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Noise disturbance of meadow birds by railway noise

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Abstract [266] The presence and use of a railway line in an open landscape may lead to disturbance of local bird populations. In order to determine whether there is a disturbance factor, and in order to quantify the disturbance the presence of 11 meadow bird species have been counted in 15 study areas near railroads in the Netherlands. A statistical relation has been developed between the noise load and the presence of birds. Various noise parameters have been taken into account, such as LAeq, Lmax and SEL. Some species appeared to be sensitive to the noise load. Quieter railway lines are showing less disturbance for these species than more busy railway lines. An application of the results will be described in order use the results of the study in Environmental Impact Assessments as well as for compensation of lost area.

1 INTRODUCTION

Meadow birds in the Netherlands show a reduction in numbers over time. This is be caused by all kinds of influences, the main being loss of area due to building activities and intensive farming. Also the noise load by railways and roads might be a factor. The indicator species of all meadow birds is the black-tailed godwit (figure 1), which has declined with 30% since 1990. The Netherlands are the most important breeding area of this birds in North West Europe, as 90% is breeding in our country. In this study the effect of railway noise on the number of birds within several areas along existing railway lines is studied.

Figure 1 *Black-tailed godwit*

2 METHOD USED IN THIS STUDY

Throughout the Netherlands study areas were selected with a density of at least 16 pairs black-tailed godwit (see figure) per km^2. This is a common meadow bird in the Netherlands, although its numbers are decreasing. The selected areas did not possess disturbing factors apart from an adjacent railroad. 15 study areas were selected of 111 ha on average, from which seven were situated in the north and eight in the west of the Netherlands. Within these areas the presence of meadow birds was

estimated based on seven visits to the areas. Examples of the bird presences in these areas as collected by birdwatchers are presented in figure 2. The following species were included in this study: black-tailed godwit *Limosa limosa*, lapwing *Vanellus vanellus*, oystercatcher *Haematopus ostralegus*, redshank *Tringa totanus*, common snipe *Gallinago gallinago*, curlew *Numenius arquata*, northern shoveler *Anas clypeata*, garganey *Anas querquedula*, yellow wagtail *Motacilla flava*, meadow pipit *Anthus pratensis* and skylark *Alauda arvensis*.

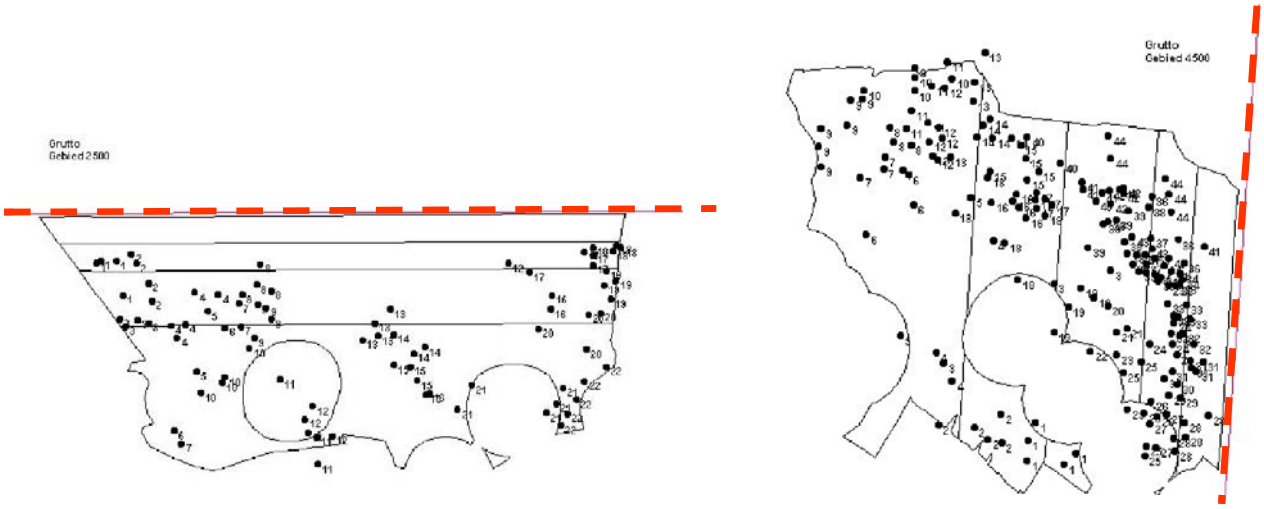

Figure 2 *Examples of the presence of birds in study areas. The red dotted lines indicate the railway. The patches are around 1 kilometer long*

The selected areas were divided into zones parallel to the railroad. Within these zones, the average noise immission was calculated using the standard Dutch noise calculation scheme. Calculation height was 1 m above ground level. The noise level used was the equivalent noise level throughout a full day-night period, the LAeq,24h. The noise levels were calculated with a standardized method [1] based on standardized weather patterns. These calculations take into account the use of the railway, in terms of the number, length and types of trains, as well as the type of track. For the analysis of bird density versus noise level a complementary log-log model was used [2].

3 RESULTS

Bird densities in the study areas did not show any regional trend: high densities occurred both along the more quiet railroads in the north and along the busier railroads in the west of the country. Noise immission, however had a significantly negative effect on the density of garganey, black-tailed godwit and skylark, as well as on all meadow birds together and all waders together. In the other species a negative trend was present, which showed most clearly in shoveler, oystercatcher and lapwing. However, the samples of these birds were too small to enable a correlation between noise exposure and the number of birds present. The threshold noise level from which densities were affected varied little between species: black-tailed godwit 45 dB(A), skylark 42 dB(A) and garganey 49 dB(A).

