

Measurement and analysis of congestion at the traditional Japanese garden "Korakuen"

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Abstract: Nature and greenery spaces are especially required in the high-density residential areas of Megalopolis in Japan. People are looking for rich greenery spaces and they are requiring for the preservation of the greenery space in redeveloping areas. But people have recently found that parks often were too crowded, when they visited them for enjoying a quiet greenery environment. Almost all old Japanese cities have parks in traditional garden style, which have been opened to the public since Meiji revolution, i.e. a hundred years ago. Originally, the gardens were possession of the Daimyo, i.e. the feudal lord, and they were enjoyed privately. Recent increase in visitors destroyed the original use pattern and the unique atmosphere, and this, of course, confused the management of the park administration. The administration and the users therefore encouraged investigations concerning the appropriate management of park as a pleasant environment.

To find a preferable carrying capacity of green spaces, the impression of congestion and quietness was analyzed in a traditional Japanese garden, using the number of visitors as an indicator. The following results were obtained.

The impression of congestion is significantly correlated with the number of visitors in the park, and 700 persons on 7 hectares generates the impression of congestion for a half of visitors.

To satisfy the impression of quietness for more than a half of visitors, their numbers must be reduced to less than 400 persons for 7 hectares.

The decreasing in number of visitors provides a more efficient impression of congestion than that of increasing.

INTRODUCTION

Generally, an increasing number of visitors in the park suggests a strong needs for greenery spaces and natural areas. In Japan, the number of visitors has heavily increased in natural parks in the last 50 years. The annual usage of the natural park has been estimated to be more than 900 million people since 1990 (Nature Conservation Bureau 1999). The most rapid increase was observed from 1965 to 1975 and the number of visitors has grown twice in this decade compared to the 10 percent increase of the total population. The demand was formed by the rapid urbanization, i.e. by the strong immigration to urban areas. This sprawl in high-density areas had isolated the residents from natural areas and prevented them form enjoyment in natural spaces. In the enlarged urban areas, the few existing green spaces were scarcely developed and people lost the chance of enjoyment of rich greenery. As a consequence, they

rushed into the greenery areas left in the city center to enjoy the precious nature. Since the Meiji revolution, Tokyo has designated the private gardens of the Daimyo, i.e. the then feudal lord, to the public. But they had never established large parks in the city for the residents, as it was the case in European cities. Furthermore, the Tokyo Metropolitan Government had once opened the gardens free of charge to the public. But as it turns out, park use has become too strong to maintain the gardens in a pleasant environment. For the present, they tried to impose the entrance fee again to control the visitors' number. But they don't know the suitable or pleasant carrying capacity of the gardens (Aoki 1984).

Park use must be controlled now to fit the mass of visitors into the traditional style of Japanese Garden. This paper aims to find reasonable carrying capacity of the traditional Japanese Garden at Koishikawa Korakuen Garden by carrying through the inquiries concerning the visitors' congestion impressions.

RECENT STUDIES

An investigation method was developed by Kirchner (1970) for the visitors' numbers of the urban parks in Vienna. Thayer (1979) developed an estimation method of park use by a multiple regression model. Cooper (1981) surveyed tourist behavior at Jersey Island, and Dwyer (1988) studied the prediction of daily use of urban forest at Chicago. Aoki (1988) studied sampling schemes for counting the daily number of visitors. Tooke and Baker (1996) investigated the effect of film to the visitors' number. Aoki and Fujinuma (1996) analyzed the effects of weather conditions and social aspects on the daily use of parking lots at the Nikko National Park, and Loomis (2000) proposed the Long-Term Monitoring for the recreational use. The investigation of park use was firstly carried out in 1923 (Yoshida 1934) and is continuing until now in Japan.

As for the study of congestion, Helberlein and Shelby (1977) firstly reported the satisfaction model of the carrying capacity and Schreyer and Roggenbuch (1978) studied the effects of the number of people encountered on the impression of congestion. Vaske, Donnelly and Heberlein (1980) reported the effects of past experience on the evaluation of congestion. Manning and Ciali (1980) reported the relationship between density and dissatisfaction. Womble and Studebaker (1981) reported the effect of noise, and West (1982) the effect of user behavior on congestion. Ditton and Fedler (1983) studied on the expectation contributing to perception of recreational crowding, and Shelby and et al. (1983) studied the preferences in recreation activities on congestion at Wisconsin. Gramann and Burge (1984) investigated the effects of attributes at intensively developed outdoor recreation sites of Lake Shelbyville. As to boaters, more precise effects were studied at Nantahala River in North Carolina by Tarrant, Cordell and Kibler (1997). Stamps and Stamps (1985) investigated the effects of sociological aspects; e.g. Race and Class, and Fujita (1997) compared the differences in Japanese and Europeans. Tarrant and English (1996) proposed an estimation model of perceived crowding including social factors. Caffyn and Prosser (1998) reviewed the policies for quietness in the national parks in England and Wales.

