DOI: 10.17242/MVvK_37.02

REGIONAL DIFFERENCES IN THE DEVELOPMENT OF THE SPATIAL AND TEMPORAL PATTERN OF WOODCOCK (*Scolopax rusticola* L.) MIGRATION IN HUNGARY

REGIONÁLIS KÜLÖNBSÉGEK AZ ERDEI SZALONKA (*Scolopax rusticola* L.) VONULÁS TERÜLETI ÉS IDŐBELI ALAKULÁSÁBAN

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1. INTRODUCTION

The characteristics of the spring migration of Woodcock were first described in Kingdom of Hungary by JAKAB SCHENK in his large-scale study published in the first third of the 20th century (SCHENK, 1924), followed by SZABOLCS (1971), who published findings on the course of the migration and its spatial and temporal patterns in the present area of Hungary. Larger-scale studies on the species – within the framework of the Hungarian Woodcock Bag Monitoring program between 1990 and 1999 – were only conducted after almost seventy years, the results of which were summarised by FARAGÓ *et al.* (2000). During these studies, no data were available that would have made it possible to investigate the spatial and temporal characteristics of the migration on a national scale. Thus, the opinion of SCHENK (1924) that the spring migration of the Woodcock in Hungary along a southwest-northeast axis is phase delayed could neither be disproved nor confirmed. The year 2009 marked a turning point in the research on Woodcock, when the spring migration of Woodcock in Hungary was threatened by the enforcement of the *European Union Birds Directive* (79/409 EEC). As a condition for the exemption from the Directive, the Hungarian Woodcock Monitoring was launched in 2009 under the coordination of the Hungarian Hunters' National Association, and in 2010 the Institute of Wildlife Management and Vertebrate Zoology of the University of West Hungary joined the project with a biometric study module. Thanks to the new national monitoring, an unprecedented opportunity was created for time-series analysis to study the migration of Woodcock based on large sample (n=23,539 specimens), as more than 500 data providers submitted data for a decade, collected in accordance with a standard protocol.

2. MATERIAL AND METHOD

Since spring 2010, the *Hungarian Woodcock Bag Monitoring*, coordinated by the *Hungarian Hunters' National Association*, has set a target of up to 5,600 Woodcocks to be bagged in Hungary each year. In addition to recording the body dimensions, the location where the birds were bagged (county, settlement, wildlife manager), the exact time of sampling (month, day, hour, minute) and the sex of the birds were also recorded.

The sampling data sheets, and the wing samples collected for age determination arrived at the *Institute of Wildlife Management and Vertebrate Zoology of the University of Sopron*

during the first period (2010–2014). In the second period of the monitoring (2015–2019), the basic data submitted by the data providers arrived at *Szent István University* from where the institution staff forwarded them to our institute.

During the monitoring, more than 500 people entitled to hunt – with more than 800 sampling points – participated in data collection in each year. To evaluate the migration dynamics in a uniform way, we analysed the data sets of the sampling period from March 1 to April 10 (41 days). To ensure uninterrupted observational data collection, during the first phase of monitoring (2010–2014) Saturday morning sampling was not possible for data providers, and therefore Saturday evening roding data were excluded from the analysis. The data submitted by the hunters were organised in a database using Microsoft Excel 2016.

In our research, we started from the proven correlation that the change in the number of bagged Woodcocks over time is proportional to the change in the number of birds migrating during the spring migration. Thus, the bagging results reflect the spatial and temporal pattern of the Hungarian spring migration of the Woodcock population reliably (Faragó *et al.*, 2012a, b; 2014; 2015a, b; 2016; SCHALLY, 2020). To characterise the time course of migration, we determined the date of the 50% sampling rate in each year of the research and the number of days between the 25% and 75% cumulative sampling rate, i.e., the length of the period when migration is most intense and 50% of the birds migrate through Hungary. The dates associated with the main migration period thus defined allow an exact comparison between the years examined. Based on the data above, the spatial and temporal patterns of the spring migration of Woodcock were plotted on chromatic maps for the whole territory of Hungary, by county, for each year, with a 25% and 75% cumulative bagging rate, using ArcGIS 10.3 geographic information software.

