or understory. In hotspot "SE-8," the unique feature of plants is the understory of *Acacia auriculiformis* trees. This area is characterized by fewer shrubs in the understory below the Acacia tree canopy. The floor of the forest is clearly visible, and covered by the fallen leaves and trunk's texture of Acacia trees. Shrubs as selfie photo backgrounds were most evident in hotspot "SE-6." There are many dense shrubs on left and right sides of the corridor. Actually, there is no specialty in the morphology of the shrubs, but because it forms a vertical sparse wall, some participants stopped and took photographs with the shrubs as background.

However, there were objects that were captured less often in selfie photos as backgrounds but captured more often in ordinary photos. These included small, detailed landscape objects such as parts of plants, animals, animals' imprints, and natural features. This shows the weakness of using only selfie photos for identifying impressive or interesting landscape elements, as the participants found it difficult to capture small detailed elements as selfie photo backgrounds.

The impressive objects captured most frequently in selfie hotspots but not as often in ordinary photos were parts of plants. In selfie hotspots "SE-8," participants mostly took photos with unique character of trees' trunk, such as close-ups of Acacia trees. In hotspot "SE-7," participants took selfie photos with wider views of the tall shrubs as selfie backgrounds.

3.5 GPS Tracking Hotspots

The GPS tracking point data were downloaded from the GPS logger that recorded each participant's position on the site. In ArcGIS, the data were represented in point features. Since each GPS logger was set to record the device's actual geoposition every one second, each point on the map represented one second. By using the Getis-Ord Gi* hotspots analysis, the researcher identified five clusters of segments as significant hotspots (Figure 35 and Table 5). The results of Getis-Ord Gi* analysis of each hotspots segment and segment ± 1 of GPS tracking hotspots is available in Appendix E. In these hotspots, the cluster of segments had a high number of GPS tracking points, which meant that more participants stayed longer in those locations than in other segments, which were not hotspots.

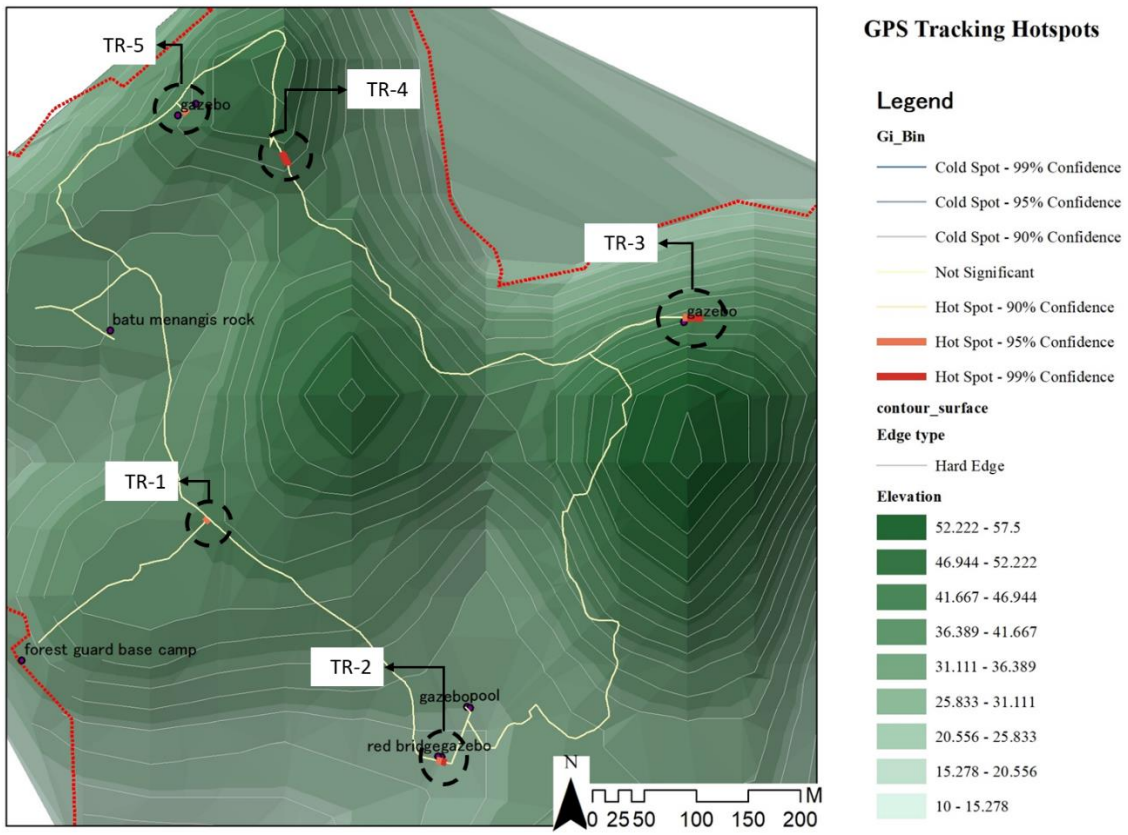

Figure 35. GPS tracking hotspots.

Table 5

Estimation of time spent in Each GPS Tracking Hotspot

No	Hotspots		Number of points	Time spent of 61 participants (second)	Time spent of 1 participant (seconds)	Time spent of 1 participant (minutes)
	Name	Segment				
1	First intersection	42	953	953	16	0
	(TR-1)	43	3,495	3,495	57	1
		44	1,313	1,313	22	0
2	Red bridge	110	1,372	1,372	22	0
	(TR-2)	111	2,591	2,591	42	1
		112	3,441	3,441	56	1
		113	2,322	2,322	38	1
3	Uphill Gazebo	271	877	877	14	0
	(TR-3)	272	1,423	1,423	23	0
		273	5,389	5,389	88	1
		274	8,476	8,476	139	2
		275	31,031	31,031	509	8
					0	0
4	Corridor	359	1,461	1,461	24	0
	(TR-4)	360	6,571	6,571	108	2
		361	4,350	4,350	71	1
		362	963	963	16	0
		363	419	419	7	0
						0
5	Historical sculpture	415	1,825	1,825	30	0
	(TR-5)	416	3,395	3,395	56	1

The first tracking hotspot (TR-1) was located on the first intersection after the starting point. It included segments number 42 to 45. It is near location with hotspots “SE-1” in Selfie Photos Hotspots. In this T crossing, participants stopped for about 0.26 minutes to 0.95 minutes of each percipient to do orientation about the site. There were no maps or available information about directions or description about the site; therefore, they stopped to await the forest guard’s arrival to make they were taking the correct trail.

The second tracking hotspot (TR-2) was located on Red Bridge area. This location was also similar to a selfie hotspot (“SE-2”) and an ordinary photo hotspot (“OR-2”). In

this location, many participants stopped for 0.37 minutes to 0.94 minutes to do sightseeing surround the bridge. The number of selfie and ordinary photos captured here was more than in any other hotspot place. This shows that there were many impressive landscape scenes or objects in this place that influenced participants to stop sometimes and take photos.

The third tracking hotspot (TR-3) was located on surround hilltop gazebo. It is similar location with hotspots "OR-7" in ordinary photographs and hotspots "SE-5" in Selfie Photos hotspots. This place was located on high elevations and participants walked on ascending trail to reach this place. There gazebo is the only convenient shade and place to take a rest after participants walked on ascending slope trail with less of trees' canopy. From the gazebo, panoramic views of Tanjungpinang City were visible. In this gazebo, participants stopped the longest of all other hotspots places, for about 8.48 minutes of each participant. In this place, all participants stopped longer in this gazebo to take a rest and enjoy the panoramic view of the city.

The fourth tracking hotspot (TR-4) was located on a corridor after hilltop gazebo on segments number 359 to 363. It is similar location with hotspots "SE-6" of Selfie Photos hotspots. On this slope, participants took a rest for a while and took selfie photos against a background of tall shrubs. In the future landscape management, this slope segment should be considered by managers of BKF as a place to provide appropriate resting facilities for visitors.

The fifth tracking hotspot (TR-5) was located in the Historical Inscription Sculpture area. This hotspot was also a selfie hotspot ("SE-6") and an ordinary photo hotspot ("OR-8"). Many participants stopped there, sometimes surrounding the historical

inscription sculpture, and took photos of the sculpture or took selfie photos with the sculpture as background.

3.6 Correlation between Selfie Photo Hotspots and Ordinary Photo Hotspots to GPS Tracking Hotspots

Each segment had the potential to have a number of nearest tracking points or selfie or ordinary photo points. Some hotspot places showed a similar trend of selfie photos, ordinary photos, and GPS tracking photos (Figure 36). This study was based on the hypothesis that there was a dependency between selfie photo hotspots with GPS tracking hotspots or ordinary photo hotspots with GPS tracking photo hotspots. The hypothesis was that the participants' activities in taking photos of either type in particular segments influenced participants who were walking to stop sometimes to enjoy the view so the number of GPS tracking points is higher than in other places that were not GPS tracking hotspots.

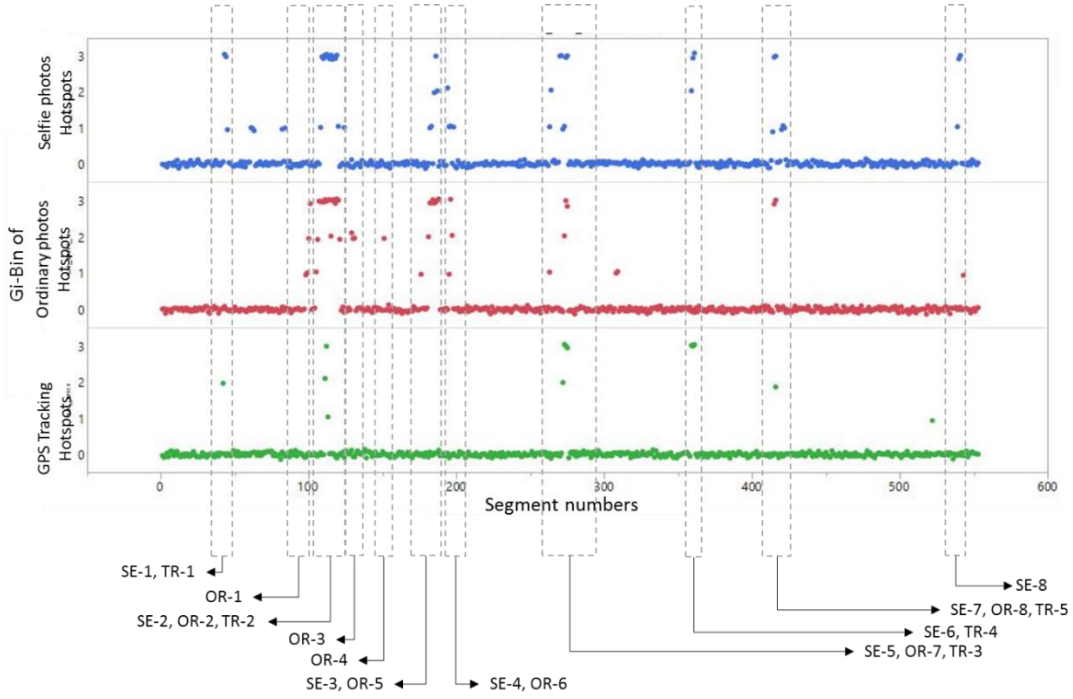

Figure 36. Selfie photo hotspots, ordinary photo hotspots, and GPS tracking hotspots in each segment.

The chi-squared test was implemented to determine if there was a dependency between the variable of selfie photo hotspots and the variable of GPS tracking hotspots and between the variable of ordinary photo hotspots to the variable of GPS tracking hotspots. In Table 6, it explained the independency between segments which become hotspots for selfie hotspots and GPS tracking hotspots. from 553 segments, there were 43 segments that become hotspots of Selfie Hotspots and 11 segments that become hotspots of GPS Tracking Hotspots. The expected value of segments that become hotspots for both Selfie and GPS tracking hotspots is 0.855. Based on hotspots analysis, there were 8 segments that become hotspots for both Selfie and GPS tracking hotspots. Based on the chi-square test, this number is more than expected value and the p-value is <.0001 (Table 7). It means that the segments where become hotspots for both selfie and GPS tracking hotspots are significantly different than other segments and selfie and GPS tracking hotspots are dependent between each other.

Table 6

Matrix of number of GPS tracking (TR) and Ordinary Photo Hotspots (OR) segments to expected values

Count Total % Col % Row % Expected	Selfie -Not Hotspots	Selfie -hotspots	Total
GPS Tracking -Not Hotspots	507	35	542
	91.68	6.33	98.01
	99.41	81.4	
	93.54	6.46	
	499.855	42.1447	
GPS Tracking - hotspots	3	8	11
	0.54	1.45	1.99
	0.59	18.6	
	27.27	72.73	
	10.1447	0.85533	
Total	510	43	553
	92.22	7.78	

Table 7

Chi-squared Test of Selfie Hotspots (SE) and GPS Tracking Photos Hotspots (TR) of Trail Segments

N	DF	-LogLike	RSquare (U)	Test	ChiSquare	Prob>ChiSq
553	1	14.92451	0.0988	Likelihood Ratio	29.849	<.0001*
				Pearson	66.025	<.0001*

The dependency between variable of Ordinary photos (OR) and GPS Tracking hotspots (TR) were also analyzed. From total 553 segments of trail, there were 42 segments become hotspots of ordinary photos hotspots and 11 segments become hotspots of GPS tracking hotspots (Table 8). The expected value of segments that become hotspots for both Ordinary hotspots and GPS tracking hotspots are 0.835. However, based on hotspots analysis, there were 7 segments become hotspots for both Ordinary Photos hotspots and GPS tracking hotspots. This number is more than expected value and p-value<.0001 (Table 9), which meant that the segments that become hotspots for both Ordinary photos and GPS tracking hotspots are significantly different with other segments. It also shows that there were dependency between Ordinary photos and GPS tracking.

Table 8

Matrix of number of GPS tracking (TR) and Ordinary Photo Hotspots (OR) segments to expected values

Count Total % Col % Row % Expected	Ordinary photos- Not Hotspots	Ordinary photos - Hotspots	Total
GPS tracking - Not Hotspots	507	35	542
	91.68	6.33	98.01
	99.22	83.33	

	93.54	6.46	
	500.835	41.1646	
GPS tracking - Hotspots	4	**7**	11
	0.72	1.27	1.99
	0.78	16.67	
	36.36	63.64	
	10.1646	**0.83544**	
Total	511	42	553
	92.41	7.59	

Table 9

Chi-squared Test of Ordinary Photo Hotspots (OR) and GPS Tracking Photos Hotspots (TR) of Trail Segments

N	DF	-LogLike	RSquare (U)	Test	ChiSquare	Prob>ChiSq
553	1	11.67378	0.0785	Likelihood Ratio	23.348	<.0001*
				Pearson	50.225	<.0001*

The results above described participants' tendency during walking on the trail while doing the site survey. Whenever participants found impressive scenes or objects on the site, they stopped sometimes to see the scenes or objects, and then took photos of them. While taking photos, the participants stopped for a short period of time to find the best angle and focus and avoid any blur effects. Therefore, in segments where selfie photos or ordinary photos were hotspots, the GPS tracking points were also high, which caused the segments to become hotspots for GPS tracking points.

3.7 Opportunity of Using Selfie Pictures in Photo-Based Research

The photo hotspots analysis showed that the ordinary photos were more concentrated into fewer hotspots places than were the selfie photos. This was evidenced by the number of hotspot places of ordinary photographs, which were located on eight hotspots influenced by 413 ordinary photographs, while selfie photos hotspots were

located on eight hotspots influenced by 292 selfie photos. All ordinary photo hotspot places were also hotspots of selfie photos. It shows that there was a correlation between selfie photos and ordinary photos captured by participants.