But the studies on this subject have not been frequently done in this realm (Greiner und Helmut 1975, Aoki 1999). And there are no studies on the congestion and the quietness of the park environment related to the number of park visitors.

STUDY AREA

Koishikawa Korakuen was planned in 1625 in Edo era by the gardener Sahyoe Daitokuji for the first

feudal lord of Mito Tokugawa family (Yoshikawa 1981). The garden comprised 7 hectares and was designed as a typical traditional Japanese garden in Kaiyushiki style, e.g. enjoy walking around ponds, and has 3 ponds, the main, the west and the east (Tamura 1929). Nowadays, people normally enter from the gate of southwest, called Kantokutei Gate, thus beginning the tour on the west side of the garden. They walk at first through an open lawn area and then cross over the west pond. The pond is established as a miniature of Lake Shifu, in the South of China, which is appreciated as a beautiful landscape in China. Then people arrive to a small bridge, called Togetsu Bridge, from where they may look to the famous bank, called Sotei, which is again a miniature of the original Sotei Bank at lake Shifu. On the other side of the bridge, people find a small waterfall. After that they come up to a mountain, where they may enjoy an overview of the main area of the garden. Continuing the path, they walk up and down a mountain and come across the Engetsu Bridge. This bridge was constructed by the vice Shogun Mitsukuni under the guidance of the Chinese scholar Shunsui. They then come up and down a hill and enjoy Iris fields. These Iris fields are very beautiful in May and June because of the colorful flowers. After that people stop at Kyuhachiya cottage looking at the main pond on their right side. The fascinating trail then leads the visitors into a clad, beyond which they pass through the ruin of Karamon Gate. They now enter the inner garden, which they may enjoy by a round trip. Back to the gate, they walk to the westward along a narrow trail like in the mountains. Behind a deep forest, they can find light impression of a maple wood. For the wood is not densely planted and kept clear by the harvesting. In autumn, especially in late November, people can enjoy beautiful colored leaves there. From the area, they also can see the island in the main pond. The island, called Horaijima, symbolizes a kind of paradise. Over a bridge the visitors finally come back to the lawn field at the beginning of the tour.

The garden captures an area of about 7 hectares and the walk takes almost an hour. The garden is maintained by the local Government of Tokyo since 1936. They once the garden opened to the public without entrance fee. But because of the destructions and the growing congestions in the garden, only one entrance is available and it requires an entrance fee of 300 yen per adult, at present. Several members of the managing staffs and part-timers have maintained the garden, so far. But now gardening is put out to contract to the professionals of maintenance companies. The garden has a Japanese style restaurant, which provides food and meeting rooms. People use the restaurant for the tea ceremony, Haiku meeting and so on. At present the annual visitors are estimated as to some 200,000 persons, constantly.

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Date of suvey	total visitors	maximum residence	ratio of peak use	weather at noon	temperature (C)	humidity (%)	wind (m/s)
3. Oct. 1970	611	305	0,5	cloudy	20,5	50	4
5. May 1971	3719	894	0,24	fine	20,7	30	6,7
15. May 1971	751	295	0,39	cloudy, fine	20,5	63	5,3
3. May 1972	3511	875	0,25	fine	16,6	24	3,2
24. May 1972	1298	206	0,16	fine	20,1	43	3,8
27. May 1972	1205			cloudy, rain	25,7	48	8,3
3. June 1972	1575	384	0,24	cloudy	22,3	60	5,3
11. June 1972	2839	647	0,23	fine	27,4	57	4
14. June 1972	1693	508	0,3	fine	22,9	44	4,2
12. May 1973	1352	450	0,33	fine	18,8	35	3,7
13. May 1973	2586	704	0,27	fine	21,9	59	4,7
5. May 1974	2922	929*	0,32	cloudy	21,9	59	4,4
14. May 1974	350			fine, cloudy	19,9	56	4,5
13. Dec. 1974	89	28	0,31	cloudy, rain	7,5	45	2
14. Dec 1974	350	105	0,3	fine	14,1	52	3
15. Dec. 1974	507	141	0,28	fine	9,4	30	5,2
10. Dec 1978	361			cloudy, rain	18,5	67	10
20. May 1979	1633			fine	23,2	41	3,1
3. May 1980	2498	863	0,35	fine	21	47	4,4
5. May 1991	2851	650	0,23	fine	16,9	30	2,8
15. May 1991	531	159	0,3	cloudy, rain	21,5	63	2,5
26. Oct. 1991	397			coudy	18,2	66	2,7

