

## Full Length Research Paper

# Evaluation of traffic noise pollution in Corlu, Turkey

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Accepted 3 July, 2011

**Evaluation and analysis of noise pollution levels have been carried out to determine the level of noise in Corlu. The selected areas of study are commercial centers, road junctions/busy roads, passenger loading parks and public parks. The road junctions had the highest noise pollution levels, followed by commercial centers. Eighteen measurement points was defined in center of county Corlu relating to traffic. Measurements of noise were carried out in the morning (07:00 to 08:00) when the traffic was heavy, in the midday (12:00 to 13:00) and in the evening (17:00 to 19:00). The results of this study show that the noise levels in Corlu exceeded 65 dB(A), limit value according to Turkish Noise Control Regulation allowed values at 17 of 18 measurements points. Statistical analysis revealed that, there were significant differences in noise levels among the streets ( $P < 0.05$ ). The results of the study showed that noise should be mentioned among the major environmental problems in Corlu.**

**Key words:** Noise, pollution, traffic, Corlu.

## INTRODUCTION

Noise pollution is a significant environmental problem in many urban areas. This problem has not been properly recognized despite the fact that it is steadily growing in developing countries (Barboza et al., 1995). Noise pollution has been stated as a serious health hazard (Bies and Hansen, 1996; Yılmaz and Özer, 2005), with noise-related damage to humans ranging from annoyance to insanity and death (Mato and Mufuruki, 1999). The influences of noise on human health may be physical or psychological. Nelson (1987) reported that long term exposure to high occupational noise can result in permanent hearing loss. Additionally, commonly experienced noise effects may include annoyance, deterioration of sleep quality, and stress-related various type of heart disease (Anonymous, 1997; Morrell et al., 1997). Traffic is the dominating source of noise (Aparicio-Ramon and Surez, 1993; Lercher 1995; Williams and Mc Creae, 1995; Skanberg and Ohrstrom, 2002). Researchers in many countries have investigated and characterized different traffic noise pollution (Stoilova and Stoilov, 1998;

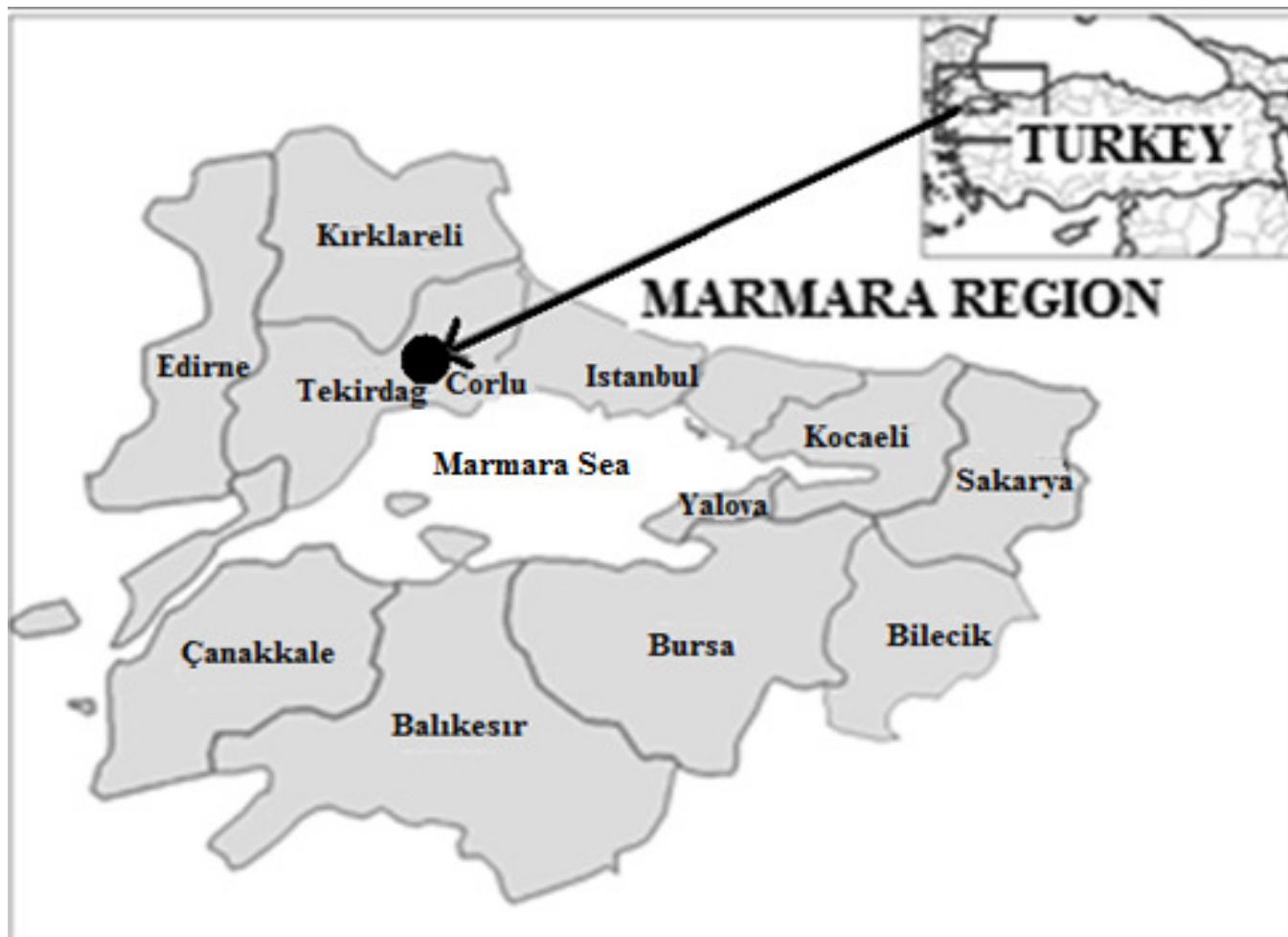
Zannin et al., 2003; Tang and Tong, 2004; Abo-Qudais and Alhiary, 2004; Piccolo et al., 2005; Zannin et al., 2006; Pathak et al., 2008; Özer et al., 2009).