To test the dependency between selfie photo hotspots and ordinary photo hotspots, the contingency chi-squared test was implemented. The null hypothesis (H_o) was that variable of selfie photo hotspots and ordinary photo hotspots was independent. From total 553 segments, there were 42 Ordinary hotspots segments and 43 Selfie Photos hotspots segments (Table 10). The expected value that segments that become hotspots for both Selfie Photos hotspots and Ordinary Photos hotspots are 3.265 segments. However, based on analysis results, the number of segments that become hotspots for both Selfie Photos hotspots and Ordinary photos hotspots are 21 segments, more than expected value. Therefore the chi-square test showed that the $p<.0001$ (Table 11) and the null hypothesis (H_0) was rejected, and that (H_1) was accepted. It means that the variable of hotspots of selfie photos and the variable of ordinary photos were not independent (and so could be said to be dependent). As happened in the site survey, in the segments where the impressive landscape objects existed, participants took many ordinary photos and also selfie photos with focused objects of impressive landscape objects. This test showed that in the segments or places where impressive landscape objects existed, participants took many ordinary photos as well as selfie photos. This highlighted the usefulness of selfie photos in identifying landscape preferences, showing that selfie photos can also be used as objects in analyses in landscape management.

Table 10

Matrix of number of Selfie Hotspots (SE) and Ordinary Photo Hotspots (OR) segments to expected values

		Ordinary photos Segments		
	Count	Not hotspots	Hotspots	Total
	Total %			
	Col %			
	Row %			
	Expected			
Selfie photos segments	Not hotspots	489	21	510
		88.43	3.8	92.22
		95.69	50	
		95.88	4.12	
		471.266	38.7342	
	hotspots	22	21	43
		3.98	3.8	7.78
		4.31	50	
		51.16	48.84	
		39.7342	3.26582	
	Total	511	42	553
		92.41	7.59	

Table 11

Chi-squared Test of Selfie Hotspots (SE) and Ordinary Photo Hotspots (OR) of Trail Segments

N	***DF***	***-LogLike***	***RSquare (U)***	***Test***	***ChiSquare***	***Prob>ChiSq***
553	*1*	*31.28305*	*0.2105*	*Likelihood Ratio*	*62.566*	*<.0001**
				Pearson	*113.003*	*<.0001**

The novelty of this research is the use of geotagged selfie photos to identify impressive landscape spaces or objects. Including selfies is a new way to research and evaluate tourism destinations, sites, and activities (Dinhopl & Gretzel, 2016). However, the use of selfie photos in photo-based landscape research to identify people's preferences is rarely implemented. In this research, the geotagged selfie photos are able to identify

impressive landscape spaces by their vantage points and through hotspot detection, even though this type of photograph is influenced by the subjective tendency of participants to show themselves in photos.

The chi-square test above shows that segments where become hotspots for ordinary photos were also hotspots for selfie photos. In places where impressive landscape objects or scenes existed, participants took ordinary photos and then selfie photos; therefore, the content of the photos in the ordinary photos and the selfie photos of each photo hotspots were mostly similar. In this research, selfie photos provided a similar benefit to that of ordinary photos as objects of research and tools in identifying attractive landscape elements.

For Indonesian people, photos of people are very important. In photo-based research studies in Indonesia using visitor-employed photography (VEP) such as research conducted by Cahyanto, Pennington-Gray, and Thapa (2013), photos that address "people" are one of the major themes of VEP research in rural tourism in Indonesia. The "people" character in VEP research tends to relate to participants' self-actualization. Although selfie taking in tourist areas may be influenced by a manifesto of self-boasting and showing of self-existence, the data on landscape background and geotagged position are nonetheless valuable to VEP research.

Selfies with particular landscape features or elements as photo backgrounds can be used as indicators of participant interest in the landscape they perceive. Related to participants' tendency to show themselves to others as proof of their visit to a location, selfies can be a marker of preferred locations. This study's photo analysis identified the significant landscape elements appearing in the background of participants' photos, indicating that selfies can be used as research objects for VEP studies. Taking selfies may

be a simple hobby for people or it may be a spontaneous response of what participants perceive in the landscape. In the present research, this type of picture was used to identify significant attractive landscape elements.

Chapter 4

Identifying Visitor Preferences for Locations and Features in Bogor Botanical Garden, Indonesia, Using GPS Tracking and Geotagged Photos

4. Identifying Visitor Preferences for Locations and Features in Bogor Botanical Garden, Indonesia, Using GPS Tracking and Geotagged Photos

Botanical gardens, originally founded as botanical conservation sites, have nowadays become popular as tourist destinations. A common problem facing modern botanical gardens is that people's motivation for visiting them is shifting from education about conservation issues to a more complex tourism context (Ballantyne, Packer, & Hughess, 2008). In the case of Bogor Botanical Garden (BBG), Indonesia, visitors' motivations include not only the acquisition of botanical knowledge, but also the opportunity to escape from their daily activities, gather with relatives, and enjoy nature (Hermansyah & Waluya, 2012). Related with those motivations, the botanical garden's visitors show trends of walking, stopping, and enjoying the view of objects of attraction. Therefore, in a botanical garden or other site that involve public users, understanding visitors' behaviors is very important. A better understanding of visitors' perceptions and preferences regarding the BBG is essential to managing the sustainability of recreation and tourism at the site.

Outdoor recreation is related to landscape quality and visitors' preferences. The aesthetic of landscape features such as human-made structures and art objects, flora and fauna, and wild and cultivated vistas is important for BBG's management because it is related to visitors' satisfaction. Therefore, a study about landscape preferences is important for evaluation, planning, and management of BBG. However, sometimes there are differences between people's statements about what they prefer in a landscape and their actual responses on site or after having an on-site experience (Aminzadeh & Ghorashi, 2007).

This research investigated participants' preferences based on an experiential paradigm that let participants select what they considered to be impressive landscape elements based on their personal perceptions and preferences with respect to the BBG site they visited. The objective of this research was to investigate impressive landscape elements and important locations in BBG by using the VEP method combined with GPS tracking. The VEP method produced participants' photos, which were used as evidence of participants' selection of impressive features, and the GPS tracking method was used to mark locations of vantage points where participants took the pictures.

4.1 GPS Tracking Hotspots

As mentioned in Chapter 2, the method used in this portion of the study was polygon-based hotspots analysis. It used 20 x 20 m^2 cells to count point density in each part of BBG site, segmenting the entire site into 1,243 square cells in which the GPS logger tracked the movements of 35 participants (Figure 37). Each cell consisted of 1 to 23,140 tracking points with an average of 240.70 points. Because the participants' routes were not predetermined, areas with fewer tracking points could reflect either places where participants were walking and not stopping, or unpopular places where fewer participants passed at all. In the same way, areas with more tracking points could represent either areas where participants stayed longer or where more participants passed by.

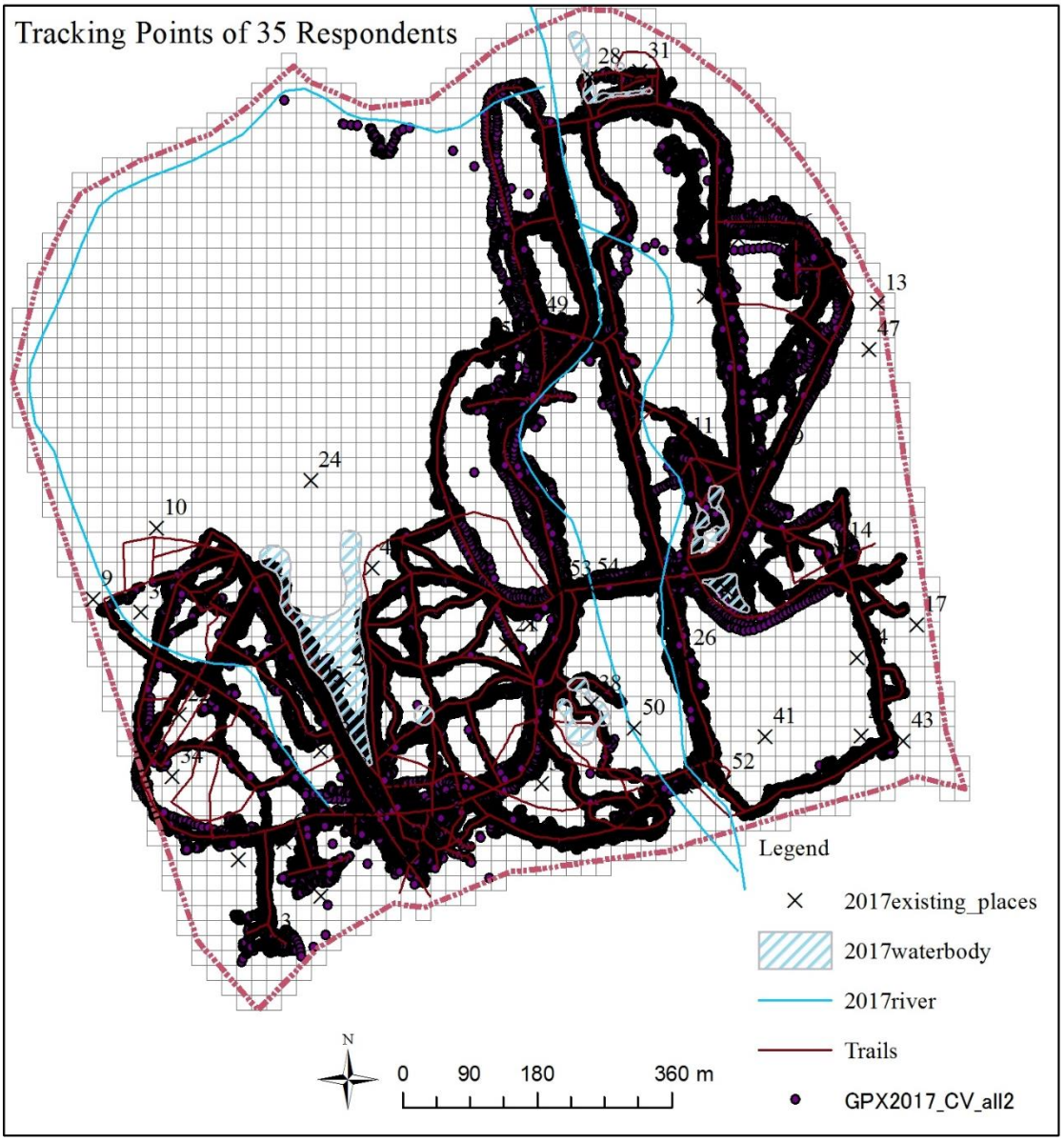

Figure 37. GPS Tracking Points that fell in each 1,243 cells

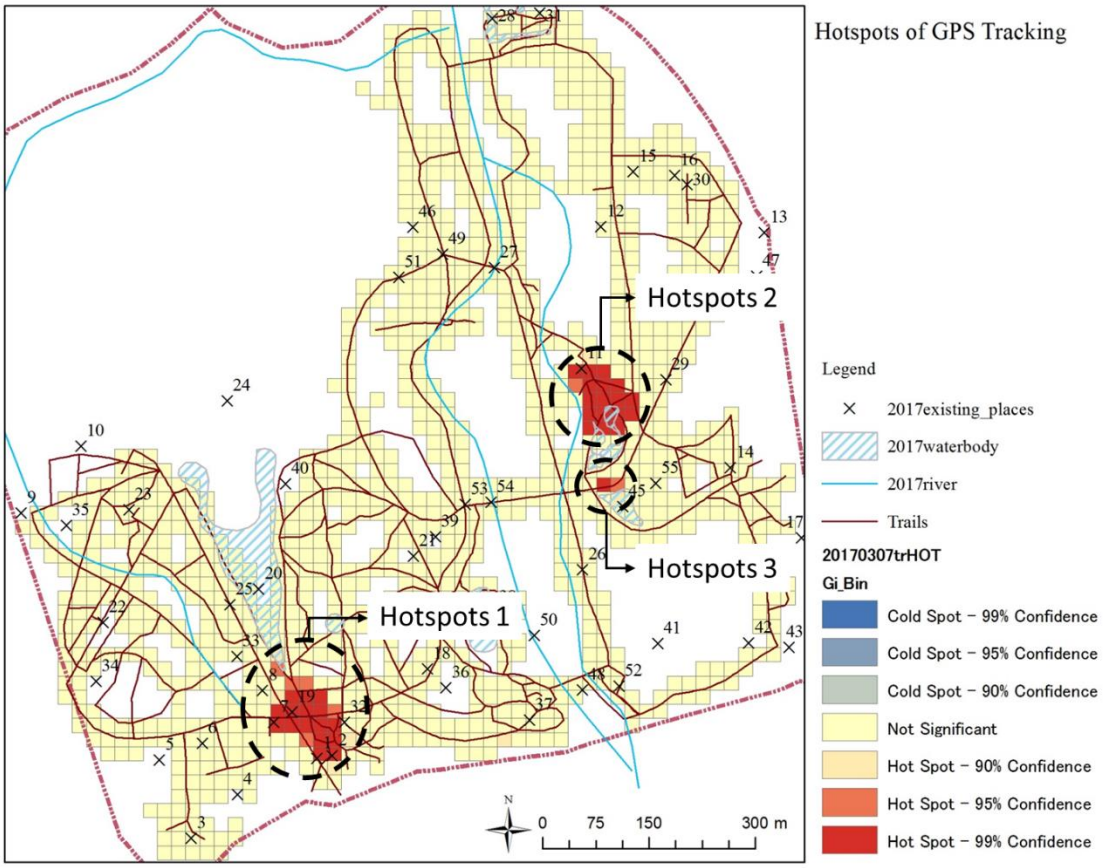

Figure 38. Hotspots defined by tracking points.

The GPS tracking hotspots shows places where participants significantly stayed longer than other cells that were not hotspots. The Getis-Ord Gi* hotspot analysis was implemented to identify cells where GPS tracking points significantly clustered (Figure 38). The calculation of Getis-Ord Gi* analysis hotspots to GPS Tracking hotspots cell can be seen in Appendix F. The GPS tracking hotspots cells with more than 95% confidence hotspots were seen in three locations: (1) the area around the Main Gate, Lady Raffles Memorial, and Srigunting Pond on the south side; (2) the area surrounding Lotus Pond and the mosque area; and (3) the transition area between lawn and the two prongs of Canary Avenue. In the first and second GPS tracking hotspot places, the landscape was characterized by space under trees providing shading (see example photo in Figures 39

and 40). The third GPS tracking hotspot place was located in the transition area between open lawn space and Canary Avenue I and II (Figure 41). In this transition area, participants saw different view than from view under the trees' canopy to wide open lawn. Therefore, most participants stayed longer in this place to see the impressive view of lawn and Lotus Pond on right and left side of trail.

Figure 39. Hotspot 1, with benches under tree canopies surrounding Lady Raffles Memorial.

Figure 40. Hotspot 2, with seating areas under tree canopies.

Figure 41. Hotspot 3, in transition area - From under trees' shadings space (Canary Avenue) to opening area (lawn).

Such hotspot cells were found in two places: between the main gate and the Lady Raffles Memorial, and in an area near the lawn, Lotus Pond, and the mosque. The first area was passed by all participants (100%), while the second and third were passed by 88.89% of participants. The first area is likely a hotspot because it is close to the main gate and thus the start of any walking route, and the second and third area are popular places to rest where most participants spent some period of time under trees.

4.2 Photo Hotspots

There were 1,710 geotagged photos captured by participants (Figure 42). All photo points were joined into 1,243 cells that contained at least one GPS tracking points. The selected cell population was GPS tracking points' cells because it assumed that photos were captured during walking, therefore each cell that contained GPS tracking points has similar chance to have photo points, too. The mean number of photos captured in each cell was 1.35, ranging from 0 to 30. The Getis-Ord Gi* analysis overcome photo hotspots as shown in Figure 43. The result of calculation of Getis-Ord Gi* hotspots analysis can be seen in Appendix G.