*: maximum residence observed, ratio of concentration: maximum residence/ total visitors

Table 1: Date of Survey

The most congested month is April and the most congested day is normally 5. of May (Aoki 1984). The largest visitor number of the day was estimated about 7.000 persons.

INVESTIGATION

Visitors' number has been studied from 1970 to 1991 (Table 1). Several questionnaire surveys were conducted and we focused the survey of 5. of May 1974, in which the maximum number of the visitors' residence was observed. The questionnaire was distributed to the every 10th visitors and collected at the entrance. The fact that only one gate was available, is useful for this kind of investigation. 91 % of the people cooperated with us and 268 samples were obtained. The respondents drew their behavior in the map and responded the question of feelings about congestion and quietness. Simultaneously the number of visitors in the garden was also counted at the entrance. The responses were accumulated in each period of time and the subjective impressions of congestion and quietness were calculated. The investigation gathered the answer of the visitors' behavior in the garden on the map in which they lined the trails walked and marked places stopped (Fig 1 and 2). The weather of the day was cloudy and pleasant. The temperature of noon was 22 degrees (Celsius) the humidity was 59% and the wind was 4.4m/s at the observation tower of Meteorological Agency located at Otemachi, 2 km away from the garden. The total number of visitors of the day was 2922 and the peak of the simultaneous stay was estimated at 929 persons. During the whole day, 46%

of the visitors have a feeling of congestion. The highest ratio of impression of congestion amounted to 60% of people at 14 o'clock in the afternoon.

RESULTS

The answers, which indicated the behavior of the respondents, were overlaid and totaled at each route and place. The largest number of the passengers was observed at the path along the Tatsuta River (Fig. 1). And the largest number of the stops could be found at the open area in front of the Kuhachiya cottage (Fig. 2). More than 10% of spent some time even in peripheral areas of the garden. So more than 100 groups visited whole area of the garden on that day.

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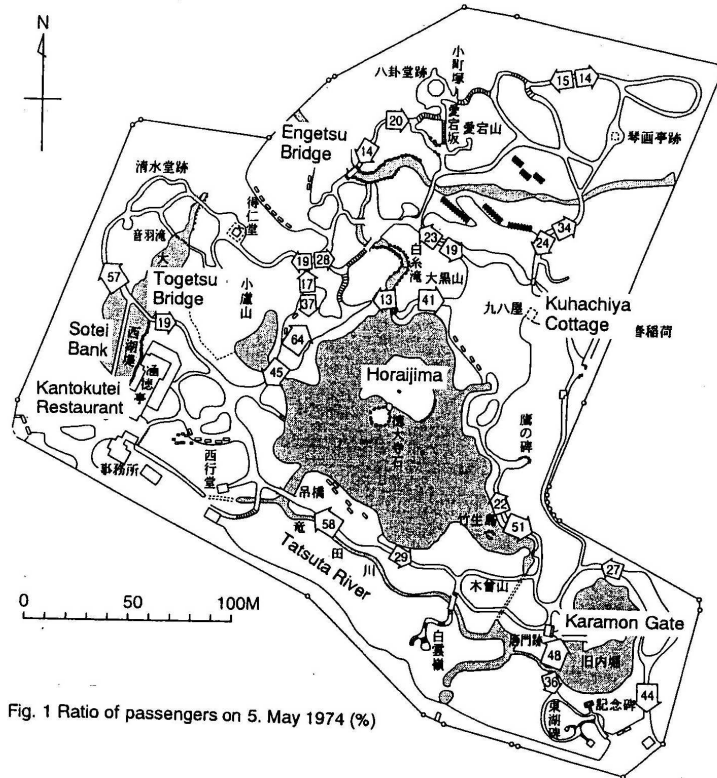


