Ornis Fennica 69:113–118. 1992

Occurrence of the Lesser Spotted Woodpecker *Dendrocopos minor* in relation to area of deciduous forest

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Received 20 March 1991, accepted 23 September 1991

In the springs of 1985 to 1988, amateur ornithologists searched for Lesser Spotted Woodpeckers in 152 census areas in the south and central parts of Sweden. Each census area was 200 ha. The frequency of occurrence of the woodpecker increased with the total area of deciduous woodland; when the census areas contained less than 17 ha, it was 24%, when the areas had 17–38 ha it was 62%, and with >38 ha deciduous woodland it was 80%. The latitude in south and central Sweden had no significant effect on the area requirement, but our results show that the species requires larger areas in managed than in natural forests. A stepwise discriminant analysis revealed that the occupation of census areas by the Lesser Spotted Woodpecker could be predicted with 68% accuracy from the area of nemoral and riparian deciduous woods (positive association with occupation) and the area of mixed coniferous/deciduous wood (negative association with occupation). Non-nemoral deciduous wood, marsh wood, stand age and the density of snags did not enter the discriminant function. The area of nemoral deciduous forest has decreased in Sweden during the second half of this century due to cutting. This is probably one cause of the decline of the Lesser Spotted Woodpecker.

1. Introduction

The methods of modern forestry practised in northern Europe are detrimental to many birds, especially those dependent on deciduous and mixed coniferous/deciduous forests (e.g. Ahlén 1977, Nilsson 1979). Several species of woodpeckers have declined in both Finland and Sweden, at least since 1960 (Pettersson 1985, Tiainen 1985, Aulén 1986), and in both countries a continuous and strong decrease has been documented for the Lesser Spotted Woodpecker *Dendrocopos minor* (Tiainen 1985, Väisänen & Koskimies 1989, S. Svensson pers. comm.).

From autumn to late spring, the Lesser Spotted Woodpecker feeds mainly on wood-boring insects, foraging both on dead trees and on dead branches on healthy trees (Glutz von Blotzheim & Bauer 1980, Cramp 1985). It prefers old, unmanaged deciduous forests (Spitznagel 1990, Pettersson & Fiskesjö 1991), where its breeding territory is 15–25 ha in size (Ahlén & Nilsson

1982, Wesolowski & Tomiałojc 1986, Spitznagel 1990). Nowadays, however, most of the population in Sweden occurs in managed forests, where the suitable habitat is fragmented.

In the present paper, we use data on the occurrence of the Lesser Spotted Woodpecker in census areas in Sweden to address the following questions:

1) How large an area of deciduous forest does the Woodpecker need in the breeding season?
2) Does the area requirement differ, depending on the character of the deciduous forest?

2. Methods

An inventory of 152 square census areas of 200 ha (1.4 × 1.4 km) was performed by some 150 amateur ornithologists during 1985 through 1988. The census areas were distributed over the southern and central parts of Sweden (Table 1). The locality of each census area was chosen by the observers themselves and was situated so as to contain as much deciduous woodland as possible.

The census areas were visited three times in April–May and once in June. A census area was considered occupied if the Lesser Spotted Woodpecker was observed at least once. At each visit a search was made of all stands with >40% cover of deciduous trees within the census area. The stands were studied in such a way that no part of them was more than 50 metres away from the route. Each census area was surveyed during one year only.

All stands with >40% cover of deciduous trees were noted on a map and the area of each stand was measured. Each stand was defined as one of five forest types (Table 2) and also classified according to age (mean age of trees 0–30, 30–75 or >75 years) and presence of snags (no snags present, <10/ha or >10/ha). A snag is here

Table 1. Proportion (%) of census areas occupied by the Lesser Spotted Woodpecker and total area of deciduous wood in each census area in the three geographical regions separated. Number of census areas in parenthesis.