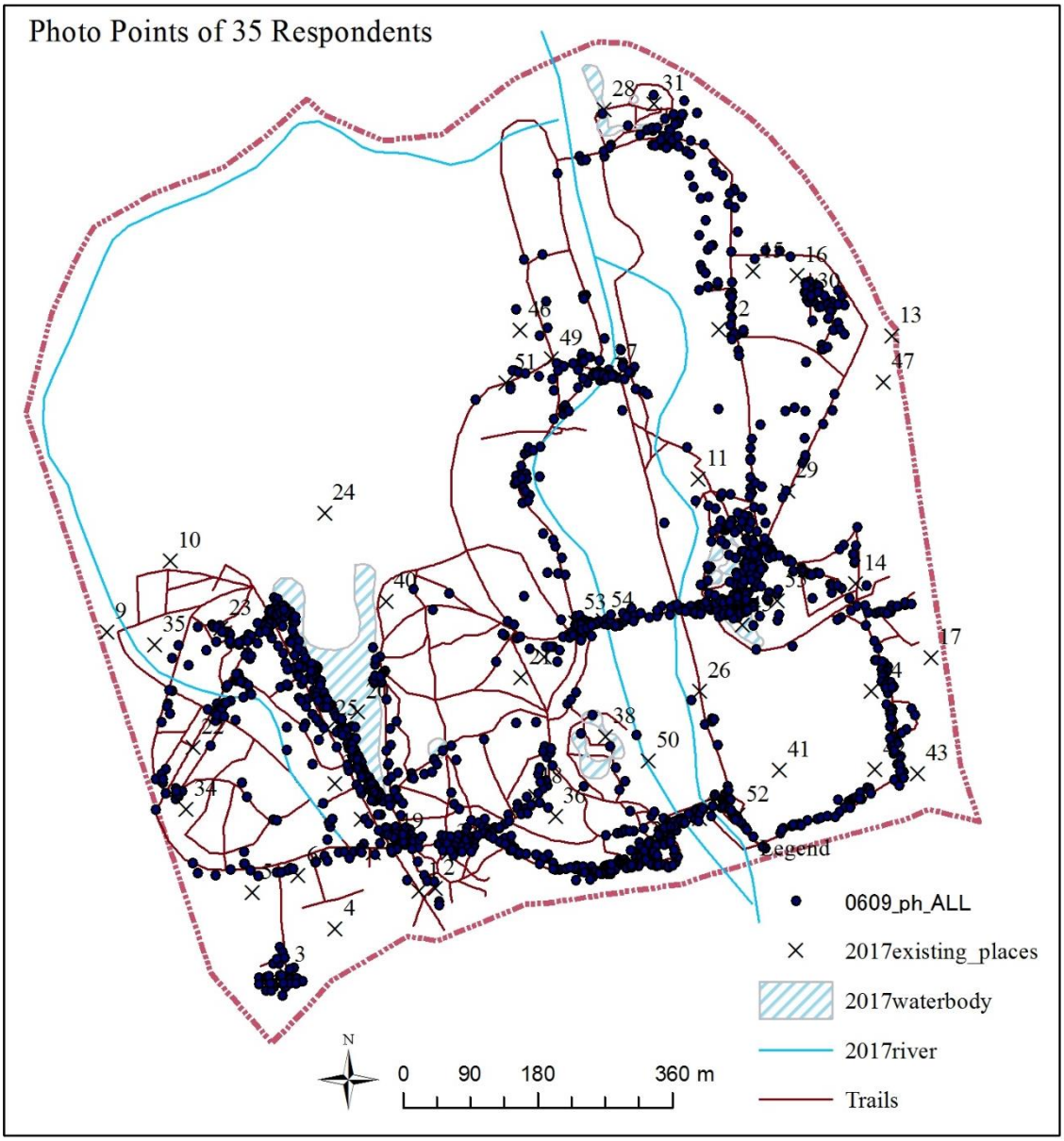

Figure 42. Vantage points of Photos

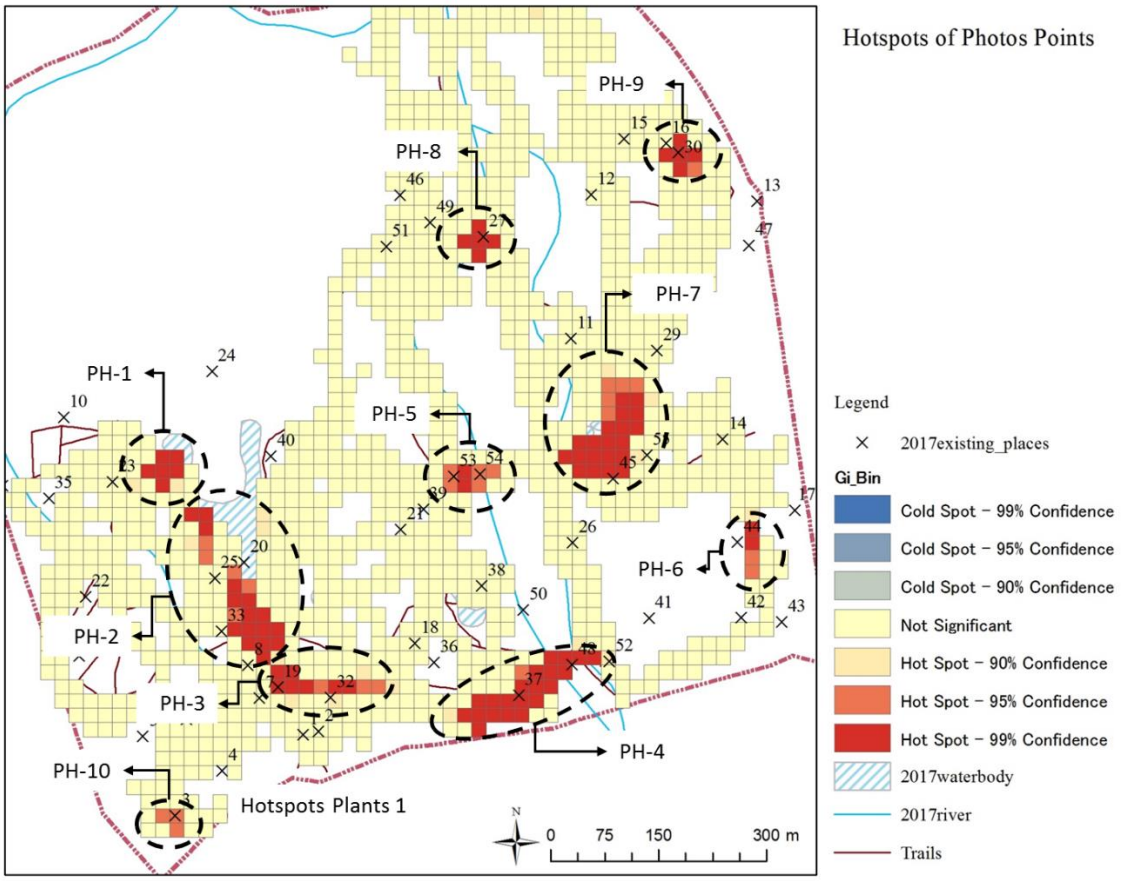

Figure 43. Hotspots defined by photo points.

There were ten clusters of cells that became photo hotspot: (1) PH-1, the north side of Srigunting pond, with a view to Bogor Palace (Figure 44); (2) PH-2, Srigunting Pond's banks (Figure 45); (3) PH-3, from the Lady Raffles Memorial to the *Koompasia* trees (Figure 46); (4) PH-4, from the Mexican Garden to small Red Bridge (Figure 47); (5) PH-5, the White Bridge (Figure 48); (6) PH-6, the *Cinnamomun* trees area (Figure 49); (7) PH-7, the area around the small, the lawn, and Astrid Avenue (Figure 50); (8) PH-8, the big red Hanging Bridge (Figure 51); (9) PH-9, the indoor Orchid House (Figure 52); and (10) PH-10, the Zoological Museum (Figure 53).

Figure 44. Example photo of Hotspot PH-1: north side of the Srigunting Pond with view to Bogor Palace.

Figure 45. Example photo of Hotspot PH-2: south side of the Srigunting Pond with view to the pond.

Figure 46. Example photos of Hotspot PH-3: Surround Lady Raffle Monuments and Koompasia Tree

Figure 47. Example photos of Hotspot PH-4: the Mexican Garden to Red-bridge I.

Figure 48. Example of photos of Hotspots PH-5: Palm garden to White Bridge

Figure 49: Example of photos of Hotspots PH-6: *Cinnamomun* trees garden

Figure 50. Example photo of Hotspot PH-7: Area at the edge of lawn area with a view toward the lawn.

Figure 51. Example photos of Hotspots PH-8: Red-Bridge II

Figure 52. Example photos of Hotspots PH-9: Orchid Indoor Garden

Figure 53. Example photos of Hotspots PH-10: Zoological Museum

To categorize the contents of each photo required identifying the focused objects of each photo. Once this was accomplished, the focused objects of each photo were categorized into six groups: plants, open lawn, corridor, water, buildings, and other. The contents of the photos in each category is shown in Table 12.

From a total 1,710 photos, there were 785 photos with focused objects of plants (45.91% of total photos), or slightly less than half. Given that the survey took place in a botanical garden, the high percentage of plant photos was not unexpected. What was more interesting was that the participants took more plant photos on average regardless of the type of hotspot, suggesting either that (a) the participants were more interested in plants than the average tourist; (b) the plants were more photogenic than most places; or (c) the plants were used more effectively within the landscape design than else. Next, the photos of plants were analyzed according to the hotspots.

Table 12

Number of Photos with Focused Objects in Each Photo Hotspot (PH)

No	Photo Hotspots	Plants	Opening lawn	Corridor	water	buildings & structures	others	total
1	not-hotspots	432	84	92	56	158	38	860
2	PH-1	7	0	5	1	34	1	48
3	PH-2	38	4	19	75	24	6	166
4	PH-3	37	0	10	0	29	1	77
5	PH-4	125	0	9	10	43	6	193
6	PH-5	6	0	8	2	25	1	42
7	PH-6	22	3	4	0	1	0	30
8	PH-7	71	55	20	42	10	3	201
9	PH-8	5	0	3	3	23	0	34
10	PH-9	42	0	0	0	0	0	42
11	PH-10	0	0	0	0	2	15	17
		785	146	170	189	349	71	1710

Beside plants, buildings and structures were also frequently captured by participants, as evidenced by the fact that 20.41% of the total number of photos included

these subjects: Lady Raffles Memorial, Bogor Palace, sculptures in the Mexican Garden, frame structures on the promenade of Srigunting Pond, the bridges, and the restaurant building in the lawn area. Of the most-photographed buildings and structures, most have a Colonial heritage value, including the Lady Raffles Memorial, Bogor Palace, the red Hanging Bridge, and the smaller Red Bridge, which were established in the Colonial era and preserved until today. This shows that the historical aspect of buildings makes them more impressive objects for participants.

"Water" is the third-most chosen focused object captured by participants (11.05% of total photos). Photos of "water" mostly captured the area around Srigunting Pond and Lotus Pond. In these locations, elements including ponds and fountains were considered the most impressive features by participants. This result is similar to what (Sugimoto, 2011) found when conducting preference research with VEP and GPS tracking, which found that a pond in a park is an impressive element that attracts people, who then take photos of the water and nearby elements. Water is an important aesthetic element for landscape attraction and supports recreation activities (Burmil, Daniel, & Hetherington, 1999).

4.3 Plant-Photo Hotspots

Due to the high number of photos with focused objects of plants captured by participants, photos with plants as focused objects were analyzed a second time for their own specialized set of hotspots. In this sub-analysis, there were three location hotspots, including Astrid Avenue, the Mexican Garden, and the Interior Orchid Garden (Figure 54). The plants most frequently captured in those places were these: (1) orchid flowers in Interior Orchid Garden; (2) Canna flowers in the median of Astrid Avenue; and (3) cactus, Agave, Yucca, Bromelia, Euphorbia, and drought-resistant plants in the Mexican Garden.

These plants were arranged well with other materials and landscape elements in a good design.

The most-photographed plants, whether in significant hotspots or not, were plants arranged in attractive garden designs and composed well with other landscape elements such as gravel, structures, ponds, and other landscape materials (see examples in Figure 55). On the other hand, plants displayed in an ordinary manner such as plants with name labels were less photographed. This means that plant collections displayed in an ordinary style were not as impressive to participants. The inference is that displaying plants in attractive designs is effective for attracting participants' attention. This result supports Villagra-Islas (2011) findings that in botanical gardens today, it is important to consider the design of plant displays in order to increase people's awareness of the environment.

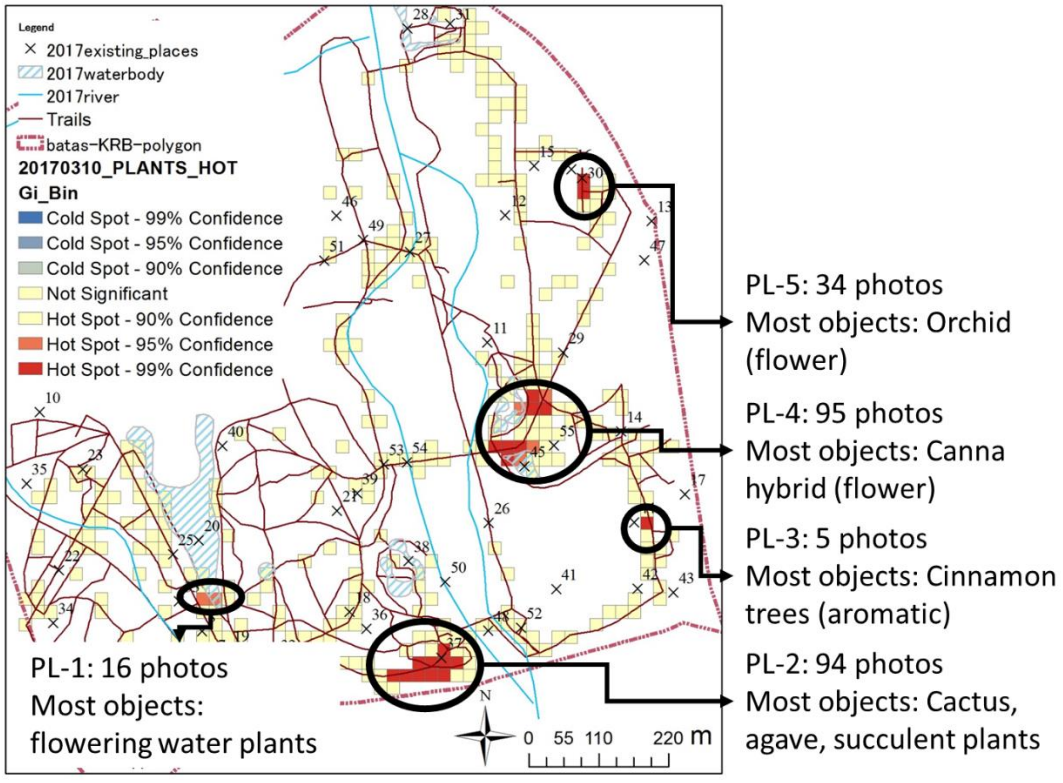

Figure 54. Hotspots of plants as photos' focused objects defined by photo points. Photos source: participants' photos.

Figure 55. Photo of Plants that mostly captured by participants in each plants hotspots

4.4 Correlation between the Trend of Photos and the Trend of Tracking

Any cell had the possibility of becoming a hotspots based on photo points and/or hotspots of GPS tracking points. There were cells that were significant as photo points but not hotspots of GPS tracking points or the opposite, or become hotspots for both photo points and GPS tracking points or not significant for both of them. There was a question

of whether the cells that hotspots for both photo points and GPS tracking points are significantly different with other cells. If it is significantly different, then the photo hotspots and GPS tracking hotspots are not independent or it can be said that they are dependent. Therefore, this was tested using a chi-squared 2x2 matrix.

