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ACOUSTICAL CHARACTERIZATION OF A NATURE PROTECTION AREA AND ITS SURROUNDINGS

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1. INTRODUCTION

In an effort to develop a reliable acoustical characterisation method of nature protection areas and rural quiet areas, large scale measurements have been carried out during the summer of 1993 in and around the nature protection area (NPA) "Walenbos" indicated on the map of Fig. 1. The environmental noise was continuously (and largely simultaneously) measured and statistically analyzed at 13 fixed noise monitoring stations (NMS). The NPA is about 600 ha and surrounded by rural areas. The investigated area is about 5 x 3.5 km^2 and limited on the north side by the A2 super-highway. Measuring periods at the different NMS ranged from 2 to 15 weeks. Concurrently, short term (15 minutes) noise measurements at another 24 locations, as well as noise spectra were repeatedly carried out. During the summer of 1995 a similar effort was made at the measuring points 01, 03, 04, 05, 07 and 13 as a follow-up and in order to assess the possible effect of a partially modified road surface of the super-highway.

2. RESULTS AND DISCUSSION

Data for the statistical parameters $L_{A95,1h}$, $L_{A50,1h}$, $L_{A10,1h}$, $L_{A1,1h}$, $L_{Aeq,1h}$ have been obtained for each hour of about 400 measuring days at the 13 NMS together. Several ways of averaging these data have been investigated in order to arrive at meaningful correlations and conclusions. In all cases unreliable data, e.g. because of bad weather conditions, have been excluded.

Averages of comparable data for different wind directions revealed that for most of the measuring points the L_{A95} averages (for the day or the night)

Fig. 1 Area map and location of measuring points.The grid spacing is 1000 m.

turned out to be somewhat higher (2 to 5 dB(A)) for wind (with speed ≤ 5 m/s) from NW, N, NE or E directions. A few exceptions could be ascribed to local influences, e.g. caused by some shielding effects of the mildly sloping terrain at some places.

A further data reduction was achieved by neglecting the (minor) wind direction dependence, and making daytime, evening and nighttime averages for each of the measuring points. For the daytime all hour values (of a given statistical parameter) between 07.00 h and 19.00 h have been averaged. For the evening averages have been made for the three hours between 19.00 h and 22.00 h. For the night, however, only the lowest four hour values have been averaged. In Fig. 2 (for the night) and Fig. 3 (day) these global L_{A95} and L_{Aeq} values have been plotted as function of distance from the A2 super-highway. In these figures the dashed lines indicate the sound pressure level of a line source as a function of distance.

Short-term (15 min.) measurements at the 13 NMS as well as at 24 other locations have also been carried out repeatedly. A quite good correlation could be found between the $L_{A95,\ 15\ min}$ and the $L_{A50,\ 15\ min}$ results and the corresponding $L_{A95,\ 1h}$ and $L_{A50,\ 1h}$ levels.
For the other statistical indices and for L_{Aeq} no such good correlation was found. Values of $L_{A95,\ 15\ min}$ at the 24 additional points largely confirmed the acoustical picture obtained from the long-term measurements at the NMS and were in accordance with the distance to the A2 dependence seen in Fig. 2 and Fig. 3.
At regular time intervals a spectral analysis of the existing noise was also made at the 13 NMS. A good correlation was practically always found between the total dB(A) value of the measured spectrum and the corresponding $L_{A50,\ 1h}$ level. From third octave spectra, it was found that nearly always the characteristic signature of traffic noise was present at all places. It was only absent in some of the spectra at the measuring points 01, 02 or 11 in the middle of the night. Thus, even rather low global background levels are marked by traffic (on the super-highway).
In 1994 part of the concrete road cover of the A2 was grinded off east of NMS 13. From a comparison between the 1993 results and these of a follow-up investigation (at NMS 01, 03, 04, 05, 07 and 13) in 1995, it had to be concluded that the effect was only noticeable very near the A2 itself and only gave a minor reduction of about 2 dB(A) at NMS 13.

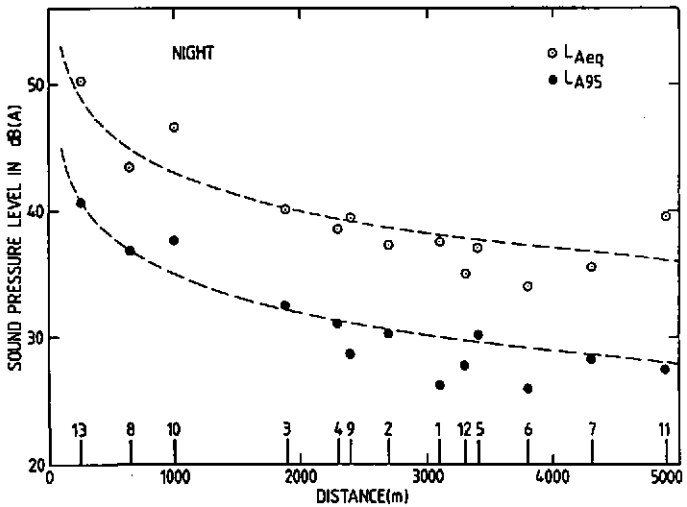

Fig. 2 Nighttime global L_{A95} and L_{Aeq} levels as function of distance from the A2 super-highway for the 13 noise monitoring stations of Fig. 1.

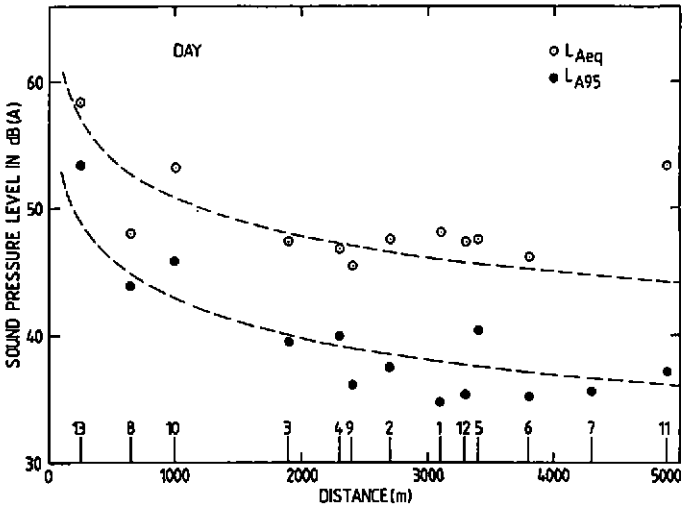

Fig. 3. Daytime global L_{A95} and L_{Aeq} levels as function of distance from the A2 super-highway for the 13 noise monitoring stations of Fig. 1.

3. CONCLUSIONS

Acoustically, the investigated area can qualitatively be subdivided in three subregions: (1) the rather quiet south-eastern part of the "Walenbos" and the nearby areas east and south-east of it; (2) the area around the NMS 08, 10 and 13 where the acoustical climate is dominated by traffic noise of the A2; (3) a transition region (around the NMS 02, 03, 04, and 05) where the influence of the A2 is present but not dominant. This acoustical picture is consistent with the distance dependence present in Fig. 2 and Fig. 3.
On the basis of this study it could also be concluded that for future evaluations of potential quiet areas (of similar size) good conclusions should be obtainable on the basis of a combination of long term measurements at a few of NMS and short-term measurements at other spots distributed over the investigated area.

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