3. RESULTS AND DISCUSSION

In our preliminary research (FARAGÓ & LÁSZLÓ, 2013; FARAGÓ *et al*. 2012a, b; 2014; 2015a, b; 2016), we compared the sampling pattern in each year of the first monitoring phase (2010–2014), using weekly 60% Kernel maps from GIS-based processing. Based on the Kernel maps, we assumed that there would be a time difference in spring migration of Woodcock between the western and eastern regions of Hungary. To investigate this phenomenon, we selected from the south-western and north-eastern counties of Hungary Somogy and Borsod-Abaúj-Zemplén counties, which have a sufficiently large number of items (**Figure 1.**).

By examining the time course of the main spring migration period of Woodcock, we found that in the ten years examined, the main migration period in Borsod-Abaúj-Zemplén county started one week (min. 3 days; max. 10 days) later average than in Somogy county.

We assumed that there would be a verifiable difference in spring migration between the western and eastern counties of the country in each year analysed, which is presented on chromatic county maps with average sampling dynamics for two years (2011; 2012). The map representation is based on the start and end dates of the main migration period, which represent the dates associated with the 25% and 75% thresholds of the cumulative sampling rates of the migrating populations. The counties (Békés, Hajdú-Bihar, Jász-Nagykun-Szolnok) where the annual sample number was less than 30 specimens were excluded from the evaluation.

The analysis showed a clear difference in the time course of migration between the south-western, central, and north-eastern regions of the country. In the south-western Hungarian counties, migration started earlier in all cases, with Baranya county typically being the first to reach the 25% cumulative bagging rate. In the years 2011 and 2012, this date fell on March 21. In relation to this start date, we analysed the time shift in the other counties. The maps clearly show that the main migration period started at a similar time to the start date in

the counties of the South-western Transdanubia region (Baranya, Zala, Somogy, Tolna counties) and in northwest Hungary (Győr-Moson-Sopron county). In Vas county and in the Transdanubian Mountains (Veszprém, Fejér and Komárom-Esztergom counties), a phase delay of at least two days was observed compared to the start date of the main period. In the area of the North Hungarian Mountains – and in some years in Komárom-Esztergom and Fejér counties – we recorded a phase delay of up to 5 days compared to the reference date, which confirms the time shift of the Woodcock migration between the South-western Transdanubia and North-eastern Hungary regions in every year analysed (2010-2019) (**Map 1–4.**).