The variables of hotspots in each cell included coldspots, not significant hotspots, and hotspots. For the chi-squared test, the variables of hotspots for each cells were scored. A cell that became a hotspot with 95% or 99% confidence was scored as a one. A cell was given a score of zero if the cell had no significant hotspots or coldspots. The chi-squared test examined the dependency of the variables of significance of hotspots of photo points and tracking points. The matrix shows that there were 109 cells as photos hotspots cells and 41 cells pf tracking hotspots cells. The expected value that the cells were both photos and tracking hotspots is 3.595. However, based on overlay of photo hotspots map and tracking hotspots map, there were 12 cells were both photos hotspots and tracking hotspots (Table 13). This number is higher than expected value.

Table 13

Matrix of number of Photo Hotspots (PH) and GPS Tracking Photos Hotspots (TR) of Each Cell to expected values

Count / Total % / Col % / Row % / Expected	Tracking - not hotspots	Tracking - hotspots	Total
Photo - not hotspots	1105	29	1134
	88.9	2.33	91.23
	91.93	70.73	
	97.44	2.56	
	1096.6	37.4047	
Photo - hotspots	97	12	109
	7.8	0.97	8.77
	8.07	29.27	

	88.99	11.01	
	105.405	3.59533	
Total	1202	41	1243
	96.7	3.3	

Table 14

Chi-squared Test of Photo Hotspots (PH) and GPS Tracking Photos Hotspots (TR) of Each Cell

N	DF	LogLike	RSquare (U)	Test	ChiSquare	Prob>ChiSq
1243	1	7.459236	0.0414	Likelihood Ratio	14.918	0.0001*
				Pearson	22.27	<.0001*

The null hypothesis (H_0) was that the variables of photos hotspots and GPS tracking hotspots were independent. The chi-squared test showed that p-value <.0001 (Table 14) because the number of cells that both photo hotspots and tracking hotspots is higher than expected value. It shows that there were more similarity of cells performed by photos hotspots and tracking hotspots, which means that photos hotspots were dependent with GPS tracking hotspots. In the survey, it shows actual situation that taking photo activities by participants influenced their speed of movements. Participants took more time in a place where impressive landscape objects were visible to sightseeing and taking photos.

4.5 Detecting Popular Trail by counting number of Points in each Cell

The Getis-Ord Gi* hotspots was only performed on local clusters of cells (each cell and its neighbors) that had a high number of points to all data or global. This did not mean that a cell that became a hotspot had an actual high number of points since it could be influenced by a surrounding neighbor cell that has high number of points. Therefore we tried to analyze the real number (count) of photo points and tracking points fell in each

cell to detect participants' actual movements and taking photos places. The cells consist of photo points and GPS tracking points were assumed as cells where were passed by participants. The popular cells or places that passed by and taking photos were analyzed by multiply the normalization number of points in each cells, where normalization number is number of points in each cell devided by its standard deviation. This formula was called as PTN_i or Photo points and Tracking points number of cell i. The PTN_i were defined as follows:

$$PTN_i = \frac{n_{ph_i}}{\sigma_{ph}} \times \frac{n_{tr_i}}{\sigma_{tr}}$$

where n_{phi} is the number of photos and n_{trj} is number of tracking points of the cell *i*. Here, σ_{ph} is the standard deviation of the photo points (3.13) and σ_{tr} is the standard deviation of tracking points (921.79).

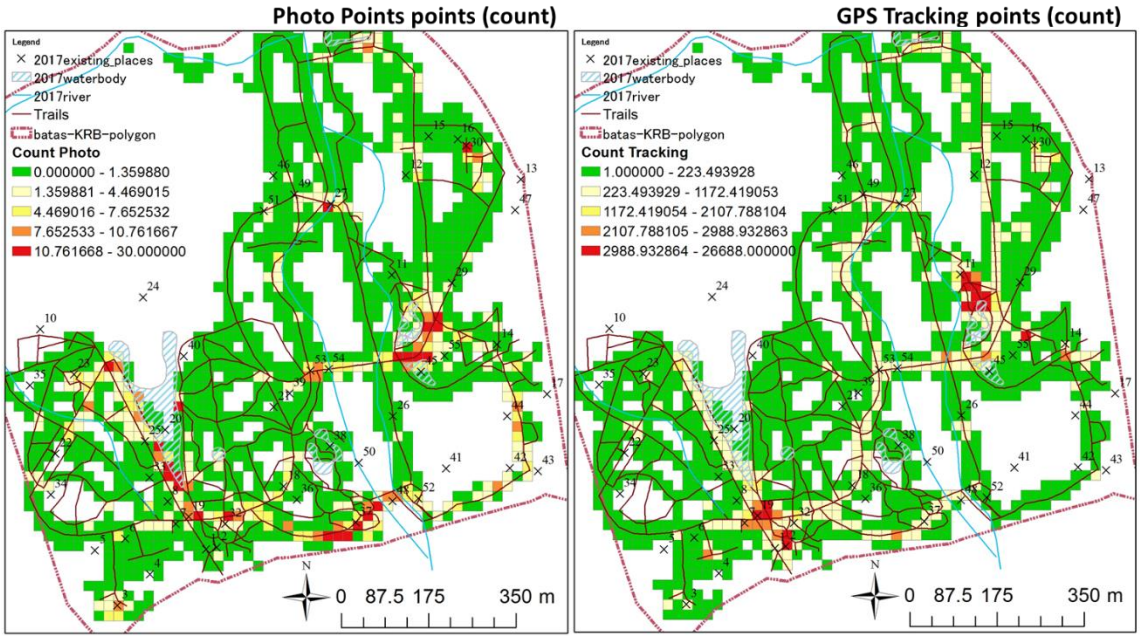

Figure 56. Comparison of high number of points (red cells) to low number of points (green cells) of each cell in Photos map and GRS Tracking map

The higher PTN shows the cells where participants passed by more and took photos more than other cells (Figure 57). The results showed that locations of high PTN

cell were spread along formal trail that provided by BBG's manager, include: Srigunting Pond promenade, from the Lady Raffles Memorial to the *Koompasia* trees, from the Mexican Garden to red Hanging Bridge, from the White Bridge and Lotus Pond to Astrid Avenue and the small Red Bridge, and near Sudjana Kassan Garden and the Interior Orchid Garden. The results showed the popular trail and the places where participants walked and rested. Actually, there were many options among both formal trails and informal trails such as walking under tree canopies, but the participants apparently preferred on the popular formal trails and taking photos in those popular places (identified by red color of cells).

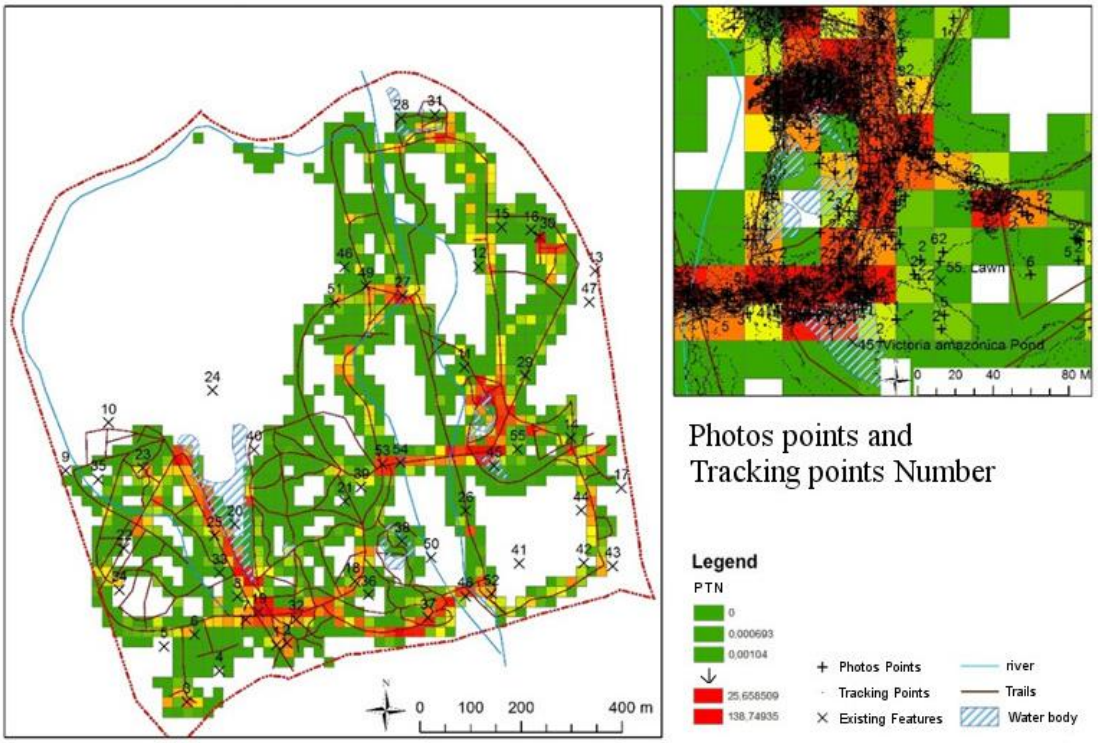

Figure 57. Photo points and tracking points in cells along popular routes.

Chapter 5

Identifying Colonial and Indonesian Styles in the Landscape of Bogor Botanical Garden

5. Identifying Historical-Colonial and Indonesian Styles in the Landscape of Bogor Botanical Garden

Bogor Botanical Garden (BBG) is the oldest botanical garden in Indonesia and has played an important role in the long history of botanical research and science (Chen, Cannon, & Hu, 2009). It is subject to a common problem facing botanical gardens today, which is that visitors' motivation for visiting has begun to shift from merely learning more about conservation issues to the expecting a destination with a more complex tourism context (Ballantyne, Packer, & Hughes, 2008). To balance the conservation and commercial use of BBG as a heritage site, studying tourist attitudes toward heritage sites is important (Henderson, 2001). In outdoor recreation activities in Indonesia, Historical-Colonial features are one of the strongest attractions for visitors. There has been much research conducted investigating people's preferences toward Historical-Colonial heritage in certain areas. However, that research sometimes left unanswered questions about exactly what landscape elements with Historical-Colonial features really attract visitors' attention on sites and which vantage points draw people to appreciate and experience those impressive elements. This study pursued these unanswered questions with respect to the BBG, and investigated visitors' perceptions of Historical-Colonial heritage within BBG accurately using spatial representation.

The history of botanical gardens in Indonesia cannot be separated from the influence of the Dutch East Indies in the colonization era. The Dutch's attention to the sciences in its colonies was implemented by the achievements of British Java Governor Thomas Stamford Raffles, who contributed to the advancement of natural sciences in Java during the British rule from 1811 to 1814 (Jepson & Whittaker, 2002). The Dutch effort

to explore science in its colony began with the establishment of the botanical garden of Buitenzorg; other botanical gardens, research institutes, and protected areas were formed after (Abendroth, Kowarik, Müller, & Von der Lippe, 2012; Jepson & Whittaker, 2002; Smith, 1924). BBG was built in 1817 under the supervision of Caspar George Carl Reinwardt, a botanist and professor who was sent by the Dutch kingdom (Abendroth et al., 2012; Jepson & Whittaker, 2002; Smith, 1924; Wieringa, Van Dun, & Gill, 1989). Reinwardt and his assistants collected plants through expeditions to various parts of the colony (Jepson & Whittaker, 2002). These plants were later used to create a botanical garden located in Bogor City that was akin to a thick rainforest (Wieringa et al., 1989). When BBG was initially formed, it functioned as a research center for biological science and agriculture, with the goal of boosting the colonial economy (Boomgaard, 2006). It was eventually used for introducing valuable plants for the establishment of other botanical gardens and protected areas in Java and other parts of Indonesia (Abendroth et al., 2012).

In 1949, four years after Indonesia gained independence, BBG's management was transferred from the Dutch East Indies to the Indonesian government (Ministry of Agriculture, 1956). BBG became a research center for botanical plants under the Indonesian Institute of Research (locally called Lembaga Ilmu Pengetahuan Indonesia or LIPI). When it was opened to the public in 1968, it served as a tourism and recreational site apart from its main function as a research center for ex-situ conservation plants. As a response to the high demand of tourism, the LIPI management developed physical elements and facilities to support both tourism and research activities. These new developments provided potential for income generation through tourism activities. This effort is hypothesized to have influenced the visual landscape of BBG. However, visitors'

perception of BBG has not been investigated to determine whether BBG's Colonial landscape can be identified by visitors, whether BBG's landscape shows elements of Indonesian style, and whether visitors have an accurate grasp of the characteristics and elements of Colonial- and Indonesian-style landscapes.

The discussion about Historical-Colonial architecture in Indonesia is an interesting topic among architects, landscape architects, scientists, and other stakeholders. Colonial architecture is interesting for Indonesians because it has different characteristics and influences than indigenous Indonesian architecture, although it has also influenced Indonesian local architecture at the past. However, there were few published papers discussing Colonial landscapes, even though the Colonial heritage applies not only to buildings but also to landscape design, botanical gardens, and protected areas (Abendroth et al., 2012; Jepson & Whittaker, 2002). In those botanical gardens and protected areas, the Dutch developed buildings, small gardens, and *viesta* that were similar to European-Colonial landscape style. However, it remained a question whether those styles could be recognized by the average Indonesian citizen and, if they could them it, what were the clues or elements that said "Colonial" to them?

The objective of this portion of the research was to identify landscape elements of Hitorical-Colonial- and Indonesian-style landscape at BBG based on participants' on-site elicitation, and to represent those objects' locations and optimal viewing vantage points spatially on maps. By determining BBG's Historical-Colonial and Indonesian landscape elements, as captured unprompted by visitors, the management of BBG might be better informed about how best to support these elements that engage, educate, and entertain the visitors.

5.1 Historical-Colonial Look Landscape and Indonesian Look Landscape

A total of 179 photos were collected that participants identified as examples of either Historical-Colonial or Indonesian style. These consisted of 85 photos of "Historical-Colonial look" landscapes or objects and 94 photos of "Indonesian look" landscapes or objects. The photos thus identified by participants were photos that they had captured themselves previously on site during the survey in BBG, which happened before the interview phase. There were nine participants (9.57%) who did not send back any photos of Historical-Colonial style landscapes; the reasons for this included their inability to find examples of Historical-Colonial style in BBG's landscape (3 people) and lack of interest in the Historical-Colonial style (1 person); the rest did not provide any reason (5 people).

The point density analysis of 179 geotagged photos from participants in ArcGIS identified the distribution of vantage points where participants saw the "Historical-Colonial look" and "Indonesian look" landscape photos. The total density of "Historical-Colonial look" landscape photos was concentrated near the Srigunting Pond, with target the being the Bogor Palace and the Lady Raffles Memorial and its environs (Figure 58). In contrast, the point density of "Indonesian look" landscape photos was more spread out, although a number of photos were concentrated near the lawn, with more various targets, such as the Sudjana Kassan Garden and the mosque (Figure 59). This trend is attributed to the fact that the participants classified photos taken along the tracks that captured the mixed composition of vegetation, which forms a tropical looking landscape, as "Indonesian looking."

