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THE SOUNDSCAPE OF CITY PARKS IN PUBLIC PERCEPTION ON THE EXAMPLE OF GLIWICE'S GRUNWALD PARK

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Purpose: This article addresses the problem of perception and evaluation of the soundscape by users of urban parks in an industrial region. According to the International Organisation for Standardization (ISO), the subjective perception of sound comfort complements the measurement of sound pressure levels (SPL) and is an essential component of the analysis of the sound environment.
Design/methodology/approach: Park Grunwaldzki in Gliwice was studied. A functional and spatial analysis of the park space was carried out along with an analysis of the acoustic map of the area. Other methods used were: observations, acoustic walks, sound recordings, 15 structured interviews with park users. The main discriminator was the category of pleasure-unpleasantness, which is considered to be the most unambiguous and context-independent. The theoretical basis is provided by R.M. Schafer's concept of soundscape.
Findings: The analysis confirms that the park is not free of mechanical sounds, which are perceived by users as unpleasant. In contrast, the evaluation of social sounds varies and depends on the context. Natural sounds are the most desirable sounds in this space. The soundscape of the park has a variable rhythm throughout the day.
Research limitations/implications: The present study has limitations due to the small number of participants surveyed and the timing of the observations, which took place in May and June. Further research should take into account the variability of the audiosphere according to the seasons.
Practical implications: The results may facilitate the planning or revitalisation of urban parks, as well as the management of the city's recreational resources.
Social implications: Research conducted in the urban environment can have an impact on improving the quality of life in cities. This is important because of the need to support public health measures and the increasing need to organise leisure time for residents of densely populated agglomerations.
Originality/value: The article demonstrates the practical needs of urban park users, knowledge of which will facilitate the work of planners and architects.

Keywords: sound scape, urban parks, noise, acoustic comfort.

Category of the paper: case study.

1. Introduction

The term soundscape was introduced by M. Southworth (1969), but was most popularised by Canadian musicologist and composer R. M. Schafer. According to him, it is: "Technically speaking, any part of the sound environment considered as a field of study. The term can refer to actual environments or to abstract constructs such as musical compositions and tape montages, especially when considered as an environment" (Schafer, 1977, pp. 274-275). The soundscape is an important element that complements other sensory experiences that are perceived by users of a space (Miller, 2013). It refers to the subjective sonic sensations of the users of a given space and is determined by a number of factors (Aletta, 2016). The discussion of the urban living environment therefore takes into account a variety of sensory experiences, not only related to visual and olfactory effects.

The study of the systematic relationship between people and the sound environment is also addressed by soundscape ecology (Pijanowski et al., 2011). The ecological perspective draws attention to the influence of the acoustic environment and soundscape on the physical responses or behavioural characteristics of the people living in it (Losiak, 2014).

According to the International Organisation for Standardisation (ISO), the soundscape is something different from the acoustic environment (ISO, 2014). The acoustic environment is related to the physical aspect of sound in a space as measured by the available sound pressure level (SPL) equipment, which directly relates to noise pollution research. Noise levels are regulated by a 2002 European Parliament Directive (Directive, 2002). In Poland, protection against excessive noise is furthermore based on the Environmental Protection Law Act (2001). As noted by researchers of this subject, the interpretation of these documents results mainly in the construction of acoustic screens along traffic arteries. However, this is not a sufficient method to improve the acoustic landscape (Lipowczan, 2013; Kwiecień et al., 2013).

In modern cities, nuisance sounds generated by industry and motor vehicles still dominate, as previously pointed out by R.M. Schafer (1977). Researchers report numerous health problems arising from exposure to permanent or temporary exposure to noisy environments (Aletta et al., 2018). Among the most annoying these days are car and air traffic noises. This is often linked to poor urban design, failing to take into account the needs and opinions of local residents, and being guided in location decisions solely by the interests of the developer (Leus, 2011).

Urban parks, as enclaves with a more diverse audiosphere, should provide a counterbalance to adverse acoustic phenomena. The natural sounds found in parks have the property of alleviating stress in humans and can therefore contribute to public health (Cao, 2021). Recreational spaces, however, are increasingly polluted by noise, which is beginning to dominate sounds that have a beneficial effect (Irvine et al., 2009).

