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地域別騒音の場所的分布

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第9報 東京都内の公園の騒音
北海道教育大学旭川分校物理学教室

Noise Distribution Report No. 9 Park Noises in Tōkyō

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Abstract

We report the summarized result of measurements made of noises at three parks in Tōkyō. The measurements were carried out from about the end of July until the early of Aug., 1986, at Ueno Park, Hibiya Park and the Outer Gardens of the Imperial Palace. In each of the above mentioned zones the noises were measured at 10 different point, chosen by an arbitrary sampling method. The main results are as follows:

- a) Sound levels and conditions at each of the measuring points are shown in Table 1-3.
- b) Examples of the measurement of noise levels at each park are summarized in Fig. 1-6.
- c) Photographs of the representative landscape of each park.

1. Introduction

Street noises in Tōkyō have already been measured by J. Morita (1953)¹⁾, while the noise distribution in various zones has been measured by T. Mochizuki and N. Imaizumi (1967)²⁾. Noise-induced shifts in the pitch of pure and complex tones have also been studied by Adrianus J. M. Houtsma (1981)³⁾. The noises of busy streets and underground markets in Tōkyō and Sapporo have subsequently been measured by S. Takeuchi (1982)⁴⁾, (1984)⁶⁾, (1985)⁸⁾, (1986)⁹⁾ and (1986)¹⁰⁾, who has also measured commercial, industrial, residential and amusement zone noises in Asahikawa (1983)⁵⁾, (1985)⁷⁾ and (1987)¹¹⁾.

The purpose of the present investigation was to measure noises in certain Tōkyō Parks, as calculated by a sound level meter (type 1015A). Accordingly, three locations were selected: Ueno Park, Hibiya Park and Outer Gardens of the Imperial Palace. Noises were measured at 10 different points at the above mentioned sites, some of the points chosen arbitrarily. The meaning of arbitrary selection is as follows. In arbitrary selection the observation points are chosen so as to represent the general level of noise in the area. At each point, the sound level in dB (A) is measured 50 times at intervals of 5 seconds. If N. L.-variation from time to time is divided into M ($M \rightarrow \infty$) N. L. s having equal durations which are sufficiently small ΔT , the average value of N. L. s

$$\lim_{M \rightarrow \infty} \frac{1}{\Delta T} \int_t^{t+\Delta T} N. L. dt, \quad \Delta T = T/M. \quad (1)$$

and each is considered to represent one 'instant value'. The sound level in the ΔT term at the unit variation,

$$m/M = f(x)dx, \quad F(x) = \int_{-\infty}^x f(x)dx, \quad F(\infty) = 1 \quad (2)$$

$f(x)dx$ and $F(x)$ is the ratio of the number of the unit variation in the T . At the same time $F(x)$ and $f(x)$ is the N. L. s time rate distribution and density function in the T . The Mode, Median and 90% range were obtained statistically from these 50 pieces of data to represent the noise level distribution. These procedures are in accordance with the Japanese Industrial Standard JJSZ-8731 "Methods of Measurement of Sound Levels".

2. Result of investigation

a) Ueno Park site

Let us first examine the noise levels of the Ueno Park site, near Ueno Station. It is bounded on the east by Ueno Station, on the west by Tōbyō Art College, on the north by Uguisudani Station, on the South by Shinobazu Pond. Table 1 and Fig. 1 illustrate the detailed data and the average sound level at 10 different points selected arbitrarily around the Ueno Park site. Both the cawing of crows and distant vehicular traffic noises show that it is a quiet place. The measured results, which were obtained in the way described above, are shown in Table 1. As in the lower part of Fig. 1, the median sound levels are arranged in an order

Table 1 Sound levels and conditions of the measuring points: Ueno Park site, Tōkyō

Zone		Category		
Park		Public garden		
Test No.	Time	Sound levels dB (A)		
		Mode	Median	90% range
①	10, 20	59	59	57~63
②	10, 30	57	58	54~72
③	10, 53	62	62	61~64
④	11, 04	55, 58, 60	60	52~68
⑤	11, 39	60	60	58~67
⑥	11, 50	57	56	53~62
⑦	12, 15	58	59	57~62
⑧	12, 47	52	52	50~61
⑨	13, 05	55	55	53~60
⑩	13, 18	55	56	54~61

increasing in magnitude as the circular spots plot the measured values in the same figure, while the mode is represented by the black spots. Solid lines move up and down to show the difference within a 90% range. A central solid line shows the average value of the medians and indicates that the average sound level is 57.7 dB (A). The dotted lines