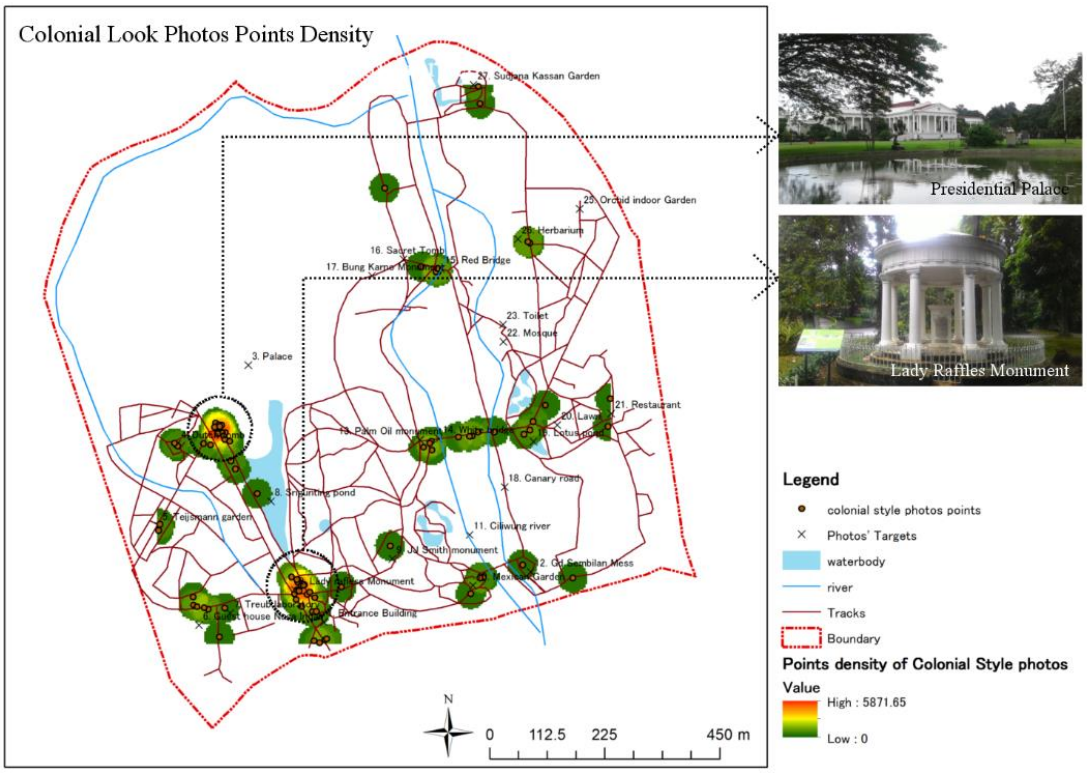

Figure 58. Trend in points density of "Colonial look" landscape.

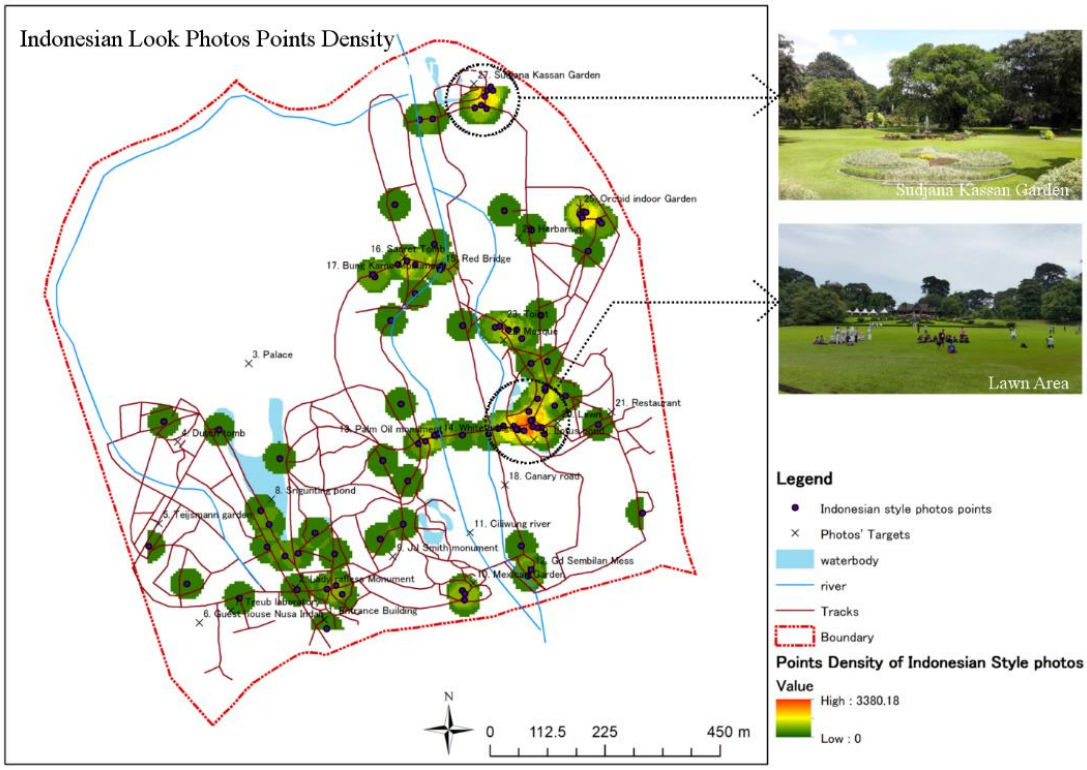

Figure 59. Trend in points density of "Indonesian look" landscape.

The photos were categorized according to focused objects, include: buildings and hardscapes, corridor, water features, plants, and garden. The photos consist with buildings and hardscapes as focused objects are mostly selected by participants to express Historical-Colonial look" landscape or an "Indonesian look" landscape (Figure 60). The number of buildings and hardscape photos in Indonesian look landscape style photos is lower than the number of buildings and hardscapes in Historical-colonial look landscape style photos but it is still higher than corridor, water features, plants and gardens as focused objects of Indonesian landscape style. It shows that most participants marked the style of landscape based on appearance of buildings and structures in photos.

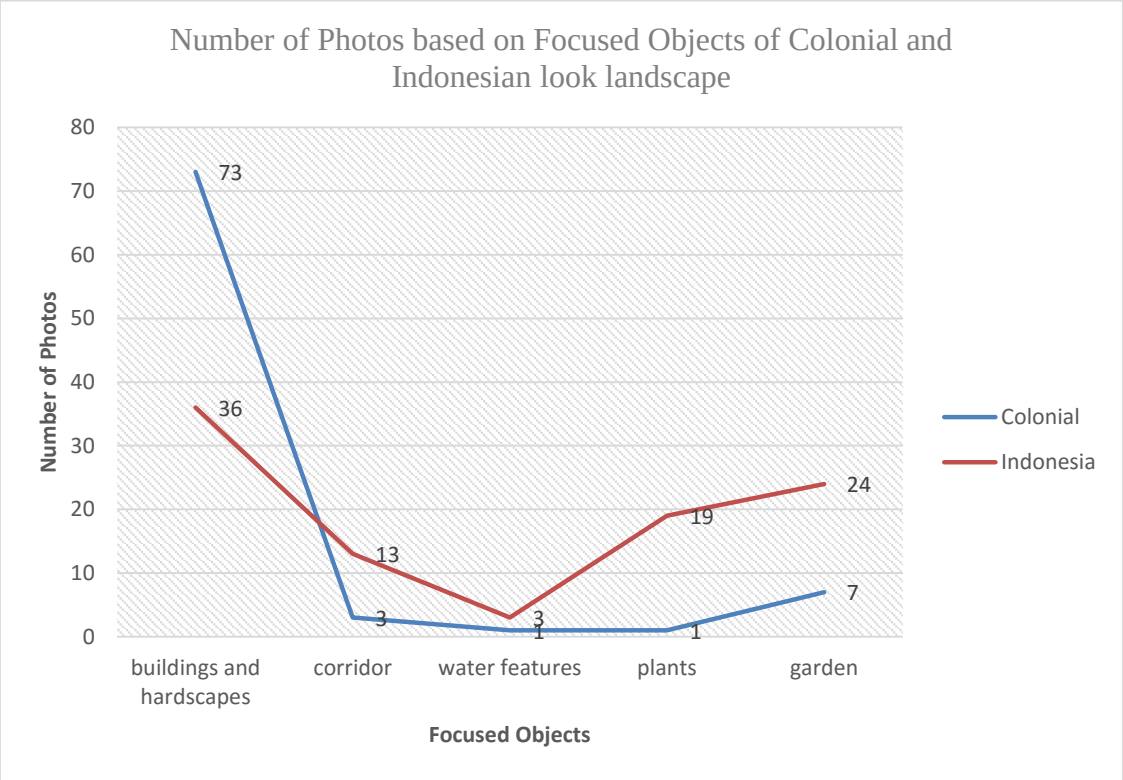

Figure 60. Number of photos based on its focused objects of "Colonial look" landscape style photos and "Indonesian look" landscape style photos.

The photos of buildings and structures as focused objects were further categorized by building's names or type of structures. There were 18 buildings and hardscapes captured as focused objects of "Historical-Colonial look" landscape style photos and

"Indonesian look" landscape style photos. Figure 61 shows the name of buildings and hardscapes that, according to the participants, marked a landscape style as "Historical-Colonial look" or "Indonesian look." The examples of buildings that selected by participants that reflected Historical-colonial look style can be seen in Figure 61, include: Presidential palace, Lady Raffles monument, Main Entrance building, White-Bridge, Red-Bridge, Guest house, Herbarium, Treub Laboratory, Teijsmann monument, JJ Smith Monument and Dutch Tomb. On the other hand, the buildings of café & restaurant, mosque, mess, Bung Karno Monument, Red-Bridge, Palm Oil monument and sacret tomb were selected by participants as Indonesian look landscape style. Figure 60 shows that the number of photos of "Historical-Colonial look" landscape style photos with focused objects in the category of "buildings and hardscapes" was higher than that for "Indonesian look" landscape style. On the other hand, the number of photos of "Indonesian look" landscape style photos with focused objects in the categories of "corridors," "water features," "plants," and "garden" were higher than for "Historical-Colonial look" landscape style photos. This result shows that in selecting "Historical-Colonial look" landscape photos, participants chose buildings and hardscapes as markers that a photo was "Historical-Colonial look" landscape style, whereas in selecting "Indonesian look" landscape style photos, they more often chose photos of natural elements such as plants or water as focused objects of photos. By this result, it can be seen that "buildings and hardscapes" are the most common elements that participants looked for when deciding whether a photos showed "Historical-Colonial look" or "Indonesian look" landscape style. For the participants, who were all Indonesian people, the existence of buildings and hardscapes in the landscape were important in being able to influence their perceptions about the character of a landscape.

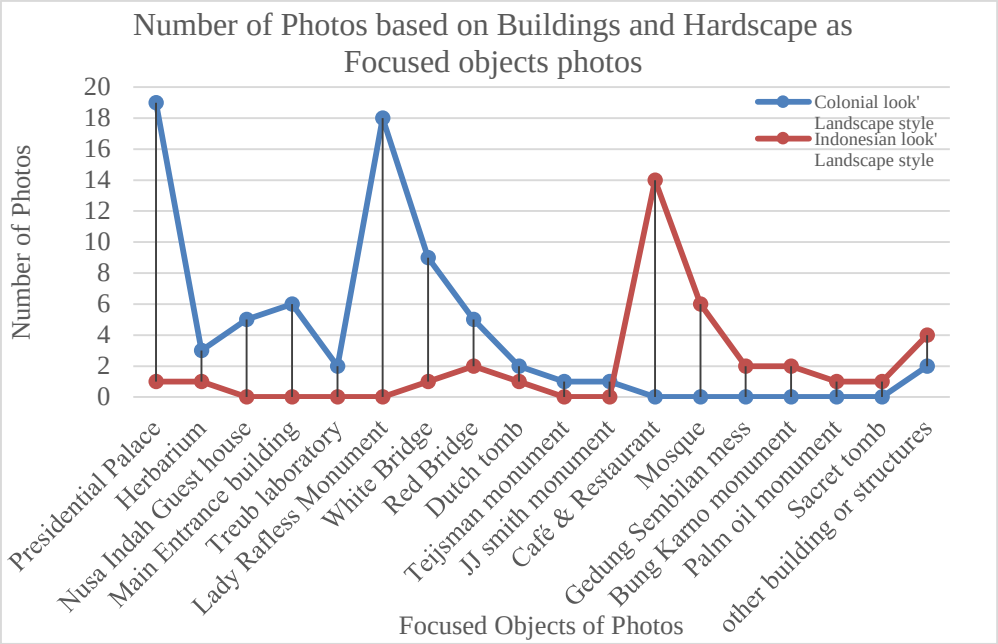

Figure 61. Number of photos based on buildings and hardscapes as focused objects

The photo-based method revealed interesting trends as regards perceptions of Colonial and Indonesian styles. In identifying a "Historical-Colonial look" landscape, participants tended to select photos of a buildings and hardscapes with such non-indigenous elements as fluted columns and plain white walls as markers. About 85% of the "Historical-Colonial look" photos were from vantage points in clusters that showed historical buildings and structures. The participants' explanations confirmed that their selection of "Historical-Colonial look" landscape photos was largely based on the presence of historical buildings and structures in the photos (69.11% of total answers). The Bogor Presidential Palace, the Lady Raffles Memorial, the White bridge, the Nusa Indah guest house, the Entrance building and the Red bridge were markers of the "Historical-Colonial look" landscape style photos sepected by participants (Figure 62). Specifically, they mentioned that the palace's roof, columns, stairs, structures, windows, doors, and white paint were indicators of the "Historical-Colonial look."

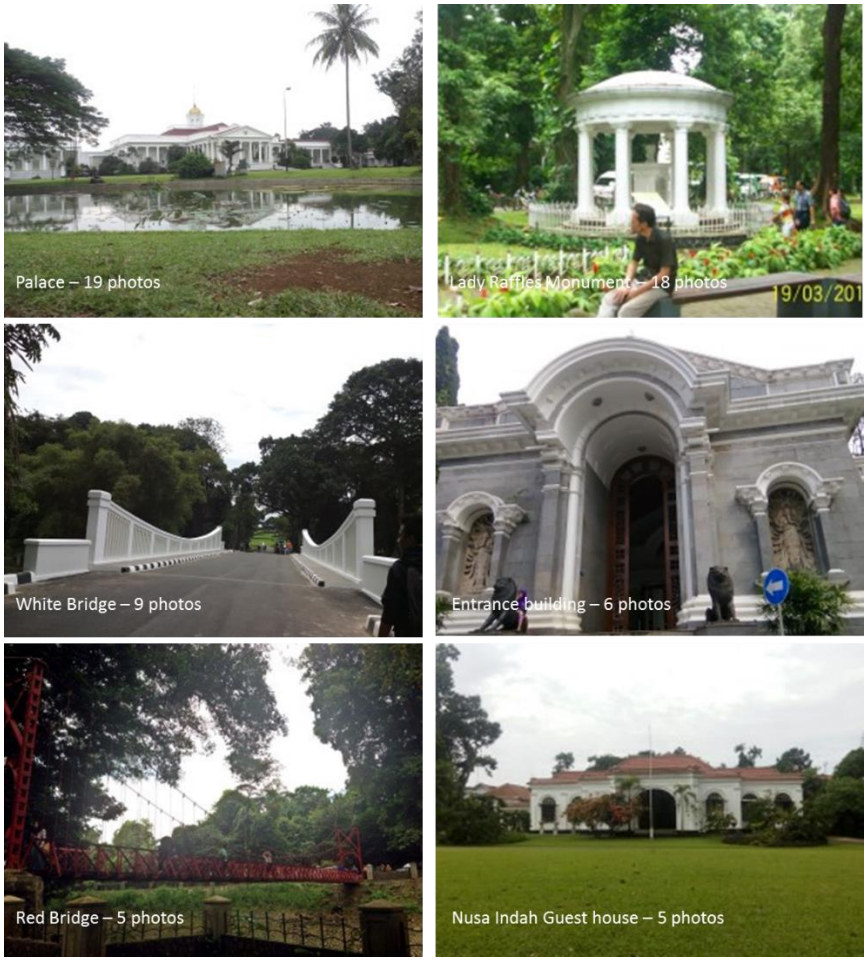

Figure 62. Example of Photos that mostly selected as Historical-Colonial look landscape

"Historical-Colonial look" buildings are found in nearly every city in Indonesia. Therefore, Indonesians easily recognize and distinguish them from both traditional and modern Indonesian buildings. This factor no doubt influenced participants to follow architectural cues in choosing Historical-Colonial-look landscape photos. In the perception of the participants, the landscape will be perceived as Historical-colonial landscape style if there are Historical-Colonial buildings as a marker or focal point. Interestingly, none of the participants chose as an example of Historical-Colonial landscape Teijsmann garden, which that has a European-Colonial landscape style, formal and symmetrical, but without buildings.

