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Acoustic climate of the Czech Republic

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1. INTRODUCTION

The project "Determination of acoustic climate in the Czech Republic" deals with global issues and noise burden on the landscape, including the recognition of the importance of quiet areas in the agglomerations and quiet areas in the open country. The project was launched by Ministry of Environment of the Czech Republic. Duration is planned for 25 months (2007-2009) and EKOLA group, Ltd., Prague is holder of the project. The required output will be "The Atlas of the acoustic climate of the Czech Republic", containing both the text and the digital global acoustic characteristics of the landscape throughout the Czech Republic. Project results will also provide strategic information on environmental noise in the Czech Republic.

2. METHODS

Systematic and large-scale data acquisition about the state of the acoustic climate of the landscape was quite rare until the preparation of the strategic noise maps in the Czech Republic in 2007. The general characteristics of those randomly acquired data is their non-homogeneity in the methodology (especially as to the calculation procedures) and their low availability due to the small centralization in the archiving. The first step in the project was, therefore, aimed at obtaining of the relevant and comparable data sets for the whole territory of the country. Such data sets served as the basis for the project processing procedure. However, the results obtained in the strategic noise maps processing provided the starting input data for the project. The second important data set for the project was provided on the base of the metaanalysis of the acoustic data collected in the national or regional EIA/SEA databases.Those databases are covered by competency of the Ministry of the Environment. The prescribed methodology of the EIA / SEA procedures leads to the typological homogeneity of the acoustic output data which enabled the acoustic scaling and subsequent assessment of the different acoustical situations in the landscape. Several hundred EIA/SEA data sets were then obtained from the metaanalysis. Their comparison shaped several fundamental lanscape categories for the global scaling of the acoustic properties of the landscape. These noise categories also form the pragmatic framework of the project solution, are as follows:

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1. Noise category for settlements
2. Noise category for the noise source(s) surroundings
3. Noise categories for the open country
4. Noise category for "the quiet areas"
   A) in the open country,
   B) in the agglomeration

The first two of the above mentioned categories relatively easily managed are from the point-of-view of the description of their acoustic properties in comparison to the other two categories. This is possible due to the existence of verified prediction tools allowing such descriptions. Essentially - we have to solve the noise mapping for the defined noise sources and the defined areas. We can use the obvious noise descriptors given in the national legislation for the description of the acoustic properties of the areas under examination. In our case it means $L_{Aeq\ Day}$ and $L_{Aeq\ Night}$.

Defined noise sources for the above mentioned categories 1 and 2 are the road traffic (on highways, dual-carriageways, and on the I., II., and III. road classes, including their parts in the settlements), the railway traffic, the air traffic noise from the the civil airports and the industrial noise from the surface mining activities. Local roads traffic in the settlement are not included in the calculation, due to their lower global priority in the overall acoustical situation in the settlements. Similarly, industrial noise sources were not taken into consideration when performing calculation in settlements.. All results of the calculations for the noise specifications in categories 1 and 2 were obtained by application software CADNA A. Input parameters in calculations of the road traffic noise were average emission values of the Czech car pool. Propagation of the emitted noise the French calculation method NMPB-ROUTES - 96 (FRANCE, EC-interim).

For the calculation of the railway noise Schall03 German calculation method was used. Its emmission output used for the calculation was subsequently corrected and verified by the measurements in the selected test areas.

Given the failure to obtain the detailed data on air traffic intensities at small civilian airports of the Liberec region and assuming (on the experiences from the survey in the 6 other Czech regions from the overall number 14 regions of the Czech Republic) that very similar situation would occur in the other regions, generalized evaluation procedure was developed for the evaluation of acoustic quality in the surroundings of the small civilian airports. The methodology is based on the geograhical coordinates of the centre of the airport and on the coordinates of airport runways according to AIP. Two buffers are created around those coordinates. The first one covers the runways (its size is 500 m around the track), the second one covers the centre of the airport and its ATZ zone with the radius of 3 miles. These buffers define the territory in which occurs a breach of the acoustic quality of the environment as opposed to acoustic situation without the airport in the same territory. For the graphic presentation of the situation GIS technology was used and will be used.

For the calculation of noise around the airports for civil aviation transport in the Czech Republic (note that the airport for civil aviation transport does not exist in the Liberec region) standard software options of the CADNA A are used, namely the calculation methodology ECAC Doc. 29, 2nd edition 1997 (International, EC-Interim). GIS technology will be used to display studied airport. As imaging techniques will be re-used GIS technology.

The calculation year for all traffic noise sources was 2008.