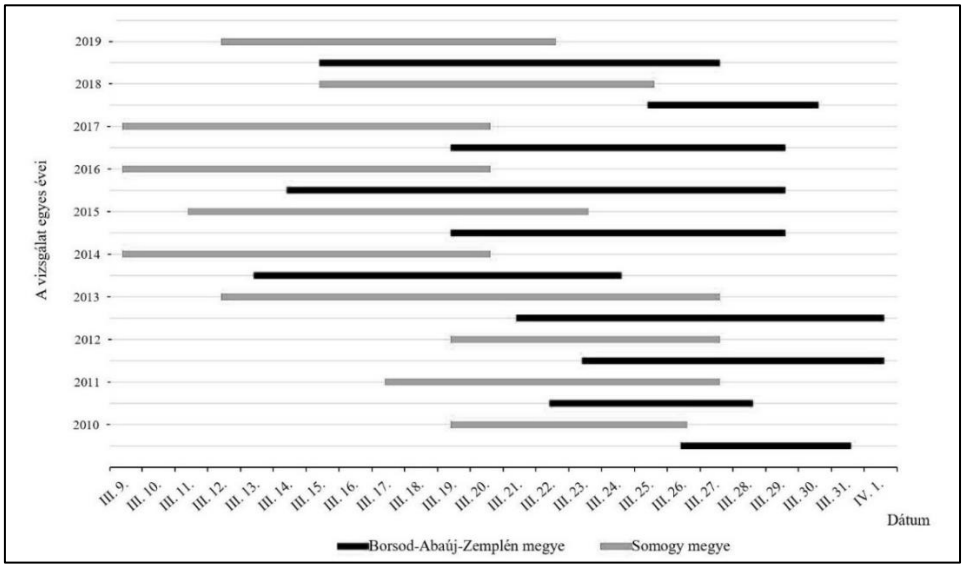
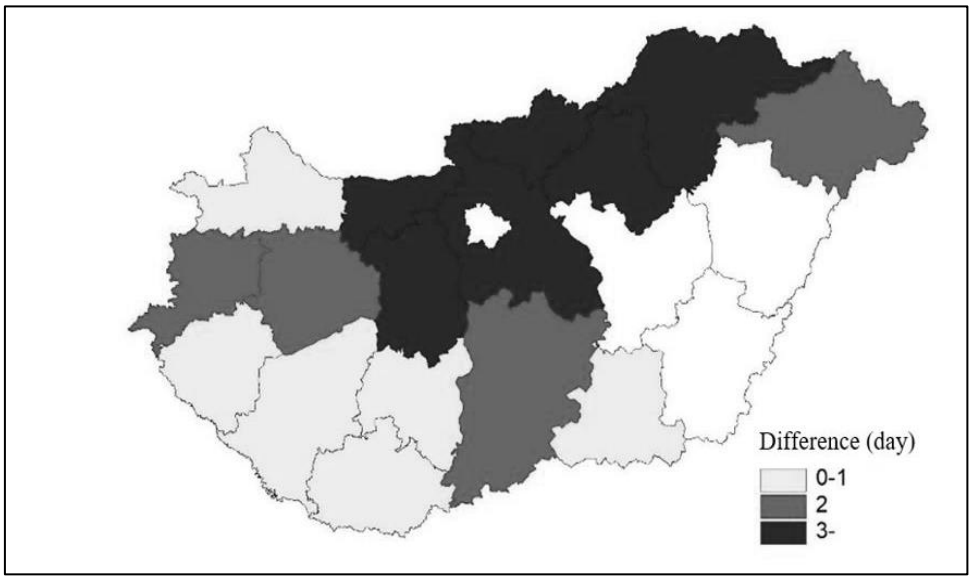


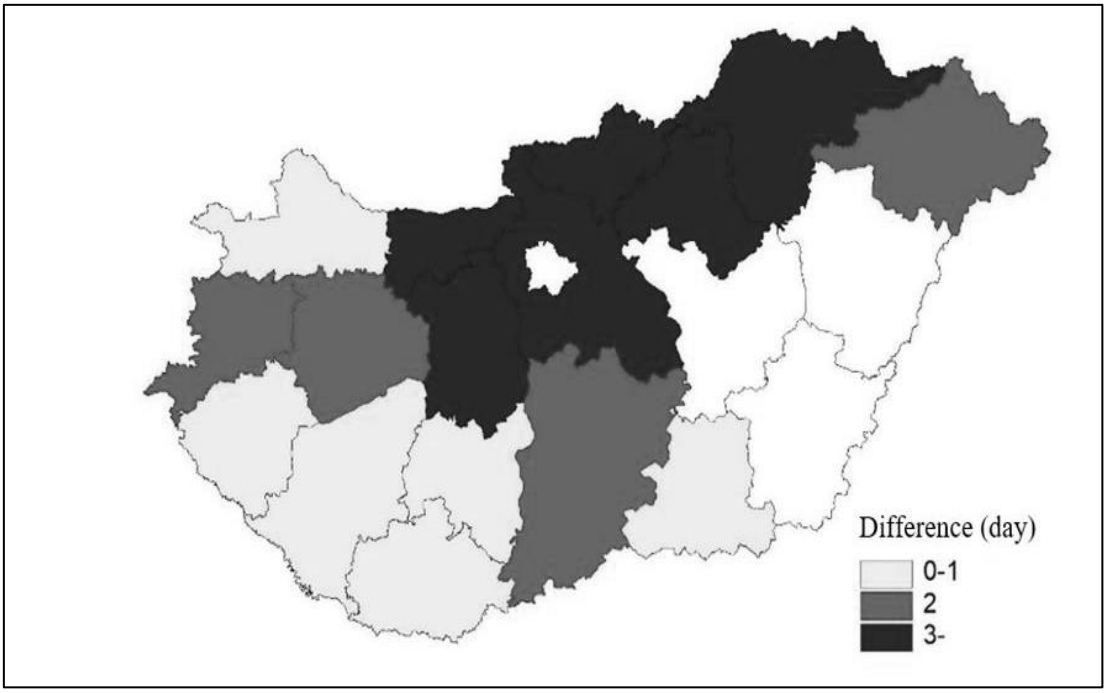
Figure 1.: Main migration periods of Woodcock between 2010 and 2019 in Somogy and Borsod-Abaúj-Zemplén counties

