University of West Hungary

Theses of doctoral (PhD) dissertation

Study of the autumn migration of the robin
***Erithacus rubecula* (Linnaeus, 1758) in Hungary**

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1. Choice of topic, aimes of the research

The bird migration is one of the most interesting natural phenomena of the animal world, which is probably as old as the birds, it is no surprise that it is studied from the ancient times. Migration routes and strategies, which established in the course of more generations, during millions of years of birds' evolution, have been endangered in the last decades as a result of the human activities. The birds unable to follow the accelerated changes in the environment, the global climate change, the extreme weather anomalies, destruction and disappearance of the habitats quite fast without higher proportion of mortalities. The examination of the bird migration is nowadays more important than ever.

The one of the most interesting and most effective behavior of the natural selection and adaptation of the birds from the point of view of survival of the species is the partial migration. The author chose a typical obligate partial migratory bird species of Central Europe, as the subject of research the robin.

The robin is a geographically widely spread species and it is absent only from the most northern areas of Europe. Birds breeding in northern and eastern territories, such as Scandinavia and Finland are obligatory migrants, while those, breeding in the more southern territories, are all resident birds. In Central Europe, the robin is an obligatory partial migrant. The robin is common in the hills and mountains of Hungary, in wooded bushy habitats. However, during migration it can also be found in suboptimal areas. At the beginning, autumn migration of robins is oriented to more western wintering places then to the Apennine peninsula, eastern areas of the Mediterranean and lastly to the Balkans.

Data of 135,078 ringed birds were recorded at the Bird Ringing Centre between 1951 and 2006. Fifteen birds ringed abroad were recaptured in Hungary and 70 birds ringed in Hungary were recaptured abroad.

The robin is one of the most frequently ringed birds in Hungary, thus sufficient data were available for detailed analysis of the autumn migration. The suitable statistical analysis of the ringing and biometric data can contribute to the knowledge of the

general characteristics of the partial migration and species-specific characteristics of migration of the robin. The new migration ecological knowledge can be useful in practical nature conservation.

The author searched the answer for the following questions:

1. Does the autumn migration dynamics of juveniles and adults differ from each other?
2. Is there a difference between the autumn migration dynamics of the robin in the study sites?
3. What kind of weather conditions does the robin prefer during the autumn migration?
4. Does the weather preference of the birds change during the autumn migration?
5. Does the weather preference of the juvenile and adult birds differ from each other?
6. Is there a difference in the wing-length, body mass and fat reserves between the study sites?
7. Is there a difference in the wing-length, body mass and fat reserves between the periods of the autumn migration?
8. What is the role of the study sites in the autumn migration of the robin?
9. Are there any similarities between the migratory distances and directions of the ringed birds in the different European countries?
10. Are there any similarities between the proportion of each country (where the bird was recaptured) based on the recaptures of the ringed robins in the different European countries?
11. Which European region do the ringed birds in Hungary belong to based on their recaptures?

2. Materials and methods

Capturing and ringing of birds took place at the bird ringing stations of BirdLife Hungary in Tömörd, Sumony, Ócsa, Izsák and Szalonna with the help of 260 mist nets. The nets were 12 m long and 2.5 m high with small-mesh (16×16 mm). Net controls were performed from dawn to dusk every hours and additionally once in the evening darkness. The capturing was stopped when it was very hot and during lasting rainfall as well. An individually numbered ring was put on each captured bird. Two age groups were established; one for the birds in their first year (juvenile) and one for the adult ones. The body mass and wing-length of the birds were measured, the fat reserves were estimated. Body mass and fat deposits were measured again in recaptured birds.

Migration dynamics research and the applied methods

The author studied the migration dynamics based on the data of the birds captured between 13 August and 27 October, 2004-2007. The chosen period of study was the overlap interval of the bird ringing work in the five areas.

The author made the following researches in all four years. The daily captures of the study sites were standardized to average captures by one net. The proportion of adults:juveniles was calculated. The average captures by one net of the study sites were compared using one-way ANOVA and Tukey HSD test. The migration dynamics was characterized by migration curves designed on the basis of daily captures. The migration curves were analyzed by generalized linear regression. The author calculated the estimated time of 10% and 50% captures, t_{10} and t_{50} with the 95% confidence interval, CI. When migration curves overlapped within the CI of t_{10} and t_{50} (lower limit to upper limit), the curves did not differ significantly (P=0.05). The average t_{10} and t_{50} (days) of the age groups were compared using Student's t-test. The recapturing proportion of the juvenile and adult birds was controlled by Chi^2-test. The minimum stopover times of the recaptured birds were calculated by determining the number of

days from the ringing to the last recapture. The stopover duration was compared using Kruskall-Wallis test and the Mann-Whitney method.