The uncertainty of these threshold levels are large, i.e. for black-tailed godwit the 90% confidence limits range from 30 to 57 dB(A). In figure 3 the relation between relative density and immission noise levels is shown for the black-tailed godwit, skylark and all meadow birds combined, as well as the confidence intervals.

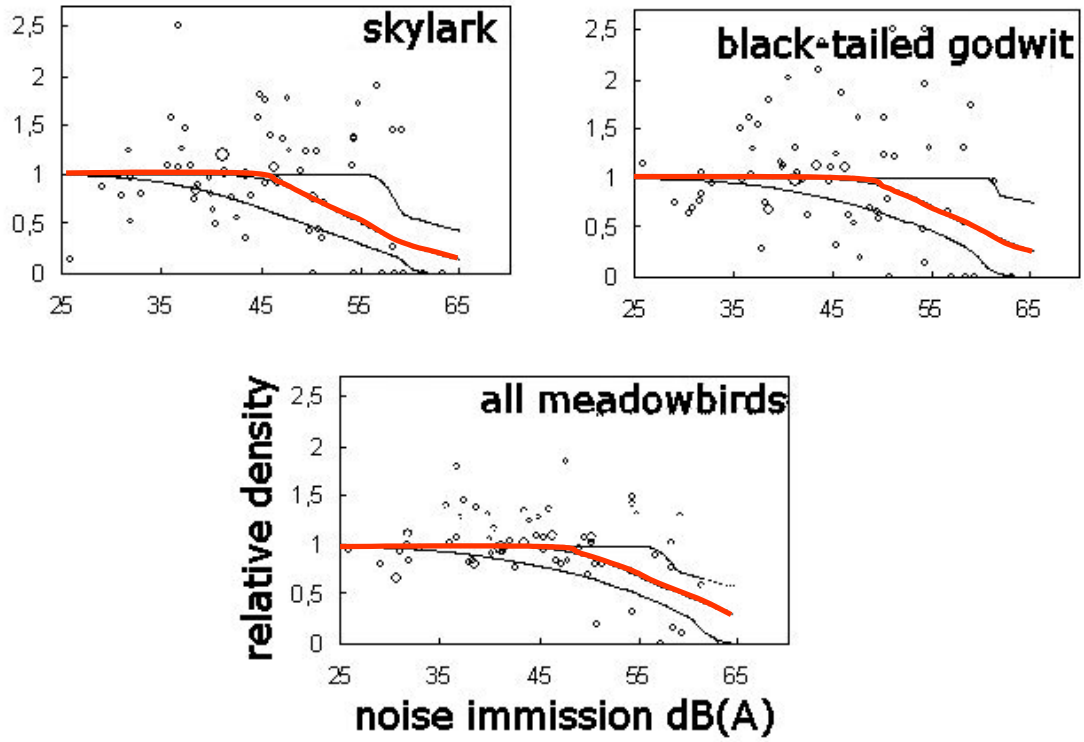

Figure 3 *Relative density of birds in relation to noise load for two species and all meadow birds together. Relations are based on regression. The symbol size reflects their importance in regression The middle red lines indicates the results of regression; the outer black lines the 90% confidence limits*

4 VARIOUS NOISE DOSE MEASURES

For calculating the noise load the LAeq,24h was used. The density of birds was correlated with several other noise measures, such as the peak noise level, and the time the train passage noise is audible, but the correlation did not improve. We feel the use of the LAeq,24h gives a good approximation for bird disturbance. However, the mechanism through which birds might be disturbed by passing trains is not known. It could be a combination of sound, vision and other factors such as the presence of a small dike on which the track is laid. Very few studies have looked into behavioral or physical responses to different causes of disturbance. The equivalent noise level is seen as a representative dose for all combined disturbance effects of a railway line, which especially takes into account the intensity of the use of the railroad.

5 APPLICATION OF THE RESULTS

The relation found will be applied in noise effect studies for new railway lines in the Netherlands. The calculation scheme is as follows:

1. Calculate the LAeq,24h contours in the area of interest1 m above ground level in steps of 1 or 2 dB(A).
2. Import these noise contours into a GIS system, together with a map of the area of interest.
3. Calculate the surface area between any pair of noise contours.

4. Determine the percentage of birds which will disappear between each pair of contours using the noise data [3] belonging to the middle line of figure 3.
5. Calculate the effective loss of area for the birds (percentage times surface area). If information about the actual number of bird territories is available, the expected loss of territories can be calculated.
6. Repeat this for each pair of contours.
7. Sum the total effective area loss.

The result of this calculation may be used for nature compensation elsewhere. Example calculations on a quiet and a busy Dutch railroad have been performed. The area loss for the black-tailed godwit lies between 16 and 23% of the total area within the 45 dB(A) noise contour. For the busy railroad the 45 dB(A) contour is farther away, but in addition the noise disturbance within the area is higher. Noisy railroads consequently have a much larger impact than quiet railroads.

6 CONCLUSION

Railway noise has some effect on the presence of meadow birds. A correlation between noise exposure and number of bird territories has been shown for three species. The presence of a railway line will result in loss of area which can be inhabited by the birds, but this may be compensated by other measures, as the probability limits are very large due to other factors which influence the number of territories in a birding area. For the black-tailed godwit this loss typically amounts to 16-23% of the area within the 45 dB(A) noise contour. The threshold levels for the disturbance (defined as the level were 1% of the birds are leaving the area) are summarized in table 1.

Garganey	49 dB(A)
Black-tailed godwit	45 dB(A) (range 30-57)
Skylark	42 dB(A)
All meadow birds	44 dB(A)
All waders	45 dB(A)

Table 3 *Threshold levels for bird disturbance*

The eight other bird species studied, however, did not show a significant effect of the presence of the railway and its noise load.

ACKNOWLEDGEMENTS

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