Protections related to planning, technical, biological, legislative and educational issues should be taken in order to avoid negative effects of noise pollution on environment.

On average, noise barriers reduce noise levels by 3 to 6 dB(A), depending on their design and height. Roadside noise barriers are only acceptable for motorways and other bypass roads where there is no need for pedestrians to cross. On busy urban streets, which are crossed by pedestrians along their entire length, noise barriers cannot be placed directly on the kerbside. It is only in non-urban areas that they can provide a solution, therefore (Boer and Schroten, 2007). Noise reduction capacity of planted vegetations can be used to abate noise pollution in town and landscape planning if the plantations are at least 12 m wide. To obtain the best effect the rows of trees have to be planted perpendicular to the direction of the sound field (Martens, 1981).

The ability to absorb the noise is most observed in leaves. That of the branches and the bodies is less. Plant types also vary in decreasing the noise depending on the characteristics of the leaves. Long and fleshy leaves with

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**Figure 1.** Location map of Çorlu city.

wide palm are more effective at the reflection and the absorption of the sound (Erdoğan and Yazgan, 2009). According to Erdoğan and Yazgan (2009), with a noise curtaining of three rows, the amount of noise has been reduced by 5 dB(A), which means the perception of noise by people in a way reduced to half. According to Özer and Irmak (2008), pine trees are the most advantageous and effective trees to be used in controlling the noise.

Noise is already recognized as a serious public health problem in Turkey. Several studies have been carried out in Turkey and the world to determine noise levels in big cities. The city of Corlu is a small city in terms of its population. This study aimed at noise pollution from urban traffic in the city of Corlu, Turkey.

#### **MATERIALS AND METHODS**

Corlu is a northwestern Turkish city in inland Eastern Thrace that falls under the administration of the Province of Tekirdağ (Figure 1). Corlu region has about 508 factories in its own area in different sectors like textile, leather, food and so on. The urban population

increased almost threefold during the past decades from 77.921 in 1980 to 190.792 in 2008 (Anonymous, 2008a) (Figure 2). The urban area of the city also expands rapidly due to the unprecedented rate of increase in urban population. Also, industrialization, economic development, population growth and urbanization increased the number of motor vehicles in Corlu from 18.937 in 2000 to 37.827 in 2007 (Figure 3). The distribution of registered vehicles in the county is 12.7% motorcycles, 3.3% buses, 4.1% lorries, 55.8% cars, 13.6% light lorries, 7.4% minibuses and 3.1% others (Anonymous, 2008b).

