

# NOISE POLLUTION MONITORING IN CLUJ-NAPOCA PARKS BY GPS MAPPING

## MONITORIZAREA POLUĂRII FONICE ÎN PARCURILE DIN CLUJ NAPOCA PRIN IMPLEMENTAREA MAPĂRII GPS

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**Abstract.** According to demographic statistics afferent for 2006, in the city of Cluj-Napoca were recorded in the local government 305.620 residents, resulting an average density of inhabitants per km<sup>2</sup>, located around 1771. The most important Romanian auditor in acoustic measurements, show that in all cities with over 250.000 inhabitants, there we have about 2.9 million people exposed to noise beyond the limit set in the auditing standards. Thus, for more than 60% of the population, quality of life is considerable affected by phonic pollution. The determinations aimed the existence of noise pollution in Cluj-Napoca parks based on standard measurements using a digital sound level meter and a ground GPS recording data such as: noise level day-evening-night  $L_{\text{den}}$  in decibels (dB), night noise  $L_{\text{night}}$ . The data collected were entered into mapping programs resulting maps related to real databases, efficient in future landscape works for reducing this type of pollution.

**Key words:** sound pollution, GPS, noise level, mapping, parks.

**Rezumat.** Conform statisticilor demografice aferente anului 2006, în Municipiul Cluj-Napoca erau înregistrați în evidența administrației locale 305.620 locuitori, rezultând o densitate medie de locuitori/km<sup>2</sup> situată în jurul valorii de 1771. Cel mai important auditor român în domeniul măsurătorilor acustice, arată că din toate orașele cu peste 250.000 de locuitori, avem aproximativ 2.900.000 de persoane expuse la zgomot peste limita prevăzută în standardele de auditare. Astfel, pentru mai mult de 60% din populație, calitatea vieții este afectată considerabil de poluarea fonică. Determinările efectuate în cadrul disciplinei de Proiectare Asistată de Calculator de către colectivul lucrării, în perioada 01.03.2013 - 30.03.2013, au vizat existența poluării fonice în parcurile din Cluj-Napoca cu ajutorul unui sonometru digital și a unui GPS terestru înregistrând date precum: nivelul de zgomot zi-seară-noapte  $L_{\text{den}}$  în decibeli (dB), nivelul de zgomot noapte  $L_{\text{noapte}}$ . Datele prelevate au fost introduse în programe de mapare rezultând hărți corelate cu baze de date reale, eficiente în munca viitorilor peisagiști pentru reducerea acestui tip de poluare.

**Cuvinte cheie:** poluare fonică, GPS, nivel de zgomot, cartare, parcuri.

## INTRODUCTION

According to a study by the European Heart Journal, Romania is considered one of the most "noisy" countries of the European Union with the predisposition of the inhabitants of this country prone to heart attack due to noise (Bluhm et. al., 2004). In our country are recorded high levels of noise pollution, especially in large cities, where

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uncontrolled urban development says it's word. European Directive 2002/49 requires the Member States to create „strategic noise maps” using harmonized noise indicators such as noise  $L_{den}$  day-evening-night ( $L_{den}$ ) and  $L_{night}$  ( $L_{night}$ ).

Also according to this Directive noise maps will be drawn up for cities with a population greater than 250,000 inhabitants, road with an estimated average traffic more than 6.000.000 vehicles/year, railways with annual average of more than 60,000 trains/year and airports (<http://ec.europa.eu/environment/noise/directive.htm>).

Following the development of noise maps authorities are obliged to inform and consult the public about noise exposure, its effects and the measures that can be taken to control noise pollution. Romanian regulations in the area represented by HG 321 of 14.04.2005 provide strict limits for noise levels in curve A with values of 70 dB for  $L_{ZSN}$  records and 60 dB for  $L_{night}$  wanting to reduce this value by 2012 at 65 dB  $L_{ZSN}$  and 50 dB  $L_{night}$  (Dumitraş et. al., 2012).