Acoustic sphere studies use noise measurement devices. The values obtained do not present data to determine the actual human perception of the sounds heard. Some of them with similar noise levels are perceived as particularly bothersome, while others are treated as less problematic or even pleasant. More information can be obtained by combining different research perspectives from psychology, ecology and acoustics, incorporating sound-related categorisations concerning: physical properties (acoustics) or how they are perceived (psychoacoustics), function and meaning (semiotics and semantics), emotional or affective properties (aesthetics) (Schafer, 1977, p. 133).

Investigating the subjectively experienced soundscape is therefore more complicated than measuring sound pressure levels. The assessment of the soundscape of parks is often made unconsciously by the users of a space. It takes many different factors into account. Researchers have presented how the individual components interfere and result in altered assessments of acoustic comfort (Preis et al., 2015; Ren et al., 2018; Bogdanov et al., 2022).

This article explores the topic of the soundscape of urban parks and is based on a case study of Grunwald Park in Gliwice. The main research questions are: Does the soundscape of the park change during the day? How are sounds in the park rated in the pleasant-unpleasant category and does the type of activity relate to this rating? The presentation of the different factors influencing the perception and evaluation of the sounds present in the park is based on a functional-spatial analysis of the park together with an analysis of the acoustic map of the area. In the study, it was important to investigate the so-called 'phonemic awareness' (Losiak, 2014), i.e. the ability to hear and name sounds, as well as the subjective assignment of sounds to the pleasant-unpleasant category.

2. The soundscape of urban parks in research

The assessment of urban noise largely takes into account not only the negative side of the saturation of urban space with sounds, but also the richness of the audiosphere that exists there (Fong, 2016; Fang et al., 2021). The sound effects experienced by residents include a whole range of diverse elements that make up the soundscape. R.M. Schafer introduced useful categorisations to differentiate the main sources of sound into, among others: natural, human, social, mechanical (Schafer, 1977, pp. 139-144). By knowing the components of the soundscape, one can consciously influence its shape. Some sounds are experienced negatively, such as traffic, and others positively, although this depends on individual characteristics and circumstances.

Researchers have argued that mechanical sounds are the most difficult to accept (Porteous et al., 1985; Irvine et al., 2009). These include traffic and the sounds of operating equipment and machinery. Slightly less annoying are the sounds created by human interaction and

communication (Jo, 2020), and most desirable - unsurprisingly - are the sounds of nature (Tse, 2012; Guo, 2019). Acoustic ecologists point out that the quality of urban acoustic experiences has declined, creating ‘lo-fi’ urban soundscapes characterised by the dominance of monotonous background sounds such as traffic and construction noises. The opposite of the above is a 'hi-fi' environment, where sounds can be heard clearly, self-separated and with a favourable signal-to-noise ratio (Schafer, 1977). Adams and his team (2006) showed that it is not just noise levels that are important to people in an urban area. Context, source, distance, temporality and noise control all play a role in people's assessment and stated desire to eliminate a particular sound from their soundscape (Adams et al., 2006).

Other aspects of the complexity of sound assessment are indicated by the research of scientists who considered both objective and subjective measurement values in their research project (Porteous et al., 1985). Preis and his team (2015) indicate that there are certain regularities in the subjective perception of sounds in a given space. Some elements of a space interact with each other, such as the visual and soundscape. Positive visual stimuli influence a higher evaluation of soundscapes (Preis et al., 2015). On the other hand, dominant natural sounds enhance the comfort of the space and increase positive perceptions of the visual landscape (Ren et al., 2018; Bogdanov et al., 2022).

The latest research takes many variables into account. X. Fang and a team of researchers (2021), based on a field study conducted in six different urban forest parks in Xi'an, China, showed that the evaluation of urban recreational areas depends on several factors, such as age, familiarity with the park, education and status, type of use, companionship, gender and length of time spent in the park. The researchers identified the following relationships on this topic: (1) participants' familiarity with the park and age increase tolerance to sounds that other people find annoying; (2) as education and higher socio-economic status increase, tolerance to sounds decreases; (3) perception of artificial sounds (e.g. sounds of various vehicles), increases with a certain type of recreational use and is considered more annoying; (4) there are differences in the perception of sounds by women, who showed more sensitivity and lower tolerance than men; and (5) longer use of the park was associated with a positive evaluation of the soundscape. The conclusion is that the better the soundscape, the more willing and longer respondents want to stay in the park (Fang et al., 2021).

