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Thesis of PhD dissertation

AUTUMN MIGRATION OF TITS (PARIDAE) IN HUNGARY BASED ON BIRD RINGING DATA

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Introduction

Different populations of tits (Paridae) are dominant members of the coexistence relationships of forest ecosystems, which, outside the breeding season, participate in the biocoenoses of habitats with different geographical locations and vegetation structures in different numbers, age and sex ratios and durations, depending on their dispersal and migration intensity. The aim of the present study is to identify the long-term and national-scale spatial and temporal patterns of the partial migration of the species under study and their possible causes.

Our ornithological handbooks have previously described the tits as resident or vagrant birds, while the chapters of the Hungarian Bird Migration Atlas describing individual species focus mainly on individuals with foreign and/or long-distance recoveries. Systematic analyses of the large amount of ringing data has not yet been achieved for many species. This dissertation is an attempt for a nationwide survey of the migration of all species of tits occurring in Hungary, based mainly on data from Hungarian bird ringing stations.

Aims

The aim of the research was to answer the following questions:
How does the annual capture of the domestic species of tits change in the post-breeding period in the study areas?
How does the timing of the autumn migration tits evolve in the study areas?
What is the migratory strategy of the species of tits studied?
Is there a difference in the age class composition of Coal Tits captured in western and north-eastern Hungary?
Are there differences in the morphological characteristics of Coal Tits banded in years with low and high captures and in different periods of autumn migration?
Is there a difference in age and sex ratios and morphological characteristics of Eurasian Blue Tits captured in western and north-eastern Hungary?
My hypotheses concerning these questions are:

1. there is no difference in the temporal pattern of annual catches of the studied species of Eurasian Blue Tits in Hungary.
2. The migration strategy of the studied species is characterised by mixed partial migration.
3. There is no difference in the age class composition of the Coal Tits captured in western and north-eastern Hungary.
4. There is no difference in the morphological characteristics of Coal Tits captured in years of low and high catches and in different periods of autumn migration.
5. There is no difference in age and sex ratios of Eurasian Blue Tits captured in western and north-eastern Hungary.
6. There is no difference in morphological characteristics between Eurasian Blue Tits captured in western and north-eastern Hungary.

Material and method

The study analysed ringing data of six Hungarian bird ringing stations (Fenékpuszta, Izsák, Ócsa, Sumony, Szalonna, Tömörd) for the species of tits (Paridae) occurring in Hungary between 2004 and 2017, from 20 August to 24 October each year.
Each year, birds were captured using mistnets set up at a fixed location. Each captured bird was fitted with an individually numbered metal ring. The species, age and, where possible,

sex of the captured birds were determined. The body weight, wing length and 3rd primary length of the ringed birds were measured and their condition estimated.

The total ringing period varied between ringing sites in each year, so only data from birds captured between 20 August and 24 October were used uniformly in the comparative statistical analyses to answer the questions. The number of nets used for captures differed between ringing sites, so the number of birds captured per year and per day was corrected by averaging the number of birds per net. For each species, we calculated the fluctuation index (FI) to characterise the magnitude of the annual variation in numbers between 2004 and 2017. We compared the distribution of corrected annual captures at bird ringing sites and the magnitude and direction of the relationship between the corrected annual catches at each site. Non-parametric tests were applied to the calculated daily catch values for each year at the study sites because daily catches deviated from the normal distribution. Cluster analysis was used to compare the dynamics of autumn migration (time trend in corrected daily catch) at the study sites.
To characterise the daily activity of Col Tits in Tömörd and Szalonna, we calculated the dispersal coefficients for the temporal and spatial distribution of birds.
The mean of body weight, fat reserve and wing length of the age and sex groups of Eurasian Blue Tits were analysed by multivariate analysis of variance in two study areas (Szalonna and Tömörd), and age and sex groups of captured birds were compared by principal component analysis based on their biometric characteristics.

Results and conclusions

The distribution of the total adjusted annual captures of Cole Tits at the ringing stations differs significantly from the normal distribution.
The averages of the corrected captures of Szalonna and Tömörd are significantly higher than the averages of all other stations, with the peak captures in September. In both 2010 and 2012, the amount of fat reserve of the birds examined increased gradually from August to November, with birds in August being significantly leaner than those caught later, and the highest condition score being shown by birds weighed in late October and early November in both years. No significant differences in body weight were found between birds observed in different years.
The value of the fluctuation index (FI), which indicates the variation in the number of individuals of the species, is typical of the irruptive species, and the fluctuations in the number of individuals per year cannot be explained by population trends alone.