1. ábra: Az erdei szalonka fő vonulási időszakai 2010 és 2019 között Somogy és Borsod-Abaúj-Zemplén vármegyékben



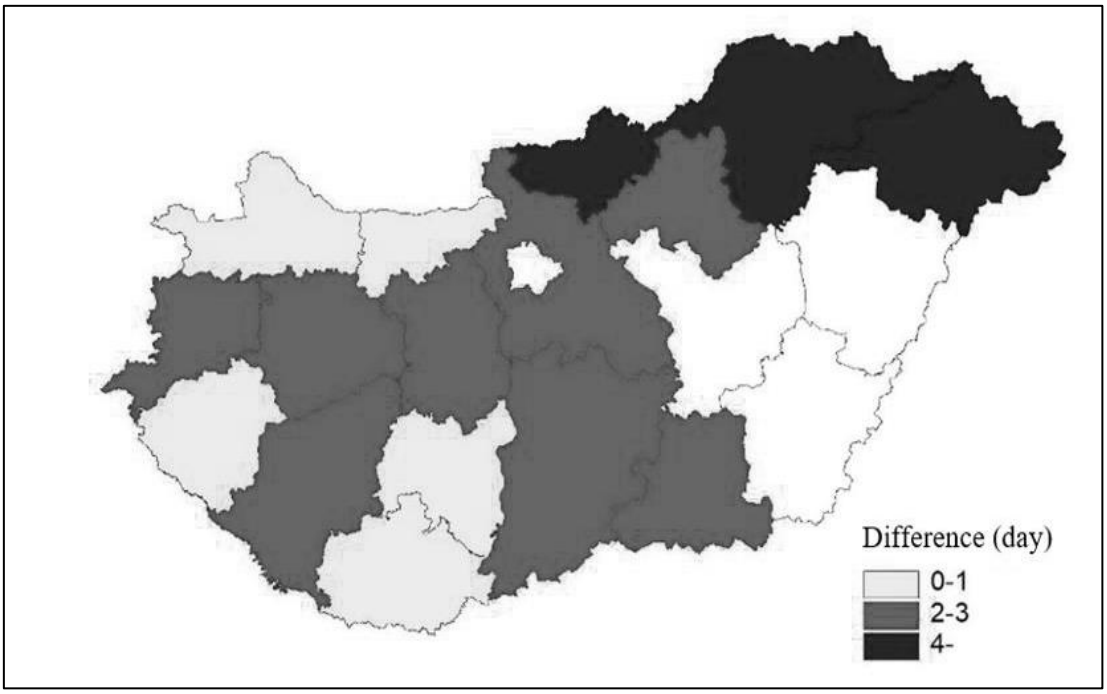
Map 1: Time difference in spring migration of Woodcock between counties in 2011, based on the dates with 25% of the cumulated bagging rates.