This research is based on the results of outdoor sound level measurements carried out in January, April, July and October 2006 at 18 different locations which were determined according to population or residential density, characteristics of land-uses or road functions such as importance of roads suggested by Doygün and Gurun (2008). The 18 different locations were selected in commercial centers, road junctions and busy roads, passenger loading parks and public parks in Corlu. The noise instrument brand of "DT805" with  $\pm 1.5$  dB(A) precision was used for the measurements.

All measurements were carried out during working days (Monday, Wednesday and Friday) and ferial days (Saturday and Sunday) under ideal meteorological conditions: no wind and no rain. The measurements have been taken three times for each location during the daytime period (Lday) between the hours of

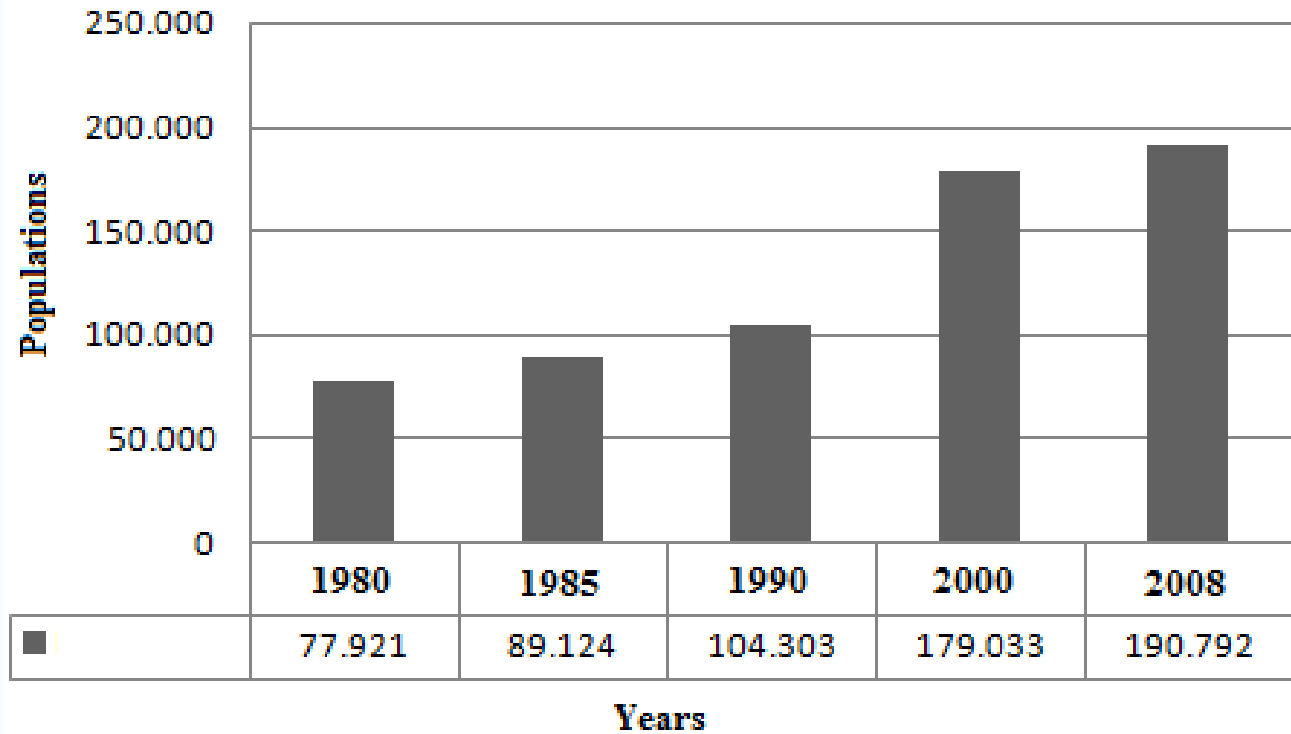


Figure 2. Urban population change between the years 1980 and 2008.