Examination of the influence of macrosynoptic weather situation on the migration dynamics

The author studied the influence of macrosynoptic weather situation on the autumn migration dynamics of the robin. The data of the individuals of the five study sites were reduced within one year because of accuracy of the calculations. The migration curves characterised for each year were designed on the basis of reduced daily captures. The author chose the three migration peak days (days with the largest numbers of captured birds) of the three months (August, September, October) every year, altogether 36 (9 per year). At the comparison of the migration dynamics of the juvenile and adult birds it was done in both age groups. To the migration dynamics comparison of the beginning and peak period of the migration the study period was divided in two parts; between 13 August and 19 September is the beginning of migration, between 20 September and 27 October is the peak period of migration. In both periods 18-18 peak days were determined. The author examined how the whole study period, the peak days, their preceding first and second days and their following days are distributed based on Péczely's macrosynoptic weather situations. The distributions were controlled by Chi^2-test. The average number of individuals of the two peak days in the most frequent weather situations were compared by t-test. The distribution based on the macrosynoptic weather situations which characterizes the peak days of the beginning and peak periods of the migrations as well as the peak days of the juvenile and adult birds was compared by correlation calculation.

Biometrical researches

In order to have as homogenous group of birds as possible only first-year individuals were included in this study. The standard periods, in which the numbers of birds ringed were high enough, was established for the months (August, September, October). The mean wing-length, body mass and fat indices were calculated from the biometrical data every month and ringing site. They were compared by two-way ANOVA in which the factors were the study sites and the month of capture and by posthoc Tukey HSD test with the exception of fat. Fat was not normally distributed therefore it was analysed with the help of the Kruskal-Wallis and Mann-Whitney test. Birds captured at different sites every month were arranged in groups on the basis of wing-length and body mass by cluster analysis (Euclides distance and Ward-Orlóczy method). Body mass and fat deposit of captured and recaptured birds were compared by Wilcoxon test at the various study sites with the exception of Izsák, where only a few individuals were recaptured during the study period.

Examination of the recaptures of the European robins and the applied methods

The author used the data (database of EURING) of 5115 (664 were ringed in the breeding period; 4451 were ringed in the autumn migration period) birds ringed in 14 European countries and recovered abroad. The ringing recoveries include data of the recaptured and the died birds, too.

The rose diagrams were made by data (degrees: 0º=North, 90º=East, 180º=South, 270º=West) of the directions of the recoveries compared to ringing places. The Rayleigh and the Chi^2-tests were used to reveal the significant differences of the recoveries directions from the random circle distribution. The average recovery directions of the birds ringed in the single regions were compared by analysis of variance (one-way ANOVA) and Tukey HSD.

The birds ringed in the different countries were compared based on their migration distances and directions by Cluster analysis (Bray-Curtis, Paird group) and Non-metric ordination analysis (Non-metric MDS, Bray-Curtis). The author worked with the percentage of the migration directions by 90 degrees and the migration distances by 500 kilometres in the Cluster analysis and the Non-metric analysis. At limited data were available from the breeding period the next breeding regions with similar recapture pattern were considered as examination units: I. region = North Europe: Denmark, Norway, Sweden; II. region = North-East Europe: Finland, Lithuania, European Russia; III. region = West Europe: Great Britain and Ireland, France, Netherlands, Spain; IV. region = Central Europe: Poland, Hungary, Germany, Switzerland.

The percentage by countries (where the birds were recaptured) of the recoveries were recorded in a table and based on the robins ringed in each country was compared by Cluster analysis (Bray-Curtis, Paird group) and Non-metric ordination analysis (Non-metric MDS, Bray-Curtis). The percentages of the recoveries in each cell were calculated to each column (ringing location), but they were compared in lines (recovery location). The author used these for the design of the histograms for each recovery sites. The percentage of all recaptures from each ringing site were compared within one recovery site with the originatings from other sites.

3. Theses

1. The migration dynamics of the robin shows that the end of September and the beginning of October is the peak time for passing through Hungary. Based on the estimated time of the 50% of daily capture, it can be stated that juvenile birds starts their migration as early as the end of September while the migration of the adults started later. There was a considerable difference in the beginning of migration between the age groups in 2004, the difference of the average estimated time of 10% capture of juveniles and adults was 11.99 ± 3.89 days (Student's t-test; $t=-2.39$, $p<0.05$). The capture dynamics of age groups did not differ significantly in the middle period.

2. The dynamics of the autumn migration was similar for each group at the study sites. Izsák was an exception where the juvenile and adult individuals start later. The migration started earliest in Szalonna, except 2006, when the adults started already earlier in Tömörd (based on the estimated time of 50% captures). The biggest breeding population can is found in Szalonna. The comparison of daily catch dynamics (based on the estimated time of 10% and 50% of daily captures) of juveniles and adults between study sites showed that similarity of daily capture was higher in the case of juveniles.

