Distribution Measurement of Cycling Visitors at Nakhon Ratchasima Zoo Using GPS Tracking System

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Abstract

The aim of this study was to investigate visitor distribution by GPS tracking system at Nakhon Ratchasima Zoo. The samples were 122 participants who received GPS tracking and cycled to visit animals around the zoo. The data were categorized into two groups including demographic and travelling profile and top animal exhibit. The result revealed that the most visitors were family, while the member of half

visitors were 3-5 people. Most visitors spent their time with cycling less than 2 hours and lower than 6 kilometers. Visitors scatteringly visited animal exhibits, and they often passed only half of the exhibits. Amongst total exhibits, the 51-75 % of them were popularly visited. The top 3 popular exhibits were giraffe, chimpanzee and tapir, whereas the most exhibit zone that the visitors spent total time were zoo kid zone, reptile, seal show building and chimpanzee zones. The chimpanzee zone was only one exhibit that was full of visitors and got the highest satisfaction score from the visitors, while the zoo kid and the reptile zones were lower score. Overall, visitor behaviors, exhibit appearances and animal types are crucial factors that influence the zoo visitors.

Keywords: Nakhon Ratchasima Zoo, GPS tracking system, animal exhibition, visitor distribution, satisfaction

Introduction

In Thailand, tourism industry plays an important role in the economic and social development (Keereephet et al., 2018). So, the survey and data collection are the necessary methods to access tourist such as number, behavior, satisfaction and expectation that might provide a better quality of service. The effective interpretation of survey result is an important tool for operators to attract visitors and enhance their experiences in tourist attractions (Wolf et al., 2013). However, the conventional survey has limitations which are bias, imprecision, time consuming, missing data and tourist interruption (D'Antonio et al., 2010), especially the data collection in the large area as in the zoos, national parks or beaches. Thus, to apply technology can solve these defects that are potential to be more rapid reliable and accurate data source.

Tracking visitors by implementing Global Positioning System devices (GPS) recording spatial locations and accurate time of the travelers, departure and arrival time, attractions visited and moving speed at real time provides higher spatial quality of the data. Moreover, it records more detailed and frankness than data collected from conventional methodologies, whereas it requires minimal time demands on the visitors and less training of staff to collect the data (D'Antonio et al., 2010; Muñoz et al., 2019). D'Antonio et al. (2010), who studied the using of GPS tracking to follow visitor locations and destinations in the park, reported that GPS tracking is beneficial in gaining information that can be used in managing protected areas, investigating impacts from natural resources and studying visitor-wildlife concerns.

Recently, a number of zoo research have examined the factors affected visitors' emotions and satisfaction, and visitors' prior knowledge. Moreover, the zoo still desires to attract visitors in order to keep operating and ensure profitable growth in such a competitive market (Luebke & Matiasek, 2013; Lee, 2015). For example, Knezevic et al. (2016) studied socio-demographic characteristics, motivation and attitudes towards the zoo of the visitors to obtain more information regarding to the demands and requirements for visitor's satisfaction and to draw implications for possible improvements.

Nakhon Ratchasima Zoo or Korat Zoo is one of the most wonderful places for visiting in the Nakhon Ratchasima province. It covers an area of 545 rai (218 acres), and it is one of the finest animal parks of Asia. Additionally, it is also the fourth out of seven zoos under administration of the Zoological Park Organization of Thailand under the Royal Patronage of His Majesty the King Rama IX (Museum Thailand, 2020). Under the strategic plan of organization are to maintain the service quality and to gain stable income which are depending on the number of the visitors

and their satisfaction (Lee, 2015). Although Nakhon Ratchasima Zoo can accommodate around 1,000,000 visitors in 2014 and 2015, the number of visitors was stable and tended to decrease that might affect on income (The Zoological Park Organization of Thailand, 2015). So, it is necessary to discover the impossible weakness, especially the attraction of visitor attention. Based on the above problems, the current trend must evaluate the distribution, satisfaction or demand of zoo visitors by suitable method. The characteristics of visitors' time and space distribution are mainly reflected how visitors spend time and place in their destination in zoo (Li, 2020; Sugimoto et al., 2019). GPS tracking system plays an important role in following visitor in the wide area. Moreover, it provides accurate position, comfortable method, real-time report and less time consuming. Consequently, the aim of this study was to evaluate behavior, pattern and popular exhibit amongst visitors by using GPS tracking. This result can be used in operating and managing the facilities in the zoo to attract visitor attention in the future.

Objective

This study aimed to apply GPS tracking system as a distribution measurement tool that provided movement and time spending of visitors around the zoo by cycling.

