Spatial distribution of a Tree Pipit *Anthus trivialis* population from Łagiewnicki Forest (Łódź – Central Poland)

JACEK J. NOWAKOWSKI

Department of Ecology and Environmental Protection, Warmia & Masuria University,
10-561 Olsztyn, Żołnierska 14, Poland, e-mail: jacekn@matman.wsp.olsztyn.pl

Abstract - Spatial distribution of a population the Tree Pipit *Anthus trivialis* in Łagiewnicki Forest, a wooded area close to Łódź city interested by increasing urbanization was studied. Nearest neighbour distances, population density, "mean crowding" and distribution of territories in relation to the edge of forest were analysed. Population density at the town edge was four times lower than that at cultivated fields edge. Frequency distribution of square roots of the nearest neighbour distances was positively and significantly skewed ($\alpha_3 = 0.81$), suggesting a clumped distribution. The centres of singing males territories of were on average 260 m apart. The distances between the territories and the forest edge bordering cultivated fields were positively skewed ($\alpha_3 = 0.85$), whilst the distances between territories and the town edge were significantly and negatively skewed ($\alpha_3 = -0.42$).

Birds of European towns have been extensively studied to date (Luniak 1977, Bezzel 1979, 1982, Luniak and Glażewska 1983, Dinetti 1994), most studies describing quantitatively and qualitatively bird communities and focusing on habitat selection. Changes in urban and suburban birds populations and communities proved to be related to urbanisation in many cases, and the inurbation of many species has been described (Tomiałojć 1970, Nuorteva 1971, Batten 1972, Luniak 1983, Nowakowski 1996).

Including natural or semi-natural wooded areas in towns boundaries can cause animal populations inhabiting these areas to undergo different selective pressures, thus changes in population structure, biological cycles or behavioral strategies are expected.

Ground-nesting birds were poorly studied in urban habitats. The Tree Pipit *Anthus trivialis* is a typical ground-nesting and ground-feeding bird, it most often inhabits the ecotonal zone between open landscape habitats, such as heathland/grassland in earlier stages of tree colonization, and tree stands or woods (mainly oak, ash and pine) (Ptushenko and Inozemtsev 1968, Cramp 1988).

In this paper changes in spatial distribution of population of Tree Pipit were studied within the Łagiewnicki Forest – a urban wooded area of Łódź, interested by increasing urbanisation.

Łagiewnicki Forest is located in the northern part of the Łódź city, it belongs to large municipal forest complex of 1,300 hectares. Pine-deciduous stand, mixed forest and pine-birch forest prevail in the forest area (92,5%). *Quercus robur* and *Quercus sessilis* form pure oak stand or mixed woods with *Carpinus betulus*, *Betula verrucosa* and *Pinus silvestris*.

The southern and western forest edges at town boundaries are composed by meadows, wastelands, and many building. Eleven minor roads (total length ca. 5,700 m) and houses cross the southern area (Arturówek). It is a recreation site, up to 10,000 persons can visit it in a week-end (Wojciechowski 1977). The northern and eastern edges faces cultivated fields and people rarely visit it.

In the Łagiewnicki Forest (Map 1) were distinguished two area with respect to the rate of progressing building works and intensified penetration of the biotope by man:

A – south-western area, at the town edge (750 ha, high urbanisation levels and increasing biotope penetration by man),

B – north-eastern area, at the cultivated fields edge (550 ha, the wildest part).

Observations of the Tree Pipit were carried out according to the improved mapping method (Tomiałojć 1980). Counts were carried out 9 times between the 12th June and 9th July 1980 in the morning and in the evening, when the singing activity of males was highest. Stations of singing males were mapped paying particular attention to contemporary records and alarm calling birds. Territory size was
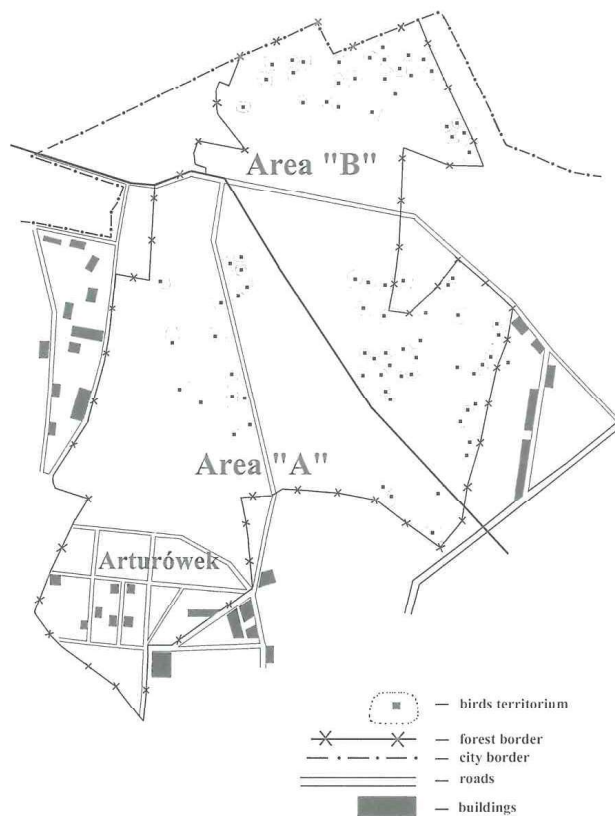
Map 1

estimated on the basis of the "minimum area method" (Dalke and Sime 1938).