Downtown parks are also studied in terms of the dominance of specific sounds and their evaluation by users. In Iran, some historic parks operating in a semi-natural environment retain their natural soundscape qualities, which is appreciated by respondents (Negar et al., 2023). However, many European parks are polluted by mechanical sounds from surrounding traffic routes (Zannin, 2006; Irvine et al., 2009; Sztubecka et al., 2020; Juszczak et al., 2021).

Soundscapes of parks can be designed using knowledge of how plants affect the acoustic environment. Classical Chinese gardens used aspects of traditional philosophy and art to create unique sound spaces. This included methods such as sound masking, sound borrowing, sound amplification, sound contrasting and sound anticipation, in which vegetation played a large role.

Researchers have demonstrated the influence of different types of plants on soundscape satisfaction (Song et al., 2018).

An attempt to enrich the sensory world of local residents is to create enclaves in recreational areas intentionally fitted with acoustic elements for education, relaxation and play. These are the so-called sensory gardens, which are becoming increasingly common in Polish and international cities. As K. Pawłowska (2008) writes: "The fashion observed worldwide for the creation of sensory gardens signifies a general focus of the creators on effects addressed to senses other than sight. In addition to the natural sounds of wind, water and birds, designs incorporate sound-producing devices as well as surfaces that become the source of a variety of noises as people pass through them. Currently, more or less successful realisations of such gardens can be found in many places in Poland.

3. Materials and methods

The main objective of the case study of Grunwald Park was to characterise the park's audiosphere, and to demonstrate its variability throughout the day due to different human activities and the rhythms of nature. It was also important to identify the categories of sounds assessed positively and negatively by users in the park space. The basic assumptions on which the research was based were as follows:

- Knowledge of the characteristics of the soundscape is an essential element in the design process, as well as in the revitalisation of green and recreational areas.
- The acoustic environment of parks designed 100 or more years ago is now more exposed to mechanical sounds due to the development of transport routes around the parks.
- The acoustic environment of parks has its own rhythm throughout the day, according to which it is subject to change.
- Psycho-cultural factors create an additional layer in the soundscape that modifies its assessment.
- Intentional activities and actions in the park modify the evaluations of the different sound categories.

Aletta and his team of researchers distinguished four basic methods of soundscape research: sound walks, laboratory experiments, interviews and behavioural observations (Aletta et al., 2016). Given the stated objectives, two of the aforementioned methods were used in this research: soundwalks and interviews. The sound walks - conducted during the first stage of the research - took the form of purposeful walks to designated areas, with an emphasis on observations focused on listening to the sounds heard in these locations. The methodology of the walks was based on the individual experience of sounds and was limited to collecting and recording the sounds heard. Compared to other ongoing studies, it did not focus on multiple

aspects of the soundscape (Jeon et al., 2013). The walks, which took place in May and June in designated zones, were conducted by a group of five architecture students involved in the research. The aim of the activities undertaken was to identify the different types of sounds present in the park space and make a categorisation using the division into mechanical, social and natural sounds according to the concept of R.M. Schafer (1977). In line with the research objectives, walks were taken at different times of the day to obtain data on the variability of sounds. During this phase of the research, sound recordings were also made using digital sound recorders. The recordings served to confirm the sound effects heard and were not used in further phases of the research.

In the second stage of the research, 15 structured interviews were conducted with park users.

According to the data resulting from the literature review, there are 8 main soundscape discs: 1. noise annoyance, 2. pleasantness, 3. quietness or tranquillity, 4. music-likeness, 5. perceived affective quality, 6. restorativeness, 7. soundscape quality. 8. appropriateness (Aletta, 2016). The main descriptor used in the soundscape research was the pleasure-unpleasantness dimension. It is considered useful for design purposes because it is more explicit and not context-dependent. Table 1 shows the main questions asked of the survey participants.