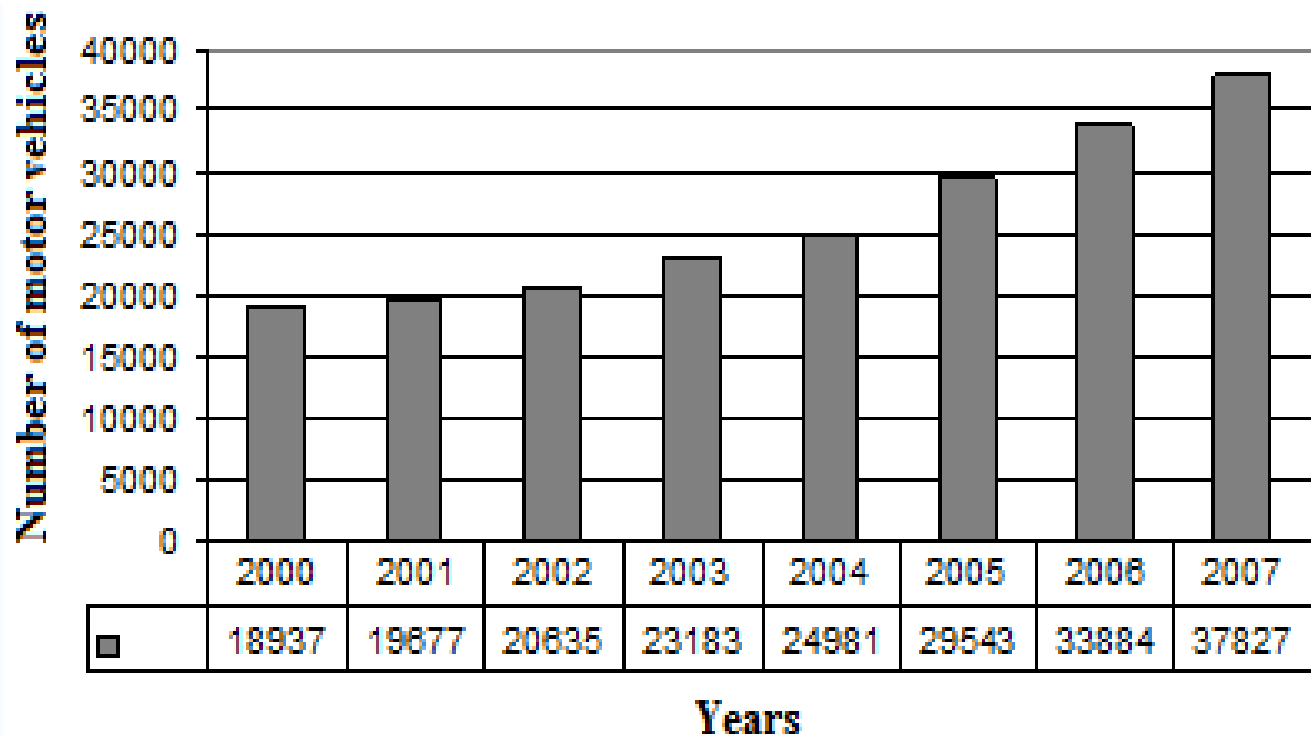
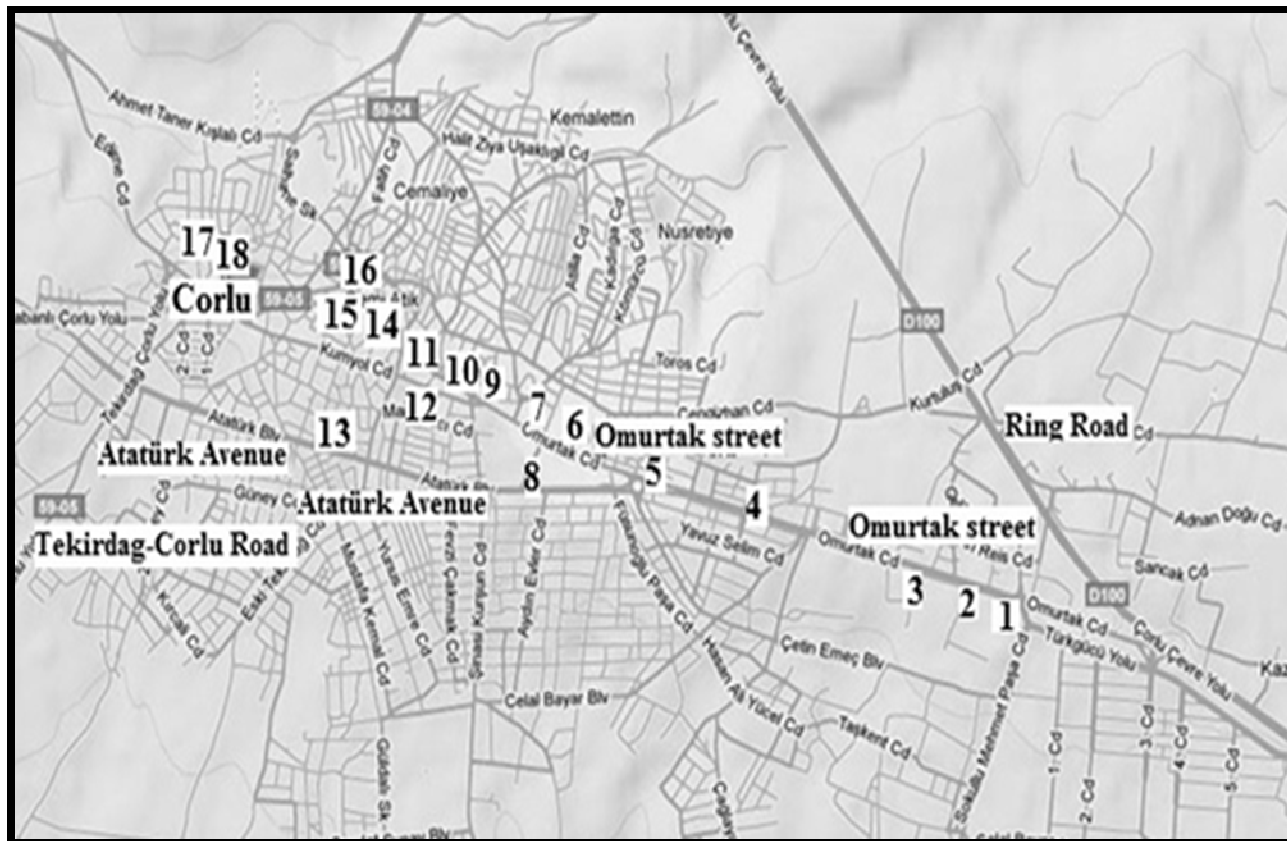