Area (ha) of deciduous wood	Region 56–58°N		58–59°N		59–62°N		All	
0–23	50	(4)	53	(19)	38	(13)	47	(36)
23–38	70	(10)	67	(15)	57	(14)	64	(39)
38–62	80	(10)	79	(19)	73	(11)	78	(40)
62–	100	(10)	73	(11)	75	(16)	81	(37)
All	80	(34)	67	(64)	61	(54)	68	(152)

Table 2. Forest types used for classification of the census areas. The combined area of the five forest types, i.e. total area of deciduous woods, is used in some analyses. In the mixed wood, deciduous trees cover 40–75%, in the other types, deciduous trees cover > 75%.

Nemoral wood	Nemoral deciduous wood. Mostly dominated by oaks *Quercus robur / petraea,* but also including beech *Fagus sylvatica*, ash *Fraxinus excelsior*, lime *Tilia cordata*, elm *Ulmus glabra* , maple *Acer platanoides* and hornbeam *Carpinus betulus*
Riparian wood	Deciduous wood on wet land by lakes and rivers
Marsh wood	Marsh with deciduous wood. Mainly alders *Alnus glutinosa / incana* and birches *Betula verrucosa / pubescens*
Non-nemoral wood	Deciduous wood on dry land with trees other than nemoral broad-leaved deciduous trees, mainly birches and aspen *Populus tremula*
Mixed wood	Wood with mixed coniferous and deciduous trees

defined as a dead, standing tree-trunk >15 cm in diameter at breast height. Only snags of deciduous trees were considered. In order to create a continuous index for age, a weighted mean was calculated for each census area, each class being weighted with the area of the class. An index for the density of snags was calculated in the same way and these indices were then used in the discriminant function analysis (see below).

The census areas occupied and unoccupied by the Lesser Spotted Woodpecker were compared using stepwise discriminant analysis (Norusis 1986) with the areas of each of the five forest types in every census area as variables, in addition to the indices for snags and age. We also used the latitude of each of the census areas.

To assess the relation between frequency of occurrence, total area of deciduous wood and geographical region, we used hierarchical loglinear models (Norusis 1986). For this analysis the census areas were divided into three geographical regions and into four groups on the basis of the total area of deciduous woodland (Table 1). The division was made in such a way that the groups were as equal in size as possible. For each forest type also, the census areas were divided into groups in a similar way, for use in χ^2-tests.

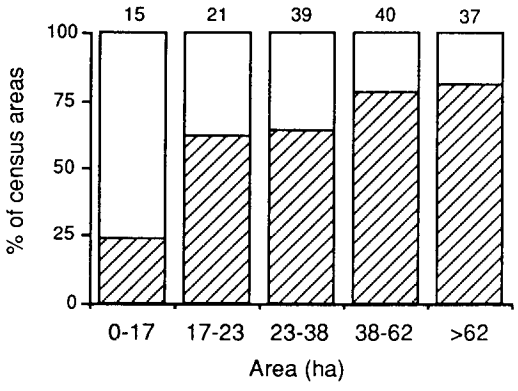

Fig 1. Proportion (%) of census areas occupied by the Lesser Spotted Woodpecker in relation to total area of deciduous forest. Shaded parts of columns represent occupied census areas and blank parts represent unoccupied ones. The numbers of census areas in each group are noted above the columns.

3. Results

The census areas studied probably represent the optimal Woodpecker habitats near the homes of the ornithologists taking part in this study. We used χ^2-tests to determine whether there were any regional differences in the census areas as regards area or forest type (Table 3). The total area of deciduous wood per census area did not differ between the three geographical regions (Table 3). The only forest type to show a regional difference was nemoral woodland (Table 3), whose area per census area decreased northwards; 76% of the census areas in the southern region contained some nemoral woodland, 64% in the central and 40% in the northern region.

We examined the possible influence of the total area of deciduous woodland and the geographical region on the occurrence of the Lesser Spotted Woodpecker using hierarchical log-linear models (Table 1). The resulting model fits the data well ($\chi^2 = 13.64$, df = 14, P = 0.48). Woodpecker occurrence increased in frequency with the total area of deciduous wood (P = 0.01), but the region had no significant effect on the occurrence (P = 0.19).

