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An experiment on nest site choice of the Common Treecreeper in fragmented boreal forest

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Experiments in the nest site choice of breeding birds in relation to the distance from habitat edge are missing or few. We performed such an experiment with the aid of nest-box -breeding Common Treecreepers *Certhia familiaris*. In their first choice of the breeding site, Treecreepers clearly favoured the boxes further away from the forest edge. In consequence, the number of successful breeding attempts was higher for the nests further away from the edge. There are two possible hypotheses to explain the results. First, the central place foraging theory predicts that a circular foraging range is optimal. The home range size of a breeding treecreeper pair is, on average, 3.3 ha, therefore, the nest of this species should be located at least 102 m from the forest edge in order to maintain a 3.3 ha circular foraging area. The results agree with this expectation, because in the first choice of nesting sites 65 per cent of the nests were further than 100 m from the edge. Secondly, nest predation often considerably reduces the breeding success of small passerine birds nesting nearby the forest edge. Treecreepers suffer high nest predation pressure, in particular when breeding in natural nest sites. If predation pressure is higher near the edge that may also contribute to the choice of a nest site further away from the forest edge.

1. Introduction

There are surprisingly few studies dealing with the reproductive success and nest-site choice of species in habitat fragments of different sizes (however, see Møller 1991) or at different distances from habitat edge. Most studies assume that the density of a species in different habitats reflects the quality of these habitats, but to be more strict one should assess the habitat quality in terms of reproductive success (van Horne 1983).

The boreal forest of Fennoscandia provides an excellent opportunity to assess these questions. It is heavily fragmented by modern forestry and there are several sedentary bird species that are found only in mature conifer or mixed forest. Our study species is the Common Treecreeper *Certhia familiaris*, a small hole-nesting passerine bird with a circumpolar distribution throughout the northern coniferous zone. With the aid of nest-boxes, we addressed the question of whether or not the nest-site choice and nesting success of this species depends on the distance from the habitat edge. Since the Treecreeper is a specialist of mature forests and has a large territory (Kuitunen 1989), we predicted that the

breeding pairs would prefer interior areas of stands for breeding over nest-sites nearer to the forest edge. This prediction was based on earlier results supposing the preference for interior forests over the margins in the Treecreepers (Kuitunen & Helle 1988).

2. Methods

The field work was conducted in southern Finland (Hauho, 61°10′N, 24°40′E) in 1988–1990. The study area was situated in the south boreal phytogeographical zone and comprises mainly (65%) commercially forested land (Kuitunen 1987, Kuitunen & Helle 1988). The landscape, in general, is patchy with a mosaic of clear-cuts and forest stands of different ages (10–100 ha). The mean rotation time in silvicultural stands is about 80 years; stands older than 200 years in natural conditions are rare. For the experiment on nest site choice, we selected mature (> 50 years) coniferous (Norway spruce *Picea abies* and Scots pine *Pinus sylvetris*) patches larger than 25 ha in size and bordered by a clear-cut or sapling stand (> 5 ha). Altogether 50 special nest boxes for Treecreepers (Kuitunen 1987) were used in ten lines running from the forest edge into the forest. One line was located in each patch, so the lines were independent of each other. We set the first box in each line ten meters from the forest edge and the other boxes at distances of 30, 80, 140, and 200 meters from the edge. The clear-cut edge was the nearest edge in every case and the minimum distance between two lines was 550 meters. Afterwards we checked the boxes for occupation and breeding success.

3. Results

During the three years 23 Treecreeper pairs bred in the boxes (1988, 4 pairs; 1989, 9 pairs; and 1990, 10 pairs). Each pair used, on an average, 2.1 (SD = 1.1, n = 23) boxes per year, either for some nest material only, or for the first breeding, renesting, or the second breeding attempt (Table 1).

Successful breeding attempts (producing at least one fledgling) were common; two in 1988 (50.0% of the breeding attempts, which included at least one egg), 13 in 1989 (81.3%), and eight in 1990 (53.3%).