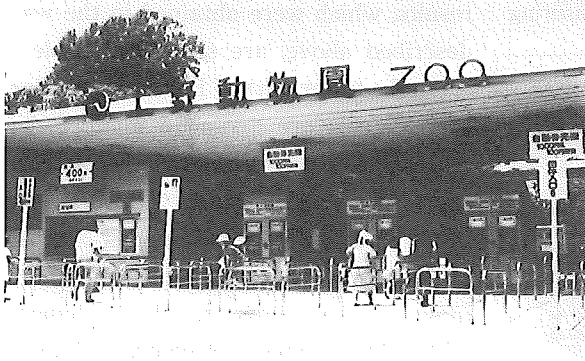
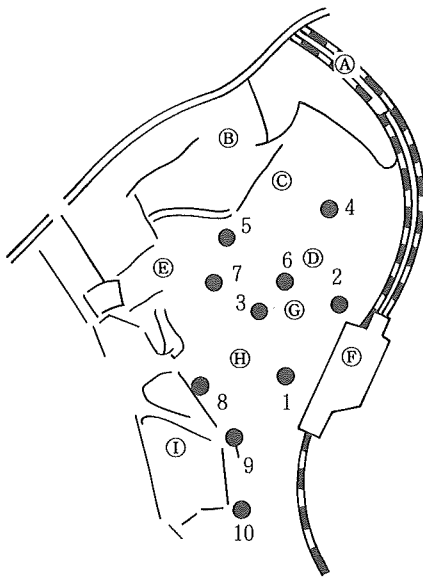


Photo. 1. Ueno Zoological Gardens (⑦)

show both its lowest and highest points as well as the average values with both lower limit values and upper limit values within a 90% range. Their average sound levels are shown as 54.9 and 64.0 dB (A) respectively. In the upper part of Fig.1 values from ① to ⑩ show the position of the measured points, while letters from A to I are used to show the most conspicuously noisy places at the Ueno Park site. Photo. 1 affords an example of this.



- Ueno Park site
 A : the Uguisudani Station
 B : the Tōkyō National Museum
 C : the Tōkyō Art College
 D : the National Science Museum
 E : the Ueno Zoological Gardens
 F : the Ueno Station
 G : the Tōkyō Cultural Center
 H : the Seiyōken
 I : the Shinobazu Pond

Hibiya Library and Hibiya Public Hall. Table 2 and Fig. 2 illustrate the detailed data and the average sound level at 10 different points selected arbitrarily around the Hibiya Park site. Both the sounds of the cicada and distant vehicular traffic noises show that it is a quiet place. The measured

b) Hibiya Park site

Let us now examine the noise levels at the Hibiya Park site, near the Hibiya Moat. It is bounded on the north by the Hibiya Moat, on the south by the

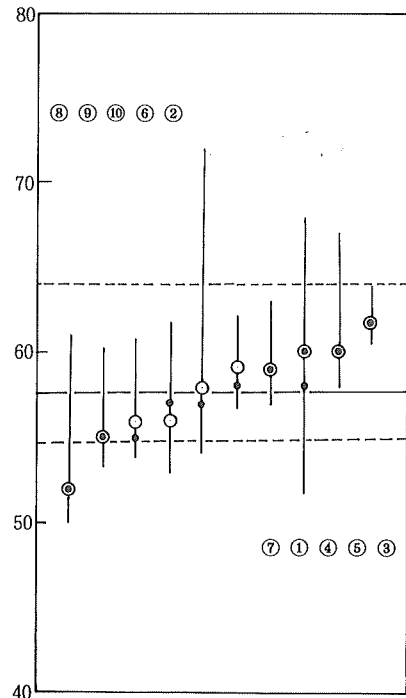


Fig. 1. Examples of measurement at park quarter : Ueno park site, Tōkyō 10 measuring points and sound levels obtained.