In this research, “Historical-Colonial” refers to those buildings and structures built in the Dutch Colonial style and before 1949, characterized by a high roof, thick walls, white paint, high doors and windows, and other ornaments. These buildings include the Bogor Palace (built in 1745 and reconstructed in 1839), Lady Raffles’s Memorial (1817), Treub Laboratory (1910), Guest House (early 20th century), zoological museum (early 20th century) (Wieringa et al., 1989), and red Hanging Bridge (Smith, 1924).

The participants’ decision to select photos of the Bogor Presidential Palace as Colonial looking matches the long history of the BBG. The BBG, built later than the palace, is actually the backyard of the palace. The view to the palace that visitors enjoy from across the pond is of an authentic English-style garden landscape. Old references, paintings, and pictures of BBG (Wieringa et al., 1989) include that view of the palace from across the pond.

As for the “Indonesian look” landscape, the participants focused on landscape elements that created a tropical look or elements related to the Indonesian identity or a traditional look that is common throughout the country. The photos of the Café & Restaurant building were mostly selected as “Indonesian look” landscape photos because of the presence of the restaurant, which was built in traditional Indonesian architecture. According to participants’ reasons, the most common reason given by the participants for identifying photos as “Indonesian look” was “because the landscape looks tropical” (Figure 63). Thus, their perception of the “Indonesian look” refers to a tropical look, seen in landscapes with a mixed composition of vegetation. Meanwhile, “Indonesian look” buildings or structures are those whose roof style and wooden materials are decidedly traditional and distinct from historical buildings.

Figure 63. The tropical look of a landscape that participants consider to represent "Indonesian look" landscape style.

5.2 Participants' Reasons

5.2.1 Reasons for selecting "Colonial look" landscape style photos. According to the photo explanations (Table 15) for the "Colonial look," one common answer is the foreground of the palace: the pond and its surrounding trees, the lawn, and the sculpture (five answers). Other participants mostly focused on the presence of historical buildings on the site. Four participants selected the photos as "Historical-Colonial look" landscape photos because of the presence of the palace in the photos. A larger group of participants identified the presence of such Colonial-style elements as high columns, high windows, gable roof, and white paint as their reason for classifying the landscape as "Historical-Colonial looking" (ten answers).

Table 15

Participants' Reasons for Selecting and Classifying Photos as "Colonial look" landscape

	Reasons of taking photos	Number
1	There is a historical building/structure on site	17
	There is a historical building or structures that the style perform by its roof, column, stairs, structures, high window, high door, white color and straight lines	23
	There is a historical background of the building and structures	5
	There are obelisk statue, trees on right and left side building	6
	The sculpture's style is Japanese look	1
	The building look magnificent	1
	No reason	7
2	Bridge shape looks colonial	1
	From the white color and the straight lines of structure	1
	There is a lawn after the bridge	1
3	There is a sculpture of men played music look colonial	1
4	There is a palace with colonial look building style	4
	There is a building that look colonial from its color, column, high window, gable roof	10
	There are garden, lawn, flower, pond, ordered shrubs pattern	5
	The palace is a colonial heritage and landmark of the city	1
5	There is a fountain inside the garden with lawn	1

5.2.2 Reasons for selecting "Indonesian look" landscape style photos. These photos were selected as "Indonesian look' landscape photos because of the presence of the restaurant, which was built in traditional Indonesian architectural style (Table 16). Related to the landscape, four participants answered that the mixed composition of

vegetation gives the landscape a tropical look, whereas two participants mentioned that the wide lawn gives the landscape an "Indonesian look." Meanwhile, three participants compared the view with other landscapes outside BBG, noting similarities with common Indonesian landscapes.

Table 16

Participants' Reasons for Selecting and Classifying Photos as "Indonesian look" Landscape

	Reason of taking photos	number
1	the sculpture express Indonesian culture	1
	No reason	1
2	there are vegetation that are common seen in Indonesia, i.e. orchid, palm oil trees, bamboo, banana trees, Plumeria trees, big root trees, big trees	14
	there are mix-composition of various plants in different high level make the landscape become tropic look	9
	the composition of vegetation that are united and make line of corridor and look symmetry	3
	there is a river in brown color of water composed with mix-composition of trees on river-bank	5
	there is a buildings/structures that look Indonesian style, such as bamboo raft, mosque, mess building, restaurant, gazebo, well, fence, and monument in red-white color	11
	there are people activities	1
	the landscape and its elements reflect Indonesian History	3
	the view reminded the participants about his/her hometown – memory	1
	the mosque's style look common in Indonesia	3
	the mosque's style can be seen by its roof, wood material and stage based	2
	the mosque's style shows collaboration of Islam and Hindu	1

	No reason	5
3	there is a building with traditional Indonesian style, that can be seen from its roof style	7
	the view to this direction looks tropic by mix-composition of vegetation	4
	the view look common in Indonesian landscape	3
	there is a wide lawn	2
4	I love flower (personal reason)	1
5	the shrubs' composition form "Garuda" symbol of Indonesia	3
	the mix-composition of vegetation make the view become tropic look	4
	the trees look common in Indonesia	2
	the river look common in Indonesia	1
	the people activities look common in Indonesia	1
	there are structures look Indonesian, i.e. bamboo raft, palace and restaurant	4
	no reason	2
	Total	94

Chapter 6

Discussion and Conclusion

6. Discussion and Conclusion

6.1 Discussion

6.1.1 The difference in method influenced the hotspots. Due to survey procedures and approach of analysis method, the impressive landscape objects identified by photos hotspots in BKF and BBG have a different meaning. In BKF, the impressive landscape elements came from the frequency of photos captured by different participants who had similar opportunity to see similar objects along because they were required to follow a fixed trail. Therefore, the photo hotspots in BKF were related to the participants' selection of objects or scenes whether they were impressive or not. In BBG, the impressive landscape elements were identified by the frequency of captured photos at places that were popular and thus passed by participants. It may be that there were other impressive elements along other trails or in other parts of the site, but they were not popular enough to be captured by the participants as few or no participants passed by them. Therefore, other factors may have influenced whether the participants determined that a scene or object in the BBG was impressive. One of possible factor that could have influence this it is the availability of maps, signposts, and information about the existing features in BBG (Table 17).

Table 17

Different Meaning of Photos Hotspots as Influenced by the Difference of Analysis Method

	Bukit Kucing Forest - BKF	**Bogor Botanical Garden - BBG**
Site Information	Not available - each participant selected impressive objects on-site without early information	Available - each participant may have information that may influenced them selecting impressive objects on-site
Hotspots approach	Line based Hotspots	Polygon based hotspots

Trail Direction	Fixed – 100% participants passed by each trail segment. Each participant has opportunity to see similar features along trails	Free direction – Not all participants passed by each cell. Each participant will not see different objects depend on the trail they walk
Meaning of Photos Hotspots	Segments where impressive objects frequently seen and captured them in photos	Cells where more participants passed by, seen impressive objects and captured them in photos
Impressive Objects	Plants (melaleuca trees, drought trees, flowering shrubs) and man-made structures (red-bridge and gazebo)	Plants (flowering plants, succulent shrubs) and man-made structures (palace and monuments)
Meaning of GPS Tracking Hotspots	Segments where participants stopped longer at the same trail segments	Cells where popular for participants passed by and stopped longer
Character of Resting places	Under hilltop gazebo shelter with panoramic view of city	Under trees shading near lawn with panoramic view of lawn

The information about existing features early in the walking course could easily have influenced the selection of popular places by participants. In BKF, participants selected impressive landscape objects without information. Additionally, they all walked along the same route. Participants had to expend more effort to explore, identify, and photograph impressive landscape objects or scenes without guided information about existing features such as signs or maps. They had to search out impressive those landscape objects that were visible from the trail and sometimes slightly off the trail to find the objects (see example of Figure 64). Nevertheless, this research provided information about participants' perceptions of impressive landscape objects and its vantage point locations that was not previously available. For future landscape management of BKF, this information will be very important for incorporating unexplored-landscape objects into recreational or tourism plans of BKF in the future.

Figure 64. Example of participants' activities in searching out impressive landscape elements on the BKF site.

In BBG, participants were able to get information about existing features and directions from flyers that they received on the ticket gate, on maps and signboards located near the gate, and from signs along the trails. There were also signboards in each cluster of existing plants that provided information about the plants. In this case, participants were helped by provided information that them in selecting and capturing impressive landscape objects or scenes. Although the participants could make their own choices about which trails to follow and what attractions to seek out, they were influenced all along the way by information provided that helped theme decide what destination they most wanted to go toward and what objects they wanted to see. For landscape preference research that has as its objective the exploration of perceptions of attractive landscape

elements as selected by group of participants, using free-direction trails and providing extensive information about existing features before site survey is not recommended.

6.1.2 Similarity of character of impressive landscape objects and scenes. The character of impressive objects selected on-site by participants in BKF and BBG were similar: unique characteristics of plants, human-made structures, and opening area. The most frequently chosen landscape elements captured in both BKF and BBG were plants. Green plants were the most prevalent objects visible anywhere at both sites for the reason that both sites were located in a tropical climate where green-leaved trees are available all throughout the year. The color of the landscape in both sites was dominated by green and it caused a monotony of color of landscape. However, participants succeeded in selecting plants that had a unique character and capturing them in photos. The unique characteristics of plants that were most frequently captured by participants were trunks, flowers, seeds, roots, and canopy shapes. Plants that were not healthy such as drought-stricken plants or burned plants, or those with parasites such as loranthus were also captured by participants. Plants that were arranged well in pleasing designs were also captured frequently by participants.

The other landscape objects that were captured often by participants were human-made structures. It mirrors results from (Sugimoto, 2011), who found that “man-made structures” as landscape elements often attract visitors’ attention in parks. The human-made structures in a forest or garden can break the monotony of greenery and attract participants’ attention.

The last objects that were frequently captured as impressive objects by participants were open areas or areas with little or no tree shading. For a forest landscape, opening are important to reduce high humidity under the tree canopy and provide places

that receive full sun and allow flowering plants to grow. The openings also provide wider views for visitors. Therefore, in both study sites, open areas were photo hotspots where participants found other impressive objects such as plants with flowers and seeds.

In management of forest-like landscape, the impressive landscape elements discussed above are very important. They must exist and be managed as attractions for visitors. Therefore, it is very important to keep the sustainability of those objects.

6.1.3 The importance of first intersection after the starting point. The GPS tracking results in BKF and BBG site both showed that participants tend to stay longer at or near the first intersection after starting point, as evidenced by the hotspots of GPS tracking (Figure 65). It is an interesting trend that suggests that the first intersection holds an important role for participants in a walking course and that landscape management should pay special attention to these locations.

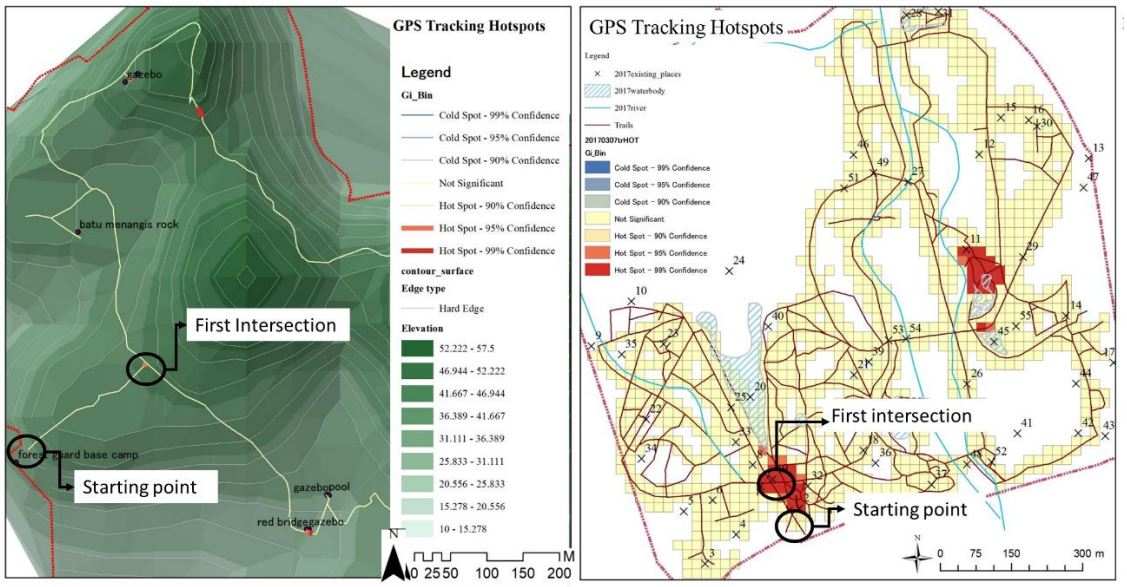

Figure 65. The first intersection after the starting points in BKF (left) and BBG (right).

In the first intersection locations, participants did orientation about the site and tried to learn about the landscape they were visiting. In BBG, information about the site was provided by a big map-board located in the first intersection and by flyers that were

handed out at the ticket gate. Most of participants of BBG read the map-board before taking a walk deeper inside the site. The situation was different with BKF. There were no maps or handouts, and no printed information at the first intersection. However, participants did self-orientation by stopping for a while to listen to the forest guards, sightseeing, talking with friends, and waiting for other friends before walking along the fixed trail. For the future planning at BKF, it is important to consider the importance of that first intersection after the starting point and to put appropriate information facilities such as a map-board and direction board. The first intersection is also a suitable place for an information center and resting facilities.

The other important point is the peak of stopping time in walking course (Figure 66). In BKF, the peak of walking course is located in hilltop gazebo. This place is located about 1 km from starting point. In this place, there is a gazebo that participants possible to walk under roof shading. In this place, participants took about 8 minutes to take a rest. In BBG, the peak of participants stopped in Mosque-lotus pond-lawn area, located about 900 meters from starting point. In this place, respondents participants took a rest under trees shading or in mosque building. This result shows the importance of peak of stopping places in a walking course in protected areas. By using GPS logger, the peak of stopping places can be detected spatially. The places selected by participants as stopping places are under roof or trees' shading and the sitting facilities are available. In landscape planning, this place is suitable to put shelters, gazebo, bench, drink water facilities, toilets and praying facilities.

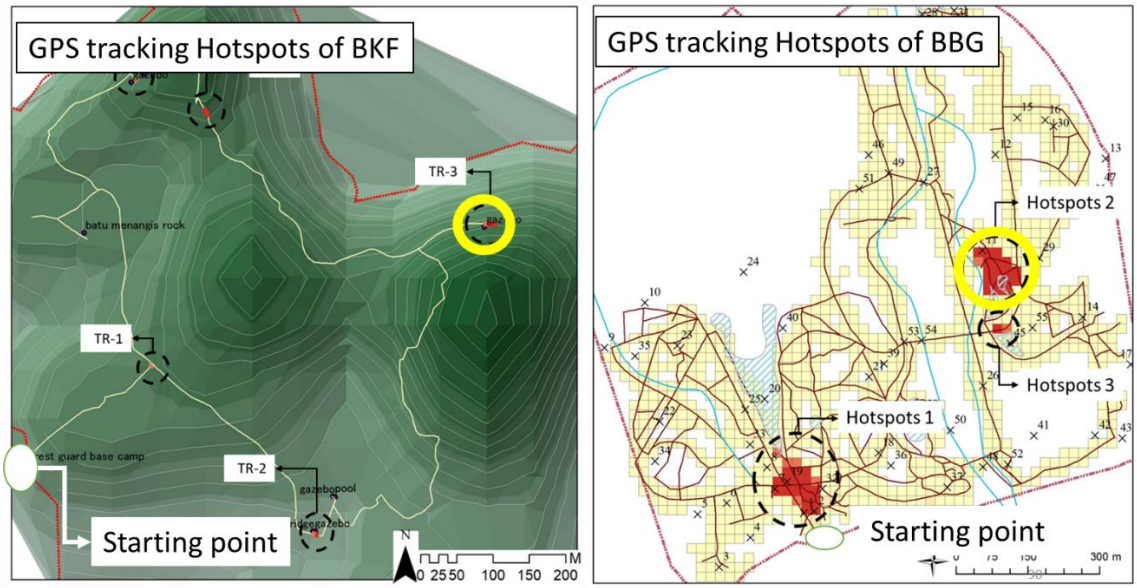

Figure 66. The Place where Participants stopped longer in BKF (left) and BBG (right)

6.1.4 Recommendation for Landscape Planning and Management. In a landscape planning and management process, the hotspots map of Photos Hotspots and GPS Tracking Hotspots can be used for landscape planning and management. Photo hotspots map shows participants' location where they clearly saw impressive objects. The places of photos hotspots where participants significantly took photos more than in other places are recommended as attraction zones (Figure 67). In those zones, the impressive objects that are potential attracts visitors' attention and impressive for visitors are visible. These information are useful as reference to preserve objects as impressive attraction, vantage points as sighting position and space between of them from any obstacle that disturbing the view.