Table 1.
Questionnaire detailed descriptions

No.	Question	Open/close qustions. Scale type.	Desired information
Q1	How often do you visit the park?	5 pre-defined options	very occasionally/very often
Q2	How much time do you usually spend in the park?	4 pre-defined options	"<20", "21-40", "41-60",">60 min."
Q3	What is the usual purpose of a visit to a park?	5 pre-defined options	"physical activity", "path of passage", "walking the dog", "walk with child", "other".
Q4	What sounds do you hear in the park at the moment?	open question	subjective description of the soundscape
Q5	Which of these sounds do you find enjoyable?	open question	subjective assessment of the soundscape
Q6	Which of these sounds do you find bothersome?	open question	subjective assessment of the soundscape

Source: own research.

3.1. Research area

The research covered one of the oldest parks in Gliwice - Park Grunwaldzki (pre-1945 Preussenplatz). It is located in the Wójtowa Wieś district bounded by Adam Mickiewicz, King Jan III Sobieski, Jan Długosz and Zawisza Czarny streets (Figure 1). This park was chosen for its central location, size, relatively least intrusion into the greenery design of the park. The nearby avenues of trees in A. Mickiewicza Street and in Króla Jana III Sobieskiego Street were entered in the register of monuments of composed greenery in 2013.

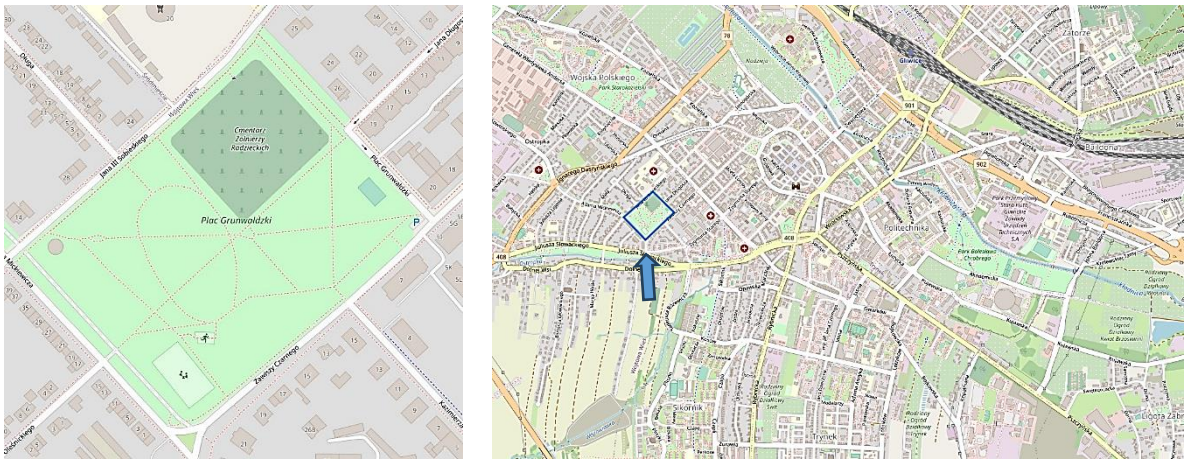

Figure 1. Park Grunwaldzki w Gliwicach.

Source: OpenStreetMap (CC BY-SA 2.0).

For the purpose of the survey, the park was divided into 5 zones differing in the functions performed (Figure 2). The data collected during the survey included the following division:

Zone 1 contains a multi-purpose pitch, structured low and high greenery and paved pedestrian and cycle routes.

Zone 2 is the central part of the park, where the paved pedestrian and cycle routes intersect to form a fairly large area devoid of greenery.

Figure 2. Grunwaldzki park in Gliwice. The park's zoning for the study.

Source: Wiśniowska (with the written permission of the author).

Zone 3 - the area in the north-west corner of the park. There are few paved footpaths here and most of the area is covered with untidy low and tall vegetation and shrubs in the form of hedges. Small architectural objects in the form of benches and litter bins are located along the pedestrian and cycle paths.

Zone 4 - in this part, in the south-western corner of the park, there is a playground and numerous objects of recreational equipment and small architecture, such as benches and waste bins. The playground area is fenced off from the street with ornamental greenery. The area around it is covered with low and tall greenery of an unstructured nature.

Zone 5 is a fenced area of the Soviet Army soldiers' cemetery with an entrance from the north-west side. There is a monument and mass graves in the central part of the establishment, and individual tombstones on the outskirts. The area is covered with low and tall vegetation of an untidy character and shrubs in the form of hedges.