Fig. 1 Ratio of passengers on 5. May 1974 (%)

Figure 1: Ratio of passengers on 5. May 1974 (%)

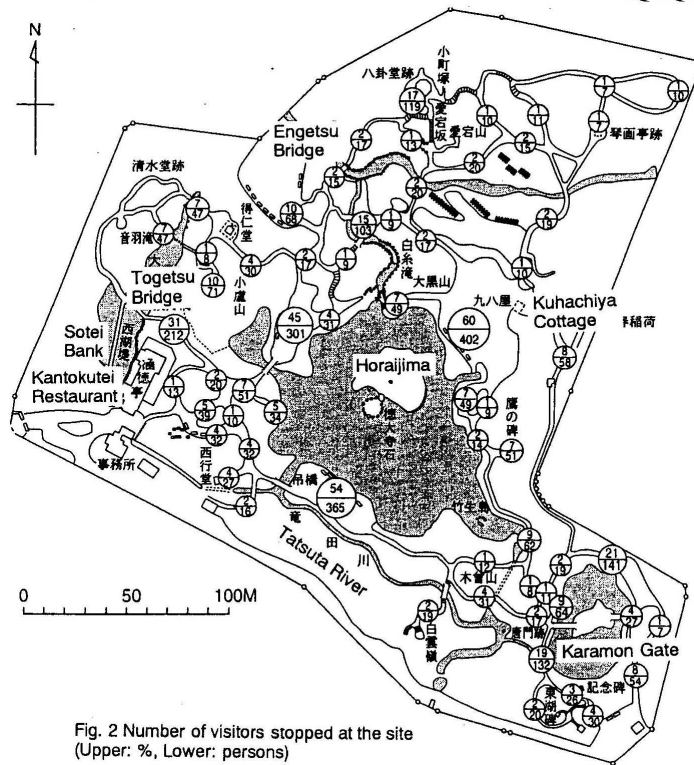


Fig. 2 Number of visitors stopped at the site
(Upper: %, Lower: persons)

Figure 2: Numbers of visitors stopped at the site (Upper: %, Lower: persons)

Factors	coefficients	T-value
Distance from the entrance	-0,099	-1,6
Area of site (m2)	0,4	5.2**
Canopy closed	0,59	0,6
Gradient of ground(%)	-1,55	-1,9
Object grade A (1,0)	5,46	4.0**
Object grade B (1,0)	4,61	4.5**
Object grade C (1,0)	2,36	2.7**
Constant	1,84	0,9

Corrected correlation coefficient was 0.89.

Number of site was 80.

** : 0.01 statistical significance level

Table 2: Effective factors to visit the sites of garden (Analysis by multiple regression equation)

The use of peripheral areas showed a full of visitors at the peak use.

The frequencies were analyzed by the multiple regression equation to find the effective factors for visitation to the local sites. The width of site and interesting objects affected to the frequency with the statistical significance level of 0.01 (Table 2), i.e. they are effective factors to visit for the respondents.

The number of the visitors in the garden was increasing in the morning and at noon (Fig. 3), it decreased after 13:30 o'clock. The impression of congestion increased slowly related to the number of visitors. And the impression was decreasing rapidly after 14:00 o'clock.

Analysis of regression equation was applied (Fig. 4) for testing the relationship between impression of congestion and number of visitors. The results satisfied the significant statistical level of 0.01.

But the efficiencies of the regression equations were not the same in case of increasing and decreasing of the visitors' number. The data obtained at the increasing of congestion fluctuated more gently than the decreasing. It was assumed that different psychological effects had happened in the density of increasing and decreasing.

This analysis reveals that the impression of congestion was related strongly to the number of visitors in the garden. It was shown that more than 700 persons in the garden arises the feeling of overcrowding in more than half of the respondents.

The analysis of regression equation was tried (Fig. 5) for the impression of quietness, too. The regression showed a statistically efficient result in relation to the decrease of the visitors and less than 400 persons simultaneously in the garden provided the impression of quietness for more than half of the visitors.

To propose a carrying capacity for this garden, the maximum number of the residence was generally

estimated around 30% to the total visitors of the day (Table 1). According to this proportion, the daily number of visitors should be controlled less than 2100, to prevent from the congested impression of more than 50% of visitors. And if the daily number will be kept under 1200 persons, the criteria of quietness will also be satisfied.