Fig. 1 illustrates the relationship between the frequency of woodpecker occurrence and the total area of deciduous woodland. However, the group of census areas with the smallest area of deciduous wood used in the log-linear model has been split into two for further resolution. There is a strong increase in the frequency of occurrence with the area of deciduous woodland; 24%

Table 3. Results of χ^2-tests of the distribution of census areas by area of deciduous wood or forest type in three geographical regions. Number of groups in each class in parenthesis.

Forest type	χ^2	df	P
Total area of			
deciduous wood (4)	6.8	6	0.34
nemoral wood (4)	16.4	6	0.01
riparian wood (3)	6.1	4	0.19
marsh wood (3)	7.0	4	0.14
non-nemoral wood (3)	5.1	4	0.28
mixed wood (3)	5.1	4	0.28

of the census areas with <17 ha deciduous wood were occupied, while the figure was 62% for those with 17–23 ha (Fig. 1). The frequency of woodpecker occurrence levels off at 80%, when the census area contains >38 ha of deciduous woodland (Fig. 1).

Lesser Spotted Woodpeckers were observed in 104 of the 152 census areas. Using stepwise discriminant analysis, we compared the area of different forest types using occupied and unoccupied census areas as prior groups in the analysis. At the 0.05-probability level, riparian, nemoral, and mixed woods entered the analysis (Table 4). The area of riparian and nemoral woods had a positive relation with occupation by woodpeckers, whereas the area of mixed woodland had a negative one. The discriminant function was not significantly improved by other forest types, the age index, the snag index or latitude. Use of the function with the three significant variables classified 68% of the census areas correctly into the prior groups (occupied vs. unoccupied census areas).

4. Discussion

In the Lesser Spotted Woodpecker we found no northward increase in the area requirements, in contrast to the results for the Treecreeper *Certhia familiaris* (Kuitunen & Helle 1988). There was a trend in the predicted direction (Table 1), but it was far from significant. Nevertheless, we suspect that the area of deciduous woodland needed by one pair of the Lesser Spotted Woodpecker is larger in northern Sweden. However, we do not have the data to test this suggestion, since most census areas were located in the southern third of the country and very few in the northern two thirds.

Table 4. Results of stepwise discriminant analysis of occupation of 200 ha census areas by the Lesser Spotted Woodpecker in relation to forest type. The table shows variables in the discriminant function at the 0.05-probability level. The values of Wilks' lambda at each step and their statistical significance are presented. The direction of the association of forest type with occupation is given.

Variable	Wilks' lambda	P	Direction of effect
1. Riparian wood	0.937	0.018	+
2. Nemoral wood	0.904	0.005	+
3. Mixed wood	0.867	0.001	–

The frequency of occurrence of the Lesser Spotted Woodpecker increased strongly with the total area of deciduous woodland up to about 40 ha. However, it is difficult to determine the area requirements of a single pair from the present results. First, deciduous stands at different ends of a 200 ha square are unlikely to be used by one pair due to the great distance between them. Second, mixed coniferous/deciduous woods with less than 40% deciduous trees were not included in this study although they are sometimes utilised by Lesser Spotted Woodpeckers for feeding (our own observation). Nevertheless, our results show that the area requirements are greater in the more fragmented and more managed forests represented in this study than in natural forests (see Introduction). Detailed observations of colour-ringed or radio-tagged birds are needed to determine their area requirements in different types of forest.

Occupation of the census areas by the Lesser Spotted Woodpecker was explained statistically only by the area of the three forest types. This species uses snags for nest excavation (Glutz von Blotzheim & Bauer 1980, Cramp 1985), but snag density did not enter the discriminant function. This could be explained by the hypothesis that the presence of the Lesser Spotted Woodpecker in an area is primarily determined by the availability of food during the winter season (i.e. landscape level), whereas selection of the nest-site is primarily determined by snag density (i.e. local or stand level). However, we do not know whether suitable nest-trees are a limiting resource in some areas or whether the occurrence is determined by the availability of winter food only.