4. Results

4.1. Acoustic map analysis of the park

Due to its location, the park is exposed to road noise, as illustrated by the Gliwice noise maps. The park is surrounded on three sides by fairly busy streets, while on the fourth side it is bordered by a quiet area consisting of courtyards, inner-city townhouses, single-family houses and access roads. The averaged noise level indicator (L_{DWN}) in the most exposed parts of the park is between 65-69.9 dB, with values ranging from 70.0-74.9 dB at the road itself. According to the Ordinance of the Minister of Environment of October 1, 2012, the permissible noise level for recreational and leisure areas is 68 dB (Figure 3).

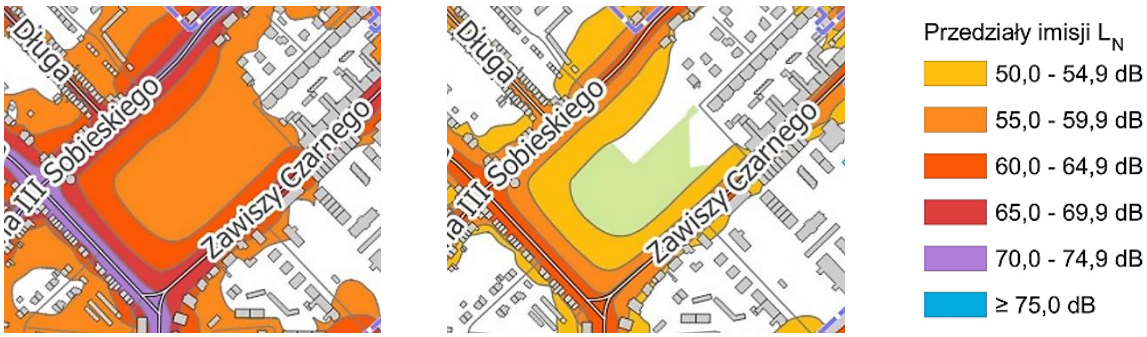

Figure 3. Acoustic map of the Grunwaldzki park (L_{DWN} and L_N indicators).

Source: own elaboration based on Acoustic Map of Gliwice Strategiczna Mapa Hałasu (gliwice.eu), https://pma.gliwice.eu/layout/mainmaps.aspx?t=0.

4.2. Sounds heard in the park space based on sound walks

The park has its own daily rhythms (Table 2). Mechanical and natural sounds dominate during the morning hours. Driving cars and motorcycles can be heard during the ongoing traffic rush. Workers hired to carry out neighborhood renovations and workers cleaning up the park start working, which is an additional source of sound. Within the park there are people walking their dogs and people heading to work, taking shortcuts through the park. Commands given to dogs and barking can be heard. More people show up around midday, so the intensity of social sounds increases. At the time of the survey in May and June, most people used the park between 12 noon and 2 p.m. Among the sounds heard at that time are: conversations, crying children, sounds of children playing, the sound of bookcrossing book cabinets being opened, footsteps on paved paths, and animal calls.

Table 2.
Sounds heard in the park according to the daily rhythm

Time	Mechanical sounds	Natural sounds	Social sounds
8.00-12.00			
12.00-16.00			
16.00-22.00			

Note.

Mechanical sounds

car, repairs, bike, city buzz, plane, motobike, scooter, playground, stroller

Natural sounds

rusteling leaves, birds, dogs barking, dogs steps, wind

Social sounds

conversation, dog commands, playing children, steps, bookcrossing, babies cry, phone call, laughter, rumbling music

Source: Wiśniowska (with the written permission of the author). Own elaboration.

In the early afternoon there is an increase in mechanical sounds generated by two-wheeled vehicles, such as bicycles, scooters and motorcycles. Footsteps, moving baby carriages, playground recreational equipment and passing airplanes can also be heard. After 2 p.m., people with small children begin to disappear from the park, and sounds generated by adults appear. Mechanical sounds associated with repairs and cleanup work can no longer be heard. In the evening, both mechanical and natural sounds decrease. Groups of young people appear in the park talking to each other and listening to loud music.

4.3. Grunwald Park - ways of using the park space

Grunwald Park offers many possibilities for use due to its varied facilities. There are areas for contemplation, meeting others and physical activities.