With these criteria, we estimated the number of congested days within 6 months of this fiscal year of 2001, i.e. from April to September. The result showed 8 days overcrowded and 22 days unsatisfied quietness.

DISCUSSION

The carrying capacity of the Koishikawa-Korakuen was estimated at 700 persons. But this was not preferred density of the users. Quietness requires more rigid control of the visitors' number: it has to be kept under 400 persons in the most congested period.

In historical times, when the feudal lord used the garden, his guests and their subordinates, only, the maximum number of people entering the garden simultaneously may be estimated at approximately 20 persons. Ono (2000) reported that the largest number of the visitors at Rikugien Japanese Garden, which comprises 10 hectares, amounted up to 50 persons in Edo era (ca. 1780). Then the density planned was seemed much lower than our result.

For example, the imperial gardens office of Kyoto has controlled the maximum guests under 40 persons simultaneously for 5 hectares of Katsurariykyu garden and 50 persons for 54 hectares of Shugakuinrikyu garden. We had better to propose more strict use capacity for the traditional Japanese gardens.

As for the entrance fee, this garden requires 300 yen per adult. But the garden of Saihoji temple, a moss garden, is reported to require about 3000 yen per adult (Dodd and Richmond 1999). Regarding better maintenance of the garden we can suggest much higher entrance fees.

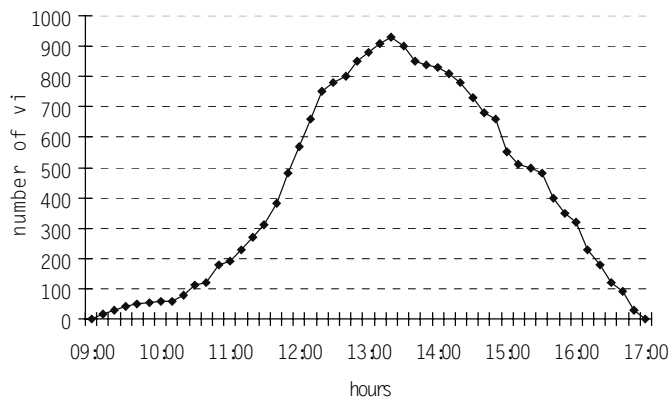


Fig.3 Fluctuation of visitors' density

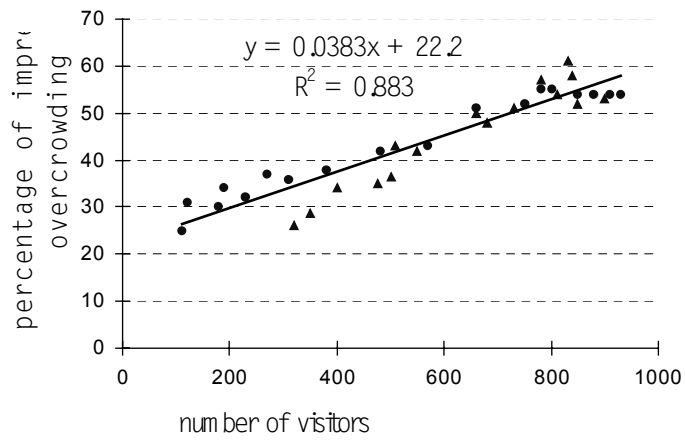


Fig. 4 Relation between congestion and visitors' density

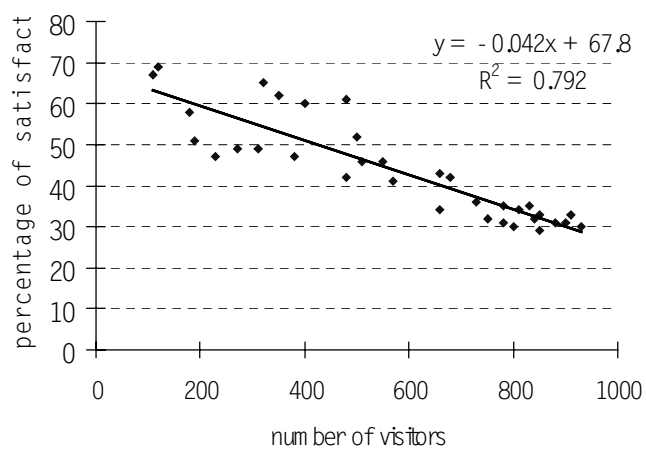


Fig. 5 Relation between quietness and visitors' density

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