The majority of the Cole Tits captured during the study period were first year birds.This proportion is similar than the the distribution found in the literature for irruptive movements.
The majority of birds were captured at a few mistnet sites in the heterogeneous grassland, but the spatial pattern of Coal Tits migration cannot be described by the pattern of capture location alone, but rather as a result of the trappability of the species. Morphological features show a normal distribution and are closely related.
The highest capture probability of the Crested Tit occurs during dispersal, at a short distance from breeding sites. The Crested Tit is the species with the lowest migratory tendency in Hungary.
The Willow is a species with a low migration tendency, moving at a short distance from the breeding sites.
There is little variation in the captures of the Marsh Tit, with a fluctuation index close to that of non-migratory species. Within the total captures, the importance of Szalonna is outstanding. The peak of captures is in mid-September.

As a result of our present study with a national perspective, it can be concluded that the fluctuations in the number of individuals at the different ringing stations in each year are not reflected in the overall results. In the overall fluctuation index, the locally observed outliers in captures are somewhat blurred and, as in the case of obligate migrants, mainly indicate population dynamics in the background. Juveniles and females are predominantly migrating, with a similar proportion of juveniles (first-year birds) in the autumn migration period in Tömördön and Szalonna (>85%). The peak of migration is in October. Particularly high capture rates are recorded in some years at stations with excluively reedbed habitat (Izsák, Fenékpuszta). Captures here are concentrated in time and space in years characterized with high capture rates, the majority of birds were ringed on a few days with high numbers.

Each year, a significant number of Great Tits were ringed at the stations, but captures are generally in lower numbers than Blue Tit. Considering its significantly larger breeding population, this suggests a lower propensity to migrate, which is confirmed by the lower value of fluctuation index. The annual variation in captures at each study site is less reflected in the national aggregate results than for the Blue Tits, and even more evenly distributed. This also means that we cannot generalize the national results from the data of a single station. The migration peaks are in October, similar to the Blue Tit but different from the Coal Tit, which has shown previous peaks. Some individuals of Great Tit remain close to the breeding area, others move to smaller or larger distances, so the Great Tit is also a facultative partial migrant in Hungary.

Theses

1. The temporal patterns of annual captures of the studied species of tits show both significant differences and similarities in Hungary. The year of the highest captures of the Coal Tit coincides with the annual capture peak of the Great Tit and MarshTit (2012). The years of highest capture of the Blue Tit (2004, 2010) do not coincide with the years of annual capture peaks of the other tit species. The annual capture peak of the Coal Tit is in September, which is different from the October migration peak of Blue Tit and Great Tit, but similar to that of Marsh.

2. Based on the capture dynamics of local and migratory birds, all domestic nesting species of tits are facultative partial migrants, but with different migration disposition.
- Coal Tit: Irruptive migrant in Hungary, with the autumn migration in autumn in years with high numbers of birds captured concentrated in western Hungary.
- Blue Tit: On countrywide scale, its locally irruptive captures are blurred and vary similarly to those of obligate migrants. The high capture rates in some years of stations operating exclusively in reedbed habitat (Izsák, Fenékpuszta) are outstanding. The catpcures here are concentrated in time and space in high capture years, with the majority of birds ringed on a few days with high numbers.
- great Tit: Despite high numbers of individuals, the variation in annual captures is lower than that of the Blue Tit, with a lower fluctuation index. Considering its significantly larger breeding population, this indicates a lower migration propensity. The annual number of national ringings reflects the reproductive success in a given year, not the change in the number of migrants.
- Marsh Tit: The cumulative fluctuation index, which indicates the change in the number of capured birds, is close to that of the permanent non-migratory species. Within the total captures, the importance of Szalonna is prominent, which is consistent with the population

trends in the northeast Hungary. The low rate of variation in annual capture numbers may represent the changes in the breeding success of the population in a given year.
- Willow Tit: Moves small distances from breeding sites, captures occurring near breeding range.
- Crested Tit: The species with the lowest migratory tendency in the country, most of its captures occur during post-breeding dispersal, at a short distance from the breeding sites.

3. The age group distribution of Coal tit captured in western and north-eastern Hungary differed significantly. In Tömörd, the proportion of juveniles exceeded 80% in the two years with the highest number of captures, while in Szalon it did not reach 80% in any of the years studied.

4. Among the morphological traits of Coal Tits captured in low and high capture years and at different times of the autumn migration, wing length and condition showed significant differences. The shorter average wing length in 2008 compared to 2012 may indicate that a higher proportion of females with shorter wings on average migrated that year. The mean body weights did not differ significantly between years, which may indicate that Coal Tits optimise their body weight within relatively narrow size limits, corresponding to their continuous but lower migration speed. The higher mean fat content of birds in September-October and October-November may be related to adaptation to current weather factors, such as lower mean daily temperatures and night frosts, and to their preparation for the migration further.

5. The age and sex ratios of Blue Tits captured in Western and North-Eastern Hungary were similar, with juvenile rates exceeding 85% in both Tömörd and Szalonna.

6. There were no significant differences in morphological traits of Blue Tits captured in Western and North-Eastern Hungary, with wing length and body weight, and the average fat index of Blue Tits captured in Tömörd being significantly higher than that of specimens captured in Szalon.

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