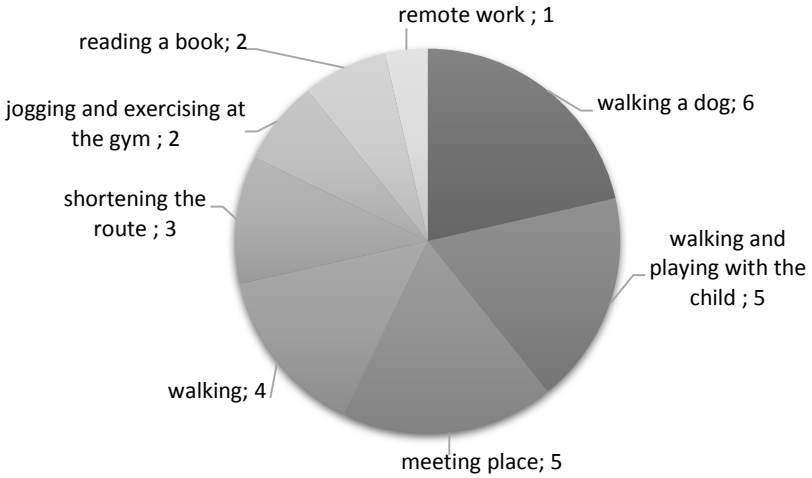

Figure 4. Uses of the park space.

Source: own research.

Park users surveyed are dominated by people who walk their dogs or go for a walk or playground with their children (Figure 4.). Most of them visit Grunwald Park frequently, even several times a day. The park is also a place for intentional and casual encounters with relatives, friends and neighbours. In this way, all sorts of social needs to be with others can be realised.

There are many paths through the park, which respondents sometimes use only as a shortcut to get around town. This is due to the fact that the park is on the line connecting their place of residence with their workplace. According to respondents, this is the only reason for being in the park.

The park also happens to be a place for joggers and people using sports equipment: outdoor gyms and a tennis table. In a group of 15 respondents, only two people indicated this way of functioning in the park. Similarly for using this space to relax with a book. Another activity that can be observed in a single case is the implementation of remote working using a private computer. The park as a work space is arguably a new idea for the role of an urban park in the warm season.

4.4. Park sound assessment

Sounds rated as pleasant are mainly birdsong and other sounds of nature, but this response does not always appear in respondents' statements (Figure 5).

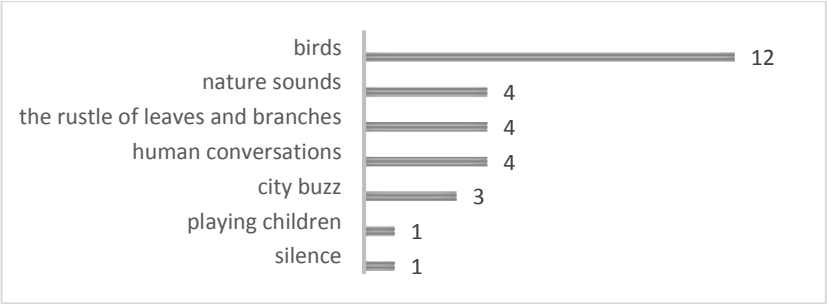

Figure 5. The most pleasant sounds in the park.

Source: own research.

The sound of people talking and the background noise of the city can also be considered pleasant by some people. Age is not a differentiating variable in this case, as both younger and older people stated this way. An older person who came to the park with her grandson perceived the sounds of children playing as pleasant.

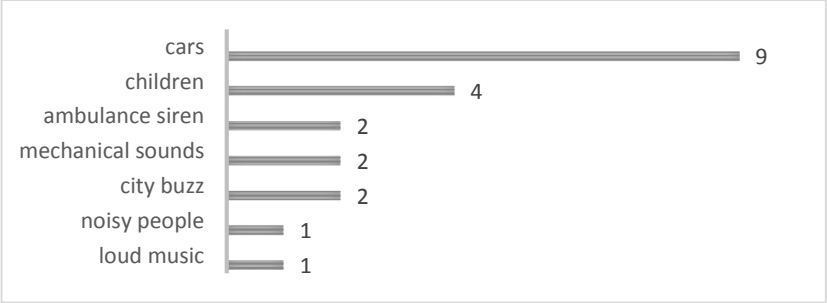

Figure 6. The most unpleasant sounds in the park.