Table 2 Sound levels and conditions of the measuring points: Hibiya Park site, Tōkyō

Zone		Category		
Park		Public garden		
Test No.	Time	Sound levels dB (A)		
		Mode	Median	90% range
①	15, 36	67	68	65~79
②	15, 54	59	61	59~64
③	16, 10	61	61	59~63
④	16, 23	59	59	57~61
⑤	16, 34	63	63	59~66
⑥	16, 51	58	58	56~59
⑦	17, 01	68	68	66~68
⑧	17, 17	58	58	57~59
⑨	17, 27	59	59	58~64
⑩	17, 37	62	61	59~63

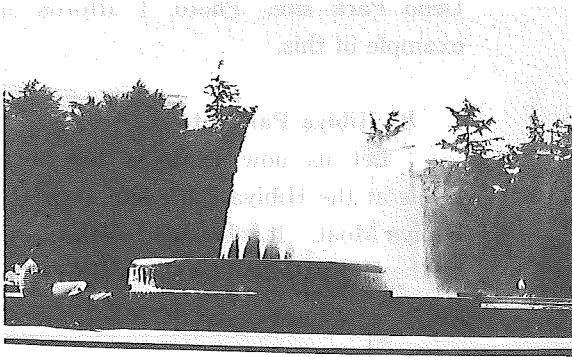
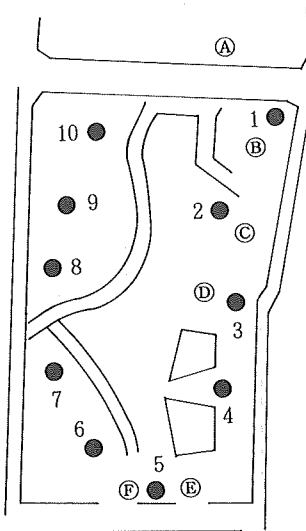


Photo. 2. Large Fountain (③)



- Hibiya Park
- A : the Hibiya Moat
- B : the Shinji Pond
- C : the Park Center
- D : the Large Fountain
- E : the Hibiya Public Hall
- F : the Hibiya Library

results, which were obtained in the way described above, are shown in Table 2. As in the lower part of Fig. 2, the median sound levels are arranged in an order increasing in magnitude as the circular spots plot the measured values in the same figure, while the modes are represented by the black spots. Solid lines move up and down to show changes within a 90% range. A central solid line shows the average value of the median and indicates that the average sound level is 61.6 dB (A). Dotted lines show both its lowest and highest points as well as the average values with both lower limit values and upper limit values within a 90% range. Their average sound levels are shown as 59.5 and 64.5 dB (A)

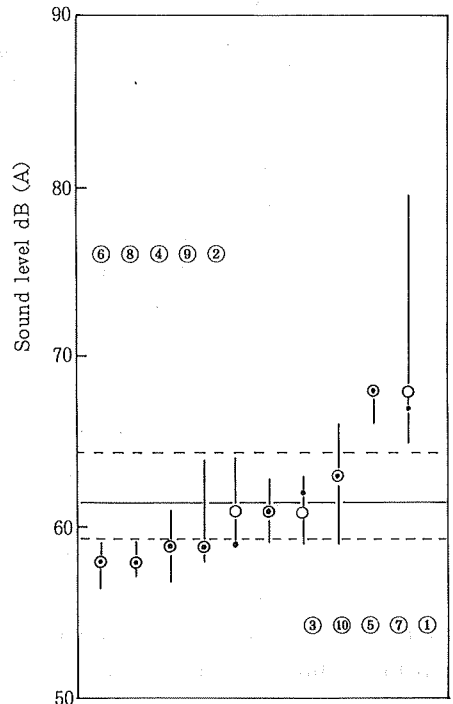


Fig. 2. Examples of measurement at park quarter : Hibiya Park site, Tōkyō 10 measuring points and sound levels obtained.

Table 3 Sound levels and conditions of the measuring points:
Outer Gardens of the Imperial Palace site, Tōkyō

Zone		Category		
Park		Public garden		
Test No.	Time	Sound levels dB (A)		
		Mode	Median	90% range
①	10, 38	56	56	54~58
②	10, 51	54	55	54~59
③	11, 04	60	62	60~67
④	11, 29	62	62	60~68
⑤	11, 46	59	59	58~70
⑥	12, 10	56	55	54~58
⑦	12, 26	58, 59	59	57~65
⑧	12, 41	57	59	55~64
⑨	13, 01	58	66	58~74
⑩	13, 17	65	65	59~80

