Ornis Fennica 71:72–74. 1994

Foraging area and feeding frequency of the Crested Tit *Parus cristatus* during the nestling period

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Reveived 9 September 1993, accepted 19 October 1993

Introduction

During the non-breeding season, the sedentary Crested Tits *Parus cristatus* and Willow Tits *Parus montanus* establish small social groups consisting of a stable and limited number of individuals that defend a common territory (Ekman 1979, Ekman et al. 1981). Breeding occurs within this territory and the partners orginate mostly from the same social group or from a neighbouring group (Ekman 1979). However, the Crested Tit does not seem to have any clearly defined breeding territory, but rather a utilized area connected to the breeding season (Deadman 1973).

In 1990 and 1991, Crested Tits occupied the same nest box in my study area. In this paper, I report the foraging area and the feeding frequency in the beginning, middle and the end of the nestling period.

Study area and methods

The study area is located in Nummi-Pusula, southwest Finland (60°26′N, 23°56′E). The forest is predominantly coniferous, consisting mainly of spruces *Picea abies* (15–25 m in height) with spread birches *Betula* sp. (< 10 m), alders *Alnus incana* (< 10 m) and old pines *Pinus sylvestris* (about 25 m). The study area is part of a larger uniform coniferous forest (about 0.75 km^2) inhabited by 3 breeding pairs of Crested Tits in 1990 and 2 in 1991.

In 1990, the first egg was laid on 8 April and in 1991, on 9 April. Clutch sizes were 5 and 6. In both years all eggs were viable and produced a fledged youngster.

All observations of food collecting Crested Tits were marked on a map (1:2250). No birds were ringed but it was assumed that food collecting individuals in the vicinity of the nest box were its owners. The birds are easily found during the nestling period, especially during the latter half when a typical buzzing call revealed the food searchers. Some observations were made from a blind, but most of the observations were done by walking through the area. Only observations of food collecters that could be observed until they flew back in the direction of the nest were included. In 1990, observations were done when the nestlings were 2, 9, and 16 days old; and in 1991, when they were 3, 7, 16, and 20 days old. Each day the first 3–4 hours after sunrise were used to determine the feeding frequency and the time one bird (presumably the female) spent in the nest. The rest of the day (5–9h) were used for area determinations.

Results

In both years, the foraging area increased during the nestling period (Fig. 1, Table 1). The birds were never seen foraging nearer than 15 m or more than 250 m from the nest. The tits travelled from tree to tree getting further away from the nest, but returned usually straight to it. The birds

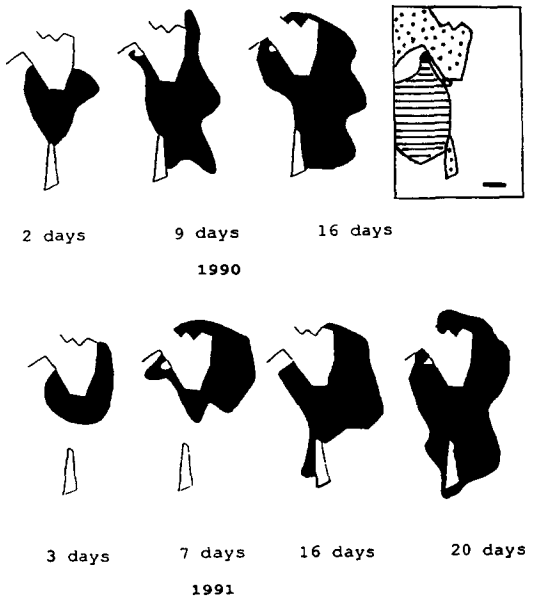

Fig 1. Area used for food collecting in different stages of the nestling period in 1990 and 1991. The age of the nestlings is given below each map. Boxed map: dotted area = field, lines = young forest, dark = clear cutted forest, white = old forest, open circle = nest box. The bar corresponds to 50 m.

frequently returned to the same location where the previous food collecting had occurred. However, this was never observed more than 3 times in succession. No preferred locations inside the utilized area could be observed.

Spruces were by far the most used source for food, but the searching behaviour depended clearly on the weather conditions. During sunny weather the birds usually foraged along sunny forest edges or in the upper part of spruces where the sun was warming, probably due to higher activity of invertebrates in these regions. On the other hand, in rainy conditions most of the foraging occurred in lower parts of the trees and on the ground.