Source: own research.

The majority of park visitors who were interviewed identified cars as a source of unpleasant noise (Figure 6). Screaming children came second most often. However, these do not disturb people who came to the park with children. Indeed, no one who indicated such a purpose for being in the park found the noises made by children unpleasant. The sound of passing ambulances with their sirens on is also perceived negatively. People are also unhappy with the background noise of the city, which can be heard in almost all parts of the park. Loud music and people behaving noisily are also among the nuisances. Interestingly, none of the people taking part in the survey found the barking of dogs unpleasant, although these noises were indicated as being audible in the park.

5. Discussion

The problem of noise pollution in recreational areas is confirmed by numerous studies conducted in many cities in Europe (Zanin et al., 2006; Sztubecka et al., 2020; Juszczak, 2021). Using the terminology of R.M Schafer (1977), it can be noted that parks are full of mechanical sounds, which in some parts dominate the soundscape in recreational areas. In studies,

this phenomenon is perceived by park users as negative (Irvine et al., 2009). Similar conclusions can be drawn from the case study of Grunwald Park. This study was qualitative in nature, so the comparisons made may serve more to formulate detailed hypotheses in further research than to present hard evidence. However, it can be posited that car sounds can be heard throughout the park throughout the day, especially on the outskirts, which are surrounded by busy streets. Nonetheless, it appears that the sound background created by the low-level noise of the city may be perceived ambivalently. Perhaps the park is seen as a kind of oasis in a hustle and bustle-filled urban space, and the audible urban noise is only a confirmation of this condition. Checking the reasons for the dissimilarity in evaluations of city noise requires further research.

In this study, human-generated sounds are perceived as positive if they are within the culturally determined social norms associated with the use of public spaces. Similarly, a study of Paris parks by Jo et al. (2020) highlights the positive perception of the social factor in soundscape studies. According to the researchers' assessment, the presence of people lends vitality to the parks. However, it can be thought that the din of conversation is also related to a sense of security. Sounds made by people are perceived as signals indicating safety and danger in an area. For R.M. Schafer, these signal souds are the basic components of a soundscape (Schafer, 1977, p. 10).

The present research points to a situation of greater acceptance of those sounds potentially associated with one's own activity in the park. Hence the positive perception of the sounds of children's play if one is in the park with children, or the absence of negative feelings toward barking dogs when the purpose of the visit to the park is to introduce one's own dog. In this case, a relationship can be seen between the type of activity in the park and ratings of the sounds heard. A study that Fang and his team (2021) conducted also considers a similar variable. However, the specifics of park use in China, including the focus on collective activities, are different from the habits found in Polish parks.

The following investigation has its limitations due to the timing of the study. The spring period when the surveys were carried out may not allow us to see other factors involved in the soundscape assessment. In the year the study was conducted (2023), outdoor temperatures in May and June were unusually low, contributing to slower plant vegetation and fewer developed leaves. Researchers have previously shown a link between the perception of sounds and the types of vegetation found in a park (Szubecka, 2020; Song, 2018). The physical parameters of the environment can influence the choice of where to be in a park and the subjective feelings of the audiosphere.

Future research may develop the concept of soundscapes taking into account the physical paramenters of the space.

6. Conclussion

Grunwald Park in Gliwice, which was the subject of the case study, is an old urban park with diverse functions. During the day, the audiosphere of the entire area is dominated by mechanical sounds, mainly from traffic. This phenomenon is noticed by park users and assessed negatively. Creating, improving or modeling the environment is a matter of soundscape design. By planning the outdoor space taking into account the relevant acoustic characteristics, it is possible to influence the improvement of the quality of life of residents. In the case under study, a factor that could improve the acoustic characteristics of the park is a thoughtful concept of greenery in the park. Examples of Chinese parks prove that different types of green space influence the creation of sound-rich, satisfying acoustic landscapes in an urban environment.

Another point is to note that the park under study plays an important role in improving the health of residents, building social relationships, opportunities to carry out caring functions towards other family members and owned animals. These activities are so important that they displace some of the negative feelings associated with the audiosphere. Parks, as components of the urban system, need to constantly follow the changing needs of residents.

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