For verification of the correctness of the calculations for road traffic noise calculation procedures based on the field measurements in surrounding of the roads in the Liberec Region have been used.

The uncertainty of the calculations was deducted from the comparison of the calculated and measured data (from the total of 15 measuring points 28 pairs of results "measurement - calculation" were obtained) in the areas where the calculated values are higher than LAeq measured. The average difference (+1,4) dB was found for 13 measured situations. The case when the calculated values od LAeq are lower than LAeq measured was found in 14 cases. The average difference in LAeq was (-1.1) dB). On the studied data sets only one of them shown the same values for calculated and the measured values of LAeq. In conclusion, the uncertainty of the results of calculations and the measurements was always less than ± 2 dB, which is the acceptable level of uncertainty of the field measurements.

The results of all calculations, respectively the results of the assessment are shown in GIS, specifically in the ArcGIS software, version 9.3.

Description of the acoustic properties of the landscape (i.e the acoustic solution for the categories 3 and 4 above) was based on the combination of the field measurements and GIS techniques. The determination of locations / sites for the measurement of the noise situation for the lanscape categories 3 and 4 was preceded by the study on the acoustic qualities of the landscape from the point-of-view of the lanscape planners.
In this acoustic typology of the landscape the crucial aspect is the presence / absence of the anthropogenic noise. Using the metaphorical indication of acoustic properties of the landscape we have clasified them according to the rock music genres:

1. Landscapes with reduced acoustic value (type A, punk rock). Acoustics of this group is dominated by the anthropogenic noise. All non-anthropogenic sounds are concealed (masked) by this type of noise.
2. Landscapes with average acoustic value (type B, hard rock). Anthropogenic components of noise in these lansdcapes are relatively comparable in size to non-anthropogenic noise components.
3. Landscapes with increased acoustic value (type C, art rock). In these types of landscapes there is virtually no (or only minor) anthropogenic noise component. Non-anthropogenic noise dominate here.
4. Acoustically specific landscapes (type D, alternative rock). This group covers unique landscapes in relation to their acoustic effect or occurence. Most distinct members of this group are the landscapes of the silence and the landscapes with echo.

The above mentioned landscape typology of acoustic properties of the landscape are in good agreement with the acoustic classification of the landscape, based on the possibility of the distinction of the environmental sound field type (field of the defined noise sources, the diffusion acoustic field).

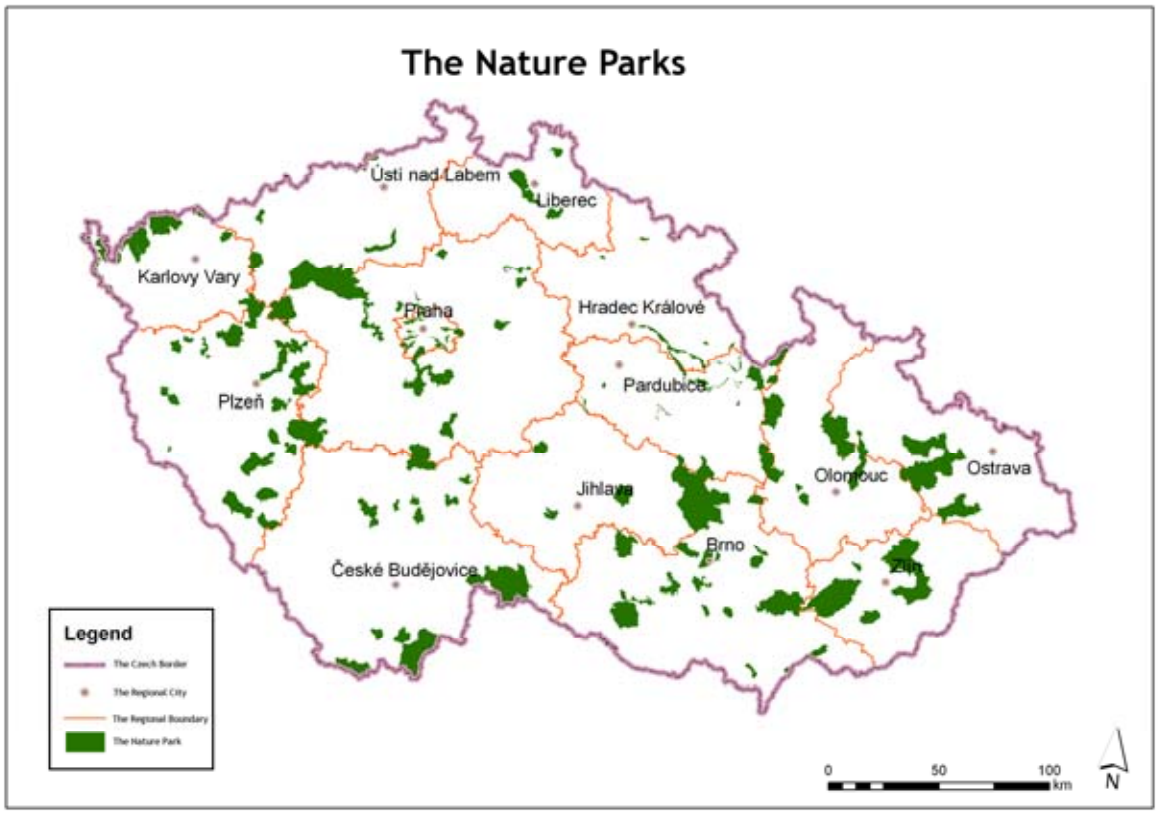
Selection of the measurement points for the measurement of the acoustic properties in the landscape type C has been primarily based on the calculations of the defined noise sources. Those areas, where calculated values of LAeq are primarily less than 50 dB in day time were chosen as a potential site for the measurement of the environmental noise for the feasibility study.

