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Bird's detectability and number of visits to the area

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Introduction

Bird counting methods usually are based on 1-3 visits. As a rule strong bias of results were indicated (Verner 1985). This bias is not very important if one is interested in counts of a single species. The problem arises when one is interested in communities of birds. If different species show different patterns of activity then the ability of an observer to detect those species must differ. Thus, a small number of visits will lead to over estimations of the number of some species and under estimation of other species. In this paper we investigate the influence of detectability on the optimal number of visit. We developed a simulation model of transect counts and used data collected during two years of transect study on avifauna of the Bieszczady National Park as an imput data for the simulations. Then we compare the simulation outcomes with the field data.

Material and methods

The field data were collected during the studies at the Bieszczady National Park (Cichoń and Zając 1991). Four transects of the total length of 8,700 m were set up in the Carpathian beach forest. A bird occurrence was recorded for each section of the transect stripe which was 25 meters long and 100 meters wide (50 meters on the left and on the right side from the walking path). Twenty visits were done each year of the study on the transects at different time of the day. We adopted a cluster of records of singing male in an adjacent sections of the transect (minimum 3 records) as a criterion of territory existence. The birds density was calculated as the number of discovered territories per area of the transect stripe. The counts were carried out in the periods: 30 May to 30 June 1987 and from 10 June to 10 July 1988.

Detectability of a species was assumed as a probability of recording of all singing males of a given species at a given visit. It was calculated according to the formula:

$$a = \frac{\sum_{i=1}^{n} \frac{m}{N}}{n}$$

where m - number of singing males recorded in a given visit, N - number of singing males recorded on transect during whole season, n - number of all visits.

Computer simulation. It was assumed that the transect was a line divided into sections in which territories were to be found or not. In one section there could be only one territory. The line of the transect was represented by the first column of the two-dimensional array. Each array element represented a section of the transect, and it was assigned with two vales 0 or 1. The values of 1 distributed randomly throughout the transect represented territories. The number of value 1 was proportional to the density of a given species in the area studied. In the simulation consecutive visits were represented by following columns of the array. The computer was running through the successive columns (it represented visits in the study area) checking if there were 1 values in the same row in the first column. If it happened to be, a value of 1 was put with the probability equal to a given detectability derived from field data. After successive check of all the columns in the whole array (in field it represents all visits in a given season) rows of the array were checked again in order to check if territories were detected. If the number of met 1 values (behind the first column) was at least 3, then it was decided that the territory from the first column was detected. It represented at least 3 records of a singing male on territory in the field. One array represented one counting season.

In order to check if accepted in the field number of visits is sufficient we run a simulation in which we used detectabilities of 4 species as an input data (data collected in the Bieszczady National Park, Cichoń and Zając 1991; Table 1): 1) species of high detectability (d) - Chaffinch *Fringilla coelebs*, d= 0.54; 2) species of medium detectability- Robin *Erithacus rubecula*, d=0.42; 3) species of low detectability - Blackcap *Sylvia atricapilla*, d=0.36; 4) species of the lowest detectability - Great Tit *Parus major*, d=0.32. The species were chosen arbitrary in order to give overview of the detect abilities and the densities found in the field (Table 1).

The simulation was run 300 times for each

Species	Detectability	Density pairs /10 ha
Fringilla coelebs	0.54	14.6
Troglodytes troglodytes	0.53	2.3
Erithacus rubecula	0.42	5.3
Sylvia atricapilla	0.36	2.0
Parus montanus	0.33	1.5
Regulus regulus	0.33	1.3
Parus major	0.32	0.8
Phylloscopus sibilatrix	0.31	3.5
Regulus ignicapillus	0.13	0.8

Table 1. Detectabilities and densities (p/10ha) of bird species in the study area in the Bieszczady Natl. Park.

combinations of detectabilities and densities. The results of the simulation were presented as a mean number of detected territories for each successive visit.

Results and discussion

We assumed that number of visits was sufficient when 95 % of the territories were detected. The number of detected territories increased very slowly above this value as it is shown in Fig. 1 presenting simulation results. The number of visits sufficient to detect 95 % territories differed among species. Thus for Chaffinch 11 visits were sufficient, for Robin 14, for Blackcap 17, and for Great Tit 20.

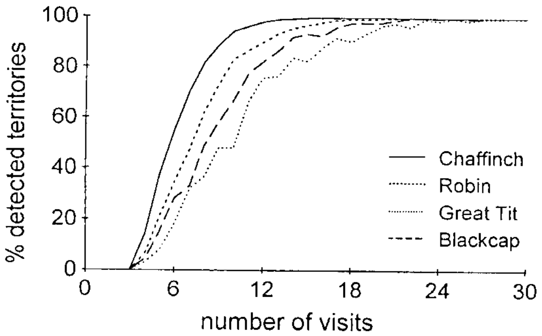

Fig. 1. The percentage of detected territories in relation to the number of visits for four species representing different detectabilities (d): Chaffinch (d = 0.54), Robin (d = 0.42), Blackcap (d = 0.36) and Great Tit (d = 0.32) - simulation results.

The simulation results were compared with the results of counts in the Bieszczady National Park (Cichoń and Zając 1991). The field data also showed that the number of detected territories did not change significantly after a certain number of visits. For high detectable species (e.g. Chaffinch, Robin) the number of detected territories stopped increasing after n = 13 visits. For species of low

Species	Simulation	Field data
Fringilla coelebs	11	13
Erithacus rubecula	14	13
Parus major	20	18
Sylvia atricapilla	17	19

Table 2. The number of visits required to detect 95% of territories as the outcome of the simulation and the numbers of visits after which number of detected territories stops to increase (the field data from the Bieszczady National Park).

detectabilities (e.g. Great Tit, Blackcap) more counts were required (Table 2).

The simulation results and the field data from the Bieszczady National Park showed that 1-5 visits usually adopted by most researchers (Järvinen and Väisänen 1976, Walankiewicz 1986) is too small if one need to know the real number of individuals. It is particularly important in the case of the species of the lowest densities and/or the lowest detectabilities.

In conclusion, we found that the optimal number of visits depended on detectabilities of species. Then if there are differences in detectability between species one should expect large differences in reliability of the counting results between species when only several visits were performed. In such a situation some species of high detectability could seem to be numerous while species of low detectability could seem to be rare, even when their real numbers were equal. One should increase number of visits to avoid such a situation, but it is sometimes difficult. Another possibility is to improve detectability of the species, for example by taking into account day-specific and seasonal patterns of song activity.

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