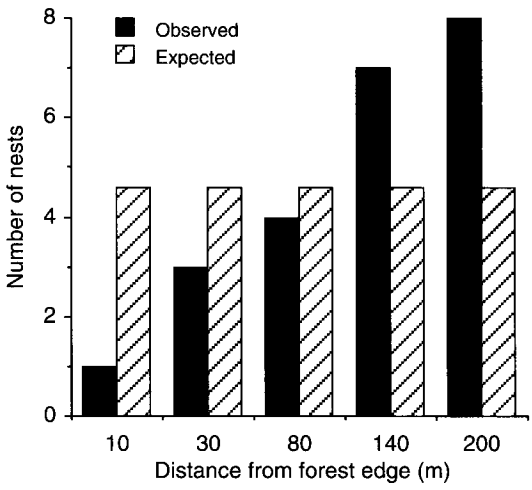

Fig. 1. Distance to the forest edge for the first nest sites chosen by the Common Treecreepers and the randomly expected distances without any preferences to any nest sites.

The first nest site (at least one egg laid in the nest) chosen by Treecreepers was significantly further away from the forest edge than randomly expected (Kolmogorov-Smirnov one-sample, $D = 0.3$, $n = 23$, $P < 0.05$; Fig. 1, Table 2). However, this analysis is based on three years data and we did not change the locations of the lines between the years. Therefore, the result could be explained by micro-habitat differences. In that case, the

Table 1. The number of nest boxes provided for and used by the Common Treecreeper during 1988–1990. Empty boxes indicate the number of totally unoccupied boxes. Occupied boxes indicate the number of boxes used for nest building, but later rejected. Eggs or chicks indicate the number of boxes that received at least one egg. Values in parentheses are percentages.

Year	Empty boxes	Occupied boxes	Eggs or chicks	Total
1988	43 (86.0)	3 (6.0)	4 (8.0)	50 (100.0)
1989	28 (56.0)	6 (12.0)	16 (32.0)	50 (100.0)
1990	30 (60.0)	5 (10.0)	15 (30.0)	50 (100.0)
Total	101	14	35	150

birds should choose the same boxes every year, because of the preferable micro-habitat. However, Treecreepers chose their breeding boxes during the three years' period, on average, further away from the forest edge in each of the lines than expected (expected = box number three; Wilcoxon signed rank test (two tailed), n = 9, P = 0.097).

In general there were more successful breeding attempts further away from the edge (Table 3). However, this depended on the first choice of nest site, since the distribution between the first chosen and succeeding nests did not differ significantly (Mann-Whitney U-test, U = 12, n_1, n_2 = 5, P = 1.0).

4. Discussion

In their first choice of the breeding site, Treecreepers clearly favoured the boxes further away from the forest edge. This result agrees well with the proposed hypothesis, which was based on earlier census results. Two Finnish studies have reported a nearly significant preference for interior forest over the margins (Kuitunen & Helle 1988 and references there in), whereas a Swedish study (Hansson 1983) did not show any significant preference. The results from the population studies (Kuitunen & Helle 1988, Kuitunen 1987 and 1989, and Kuitunen & Suhonen 1991) suggested that Treecreepers use the forest interior rather than margin areas for breeding.

There are two possible reasons for the result. Firstly, the area of the home range size in a breeding pair is, on average, 3.3 ha in the study area (Kuitunen 1989, and J. Suhonen & M. Kuitunen, unpubl.), which is a relatively large home range for a bird species of this size. Treecreepers forage only on tree trunks and hence the suitable foraging sites are available only on a small part of the whole territory. According to the optimal foraging and central place foraging theory (e.g. Stephens & Krebs 1986) parents should minimize the distance to all the trunks in the territory. In that case, the nest of this species should be located at least 102 m from the forest edge in order to maintain a circular foraging area of 3.3 ha. The results agree well with this expectation, because 65.2% of the first nesting sites were further than 100 m from the edge. The preference of forest edge in some other species is probably based on the increased amount of food near the edge. Treecreepers mostly feed their nestlings on spiders (Kuitunen 1989). Helle & Muona (1985) found also the food source to increase in abundance near the forest edge. This may partly counteract the benefit of chosen nest sites farther from the edge. However, if food availability per trunk varies in relation to the distance to the edge, the above expectation is not strictly true.

Secondly, it has been suggested that predation affects the structure of the bird assemblage in fragmented environments. The importance of high predation pressure nearby the forest edge has been especially emphasized (Andren et al. 1985, Angelstam 1986, Andren & Angelstam 1988, Martin 1988, Møller 1989a). Angelstam (1986) specifies especially that the steepness of productivity gradients between an habitat island and the surrounding matrix is an important factor affecting the predation rate. Kuitunen & Helle

Table 2. The first nest site choice in the Common Treecreeper in relation to distance from the forest edge.