However, the experience of the repeated 24-hour measurements of the acoustical situation therein showed that the stability of the measured results is acceptable only if the wind velocity at the time of measurement is less than 1 m / s (equivalent to Beaufort scale „Calm“). The increasing wind speed changes the measured LAeq values due to interaction with the natural environment in the vicinity of the measurement point. The above mentioned measurement conditions also apply to the measurements of the potential "quiet areas", both in the urban area and in the open country.

Selection of the measurement points/sites for the acoustically specific landscape areas (landscape type D) was based on the experience with specific categories in the territorial planning until 1992, especially with the experience bound on the territorial category named „the tranquil areas“. Czech legislation - ActNo. 114/1992 Coll. on the protection of the nature and the landscape has automatically transferred the category of „ tranquil areas“ to the current category „ natural parks“. As the natural park category is not too narrowely defined, it would be beneficial to use them also when defining „the quiet area in open country."

At present there are 135 natural parks in the Czech Republic. Their total area is over 7700 km^2, which is approximately 10 % of the whole area of the Czech Republic. Average size of the Czech Nature Park is approximately 57 km^2.

The locations of the current natural parks in the Czech Republic are shown in Figure 1.



Figue 1: The Nature Parks in the Czech Republic - 2008

Therefore, acoustic qualities of the lanscape in natural parks and protected lansdcape areas have been studied as those areas could have potential to be "the quiet areas in open country". Measurement methods used for the study were 24-hour continuous measurements of the environmental noise (long-term measurements) and 1 - and 2-hour sample measurements (the short-term measurements) of the environmental noise. Long-term measurements was performed on 12 different measurement sites. Technique of the short-term measurements (sample technique) was used to obtain basic information data sets on the potential "quiet areas in the urban area". Sample technique was used in two agglomerations - Liberec, Pilsen, and in two district cities - Turnov, Uherské Hradiště. 54 data sets were collected. The following qualitative typology of the acoustic properties of the landscape was based on the results of the above mentioned measurements and calculations:

1. Luxury areas (with the values of LAeq Day as well as LAeq Night < 40 dB)
2. Comfortable areas (with the values LAeq Night < 40 dB and the values of LAeq Day in the range of 40-50 dB)
3. Good areas (with the values of LAeq Night in the range 40 – 45 dB and the values of LAeq Day in the range 50-55 dB)
4. Acceptable areas (with the values of LAeq Night in the range 45 – 50 dB a the values of LAeq Day in the range 55 – 60 dB)
5. Unfavorable areas (in which it is either the value of Laeq Night 50 dB exceeded or the value of LAeq Day 60 dB exceeded)

The obtained results for the Liberec Region in 2008 were presented on 4 maps in the A2 format. These maps have shown overall acoustical situation in the studied area in the 5 qualitative acoustic categories. The sample (part of the map) is given in the Figure 2.

In addition,GIS procedures parallel to the graphics obtained different sets of the numerical data. Both data sets enable the different types of the analysis of the environmental noise. Analysis have shown that 41 743 ha (13.2% of the whole region) of the Liberec Region is influenced by noise levels greater than LAeq 50 dB in daytime. This afected area contains 50 131 buildings (47.4%) from the total set of 105 759 buildingsin the Liberec Region.