The other recommendation related with facilities attachment into the site. In BKF that still need improvement in adding supporting facilities, the photo hotspots maps is a reference in attaching new facilities for sightseeing and observation, such as signboard, binocular and shelter. The objective of attaching those facilities are giving information

about existing objects and supporting visitors to do recreational activities conveniently in the hotspots area.

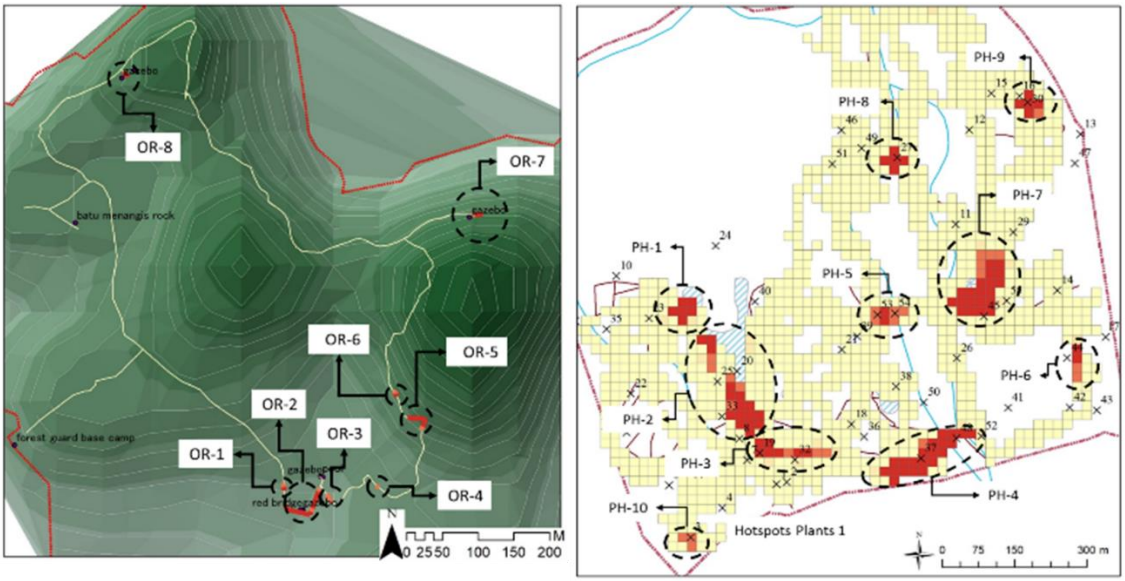

Figure 67. The Photo hotspots places, include: red segments in BKF (left) and red cells in BBG (right) that are recommended as attraction zones.

Beside photos hotspots map, the tracking hotspots map also can be used as reference in deciding resting zones (Figure 68). In the places where GPS tracking points significantly clustered, participants selected those places to stop longer than in other places. In those places, the attachment of facilities and structures that supports visitors to take a rest, such as benches, shelters, fresh water and toilets, is recommended.

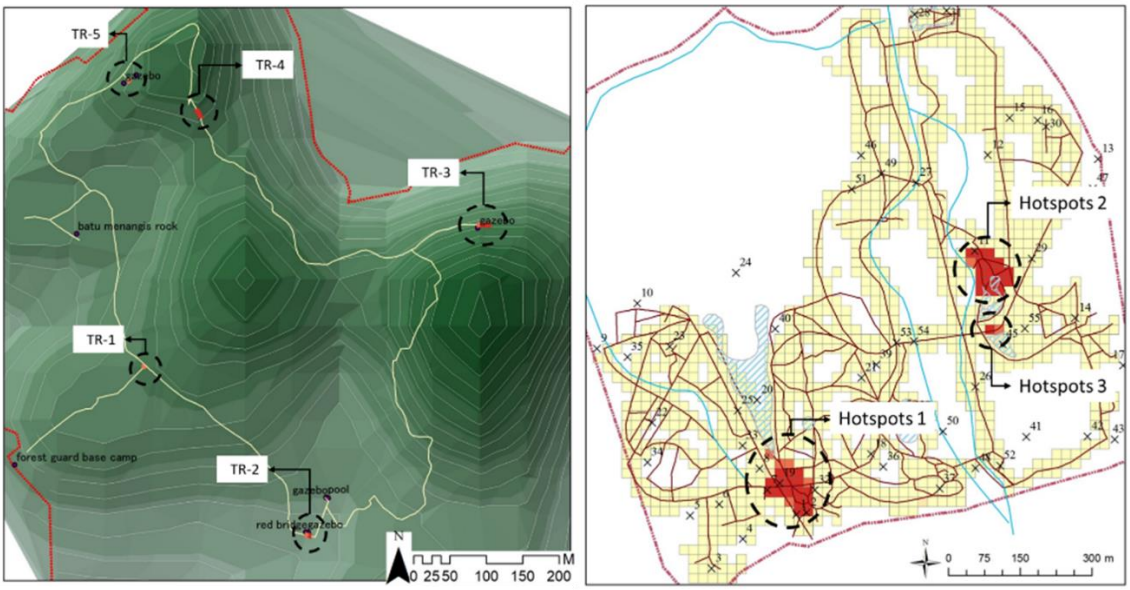

Figure 68. The Tracking hotspots places, include: red segments in BKF (left) and red cells in BBG (right) that are recommended as resting zones.

6.2 Future Research

The research at BKF and BBG show that some of the important places identified by GPS tracking hotspots were places that provided shade and seating facilities. In those places, participants stopped longer than at other trail segments or cells. This is probably a result of the hot weather in those two study sites, both located in Indonesia. The range of temperature of Tanjungpinang City (BKF) is 23^{o}C to 34^{o}C throughout the year (http://jdih.tanjungpinangkota.go.id/index.php/profil/hujhakfkak), and in Bogor (BBG) it is 21.8^{o}C to 30.4^{o}C throughout the year (http://jabarprov.go.id/index.php/pages/id/1058). Thus, the temperatures at both sites are usually high. Unfortunately, the daily weather data of the on-site survey days were not recorded. In the future, research to analyze the influence of local climate to participants' behavior when doing VEP with GPS tracking is needed. This future study will answer why participants show similar trend of staying longer in shaded place and what should be recommended for landscape and visitors' management.

6.3 Conclusion

The landscape preference research using VEP method combined with GPS tracking method in this research was successful in identifying impressive landscape objects and important places selected on-site by participants. The impressive landscape objects that were identified by participants at both study sites were the unique characteristics of plants, human-made structures and buildings, and open area and panoramic views. The important places where participants stayed longer and clustered to create high density of vantage points were also successfully identified. Compared with other landscape preference research using questionnaires, photo selection, or interviews, this method proved to deliver more accurate results about what participants actually perceive as attractive and impressive in a landscape site as they document, with their own photographs, those landscape elements which are recorded in situ via GPS tracking.

The other benefit of using this method is the geo-locations of vantage points of each photos can be represented spatially. The important places where vantage points clustered spatially were represented by Getis-Ord Gi* hotspots results. The hotspots maps overcome in this research show important places where participants can see impressive landscape objects on the site. In landscape planning and management, the map of photo hotspots can be used to optimized the existing objects into attractions for recreation by managing the views of impressive objects. The important places were not only performed by photos' vantage points hotspots but also GPS tracking points hotspots. GPS tracking hotspots shows places where participants significantly stayed longer than other places along the walking trail. The first intersection after starting point or main gate, hilltop places and under trees shading places were places where popular for participants to stay longer according to GPS tracking hotspots results. Similar with the map of photos

hotspots, the map of GPS tracking hotspots can be used as reference for attaching new facilities or improving existing facilities. For BKF, which is relatively new in its role as a public recreation resource, the results of this study can be an invaluable reference in making a masterplan. For BBG, which is already well managed, the results can be used as evaluation of ongoing management.

The novelty of this research is its inclusion of selfie photos as tools in landscape preference research, as explained in Chapter 2. Most research involving selfie photos has focused on identifying people's behavior in daily life or tourism. However, this study used the vantage points chosen for selfie photos to show that there were hotspots where participants took more selfie photos than those in other places in BKF trail. By identifying each selfie photo's focused objects, the impressive landscape objects that were popular for selfie photos in BKF forest were identified, including plants, human-made structures, and open areas. From this research, it can be concluded that the selfie photos captured by participants in this research were not only for enjoyment but also for showing impressive landscape objects in the same way as the ordinary photos were used.

Landscape preference research using the VEP method and GPS tracking was never implemented in Indonesia before. Therefore, this research is very useful at furthering a relatively new toolset for landscape architecture science and practitioners in Indonesia. For case studies in Indonesia with respect to landscapes involving public visitors, social data is usually analyzed non-spatially. By this method, however, the information of impressive landscape objects can be represented spatially and can be used as reference or data to develop sustainable recreation planning or design. Based on those benefits, it will clearly be useful to expand the use of VEP combined with GPS tracking in landscape preference research in other public botanical gardens or forest settings.

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Appendix

Appendix A. Questionnaire sheet of Bukit Kucing Forest

Questionnaire (translated to English)

Public Preferences of Bukit Kucing Forest Tanjungpinang Indonesia

My name is Akhmad Arifin Hadi. I am a PhD Student of Chiba Unviersity Japan. This is a questionnaire of my research " **Public Preferences of Bukit Kucing Forest Tanjungpinang Indonesia"**. The reseach objective is to explore people of Tanjungpinang's preferences of Bukit Kucing Forest related with ecotourism activities. The result will be used as an input in landscape design of Bukit Kucing Forest. This questionnaire takes time about 10 minutes. Thank you very much for your cooperation.

PARTICIPANT IDENTITY

Age :

Sex : male/female

Are you a citizen of Tanjungpinang?: yes/no

Please write your village/residential/district/city's name*….

Occupation :

a. Student
b. Others: ….

PARTICIPANTS EXPERIENCES

Did you KNOW if there is a protected areas in Tanjungpinang city called BUKIT KUCING FOREST before?

a. Yes
b. No

If you ever come to Bukit Kucing Forest, how many times did you come before (including today)?

a. Only 1 time (only today)
b. more than 1 time please mention:…
c. I come here everyday
d. I come here frequently, please mention : … (example once a week)

When you came to Bukit Kucing Forest, did you:..

a. walk
b. by vehicle, please mention:….

PARTICIPANTS EXPECTATIONS

In the future, What kind of activities you expect to di in Bukit Kucing Forest? ….

What kind of object you expected to see in Bukit Kucing Forest? ….

What kind of facilities should be added related with your expected activity in Bukit Kucing Forest?

……..

PARTICIPANTS PERCEPTIONS

Please give value of this questions. From scale 1-4, 1 is very not agree to 4 is very agree

		Very disagree	disagree	Agree	Very Agree
A	After today, I will back again to this site to do ecotourism in Bukit Kucing Forest				
B	I want to learn about birds and animals in Bukit Kucing Forest				
C	I want to learn about plants in Bukit Kucing Forest				
D	I want to get good view to the city from Bukit Kucing Forest				
E	I want to get amenities (such as cafeteria, toilet, sitting area etc) in Bukit Kucing Forest				
F	I want to do sports in Bukit Kucing Forest				
G	I want to take a bath on springs or pond of Bukit Kucing Forest				
H	I want to do camping very well in Bukit Kucing Forest				
I	Bukit Kucing Forest has advantages for me				
J	Bukit Kucing Forest has advantages for society				

Appendix B. Questionnaire Sheet of Bogor Botanical Garden

Questionnaire (paper-based)

Thank you very much to be my participants. My name is Akhmad Arifin Hadi, I am a doctoral student of Landscape Architecture, Chiba University Japan. I would like to do research about preferred landscape according to visitors' perspective. **The purpose** of this research is investigating the utility of Visitors employed photography for obtaining information of preferred landscape. Your participation, opinion and inputs are very helpful in order to reach this research objective. Once again, thank you very much.

Participants attributes

1. Gender : male / female
2. Age :…….
3. Latest Education:……
4. How many times did you visit this place (include today)?.....

Facebook Pictures Shared

5. Will you upload and share the pictures you get today into your Facebook? Yes / No
6. May we investigate how many people "like" the pictures and its comments? Yes / No

Participants preferences

7. What is your preferred sceneries in this site? Please explain the name of the place or its characteristics
   Name of location/scenery:…….
   Why:……..
8. What is your preferred landscape elements in this site? Pease circle, may more than one

A	Trees	K	Flower (single)
B	Shrubs	L	Orchids
C	Weeds	M	Flower beds (mass)
D	Lawns	N	Old buildings
E	cactus	O	Modern buildings
F	Ferns	P	Roads
G	Palm	Q	Bridges
H	Bamboos	R	View to the cities
I	Coniferous	S	View to evation places
J	Water plants	T	Others: ……

Why did you select the landscape elements above?
……
…….

9. What is your preferred zoom in object in this site? Pease circle, may more than one

A	Trees	J	Water plants
B	Shrubs	K	Flower (single)
C	Weeds	L	Orchids
D	Lawns	M	Flower beds (mass)
E	Cactus	N	Old buildings

F	Ferns	O	Modern buildings
G	Palm	P	Roads
H	Bamboos	Q	Bridges
I	Coniferous	S	Others: ……

Why did you select the landscape elements above?

…….

Selfie Photos

10. Did you take selfie photos? Yes / No
    a. If it is yes, why did you take them?

    ……
    b. If it is No, why?

    ……..

11. What kind of landscape or sceneries you prefer to do selfie photos?

A	Trees	L	Orchids
B	Shrubs	M	Flower beds (mass)
C	Weeds	N	Old buildings
D	Lawns	O	Modern buildings
E	cactus	P	Roads
F	Ferns	Q	Bridges
G	Palm	R	View to the cities
H	Bamboos	S	View to evation places
I	Coniferous	T	Others: please mention.
J	Water plants		……
K	Flower (single)		……

Why did you select the landscape elements above?

…….

Characteristics of landscape

Please answer the questions below by writing the name of the place, name of elements or its characteristics

12. What are the sceneries, landscape, or elements that shows “colonial look”?

    ……
13. What are the sceneries, landscape, or elements that shows “Indonesian look”?

    ……

Preferred places

Please circle on the map, or write the name of the place that you prefer most

Name of the place:……..

Why:……..

.