Methodology

1. Study site and participant

This study was designed to collect the data during January to September, 2016 at Nakhon Ratchasima Zoo, Ministry of Natural Resources and Environment, Thailand. The zoo is located at Ratchasima-Pak Thong Chai Road, Chai Mongkhon, Mueang Nakhon Ratchasima, Nakhon Ratchasima province. The participants who

travelled in the zoo were calculated by Taro Yamane (Yamane, 1973) formula which presented below with 1,000,000 population (N) and ±10 % allowable error (e). So, the participants were randomly at less 100 visitor groups who cycled to visit animals.

$$Sample\ number = \frac{N}{1 + N(e)^2}$$

2. GPS-Based data collection

The data collection was performed through www.zootou.tk, including pin of place, participant registration and data analysis. The software and assessment of GPS Tracking System were programmed by Mono GPS company, while the signal was connected by dtac TriNet Co., Ltd. Each animal exhibits or its parking places were completely pinned in the map through website (figure 1 (left)). The GPS receivers were registered the personal information including name, visiting frequency, gender, their relationship (in the group) and member number at the ticket counter in the website as well (figure 1 (right)). The GPS unit recorded visiting area at 30 second intervals. That is to say, over 90 second interval at each visiting area means they stopped at that visiting area. So, if they stop at each visiting area less than 90 seconds meaning that they passed that visiting area.

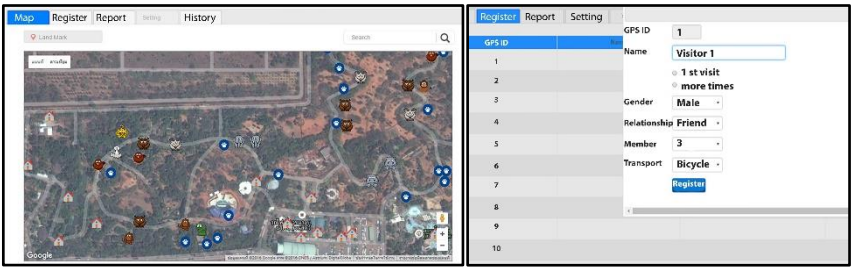


Figure 1: The pin of animal exhibition and participant registration

3. Data analysis

GPS data were automatically divided into 2 groups by website. They are demographic and travelling profile and top animal exhibit which are used to identify travelling patterns and visitor distribution. Demographic and travelling profile consisted of relationship amongst the visitors in the group, member number, travelling distance, total visiting duration, velocity, percentage of time spending at each exhibit, percentage of passing animal exhibit, and percentage of visiting animal exhibit (figure 2 (left)), while top animal exhibits were summarized as percentage of visitor visiting at the exhibit, time of visitor spending at each exhibit and total time of visitor spending at exhibits (figure 2 (right)). The top scores of animal exhibits were from the sum of percentage of visitor visiting at the exhibits, time of visitor spending at each exhibit and total time of visitor spending at exhibits. Additionally, the ranking of top animal exhibits was scored between 1-4 following its popularity.

Figure 2: The example of demographic and travelling profile and top animal exhibits

Results

The demographic and travelling profile of visitors were summarized in table 1. The total survey of 122 travelling groups revealed that the majority of visitors were

groups of family (55%) which was slightly higher than groups of friends (45%), and the number of visitors in travelling group were about 3-5 (54%). Most of them travelled for 2-4 kilometers (62%) and spent 1-2 hours (57%) at the zoo, whereas the velocity was 2-3 kilometers/hour (54%). Additionally, 43% of the visitors spent most of their time around 51-75% of total time to visit exhibit zones, and 57 % of the visitors passed 26-50 % of total exhibits, while they visited 51-75 % of total passing exhibits.

Table 1

The demographic and travelling profile of visitors

Data	Group No.	%	Data	Group No.	%
1. Relationship			5. Velocity (km/h)		
Friend	55	45	0-1	3	2
Family	67	55	2-3	66	54
2. Member number			4-5	45	37
1-2	49	40	6-7	8	7
3-5	66	54	6. Percentage of time spending at exhibit		
>6	7	6	0-25	6	5
3. Travelling distance (meter)			26-50	38	31
0-2000	10	8	51-75	53	43
2001-4000	75	62	76-100	25	21
4001-6000	25	21	7. Percentage of passing animal exhibit		
6001-8000	9	7	0-25	49	40
>8000	3	2	26-50	69	57
4. Total visiting duration (minute)			51-75	4	3
0-60	36	30	76-100	0	0
61-120	70	57	8. Percentage of visiting animal exhibit		
121-180	10	8	0-25	6	5
181-240	6	5	26-50	46	38
			51-75	55	45
			76-100	15	12
Total	122	100	Total	122	100