Distance to edge(m)	1988	1989	1990	Total (%)
10	–	1	–	1 (4.3)
30	1	1	1	3 (13.0)
80	–	1	3	4 (17.4)
140	1	2	4	7 (30.4)
200	2	4	2	8 (34.8)
Total	4 (17.4)	9 (39.1)	10 (43.5)	23 (100.0)

Table 3. The successful breeding attempts in the Common Treecreeper in different years in relation to the distance from the forest edge.

Distance from edge (m)	1988	1989	1990	Total (%)
10	–	2	–	2 (8.7)
30	1	2	1	4 (17.4)
80	1	1	1	3 (13.0)
140	–	4	3	7 (30.4)
200	–	4	3	7 (30.4)
Total	2	13	8	23 (100.0)

(1988) found a slight, though insignificant, decrease in the breeding success of Treecreepers near the forest edge because of predation. Nest predation often reduces the breeding success of small passerine birds considerably. This is especially true for open-nesting species, but also for hole-nesting species breeding in natural holes (e.g. Alatalo et al. 1991). Bias in the results obtained from nest-box studies, especially in relation to the importance of nest predation, has often been neglected (Mller 1989b). In Treecreepers, Kuitunen (1987) found that nest predation caused total failure in less than 10% of the breeding attempts in nest boxes in southern Finland. However, nearly 40% breeding failure due to nest predators, mostly mustelids, occurred in a study of natural holes (Kuitunen & Aleknonis 1992). In the British Isles, breeding failure is intermediate (about 30%, Flegg 1973), probably because the data have been collected from the nest card records based both on nest boxes and natural holes. Moreover, the home range size is probably less than 3.3. ha in the British isles, because of the differences between biotops. This might mean a shorter distance to the edge in Britain compared to Finland, and accordingly, differences in predation rate. Increased predation pressure near the edge also could favour choice of a nest site further away from the forest edge.

In conclusion, it seems that the need to minimize the distance to a large number of tree trunks may be a sufficient explanation for avoidance of edges. Additionally, if predation pressure is higher nearer the edges, that may also contribute to the avoidance of edges.

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Selostus: **Pesäpaikan valinta pirstoutuneessa ympäristössä puukiipijällä**

Ympäristön pirstoutuneisuutta ja sen merkitystä erityisesti eläinyhteisöjen rakenteisiin on tutkittu viime vuosina runsaasti. Sen sijaan tutkimukset ja erityisesti kokeet, joissa olisi tarkasteltu populaatio- tai yksilötason ongelmia ovat jääneet vähäisiksi. Esimerkiksi lintujen pesäpaikan valintaa suhteessa saarekkeen reunaan tai kokoon on tutkittu varsin vähän. Me toteutimme valintakokeen, jossa tarjosimme puukiipijäpareille mahdollisuuden valita pesäpaikkansa viidestä hakkuuaukon reunaan nähden eri etäisyyksillä sijainneesta pöntöstä. Pönttöjä oli kussakin linjassa viisi kappaletta ja ne sijaitsivat 10, 30, 80, 140 ja 200 m:n etäisyydellä aukon reunasta. Kokeen toteutimme eteläsuomalaisessa sekahavumetsässä, joka oli pirstoutunut metsähoitotoimenpiteiden seurauksena erikokoisiin metsäpirstaleisiin. Tutkimuksessa käytimme saarekkeita, jotka olivat halkaisijaltaan vähintään 400 m laajuisia ja käsittivät tasalaatuista vanhahkoa metsää.

Valitessaan ensimmäistä pesintäpaikkaansa puukiipijäparit suosivat selvästi etäämmällä reunasta sijainneita pesäpönttöjä. Tämä voi puukiipijän osalta johtua kahdesta eri syystä: 1) Optimisaalistusteoria ennustaa, että emojen liikkuma-ala pesäpaikan ympärillä tulisi olla pyöreä. Tällöin puukiipijäemojen pitäisi valita pesäpönttö vähintään 102 m etäisyydeltä aukon reunasta, jotta niiden keskimääräiseksi havaittu liikkuma-ala (3.3 ha) toteutuisi. Saatujen tulosten mukaan 65% puukiipijäemoista valitsi ensimmäisen pesäpaikkansa kauempaa kuin 100 metriä aukon reunasta. 2) Pesäpredaation on todettu vähentävän varpuslintujen pesintämenestystä reunan läheisyydessä. Koska puukiipijät kärsivät pesäpredaatiosta varsin voimakkaasti erityisesti pesiessään luonnonkoloissa, olisi niiden edun mukaista pesiä etäämmällä reunasta, kuten ne myös tekivät.

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