In 1990, the feeding frequency increased as the nestling period progressed (Table 1). The increase was not obvious in 1991. Both parents fed the nestlings. There were no clear differences in the time, presumably the female, spend in the nest during the three morning hours following the first feeding for each day.

Discussion

The area used during different breeding stages has been studied for several small passerines (e.g. Stefanski 1967, Yarrow 1970, Tryon & MacLean 1980), but none of these reports discuss in detail the area utilization in different stages of the nestling period. In this study the Crested Tits enlarged their foraging area as the nestlings grew older. There were no preferred locations inside the used area, but the enlargement of the area was clearly concentrated in the old spruce forest. This is in good agreement with the known habitat preference of this species (Durango 1945, Ekman 1979, Raivio & Haila 1990).

The foraging area was as large as 3.6 ha. Kuitunen (1989) has calculated that a pair of the

Table 1. Foraging area (ha) of the Crested Tits and the hourly feeding rate (feedings per hour), hourly feeding rate per nestling, and brooding time as a percentage of the first 3 morning hours in relation to nestling age in 1990 and 1991. In 1990 no observations were done at nestling age 20 days. N = Number of observations that has been used in the area determination, Obs. hours = Time used for area determinations.

Year:	1990	1991	1990	1991	1990	1991	1991
Age (days)	2	3	9	7	16	16	20
Area (ha)	1.1	1.1	2.2	1.4	3.2	2.5	3.6
N	35	28	42	49	40	35	69
Obs. hours	7.5	7	5	8	5	7	9
Feeding rate	13.0	8.95	17.1	11.2	25.7	11.5	16.5
Feeding rate per nestling	2.6	1.5	3.4	1.9	5.1	1.9	2.8
Brooding time (%)	59	67	12	31	< 5	< 5	0

Common Treecreeper *Certhia familiaris* needs in average an area of 4.7 ha for their own food needs and for feeding the nestlings, in coniferous forests of southern Finland. Both the Common Treecreeper and the Crested Tit are early breeders (v. Haartman 1969), prefer old coniferous forests (Raivio & Haila 1990), and have roughly the same energy requirement. However, the foraging microhabitat of the Common Treecreeper is limited to the tree trunks, but is much wider for the Crested Tit. It is therefore likely that the Crested Tit does not need as large foraging area as the Common Treecreeper in the same habitat.

The study was done by visual observations, which do not exclude the possibilities that the birds moved outside the observed foraging area for other reasons. If so, it occured probably infrequently, because the activity of both female and male Crested Tits are, during the nestling period, mainly concentrated on the feeding and care of the nestlings (Durango 1945).

At least during the spring of 1990, the feeding frequency increased steadily as the nestling period progressed. A similar increase has also been reported for other members of the tit family (Laskey 1957, Gibb & Betts 1963). No clear correlation between the size of foraging area and the feeding frequency could be observed.

Acknowledgements. The author highly appreciates the criticisms and suggestions made by Prof. Lars von Haartman, Kari Heliövaara, Antero Järvinen, Markku Orell, and Hannu Pietiäinen.

Sammandrag: **Utnyttjad areal för födosökning samt matningsfrekvensen under boungstiden hos tofsmesen *Parus cristatus***

I denna studie undersöktes storleken på det område som ett par av tofsmesen *Parus cristatus* utnyttjade under boungstiden 1990 och 1991. Häckningen skedde bägge vårar i samma holk och med likartad tidschema. Storleken på det utnyttjade skogsområdet ökade då boungsperioden framskred och varierade från 1.1 ha i början till 3.6 ha i slutet av perioden (Fig. 1, Tabell 1). 1990 ökade matningsfrekvensen med ungarnas ålder och varierade mellan 13.0 matningar/timme i början av boungstiden och 25.7 i slutet (Tabell 1). En sådan ökning var ej lika uppenbar 1991. Ungarnas antal var 1990 5 och 1991 6. Samtliga ungar blev flygfärdiga. Inget tydligt samband mellan intensivare matningsfrekvens och större utnyttjad areal kunde noteras.

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