Due to overlapping area for pin, some animal exhibits were sorted out. Among 43 animal exhibits, the top 3 popularities that 76-100 % of visitors visited were giraffe, chimpanzee and tapir exhibits (table 2), meanwhile there were 11 exhibits that visitors spent their time over 3 minutes (table 3). There were only 4 animal exhibits that the group of visitors stayed over 3 hours, while over half of the exhibits (24 exhibits) were visited for 0-1 hour (table 4 and figure 3). Figure 3 presented the total score of visitor satisfaction including percentage of visitor visiting at exhibit, time of visitors spending at exhibit and total time of visitors spending at the exhibit following the travelling route. It was found that only chimpanzee exhibit got the highest satisfaction from the visitors followed by the reptile exhibit and the zoo kid zone. The third top score fell to seal show building, tapir exhibit, giraffe exhibit, white lion and white tiger exhibits.

The study found unsurprising result that the most of zoo visitors are family. According to the low passing animal exhibit that 97 % of visitors passed less than 50 % of total exhibits, zoo manager must realize what is the key to solve this disadvantage such as the bicycle quality or bike path. By focusing on top animal exhibit, the visitor behavior, exhibit appearance and animal type have significant potential to impact visitor attention. Among them, visitor behavior and animal type are difficult to change or improve, while exhibit appearance is possible. For example, the unclear signboard or obscure building could be resolution, and the minor route must be completely clear signboard or available map. At the same time, it is important to consider the facilities such as parking, toilet, kiosk or relaxation during trip at top animal exhibit to support the conveniently majority visitors especially for children safety. Overall, this result could be applied to operate and manage the programs and facilities at Nakhon Ratchasima Zoo in the future.

Table 2

Percentage of visitor visiting exhibit

Percentage of visitor visiting exhibit (%)	Exhibit No.	Exhibit list
76-100 (Score = 4)	3	Giraffe, Chimpanzee, Tapir
51-75 (Score = 3)	15	Reptile, White lion and White tiger, Malayan Sun Bear and Asian black bear, Zoo kid zone, African buffalo, Lion, Serows, Asian deer, Scimitar-horned Oryx, Banteng, African elephant 2, Tiger and Leopard, White rhino 2, Horse riding field, African elephant 1
26-50 (Score = 2)	8	Jaguar and Siberian tiger, Seal show building, Waterbuck, Arabian camel, Hornbill and vulture, Turtle building, Llama, Tortoise
0-25 (Score = 1)	17	Flamingo and parrot, Giant stump, Pygmy hippopotamus, Hippopotamus, Red kangaroo, Gibbon island, Greater kudu and wildebeest 2, Eastern sarus crane and scarlet ibis, Crocodile, Eland, Fluorescent animal building, Wildebeest 1, Water park, Small cat, White rhino 1, Bos gaurus frontalis, Ostrich
Total	43	

Table 3

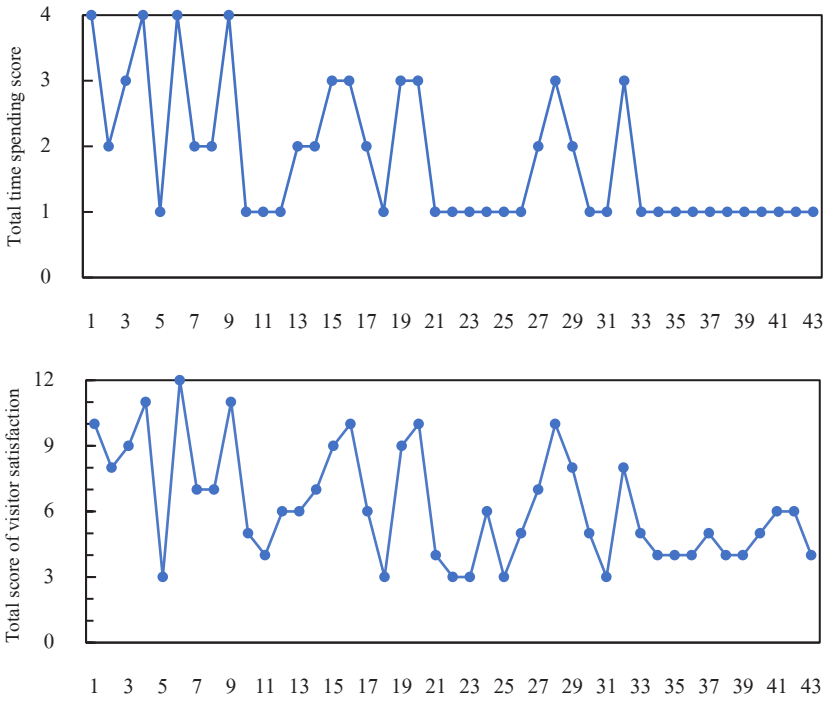
Individual time of visitor spending at exhibit