Figure 3. Number of motor vehicles between the years 2000 and 2007.

07:00 to 08:00 A.M., 12:00 A.M. to 13:00 P.M., and 17:00 to 19:00 P.M. which correspond to times of going to work, lunch break and

returning home after a working day, respectively. The duration of measurement was 10 min for each location, and A-weighted



**Figure 4.** Distribution of measurement location.

continuous equivalent sound level  $L_{eq}$  was measured. The noise instrument was fixed 1.5 m high above (Piccolo et al. 2005, Pathak, 2008) local ground level with a vertical angle of  $45^\circ$ . The noise levels were calculated in  $L_{Aeq}$  dB(A) units by using the data from the results (Özyonar and Peker, 2008) and the monthly averages are represented as schedules. Statistical evaluation was done on the results of the noise measurements. A variance analysis procedure was applied to the data through SPSS software program.

## RESULTS AND DISCUSSION

Eighteen measurement points as shown in Figure 4 was defined in center of county Corlu relating to traffic. The results of the measurements made on these points are given in Table 1.

Evaluations on noise measurement were based on limit value of 65 dB(A) in noise control regulation in Turkey and it was found that allowed limit values were exceeded at 17 of 18 measurement points (Table 1). In the city, excessive noise levels were found on especially commercial centers, road junctions and busy roads.