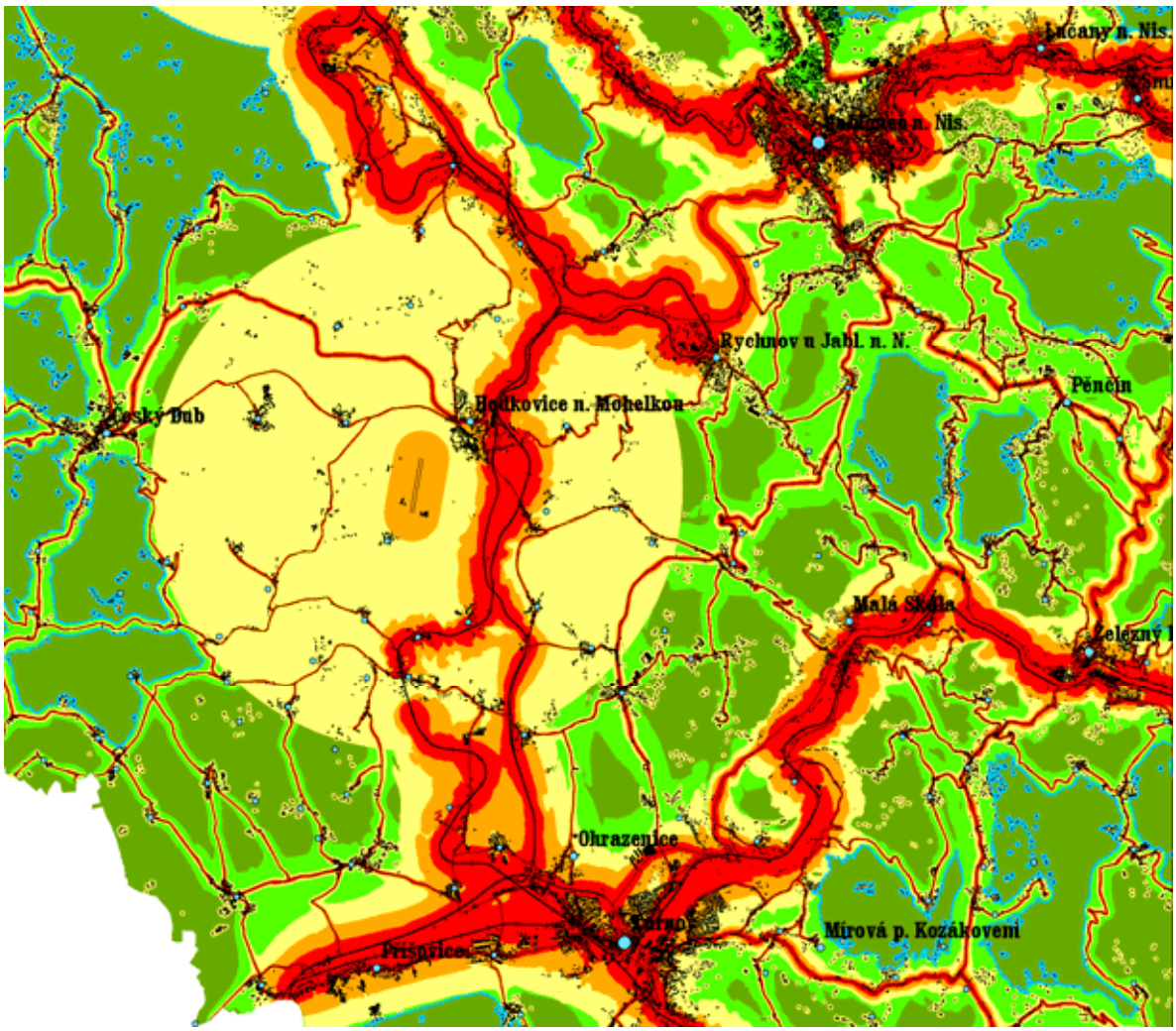


Figure 2: The presentation of the qualitative acoustic categories of the environmental noise

3. Conclusions

1. Combination of methods used in the project solution (field measurements, computation techniques, GIS techniques) proved to be very effective. However, it is very important to ensure the complementarity of individual methods.
2. We are of the view that "the quiet areas in open country" category by all means consist of luxury areas and, depending on the local situation, of comfortable areas.
3. The results show that category of "the quiet areas in an agglomeration" can certainly include the luxurious and comfortable areas and depending on the local situation, also the good areas, too.
4. Last but not least, we also consider the need to raise awareness of users and of general public on the utility of gained results. The core of such information flow should be emphasis on the necessity not to interchange the strategical and detailed data about the acoustic situation in the area under examination.

References

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