Peta Kebun Raya Bogor
Bogor Botanical Gardens Map
U/N
Taman Sudjana Kassan
Sudjana Kassan Garden
Orchidarium
Herbarium
Griya Anggrek
Orchid House
Pintu 3/Gate 3
(Open at 17.00-22.00)
Wisma Tamu Pinus
Pinus Guest House
Istana Bogor
Bogor Presidential Palace
Kantor Utama
Main Office
Café de'Daunan
Pintu 2/Gate 2
(Open on Sunday & public holiday)
Pintu 4/Gate 4
(Open on Saturday, Sunday & public holiday)
Wisma Tamu Nusa Indah
Nusa Indah Guest House
Gerbang Utama
Main Gate/Gate 1
Pusat Informasi
Information Center
Tugu Kujang
Monument of Kujang
Laboratorium Treub
Treub Laboratory
Pintu Tol Jagorawi
Jagorawi Toll Gate
Museum Zoologi
Zoological Museum
Gd. Konservasi/Perpustakaan
Conservation Building/Library
Toko tanaman/cinderamata
Garden Shop
Taman Meksiko
Mexican Garden
Koleksi Tanaman Air
Aquatic Plant Collection

Appendix C. The significance of each Hotspots' segment of Ordinary Photos Hotspots in BKF (Chapter 3)

No	Hotspots		Getis-Ord Gi* analysis results				
	name	Segment	Count of nearest points	GI Z-score	Gi p-value	Gi Bin	
1	Melalueca trees	99**	5	1.8376	0.0661	1	hotspots - 90% confidence
	(OR-1)	100	9	2.3553	0.0185	2	hotspots - 95% confidence
		101	7	2.8730	0.0041	3	hotspots - 99% confidence
		102**	8	1.3200	0.1869	0	not significant
2	Red-bridge area	105**	10	1.8376	0.0661	1	hotspots - 90% confidence
	(OR-2)	106	4	2.1828	0.0291	2	hotspots - 95% confidence
		107	6	2.7004	0.0069	3	hotspots - 99% confidence
		108	13	5.4614	0.0000	3	hotspots - 99% confidence
		109	20	6.6694	0.0000	3	hotspots - 99% confidence
		110	13	7.5322	0.0000	3	hotspots - 99% confidence
		111	18	7.7047	0.0000	3	hotspots - 99% confidence
		112	21	7.8773	0.0000	3	hotspots - 99% confidence
		113	14	5.2889	0.0000	3	hotspots - 99% confidence
		114	3	2.7004	0.0069	3	hotspots - 99% confidence
		115	6	2.0102	0.0444	2	hotspots - 95% confidence
		116	10	3.0456	0.0023	3	hotspots - 99% confidence
		117	9	3.2181	0.0013	3	hotspots - 99% confidence
		118	7	3.2181	0.0013	3	hotspots - 99% confidence
		119	10	3.3907	0.0007	3	hotspots - 99% confidence
		120	10	3.7358	0.0002	3	hotspots - 99% confidence

		121	9	2.5279	0.0115	2	hotspots - 95% confidence
		122**	3	1.0768	0.2816	0	not significant
3	Transition area 1	128**	5	0.8023	0.4224	0	not significant
	(OR-3)	129	2	2.1828	0.0291	2	hotspots - 95% confidence
		130	13	2.0102	0.0444	2	hotspots - 95% confidence
		131	4	2.3553	0.0185	2	hotspots - 95% confidence
		132**	4	0.2846	0.7760	0	not significant
4	Transition area 2	150**	7	1.4925	0.1356	0	not significant
	(OR-4)	151	6	2.1828	0.0291	2	hotspots - 95% confidence
		152**	7	1.3200	0.1869	0	not significant
5	Grassland 1	180**	4	1.3200	0.1869	0	not significant
		181	3	2.0102	0.0444	2	hotspots - 95% confidence
		182	12	6.3242	0.0000	3	hotspots - 99% confidence
		183	29	9.0852	0.0000	3	hotspots - 99% confidence
		184	19	9.7755	0.0000	3	hotspots - 99% confidence
		185	16	6.8419	0.0000	3	hotspots - 99% confidence
		186	12	5.8065	0.0000	3	hotspots - 99% confidence
		187	13	4.5986	0.0000	3	hotspots - 99% confidence
		188	9	3.0456	0.0023	3	hotspots - 99% confidence
		189**	3	1.1474	0.2512	0	not significant
6	Grassland 2	195**	7	1.8376	0.0661	1	hotspots - 90% confidence
		196	8	2.8730	0.0041	3	hotspots - 99% confidence
		197	9	2.1828	0.0291	2	hotspots - 95% confidence
		198**	3	1.4925	0.1356	0	not significant
7	hilltop gazebo	272**	4	1.1474	0.2512	0	not significant
	(OR-7)	273	8	2.1828	0.0291	2	hotspots - 95% confidence

		274	8	5.6340	0.0000	3	hotspots - 99% confidence
		275	24	5.7221	0.0000	3	hotspots - 99% confidence
8	Historical Sculpture	414**	1	0.0298	0.9763	0	not significant
	(OR-8)	415	8	3.9084	0.0001	3	hotspots - 99% confidence
		416	21	5.0886	0.0000	3	hotspots - 99% confidence

Appendix D. The significance of each Hotspots' segment of Selfie Photo Hotspots in BKF (Chapter 3)

No	Hotspots			Getis-Ord Gi* analysis results			
	Name	Segment	Count	GI Z-score	Gi p-value	Gi Bin	
1	First intersection	43	4	2.809	0.005	3	hotspots - 99% confidence
	(SE-1)	44	3	3.846	0.000	3	hotspots - 99% confidence
		45	2	1.772	0.076	1	hotspots - 90% confidence
2	Red-bridge area	108	2	1.772	0.076	1	hotspots - 90% confidence
	(SE-2)	109	3	5.921	0.000	3	hotspots - 99% confidence
		110	8	6.439	0.000	3	hotspots - 99% confidence
		111	3	9.032	0.000	3	hotspots - 99% confidence
		112	8	7.476	0.000	3	hotspots - 99% confidence
		113	5	6.439	0.000	3	hotspots - 99% confidence
		114	1	3.846	0.000	3	hotspots - 99% confidence
		115	3	3.327	0.001	3	hotspots - 99% confidence
		116	4	4.365	0.000	3	hotspots - 99% confidence
		117	3	5.402	0.000	3	hotspots - 99% confidence
		118	5	4.365	0.000	3	hotspots - 99% confidence
		119	2	3.846	0.000	3	hotspots - 99% confidence
		120	2	1.772	0.076	1	hotspots - 90% confidence
3	Grassland I	184	1	1.253	0.210	0	not significant
	(SE-3)	185	2	2.290	0.022	2	hotspots - 95% confidence
		186	3	2.809	0.005	3	hotspots - 99% confidence
		187	2	2.290	0.022	2	hotspots - 95% confidence
		188	1	0.734	0.463	0	not significant
4	Grassland 2	193	1	0.734	0.463	0	not significant
	(SE-4)	194	2	2.290	0.022	2	hotspots - 95% confidence

		195	3	1.772	0.076	1	hotspots - 90% confidence
5	Hilltop gazebo	263	4	1.772	0.076	1	hotspots - 90% confidence
	(SE-5)	264	1	2.290	0.022	2	hotspots - 95% confidence
		265	1	0.216	0.829	0	not significant
		269	0	1.253	0.210	0	not significant
		270	3	2.809	0.005	3	hotspots - 99% confidence
		271	4	3.327	0.001	3	hotspots - 99% confidence
		272	1	1.772	0.076	1	hotspots - 90% confidence
		273	0	1.772	0.076	1	hotspots - 90% confidence
		274	4	5.402	0.000	3	hotspots - 99% confidence
		275	8	6.945	0.000	3	hotspots - 99% confidence
6	Corridor	358	0	0.216	0.829	0	not significant
	(SE-6)	359	2	2.290	0.022	2	hotspots - 95% confidence
		360	4	3.846	0.000	3	hotspots - 99% confidence
		361	3	2.809	0.005	3	hotspots - 99% confidence
		362	0	0.734	0.463	0	not significant
7	Historical	414	1	1.748	0.080	1	hotspots - 90% confidence
	(SE-7)	415	4	6.439	0.000	3	hotspots - 99% confidence
		416	9	7.580	0.000	3	hotspots - 99% confidence
8	Batu menangis Rock Springs	539	2	1.772	0.076	1	hotspots - 90% confidence
	(SE=8)	540	3	3.846	0.000	3	hotspots - 99% confidence
		541	4	2.809	0.005	3	hotspots - 99% confidence
		542	0	1.253	0.210	0	not significant

Appendix E. The significance of each Hotspots' segment of GPS Tracking Hotspots in BKF (Chapter 3)

No	Hotspots			Getis-Ord Gi* results			
	name	segment	count	GI Z-score	Gi p-value	Gi Bin	
1	first intersection	41	791	0	1	0	not significant
	(TR-1)	42	953	2	0	2	hotspots - 95% confidence
		43	3495	2	0	0	not significant
2	red bridge	110	1,372	1	0	0	not significant
	(TR-2)	111	2,591	2	0	2	hotspots - 95% confidence
		112	3,441	3	0	3	hotspots - 99% confidence
		113	2,322	2	0	1	hotspots - 90% confidence
3	uphill hazebo 2	271	877	0	1	0	not significant
	(TR-3)	272	1,423	2	0	2	hotspots - 95% confidence
		273	5,389	5	0	3	hotspots - 99% confidence
		274	8,476	17	0	3	hotspots - 99% confidence
		275	31,031	19	0	3	hotspots - 99% confidence
4	slope	358	488	0.14874	0.881759	0	not significant
	(TR-4)	359	1,461	3	0	3	hotspots - 99% confidence
		360	6,571	4	0	3	hotspots - 99% confidence
		361	4,350	4	0	3	hotspots - 99% confidence
		362	963	2	0	0	not significant
5	historical	415	1,825	2	0	0	not significant
	(TR-5)	416	3,395	2	0	2	hotspots - 95% confidence

Appendix F. The significance of each Hotspots' Cell of GPS Tracking Hotspots in BBG (Chapter 4)

No	Hotspots name	Cell's ID number	Number of points	Gi Z-Score	Gi P-Value	Gi Bin
1	TR-1	990	2171	2.161	0.031	2
		1019	454	1.964	0.050	2
		1020	88	2.354	0.019	2
		1054	2343	7.125	0.000	3
		1055	5204	15.557	0.000	3
		1056	929	3.979	0.000	3
		1085	1370	5.287	0.000	3
		1086	6926	17.670	0.000	3
		1087	23140	20.137	0.000	3
		1088	2802	14.118	0.000	3
		1089	974	2.163	0.031	2
		1121	2567	2.780	0.005	3
		1122	2066	6.706	0.000	3
		1123	2609	14.244	0.000	3
		1124	1039	4.039	0.000	3
		1125	385	2.666	0.008	3
		1158	277	2.294	0.022	2
		1159	2294	3.393	0.001	3
		1160	3417	4.111	0.000	3
		1189	836	2.988	0.003	3
		1190	3127	3.782	0.000	3
2	TR-2	393	1527	2.699	0.007	3
		394	4126	5.895	0.000	3
		395	2889	4.644	0.000	3
		409	522	2.386	0.017	2
		410	3740	5.495	0.000	3
		411	3246	6.578	0.000	3
		412	315	3.410	0.001	3
		427	349	6.321	0.000	3
		428	3916	9.200	0.000	3
		429	3295	7.377	0.000	3
		430	1364	3.227	0.001	3
		441	5502	8.133	0.000	3
		442	8439	12.410	0.000	3
		443	6781	10.024	0.000	3
		444	1773	5.039	0.000	3
		457	944	3.763	0.000	3
		458	898	4.939	0.000	3

		459	572	4.052	0.000	3
3	TR-3	567	1107	2.759	0.006	3
		568	2245	2.364	0.018	2

Appendix G. The significance of each Hotspots' Cell of Photos Hotspots in BBG (Chapter 4)

No	Hotspots name	Cell's ID number	Number of points	Gi Z-Score	Gi P-Value	Gi Bin
1	PH-1	546	7	4.531	0.000	3
		547	4	2.731	0.006	3
		586	2	3.292	0.001	3
		587	23	5.281	0.000	3
		588	8	4.571	0.000	3
		633	4	4.145	0.000	3
2	PH-2	717	5	3.008	0.003	3
		718	10	3.098	0.002	3
		747	6	3.292	0.001	3
		776	9	2.156	0.031	2
		806	4	2.298	0.022	2
		840	4	2.150	0.032	2
		872	12	3.008	0.003	3
		873	1	1.991	0.046	2
		905	10	3.292	0.001	3
		906	5	3.008	0.003	3
		931	2	2.440	0.015	2
		932	12	5.850	0.000	3
		933	0	3.719	0.000	3
		959	0	3.434	0.001	3
		960	29	7.839	0.000	3
		961	18	9.401	0.000	3
		962	2	3.719	0.000	3
		989	3	7.128	0.000	3
		990	24	6.844	0.000	3
		991	8	4.145	0.000	3
		1018	2	3.292	0.001	3
3	PH-3	1054	8	2.582	0.010	3
		1055	4	3.008	0.003	3
		1086	10	4.145	0.000	3
		1087	15	3.719	0.000	3
		1088	3	2.582	0.010	3
		1089	6	2.440	0.015	2
		1090	13	3.292	0.001	3
		1091	8	3.292	0.001	3
		1092	4	2.298	0.022	2
		1093	6	2.014	0.044	2
4	PH-4	1036	2	4.690	0.000	3
		1037	9	2.626	0.009	3

		1038	9	2.785	0.005	3
		1039	5	3.579	0.000	3
		1068	1	2.298	0.022	2
		1069	10	5.566	0.000	3
		1070	23	4.713	0.000	3
		1071	2	5.480	0.000	3
		1101	7	4.855	0.000	3
		1102	11	3.719	0.000	3
		1103	3	5.802	0.000	3
		1136	0	4.571	0.000	3
		1137	8	3.292	0.001	3
		1138	7	6.986	0.000	3
		1139	21	4.429	0.000	3
		1140	2	5.423	0.000	3
		1170	8	5.281	0.000	3
		1171	30	6.560	0.000	3
		1172	15	10.565	0.000	3
		1173	19	5.802	0.000	3
		1174	1	6.595	0.000	3
		1196	0	4.931	0.000	3
5	PH-5	602	5	2.298	0.022	2
		603	9	3.150	0.002	3
		604	7	2.014	0.044	2
		605	5	2.014	0.044	2
		648	8	2.156	0.031	2
		649	8	2.724	0.006	3
		650	0	2.150	0.032	2
6	PH-6	764	9	3.098	0.002	3
		796	7	3.102	0.002	3
		826	9	2.467	0.014	2
		859	5	2.150	0.032	2
7	PH-7	443	7	2.156	0.031	2
		444	3	2.440	0.015	2
		445	2	2.014	0.044	2
		459	0	2.014	0.044	2
		460	8	4.855	0.000	3
		461	14	4.145	0.000	3
		477	4	2.440	0.015	2
		478	16	6.134	0.000	3
		479	12	5.992	0.000	3
		503	3	3.261	0.001	3
		504	10	4.145	0.000	3
		505	2	2.724	0.006	3

		528	4	2.582	0.010	3
		529	0	4.531	0.000	3
		530	9	4.287	0.000	3
		531	5	4.855	0.000	3
		565	7	4.429	0.000	3
		566	18	6.276	0.000	3
		567	21	8.691	0.000	3
		568	20	9.117	0.000	3
		569	15	5.708	0.000	3
		611	1	3.861	0.000	3
		612	9	4.287	0.000	3
		613	6	4.713	0.000	3
		614	5	3.008	0.003	3
8	PH-8	250	3	3.576	0.000	3
		265	4	3.292	0.001	3
		266	22	3.861	0.000	3
		267	5	3.576	0.000	3
		285	0	2.626	0.009	3
9	PH-9	158	0	3.150	0.002	3
		178	0	3.150	0.002	3
		179	29	4.145	0.000	3
		180	0	4.571	0.000	3
		194	7	5.423	0.000	3
		195	8	2.014	0.044	2
10	PH-10	1233	3	2.156	0.031	2
		1234	9	2.298	0.022	2
		1240	5	2.308	0.021	2