The number of breeding pairs, population density, distribution of mean distances between individuals and the distances among territories and forest edge of sites A and B were compared respectively.

Mean population density of the entire forest was estimated according to (1) standard methods and (2) the method of Dice (Dice 1952)

$$P = 1.55/s^2$$

where: P – density; s – average distance between territorial centres.

The type of spatial structure of population was characterised by using the Dice's method (Dice 1952). Distances between the centres of male territories and their nearest neighbours were used to calculate a values of skewness measure (α_3) of territories distribution, given by the above formula

$$\alpha_3 = \frac{\mu_3}{s^3}$$

where:

$$\mu_3 = \frac{1}{N} \sum (x_i - \overline{x})^3$$

where: N – number of distances measured, x_i – distance, $\overline{x}$ – mean distance, s – standard deviation.

The distribution of square roots for the measured distances among neighbours and the values of its skewness measure can infer the type of population distribution.

The "mean crowding" of an area was calculated by Lloyd method, which can calculates the number of neighbours each territorial bird has (Lloyd 1967).

Distribution of Tree Pipit territories in relation to the edge of the wooded area was also analysed. Along the forest perimeter 53 markings (every 500 m) were places; the distances between the markings and the central point of territories were than measured.

In the whole forest, 83 pairs of Tree Pipits were found, i.e. 0.6 pairs/10 ha (standard method). Population density differed in areas A and B of Łagiewnicki Forest. In area A (adjoining the city) observed density was 0.3 pairs/10ha, four times lower than that of area B (at the rural edge) (1,2 pairs/10ha).

The population density estimated with Dice method (P) was higher than that reported above: on average 1.7 pairs/10 ha for the whole forest, 1.3 pairs/10 ha for the area A and 1.9 pairs/10 ha for the area B.

Frequency distribution of square roots of distances between central points of birds territories were significantly and positively skewed ($\alpha_3 = 0.81$), thus territories were clearly clustered (Fig. 1). The centres of the territories of singing males were about 260 m apart and their area averaged ca. 5,000 m^2. The bird territories in the forest were irregularly distributed and clumped in area B (81.1% of stations). In this area the territory of each male was surrounded by 4.1 territories of neighbours, whilst in area A each bird had only 1.6 territories of neighbours ("mean crowding" method).

Distributions of territories distances from the forest edge are different in two part of the Łagiewnicki Forest (Fig. 2). Territories of area B were about 280 m apart from forest edge and its distribution were positively skewed ($\alpha_3 = 0.85$), that of area A about 850 m and the distributions of these distances were negatively skewed ($\alpha_3 = -0.42$).