The apparently negative association between mixed coniferous/deciduous woodland and occurrence of the Lesser Spotted Woodpecker is difficult to interpret. Within the occupied census areas also, the woodpecker avoided stands of mixed woodland (Olsson et al. 1992). One possibility is that, among the forest types in this study, mixed woodland is the one which is most affected by thinning and logging and because of

this contains less dead wood, which makes it less attractive to the Woodpecker. Mixed woodland had an intermediate density of snags (Olsson et al. 1992) and possibly offers enough snags for nesting. In that case, availability of food could be the limiting factor. Another explanation, which only applies at the landscape level, is that mixed woods are the result of forest management in woods with a previously higher proportion of deciduous trees. A large proportion of mixed woods in a census area could then indicate more intensive management, also extending to neighbouring woods of other forest types, i.e. it is not necessarily the presence of mixed woodland *per se* that is negative, but most woods in the census area might have deteriorated as Woodpecker habitats.

In central Europe the Lesser Spotted Woodpecker prefers unmanaged wet and nemoral woods (Wesolowski & Tomiałojc 1986, Spitznagel 1990). This study confirms the importance of riparian woods for the woodpecker. A reason for this might be that this type of forest provides ample food, since it is often left unmanaged (our own observation) with a resulting large amount of dead wood. Of the forest types in this study, riparian woods (and marsh woods) were found to have the highest density of snags (Olsson et al. 1992). Thus, the importance of riparian woodland could also be explained in terms of providing good nesting sites.

We found nemoral deciduous woods to be important for the occurrence of the Lesser Spotted Woodpecker, which might also be explained in terms of availability of food or nesting sites. Nemoral deciduous woodland was the forest type that had the lowest density of snags, but the oldest treestands (Olsson et al. 1992); 60% of these woods were over 75 years, but only 10–20% in the other forest types (Olsson et al. 1992). Old trees contain more dead wood (unpublished data) and because of this, the availability of food is possibly a more relevant factor for explaining the importance of nemoral woods than is the availability of snags for nesting.

The finding that nemoral deciduous forest is an important habitat for the Lesser Spotted Woodpecker may throw some light on the mechanisms behind the decrease of the species. As a result of logging, the area of nemoral deciduous forest has decreased markedly in Sweden, at least since the middle of this century (Naturvårdsverket 1982). Since 1960, the yearly decrease has been 1% (Naturvårdsverket 1982). In 1984 the decrease in area was brought under some control by the enactment of a new law, but the quality of the forests might still be affected by forestry. The changes in the nemoral deciduous forest are probably one important factor explaining the decline of the Lesser Spotted Woodpecker.

Acknowledgements. We are greatly indebted to all the amateur ornithologists who made this study possible and to the Swedish Ornithological Society which organised the survey. We are grateful to Raimo Virkkala, Hannu Pietiäinen, Esa Lehikoinen and the late Olli Järvinen for valuable comments on an earlier draft of this paper. We wish to thank Fredrik Schlyter for statistical advice. The project was supported financially by the World Wide Fund for Nature in Sweden, the Swedish Natural Science Research Council and the National Swedish Environment Protection Board.

Sammanfattning: **Förekomst av mindre hackspett i förhållande till lövskogsareal**

Vi har analyserat data från en inventering av mindre hackspetten som genomfördes av amatörornitologer under vårarna 1985 t. o. m. 1988. Totalt inventerades 152 provrutor om vardera 200 ha i Syd- och Mellansverige (Tabell 1). Andelen provrutor med observation av mindre hackspett ökade med arealen lövskog i rutorna, från 24% vid <17 ha lövskog till 80% vid >38 ha. Vi fann inget samband mellan latitud och arealkrav. Resultaten i Fig. 1 visar att mindre hackspettens arealkrav är större i brukade skogar än i naturskog. Mindre hackspett observerades minst en gång i 104 av de 152 rutorna. Vi fann att rutor med observation hade en större areal ädellövskog och en större areal strandskog än rutor utan observation (Tabell 4). Det omvände gällde för blandskog (Tabell 4). Areal av annan lövskog och lövkärr, täthet av högstubbar och skogens ålder skiljde sig inte mellan rutor med och utan observation. Arealen ädellövskog har minskat i Sverige under sista hälften av detta sekel till följd av skogsbruk. Detta är sannolikt en orsak till mindre hackspettens tillbakagång i landet.

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