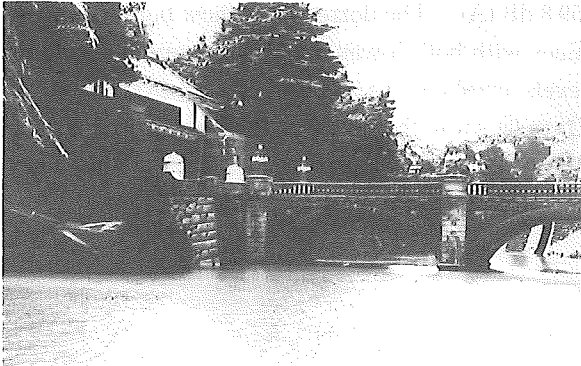
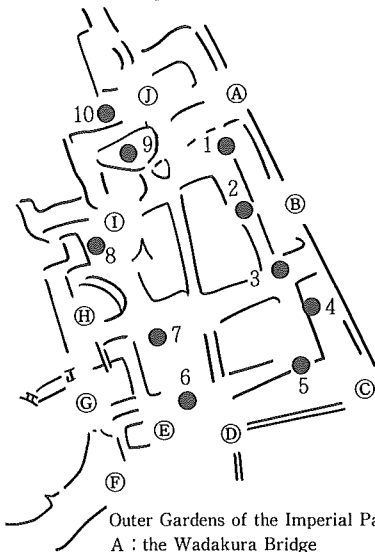


Photo. 3. Double Bridge before the entrance to the Imperial Palace (⑦)



Outer Gardens of the Imperial Palace site

- A : the Wadakura Bridge
- B : the Babasaki Moat
- C : the Hibiya Moat
- D : the Gaisen Moat
- E : the Sakurada Gate
- F : the Sakurada Moat
- G : the Double Bridge before the entrance to the Imperial Palace
- H : the Nijū-bashi Moat
- I : the Hamaguri Moat
- J : the Kikyō Moat

respectively. In the upper part of Fig. 2 values from ① to ⑩ show the position of the measured points, while letters from A to F are used to show the most conspicuously noisy places at the Hibiya Park site. Photo. 2 affords an example of this.

c) Outer Gardens of the Imperial Palace

We also examined the noise levels at the Outer Gardens of the Imperial Palace. It is bounded on the north by Kikyō Moat and Wadakura Bridge, on the south by Gaisen Moat and Hibiya Moat, on the west by Hamaguri Moat and Nijū-bashi Moat, on the east by

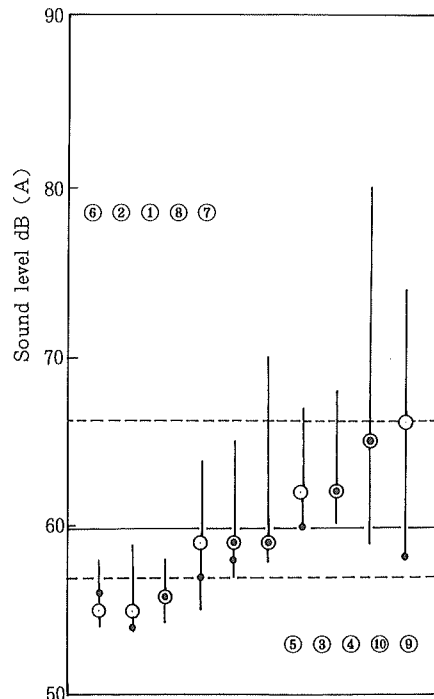


Fig. 3. Examples of measurement at park quarter : Outer Gardens of the Imperial palace site, Tōkyō 10 measuring points and sound levels obtained.

Babasaki Moat and Hibiya Moat. Table 3 and Fig. 3 illustrate the detailed data and the average sound level at 10 different points selected arbitrarily along the Outer Gardens of the Imperial Palace site. Both distant vehicular traffic noises and the sound of foot steps show that it is a quiet place. The measured results, which were obtained in the way described above, are shown in Table 3. As in the lower part of Fig. 3, the median sound levels are arranged in an order increasing in magnitude as the circular spots plot the measured values in the same figure, while the mode is represented by the black spots. Solid lines move up and down to show the difference within a 90% range. A central solid line shows the average value of the median and indicates that the average sound level is 59.8 dB (A). The dotted lines show both its lowest and highest points as well as the average values with both lower limit values and upper limit values within a 90% range. Their average levels are shown as 56.9 and 66.1 dB (A) respectively. In the upper part of Fig. 3 values from ① to ⑩ show the position of the measured points, while letter from A to J are used to show the most conspicuously noisy places at the Outer Gardens of the Imperial Palace site. Photo. 3 affords an example of this.