## MATERIAL AND METHOD

The paper proposes to monitor noise pollution in the central park from Cluj-Napoca, aiming registration standard indicators  $L_{den}$  and  $L_{night}$ . After processing the recorded data using a digital sound level meter Testo 815 and a terrestrial GPS, will be able to generate a digital sound map that highlights areas with risk of noise pollution in the park taken in study, as well as possible proposals to reduce the noise risk pollution. As a result of study undertaken were recorded curves values of the sound level A (35-100 dB). Thus, „the curve of sound level A” deals with recording and monitorisation of sound values supported by the human ear.

Phonic noise determinations were correlated with the standard required in the acoustic field ISO 8297:1994 (<http://www.primariacj.ro/docs/Harta.de.zgomot.pentru.municipiul.Cluj.pdf>).

The drawing up noise map was made daily by daily measurements for a period of 7 days consisting of diurnal (in the morning 800) (in the afternoon 1500) and nocturnal observations (hour 2000). Using the terrestrial GPS, have been highlighted on the map of noise data sampling points. Sampling points that have achieved identical values of noise level were linked through various mapping programs resulting polygons of dispersion of sound associated with the help of a chromatic map (Lubos et. al., 2006; Henrique et. al., 2006). Central Park taken in the study, it's bordered by the Municipal Stadium in the west, the Hungarian state theater to the east, the river Someşul Mic at north, namely street Iuliu Hossu (formerly Pavlov) at south. It is entered on the list of historical monuments in Cluj County, prepared by the Ministry of Culture and National Heritage of Romania in 2010 ([www.wikipedia.org](http://www.wikipedia.org)). After 1989 the park has been assigned the name of Central Park „Simion Bărnuțiu”. In 2011, during the mandate of Mayor Sorin Apostu were concrete alleys and were destroyed several secular trees, which caused discontent and protests at local level by various NGO's. Sound determinations made during February-March 2013 want to highlight noise pollution in a central park full of trees with irrational toilet without the existence of foliage at deciduous species, noise pollution barrier being non-existent. Figure 1 treats graphically the neighborhood of central park „Simion Bărnuțiu” highlighted in the text, by emphasizing the accentuated graphic of park framing in the urban tissue and the registration points of phonic values.



**Fig 1 - Framing in the area of the studied dig and the GPS positioning points of observations (original)**

## RESULTS AND DISCUSSION

According to the 15 observation points (from  $m_4$  to  $m_{19}$ ) established with the help of a GPS during the study were obtained the average values related to the table 1. The average of the three stages of recording sound on values between  $8^{00}$ - $15^{00}$ - $20^{00}$  show that the area with the lowest noise recorded value is generated by the observation points  $m_8$ ,  $m_9$ ,  $m_{17}$ ,  $m_{18}$ ,  $m_{19}$ , with mean values ranging between 50.4 and 58.4 dB.

*Table 1*

**Average values of recordings obtained in central park Simion Bărnuțiu Cluj Napoca (dB) (after Singureanu V. et al.,)**

No.	Phonic curve A (dB)		Average	Phonic curve A (dB)		Average	Phonic curve A (dB)		Average
	min.	max.		min.	max.		min.	max.	
	8 <sup>00</sup>			15 <sup>00</sup>			20 <sup>00</sup>		
m4	54,5	57,2	55,9	57,3	60,2	58,8	60,2	63,4	61,8
m5	57,7	58,1	57,9	58,2	59,2	58,7	61,7	63,2	62,5
m6	60,0	62,3	61,2	64,9	66,8	65,9	65,8	67,4	66,6
m7	58,6	59,2	58,9	63,7	65,5	64,6	67,9	69,2	68,6
m8	50,0	53,5	51,8	54,2	56,2	55,2	58,5	60,2	59,4
m9	51,6	53,4	52,5	53,1	55,5	54,3	55,7	57,6	56,7
m10	49,9	52,5	51,2	58,8	60,1	59,5	60,1	62,3	61,2
m11	62,9	64,2	63,6	66,4	68,2	67,3	68,8	69,1	69,0
m12	66,3	67,1	66,7	70,4	72,1	71,3	72,4	74,2	73,3
m13	70,1	72,1	71,1	73,2	74,2	73,7	72,6	73,8	73,2
m14	65,2	69,2	67,2	68,2	73,4	70,8	70,1	76,3	73,2
m15	58,8	59,5	59,2	62,1	63,7	62,9	68,8	70,3	69,6
m16	61,5	66,3	63,9	63,6	67,2	65,4	69,2	70,5	69,9
m17	48,8	54,4	51,6	50,5	56,2	53,4	59,8	60,6	60,2
m18	47,6	50,2	48,9	53,4	55,2	54,3	57,7	58,5	58,1
m19	46,2	48,2	47,2	56,7	57,2	57,0	57,4	58,1	57,8