The observed concentration of the Tree Pipit population in the Łagiewnicki Forest is comparable to the density of this species in similar forest habitats throughout Europe (Tomiałojć 1974, Klafs and Stubs 1977, Piotrowska and Wolk 1983, Tomialojć et al. 1984, Flade 1994). Noticeably higher concentrations were found only in pine forests, ranging from 4.9 to 6.5 pairs/10 ha (Mrugasiewicz 1974, Ranoszek and Witkowski 1975, Grabiński and Stawarczyk 1986). On the basis of previous studies and of the results of this study it can be argued that population density and distribution of this species strictly depend on habitat.
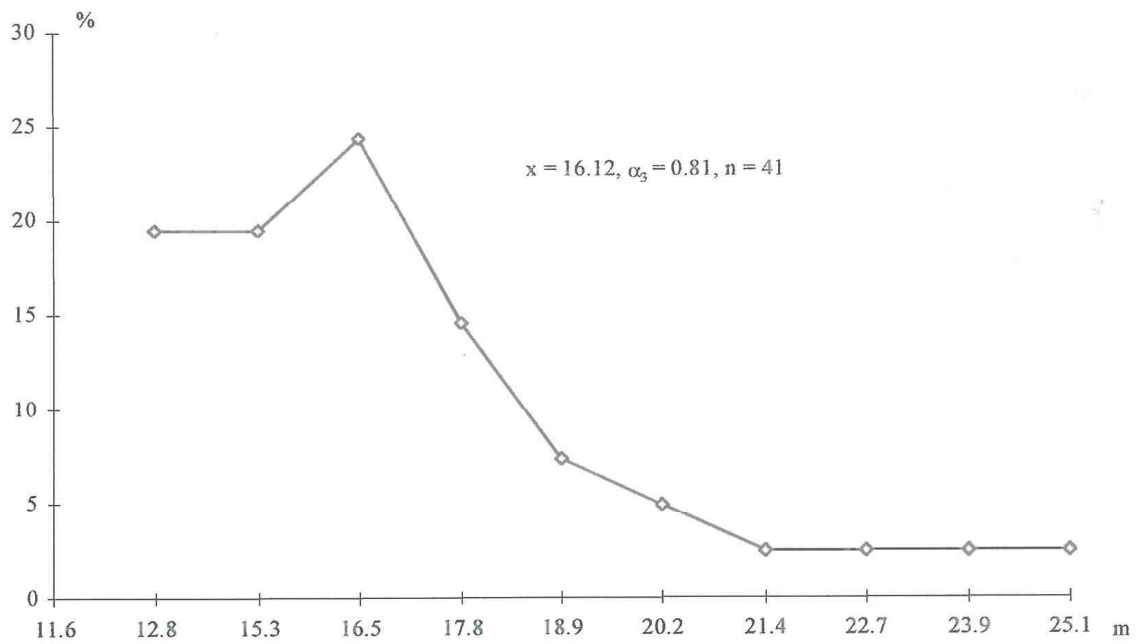
Fig. 1. The distribution of frequencies squares roots of distances between central points of neighbour territories in Tree Pipit population.
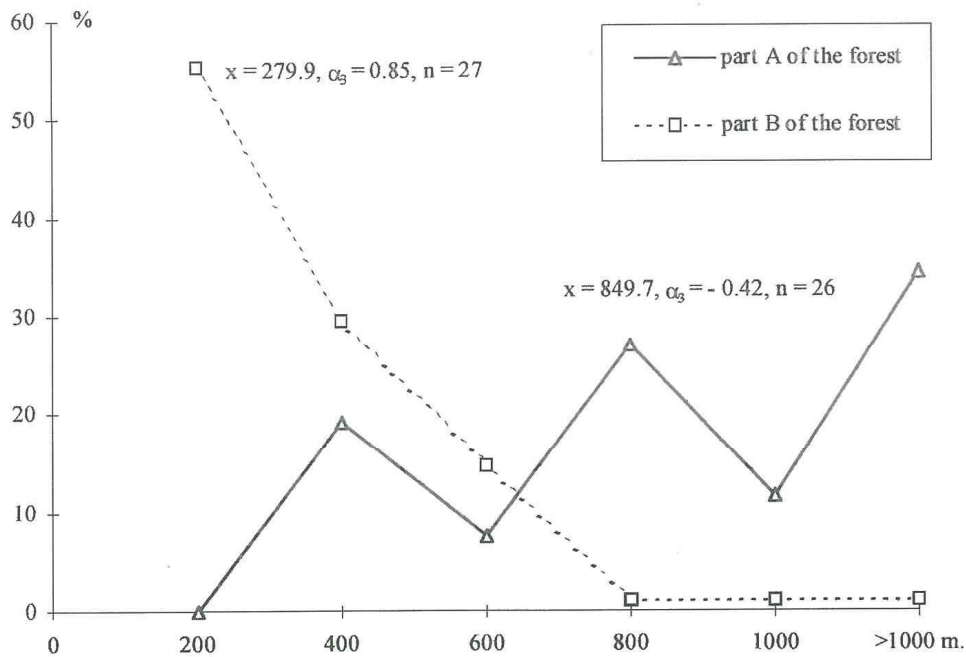

Fig. 2. The distribution of frequencies distance between marking points on the forest edge and the central points of male territories.

Population density at the forest edge furthest from the town is considerably higher (1.2 pairs/10 ha) than in the part adjoining the city (0.3 pairs/10 ha). The observed differences are probably caused by man-related activities in area A and progressing development of building grounds, which potentially disturb birds and may significantly changing spatial structure of population. Birds avoided the forest area at the town edge, assembled in part B but also inhabited the deepest forest (apparently unsuitable habitat of this species).

The population density estimated by the Dice method was considerably higher, especially in area A; this

results might be related to the pattern of individual distribution of this species and seems as a clumped type of population distribution. The distribution of territories and distances between territories neighbouring pairs confirmed the results obtained by Dement´ev and Gladkov, Inozemtsev, Kovshar, Lehmann and Van Hecke (reported in Cramp 1988). Also, territory sizes estimated in this study was similar to values reported by Cramp (1988).