Duncan Multiple Range Test was used to compare the significance of the differences between the mean values (Table 2). Statistical analysis revealed that there were significant differences in noise levels among the streets ( $P < 0.05$ ).

The average  $L_{Aeq}$  dB(A) values of January, April, July and October representing the seasons are shown on Figure 5; the average  $L_{Aeq}$  dB(A) values of morning, noon and evening are shown on Figure 6.

Growing number of vehicles has become the main cause of traffic noise reaching important levels in Corlu. Only one (Public park 1 (inside)) of 18 measurement points has remained under the limit level. Separately all measurement point values have passed over the level (55  $L_{eq}$  dB(A)) accepted for outdoor places by World Health Organization (WHO) (Anonymous, 2007).

The bypass in Corlu entrance from Istanbul side decreases an important part of vehicle density by preventing the entrance to the center of Corlu. The noise measurement points (1-2-3-4-5-8-13-17) placed at outside the center of Corlu are in effect of heavy vehicles' noise during all day hours. The noise measurement points (6-7-9-10-11-12-14-15-16-18) placed at inside the center of Corlu is not in effect of heavy vehicles' noise.

Corlu city centers are exposed to intracity road traffic noise every day; the most affected being the traders, pedestrians, commercial vehicle drivers and school children having their schools close to the main road.

At the end of these measurements; the highest noise value has been determined in road junctions 6 (13) measurement point placed at Atatürk Boulevard (84

**Table 1.** Noise range of measurement locations and level.

No. of measurement locations	Name of measurement locations	Annual noise range in the measurement locations		Noise level (mean)
		$L_{Aeq}$ , (dB(A))		
1	Road junctions 1	80 < $L_{Aeq}$ ≤ 85		81
2	Commercial center 1	70 < $L_{Aeq}$ ≤ 75		72
3	Commercial center 2	70 < $L_{Aeq}$ ≤ 75		72
4	Road junctions 2	75 < $L_{Aeq}$ ≤ 80		80
5	Road junctions 3	70 < $L_{Aeq}$ ≤ 75		75
6	Public Park 1 (inside)	60 < $L_{Aeq}$ ≤ 65		64
7	Public Park 1(outside)	65 < $L_{Aeq}$ ≤ 70		69
8	Road junctions 4	75 < $L_{Aeq}$ ≤ 80		79
9	Road junctions 5	70 < $L_{Aeq}$ ≤ 75		73
10	Commercial center 3	70 < $L_{Aeq}$ ≤ 75		73
11	Commercial center 4	65 < $L_{Aeq}$ ≤ 70		66
12	Commercial center 5	70 < $L_{Aeq}$ ≤ 75		74
13	Road junctions 6	80 < $L_{Aeq}$ ≤ 85		84
14	Commercial center 6	70 < $L_{Aeq}$ ≤ 75		75
15	Public Park 2 (outside)	65 < $L_{Aeq}$ ≤ 70		69
16	Public Park 2(inside)	60 < $L_{Aeq}$ ≤ 65		65
17	Busy Road 1	75 < $L_{Aeq}$ ≤ 80		79
18	Busy Road 2	70 < $L_{Aeq}$ ≤ 75		74

**Table 2.** Results of the noise measurements variance analysis table.

Variation source	Standard error	Error sum of square	Error mean square	P
Location	17	6595	388	0,000
Season	3	265	88	0,000
Location × Season	51	219	4	0,000
Error	144	268	2	0,000
General	213	-	-	-
Ggroup	1	3780,7	3780,7	0,00
Error	214	3566,8	16,7	-

dB(A) is due to their closeness to the main road. Therefore, apart from noise due to commercial activities, there is traffic noise from vehicle horns, engines, and traffic volume. Additionally, since bus stops of the factory services take place in this point, densities of traffic and passengers are higher.

With examining average  $L_{eq}$  dB(A) of morning, noon and evening hours it is seen that noise level in Number 13 measurement point is high in morning between the hours (7 to 8) and in evening between the hours (17 to 19). This is because this point is a stop point and being used by both heavy and other motor vehicles intensively. Noise value of Number 6 measurement point has been determined 63 dB(A) in afternoons.