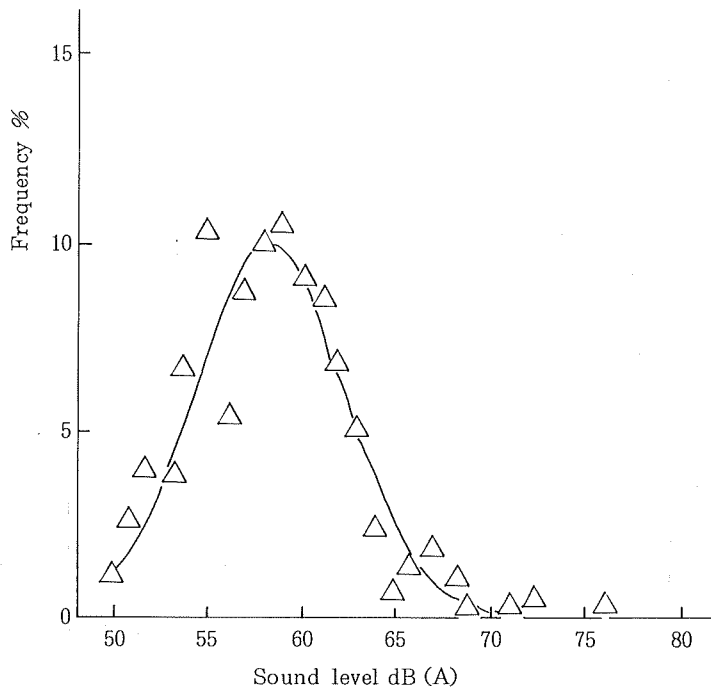


Fig. 4. Relation between the sound level and the frequency percentage in the Ueno Park site. The solid line is calculated by the equation of Gaussian distribution curve and the measured values are represented by the triangular spots.

3. Discussion

a) Ueno Park site

This area was the quietest in our sample and the average sound level was 58.3 dB (A), once dropping to 50.0 dB (A). For example, the lowest sound level recorded in front of the Seiyōken (㊸) was 50.0 dB (A), as aforesaid ; it is marked both by few people and the cawing of crows. But in front of the Fountain (㊸), the average sound level was 62.1 dB (A), because of both the sound of the Fountain and the Sounds of crows. The distribution percentage y of sound levels is give by the equation of the Gaussian distribution curve

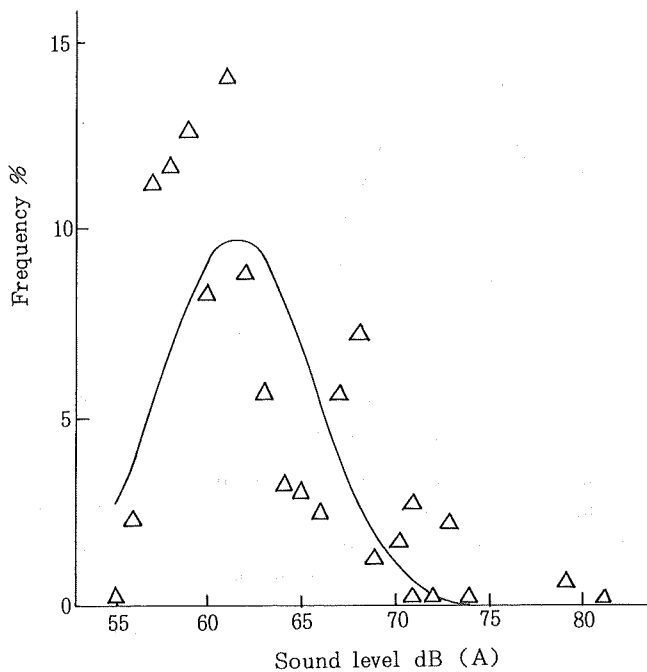


Fig. 5. Relation between the sound level and the frequency percentage in the Hibiya Park site. The solid line is calculated by the equation of Gaussian distribution curve and the measured values are represented by the triangular spots.

$$y = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(x-m)^2}{2\sigma^2}} \quad (3)$$

in which σ is the standard deviation, σ^2 the dispersion, x the sound level and m the average sound level at the Ueno Park site. Fig. 4 is the relation between the sound level and the frequency percentage at the Ueno Park site. The solid line is calculated by the equation of the Gaussian distribution curve and the measured values are represented by the triangular spots.