a)



b)



c)

**Fig. 2** - Average values of the observation points limits on the noise level in dB - central park „Simion Bărnuțiu” Cluj-Napoca (a - 8<sup>00</sup>; b - 15<sup>00</sup>; c - 20<sup>00</sup>) (original)

Graphics corresponding to figure 2 highlights chromatic noise zoning related to central park „Simion Bărnuțiu” providing quantifiable data on range of sound to which potential visitors of the park can be exposed. Thus, red, orange and yellow highlights areas with risk of noise pollution from central park.



According to recorded data chromatic green zone highlights the legal values of the sound level. The observed noise values curve presents a continuous descent during the study period with reaching maximum values at 20<sup>00</sup> with the increase of traffic in the area (Mihăiescu et. al., 2007).

The study area consists of the observation points  $m_{11}$  and  $m_{12}$  records the highest values of the noise from study, being located at the eastern entrance of the park near the Hungarian Theatre and a central point of intersection car with an average of 65.2 dB noise values at 8<sup>00</sup>, 69.2 for 15<sup>00</sup> and 71.2 for 20<sup>00</sup> with a peak sound of +21.2 dB versus  $L_{night}$  admitted by the legislation in force.

The chromatic orange color represented by the observation points:  $m_{13}$ ,  $m_{14}$ ,  $m_{15}$ ,  $m_{17}$ , located along Emil Isaac street in the northern part of the of Central Park, record high average noise values during the study due to their proximity to road artery frequently circulated by public transport (trams, buses) as well as small tonnage machines. The values of car traffic are high due to the two-lane road going towards the direction of stadium „Cluj Arena”. Obtained values recorded an ascending curve starting at time 8<sup>00</sup> (62.5 dB) and ending with the hour 20<sup>00</sup> (69.4 dB) with a peak sound of +19.4 dB from  $L_{night}$  permitted by the legislation in force.

The only area in central park „Simion Bărnuțiu” relatively „safe” in terms of noise pollution is represented chromatically on plan with green and is composed of the observation points  $m_{17}$ ,  $m_{18}$ ,  $m_{19}$ ,  $m_9$  and  $m_8$  indicating that this area also shows a peak of +8.4 dB sound to  $L_{night}$  allowed by law for values specific for observation hour 20<sup>00</sup>.

## CONCLUSIONS

In addition to aesthetic effect totally desolate (fig. 3), irrational trimming of existing trees within the Central Park „Simion Bărnuțiu” in Cluj-Napoca, lead to increased noise through lack of roof trusses or under roof trusses entirely developed on trees in the park.



**Fig. 3** - Chaotic trimming trees in Central Park „Simion Bărnuțiu” (original)

Hedges that border the park, executed from different deciduous species with obsolete foliage, poorly developed, does not ensure attenuation of the effect

of noise pollution during the cold season. We recommend planting a hedge using evergreen species such as *Taxus bacatta* or *Thuja occidentalis* 'Danica'.

Where the topography permits, we recommend insertion of resting places in the park at the base of some uplifted landforms (on the slopes). Also recommend planting in park slope with plagiotrope evergreen species such as *Lonicera pileata* or *Juniperus horizontalis* 'Andorra Compact'. Recognized for their outstanding ability to filter rainwater, and absorbing effect, we recommend changing the main alleys material layer concrete slabs current grass.

Recognized for their particular ability to filter rainwater and phono-absorbing effect, we recommend changing the material alleyway from the actual concrete layer in the grassed tiles.

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