By examining the results seasonal in the end of the study, when the seasonal results are considered, it can be seen that the highest noise values have been measured in winter months. The reason is that Corlu is a dense industrial region and has a growing ratio of using

of heavy motor and service motor vehicles in winter months.

The highest noise value has been measured in Number 13 point in January and the lowest noise value has been measured in Number 6 point in April.

Trees and bushes can decrease noise between 0 to 12 dB(A) (Ürgenç, 1990). It is observed that the present plants (*Salix sp*, *Cedrus sp*, *Pinus nigra*, *Pinus brutia*, *Acer campestre*, *Robinia pseudoacacia*, *Cercis siliquastrum*, *Liquastrum vulgare*, *Platanus orientalis*, *Platanus occidentalis*, *Pyracantha coccinea*) has decreased the noise levels 5 dB(A) inside and outside the two parks (Public park 1 and Public park 2) which were included to the study in order to find out the efficiencies of the plants even though the parks do not have a specific plant rows around them.

The noise levels in parks placed at inner city have been determined up to limit level (The noise limit level in park areas is 55 dB(A), Anonymous, 1974; Anonymous, 1999)

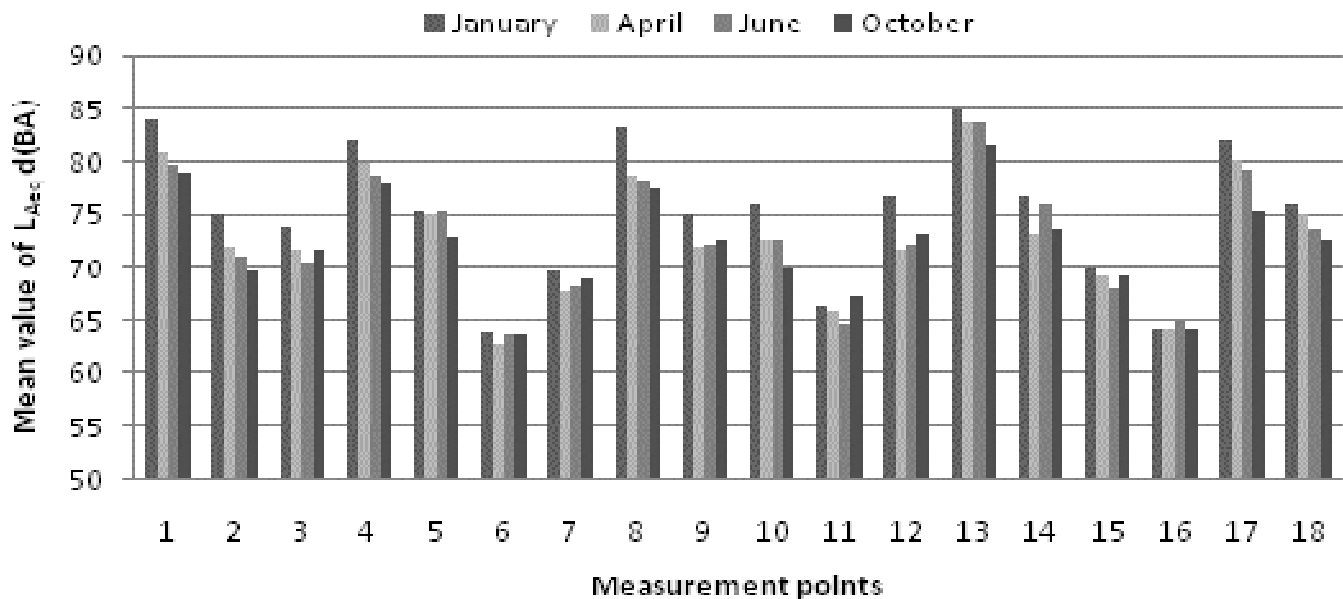


Figure 5. Mean value of  $L_{Aeq}$  dB(A) of January, April, June and October.