Individual time (minute)	Exhibit No.	Exhibit list
> 3 (Score = 4)	11	Water Park, Small cat, Seal show building, Turtle building, Zoo kid zone, Reptile, Gibbon island, Fluorescent animal building, Tortoise, Chimpanzee, White lion and White tiger
2-3 (Score = 3)	7	Flamingo and parrot, African buffalo, Giraffe, African elephant 2, Giant stump, Tapir, Tiger and leopard
1-2 (Score = 2)	13	African elephant 1, Hornbill and vulture, Serows, Banteng, Pygmy hippopotamus, Malayan sun bear and Asian black bear, Jaguar and Siberian tiger, Lion, Eland, Hippopotamus, White rhino 2, Eastern sarus crane and scarlet ibis, Wildebeest 1
0-1 (Score = 1)	12	Red kangaroo, Greater kudu and wildebeest 2, White rhino 1, Scimitar-horned Oryx, Crocodile, Asian deer, Horse riding field, Waterbuck, Bos gaurus frontalis, Llama, Arabian camel, Ostrich
Total	43	

Table 4

Total time of visitor spending at exhibit

Total time (hour)	Exhibit No.	Exhibit list
> 3 (Score = 4)	4	Zoo kid zone, Reptile, Seal show building, Chimpanzee
2-3 (Score = 3)	7	White lion and white tiger, Giraffe, Turtle building, Tapir, African buffalo, African elephant 2, Lion
1-2 (Score = 2)	8	Tiger and leopard, Malayan sun bear and Asian black bear, Serows, Banteng, Tortoise, African elephant 1, Hornbill and vulture, Gibbon island
0-1 (Score = 1)	24	Water park, Flamingo and parrot, White rhino 2, Scimitar-horned oryx, Asian deer, Horse riding field, Small cat, Waterbuck, Arabian camel, Fluorescent animal building, Ostrich, Hippopotamus, Llama, Red kangaroo, Pygmy hippopotamus, Greater kudu and wildebeest 2, Eastern sarus crane and scarlet ibis, Eland, Crocodile, White rhino 1, Bos gaurus frontalis, Wildebeest 1, Jaguar and Siberian tiger, Giant stump,
Total	43	



1. Seal show building	11. Sarus Crane and	21. Wildebeest 1	29. Tiger and Leopard	40. Pygmy hippopotamus
2. Tortoise	Scarlet Ibis	22. Greater Kudu and	30. Jaguar and Siberian tiger	41. Giant stump
3. Turtle building	12. Small cat	Wildebeest 2	31. Ostrich	42. Fluorescent animal
4. Reptile	13. Hornbill and vulture	23. White rhino 1	32. Lion	building
5. Crocodile	14. Serows	24. White rhino 2	33. Arabian camel	43. Water park
6. Chimpanzee	15. African buffalo	25. Bos gaurus frontalis	34. Asian deer	
7. Gibbon island	16. Tapir	26. Scimitar-horned Oryx	35. Waterbuck	
8. Banteng	17. African elephant 1	27. Malayan Sun Bear	36. Eland	
9. Zoo kid zone	18. Red kangaroo	and Asian black bear	37. Llama	
10. Flamingo and	19. African elephant 2	28. White lion and	38. Horse riding field	
parrot	20. Giraffe	White tiger	39. Hippopotamus	

Figure 3: Total time spending score at exhibit following travel route and total score of visitor satisfaction at exhibit following travel route

Discussion

The distribution survey by using GPS tracking proved an effective method for investigating how and where visitors spent their time at the zoo in order to get the visitors' destinations. In this study revealed that the visitor tracking provided how they freely move to spend their time by cycling to visit abundant exhibits. Consistent with previous findings who reported that spending quality time with children, friends and family is primary reason to visit zoo (Knezevic, 2016) we found that the proportion between family and friend of visitor was almost equal. Time spending, distance, and velocity at zoo depend on numerous factors such as vehicle for travelling, zoo area and characteristic, member behavior, visiting frequency or seasons (East et al., 2017). The majority visitors (57%) spending time for 1-2 hours conformed to Knezevic et al. (2016) who reported that the average time at zoo was approximately 2 hours. Surprisingly, there were only 3% of visitors rode through 51-75 % of total exhibits, while half of them passed only 26-50 % exhibits. Additionally, there were only 12 % of visitors visited 76-100 % of exhibits that they passed. It can be caused by unaccustomed route or another reason that will be mentioned below.