The "mean crowding" of area B was relatively high, and the territories were frequently close to each other, which is rather uncommon in natural habitats (Ptushenko and Inozemtsev 1968). Populations of the Tree Pipit in the nearby forests of Wiączyń and Szczawin, located beyond the city and rarely exposed to human pressure, is not also relatively clumped (Nowakowski – unpublished data, Wojciechowski – unpublished data). In the years seventieth the Tree Pipit was a common species in the Łagiewnicki Forest (Wojciechowski - unpublished data), but at present it almost exclusively inhabits wild habitats futherst from town (Arturówek, Letniska sites).

This study confirms that human impact and presence can to be detrimental for birds populations, especially ground-nesting ones (Luniak 1983).

Refferences

Batten L.A., 1972. Breeding bird species diversity in relation to increasing urbanisation. Bird Study 19: 157-166.

Bezzel E., 1979. Allgemeine Veränderungstendendenzen in der Avifauna der mitteleuropäischen Kulturlandschaft. Vogelwelt 10: 8-23.

Bezzel E., 1982. Vögel in der Kulturlandschaft. Verlag Eugen Ulmer Stuttgart.

Cramp S., 1988 (ed.). Handbook of the Birds of Europe the Middle East and North Africa. The Birds of the Western Palearctic. Vol. 5 Tyrant Flycatcher to Thrushes. Oxford University Press, New York.

Dalke P.D. and Sime P.R., 1938. Home and seasonal ranges of the Eastern Cottontail in Connecticut. Trans N. Am. Wildl. Conf. 3: 659-669.

Dice L.R., 1952. Measure of spacing between individuals within a population. Centr. Lab. Vert. Biol., Univ. Mich. 55: 1-23.

Dinetti M., 1994. The urban ornithology in Italy. Memorabilia Zool. 49: 269-281.

Flade M., 1994. Die Brutvogelgemeinschaften Mittel- und Norddeutschlands. Grundlagen für den Gebrauch vogelkundlicher Daten in der Landschaftsplanung. IHW-Verlag.

Grabiński W. and Stawarczyk T., 1986. [Birds of south-western part of Lower Silesia Forests in breeding season]. Ptaki Śląska 4: 40-68 /in Polish/.

Klafs G. and Stubs J., 1977. Die Vogelwelt Mecklemburgs. Jena.

Lloyd M., 1967. Mean crowding. J. Anim. Ecol. 36: 1-30.

Luniak M., 1977. [Studies on birds of Polish towns]. Wiad. ekol. 23: 399-406 /in Polish/.

Luniak M., 1983. The avifauna of urban green areas in Poland and possibilities of managing it. Acta orn. 19: 3-61.

Luniak M. and Glażewska E., 1983. [Birds of urban areas in Poland – a review of studies]. Not. orn. 28: 3-15 /in Polish/.

Mrugasiewicz A., 1974. [Quantitative study on breeding avifauna of forest in Milicz district]. Acta Univ. Wratislaviensis 223, Prace zool. 6: 15-35 /in Polish/.

Nowakowski J.J., 1996. Changes in the breeding avifauna of Olsztyn (NE Poland) in the years 1968-1993. Acta orn. 31: 39-44.

Nuorteva P., 1971. The synantropy of birds as an expression of the ecological cycle disorder caused by urbanisation. Ann. zool. fenn. 8: 547-553.

Ptushenko E.S. and Inozemtsev A.A., 1968. Biologija i chozjajstvennoje znacenije ptic Moscowskoj oblasti i sopredel´nych territorij. Moscow.

Piotrowska M. and Wołk K., 1983. Breeding avifauna in coniferous forest of the Bialowieża Primeval Forest. Acta orn. 19: 81-95.

Ranoszek E. and Witkowski J., 1975. [Breeding birds of pine forest in Barycz valley: an investigation of the relationship between the results taken by use of two mapping methods in relation to breeding population.] Acta Univ. Wratislaviensis 301, Prace zool. 7: 69-83 /in Polish/.

Tomiałojć L., 1970. Quantitative studies on the synantropic avifauna of Legnica and its environs. Acta orn. 12: 293-392.

Tomiałojć L., 1974. The quantitative analysis of the breeding and winter avifauna of the forests in the victinity of Legnica (Lower Silesia). Acta orn. 14: 59-91.

Tomiałojć L., 1980. The combined versi0on of the mapping method. In: Oelke H. (ed.) Prov. VI Int. Conf. Bird Census Work, Gottingen: 92-106.

Tomiałojć L., Wesolowski T. and Walankiewicz W. 1984. Breeding bird community of a primeval temperate forest (Bialowieża National Park). Acta orn. 20: 241-310.

Wojciechowski Z., 1977. [Observations on birds of prey in Łagiewnicki forest near Łódź]. Not. orn. 12:37-63 /in Polish/.