3. The author proved that during autumn migration, the robin prefers the anticyclonic weather situations that was typical for the two-thirds of the examined days. The birds took the advantages of the anticyclons north of the Carpathian Basin (An) and over the Carpathian Basin (A) in the biggest proportion (44%). The former situation with north-eastern and north-western winds helps the migration of the birds, in the latter weather situation the risk of not to keep their original preferable way is smaller, and the feeding conditions are also good. The cold front of the cyclone also takes effect on the autumn migration of the robin. On the following day of the cold front (mCc) great numbers of

individuals were caught. When the weather conditions are not favourable, they stay at resting places.

4. In the beginning of the migration the birds prefer the long spell of anticyclonic situations, they took advantage of the anticyclones which occur to the west of Carpathian basin (Aw) and over the Carpathian basin (A) most intensively. Following the peak days the anticyclone was typical in both periods which occur to the east of the Carpathian basin (Ae) with headwind. The effect of the cold front of the cyclone (mCc) and the headwind of the anticyclone to the north of the Carpathian basin were took more intensively by the birds in the peak period. Toward the end of the migration the birds started also during unfavourable weather conditions. The distribution based on the macrosynoptic weather situations which characterizes the peak days of the two periods differed from each other (R=0.49, p<0.085).

5. The juveniles and adults prefered the same weather situations (R=0.82, p<0.0006). The migration of the adults is more concentrated. The third of the captured birds migrated on the peak days. The both age groups prefer same weather conditions during autumn migration. The adult birds took advantage of the anticyclone (An) more.

6. The author proved that adult and dominant birds with greater wing-length and better condition occupy the wooded and dense bushy habitats. The greatest mean body mass and wing-length were measured in the case of those birds that were captured in bushy, wooded habitats. The thinnest birds were captured mostly in Izsák. The stock of birds, which were ringed in August, was homogeneous at the study sites based on the data of wing-length. The shortest mean wing-length was observed in the case of birds that migrated across the study sites of Ócsa and Tömörd in September. This can be explained by the greater presence of short-wing local individuals at both sites. Based on the monthly analysis of body mass and wing-length at each site, it has been found that the birds migrated across geographically more distant

study sites differed from each other the most. Most possibly they came from various northern territories. The majority of migrating birds not only rest but also increase their fat deposits at the study sites.

7. The lowest body mass and the shortest wing-length were observed in the case of birds captured in August. They could have been local individuals that bred in Hungary. The mean wing-length of northern birds, which migrates through Hungary in September and October, is greater, since wing-length is related to the length of their journey. The stopover time of birds captured in August was the longest. The northern birds possessed enough body mass to leave the site after a short stopover.

8. The author proved that the study sites, which differ in vegetation, may play different role in migration. The results show that the reed-bed of Izsák had only peripheral importance while the other forest and bushy study areas played a key role in resting and feeding during the migration of the robin. The number of captured juvenile and adult individuals rated to one net was the lowest in the reeds of Izsák and the highest in the woody areas of Szalonna and Tömörd every year. The woody areas of Szalonna was occupied by experienced dominant adult birds in the highest proportion while the less favourable reed-bed of Izsák was populated by juvenile birds in a higher proportion. The habitats optimal for the species, thick woods and bushy areas, are occupied by the dominant adult birds. Some individuals are crowded out of their preferable areas by dominant birds, while juveniles may go to such suboptimal habitats that they measured badly beforehand because of their lack of experience and the next day they leave it. The rate of the recaptured adults was the highest in Sumony and Szalonna, where the highest percentages of the nets were set up in the bushy areas. From the five study sites, the birds that bred in Szalonna stayed for the longest period of time.

9. The main direction of the autumn migration in Europe is S-SW. The birds of the examined European countries in every region

showed higher similiarity on the basis of migration directions and distances in both ringing periods. The majority of the ringed birds in West Europe migrated in SSE direction had to fly less than 500 kilometres to their wintering areas. The North-East European countries' birds had to fly the longest to more western direction. Based on the percentage of the recovery directions, the ringed birds in Hungary are similar to those birds the best, which ringed in Finland and North-West Russia.

10. The majority of European robins spend winter in Western wintering areas and in the Mediterranean region. The wintering areas are occupied by populations from different nesting areas and birds belonging to the same nesting region show higher similarity on the basis of the percentage of the recapturing. The reason of this that the regression of birds into different refugiums created the geographical isolated populations in which different population specific migration directions and distances could be fixed genetically.

11. The ringed birds in Hungary based on their recapturing are significally different from all others, their main wintering area can be found on the Apennine Peninsula. The reason of this presumably that only the robins survived on the Apennine refugium the last glacial period could occupied the Carpathian basin and these birds were able to keep their migration features because of their typical, relatively big degree philopatry and the isolation of Carpathian basin by high mountains.

4. Bibliography of personal publications related with theses

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