The factors affecting visitor satisfaction at zoo consisted in visitor behavior, exhibit appearance and animal type. Figure 3 was presented score of total time that total groups spent their time at each exhibit following route. It showed that only at the beginning of route such as zoo kid zone, reptile, seal show building and chimpanzee obtained the highest visiting score, while the lowest score was almost presented at the end including antelope, deer, rhino and hippopotamus. It is possible that the visitors were energetic and fresh at the beginning, so they extremely interested on animal exhibit. After a while, the attention was continually decrease

during the trip. Characteristic or appearance of exhibit is one of the important factors to attract visitors.

For example, the divided exhibits of small animal such as reptile and zoo kid zone, that were presented at the beginning and main route, got the highest score at 4. Moreover, the 15-25 minor exhibits of them were fenced by glass or net, so the visitors can intimately look at those animals and spent a long time here until ending. Contrary, the extreme distance between fence and animal at extensive exhibits such as antelope and deer got only 1 score because visitors can not clearly see animal physical, beauty, attractiveness and behavior. As well as the divided exhibit such as flamingo, parrot and small cat presented at minor road, unclear signboard or obscure building by tree had low attraction. Animal type, weight, size and characteristic significantly impacted to the visitor attraction to them. Although crocodile was begun at route, it got only 1 score that consisted with Whitworth (2012) who reported that bite or sting, sharp teeth and dull color were listed as dislike animal. Additionally, he reported that primates were the most popular group of mammals, and the ability to hold objects also attracted most visitors as well as chimpanzee and seal show in this study (4 scores). The 4 types of huge mammal and ungulate animal including African buffalo (350 kg), tapir (250 kg, African elephant (2,700 kg) and giraffe (1,010 kg) got the attraction at 3 score. In Thailand, the African elephant was only show at Nakhon Ratchasima Zoo, due to this it was very interesting and popular, while the unique characteristic and allowable feeding caused giraffe as the super star at all zoos. It is consisted with Knezevic et al. (2016) who revealed that zoo visitors required large animal and spacious exhibits such as elephant and giraffe. Additionally, they reported that the public feeding could prove visitor interesting and exciting. Moreover, Lee (2015) revealed that the satisfaction of visitors was getting

close to wildlife, seeing large and rare species. The large predator (3 and 2 score), that affected on human fear and display colorful body including white lion, white tiger, tiger, leopard and lion attracted visitors to spend their time at the exhibits. White lion and white tiger presented their special color that visitors were unfamiliar, while tiger and leopard were convinced the natural behavior by trainer twice a day to show visitors, so they were attractive. This result was similar to Whitworth (2012) who presented that bright color, easy to see and active animal were listed by visitors as popular exhibits. In contrast, the similarity of animal physical and characteristic reduced visitor attention, so behavioral intention of visitors become lower since Asian deer exhibit because the sequence of exhibit compose of deer and antelope group.

Figure 3 also presented the total score of visitor satisfaction to each animal exhibits. Interestingly, the score pattern of figure 3 were similar, so it answered that the time spending at each exhibit was significant data to evaluate visitor satisfaction at zoo. Among 43 exhibits, chimpanzee was only one exhibit presenting the highest attention that got the full score from total top animal exhibits. Secondly, reptile and zoo kid zone had equal score because they not presented at top 3 exhibits that visitor visited. Thirdly, although seal show was highlighting and interesting to children but added cost caused it got low at top exhibit, while tapir and giraffe got low score at time spending. Contrary, even though special characteristic of white lion and white tiger got the high individual time spending, but they had low total time spending and top exhibit. Surprisingly, there were more than half of exhibits that had lower attention less than or equal to half score. Because it is quite difficult to visit a majority of exhibits in large area by bicycle especially for family that consisted of children who were hyperactivity and petulance.

Limitations and recommendations

The GPS tracking is possible to evaluate the visitor pattern at zoo such as how they move or spend their time at abundant exhibits. However, this method only receives the movement data from network to analyze the visitor behavior or patterns, it does not contain the opinion or aspect of visitor that could be answer what is their real satisfaction or requirement. So, future research is required to collect the interview data together.

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