The measured values is in satisfactory agreement with the Gaussian distribution curve.

b) Hibiya Park site

In this area the sound levels are comparatively low, and the average level was 61.6 dB

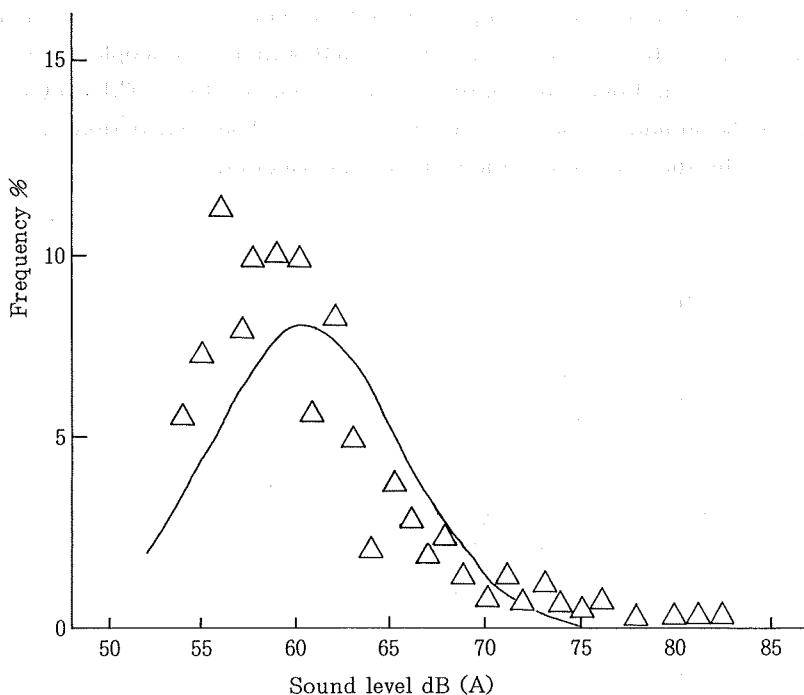


Fig. 6. Relation between the sound level and the frequency percentage in the Outer Gardens of the Imperial Palace site. The solid line is calculated by the equation of Gaussian distribution curve and the measured values are represented by the triangular spots.

(A), often dropping to 55–57 dB (A). For example, the lowest sound levels were recorded in the neighborhood of the Hibiya Library (⑥), where the average sound level was 57.1 dB (A), because there were neither vehicular noises nor the sounds of passersby. But in front of the Shinji Pond (①), the average sound level was 67.8 dB (A), because there were vehicular traffic noises. In the same manner as for the preceding data, Fig. 5 shows the relation between the sound level and the frequency percentage at the Hibiya Park site. The solid line is calculated by the equation of the Gaussian distribution curve and the measured values are represented by the triangular spots. The measured values are very scattered, but their tendency coincides approximately with the Gaussian distribution curve.

c) Outer Gardens of the Imperial Palace

In this area the sound levels were low, and the average sound level was 60.4 dB (A), often dropping to 52–54 dB (A). For example the lowest sound levels were recorded in front of the

Sakurada Gate (⑥), where the average sound level was 60.4 dB (A), because there were neither high vehicular noises nor the sounds of passersby. But in front of the Kikyō Moat (⑩), the average sound level was 67.0 dB (A), because there were both much vehicular traffic and the quacking of spot bill ducks. In the same manner as for the preceding data, Fig. 6 shows the relation between the sound level and the frequency percentage at the Outer Gardens of the Imperial Palace. The solid line is calculated by the equation of the Gaussian distribution curve and the measured values are represented by the triangular spots. The measured values almost coincide with the Gaussian distribution.

4. Conclusion

The average median sound levels at the Ueno Park site, Hibiya Park site and Outer Gardens of the Imperial Palace site were 57.7, 61.6 and 59.8 dB (A) respectively ; the average of the highest sound levels are 64.0, 64.5 and 66.1 dB (A) ; the averages of the lowest sound levels are 54.9, 59.5 and 56.9 dB (A). The average levels of sound within a 100% range for the Ueno Park site, the Hibiya Park site and the Outer Gardens of the Imperial Palace were 58.3, 61.6 and 60.4 dB (A) respectively, while the standard deviation of sound level was 4.04, 4.06 and 5.01 dB (A).

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