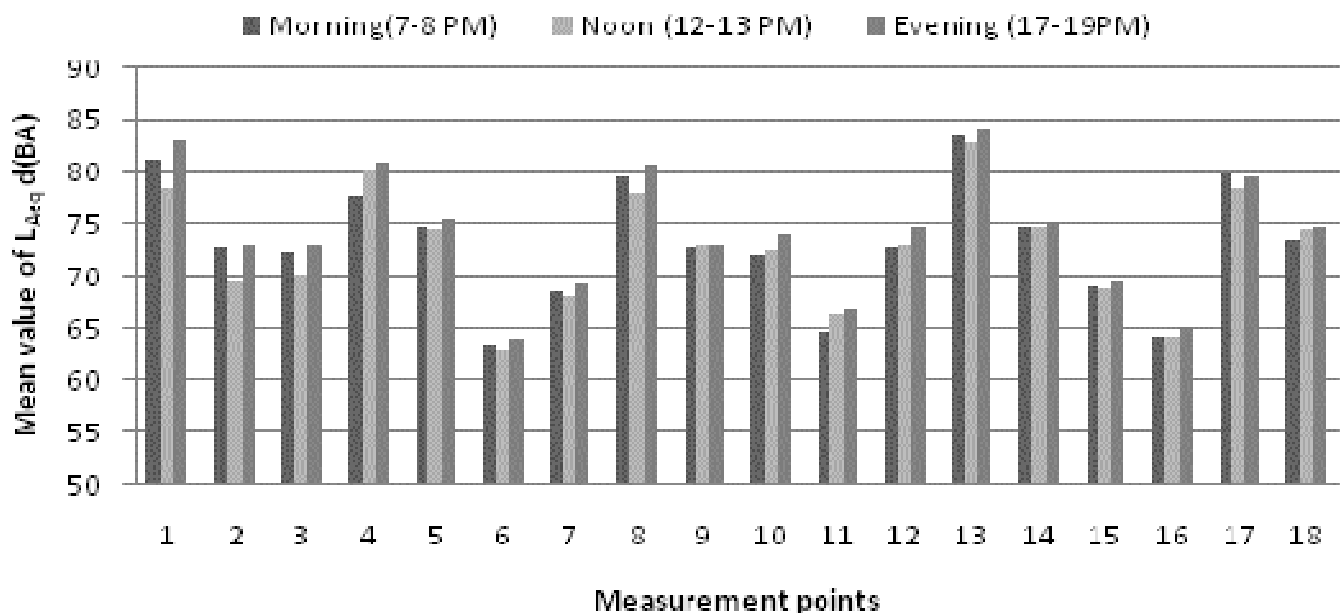


Figure 6. Mean value of  $L_{Aeq}$  dB(A) of morning, noon and evening.

in the study of Zannin et al. (2006). In our study, according to the noise measurements (inside park and outside park) in two public parks placed at inner city and affected by motor vehicle traffic, the noise levels inside park (60 to 65) dB(A) and outside park (65 to 75) dB(A) are up to limit level.

Even though the only method to prevent noise in high noise level points is using noise barriers made by inorganic materials, this method will bring esthetics

worries as a matter of fact Corlu is short of green areas. To prevent with plant materials is impossible because of space problems.

It has been fixed in the end of this study that highway traffic noise levels have approached to important levels and have been up to limit level in many points. The amount of motor vehicles will get more and more because of population and economic growing in next years. Because of this, precautions should be taken in a

short period for a public health reason.

## Conclusions

The urban noise survey presented in this study has revealed that even in a small size city such as Corlu, environmental noise levels due to road traffic are notably higher than the limits set by Turkish noise standards and policy to protect public health. Due to adverse effects of noise pollution on the human health, a number of protections can be taken to decrease the environmental noise pollution in Corlu. These include technical, planning, biological, behavioral, and educational solutions. Inspection of traffic vehicles, particularly, public transportation vehicles such as minibuses should be ensured to prevent the noise pollution at its sources. Motorcycles also cause a considerably high noise level; therefore, city people should be encouraged to use bicycles on their ways to work. There are a variety of strategies for mitigating roadway noise including: use of noise barriers, limitation of vehicle speeds, alteration of roadway surface texture, limitation of heavy vehicles, use of traffic controls that smooth vehicle flow to reduce braking and acceleration, and tire design. In addition, suitable tyre use and the increase in the volume of noise preventive devices, suitable road covering materials, changing road elevation, increasing the public awareness can be mentioned among other noise preventive methods.

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