1. térkép: Az erdei szalonka tavaszi vonulásának időbeli eltérése az egyes megyék között 2011-ben a 25%-os kumulált elejtési értékekhez tartozó időpontok alapján.



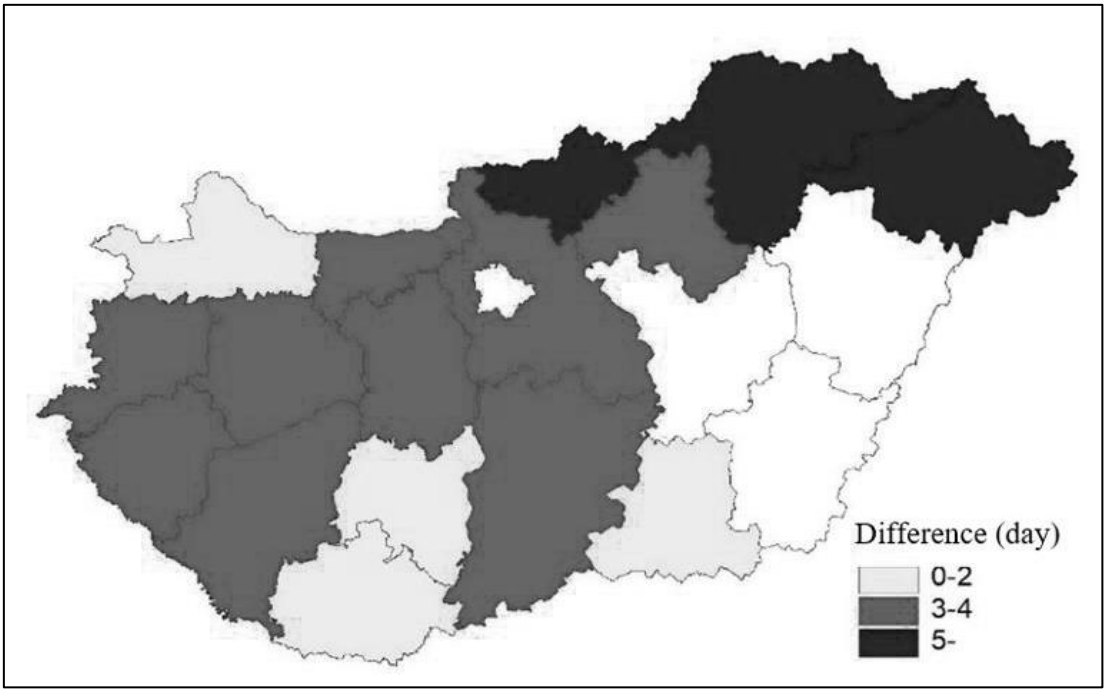
Map 2: Time difference in spring migration of Woodcock between counties in 2011, based on the dates with 75% of the cumulated bagging rates.

2. térkép: Az erdei szalonka tavaszi vonulásának időbeli eltérése az egyes megyék között 2011-ben a 75%-os kumulált elejtési értékekhez tartozó időpontok alapján.



Map 3: Time difference in spring migration of Woodcock between counties in 2012, based on the dates with 25% of the cumulated bagging rates.

3. térkép: Az erdei szalonka tavaszi vonulásának időbeli eltérése az egyes megyék között 2012-ben a 25%-os kumulált elejtési értékekhez tartozó időpontok alapján.



Map 4: Time difference in spring migration of Woodcock between counties in 2012, based on the dates with 75% of the cumulated bagging rates.

4. térkép: Az erdei szalonka tavaszi vonulásának időbeli eltérése az egyes megyék között 2012-ben a 75%-os kumulált elejtési értékekhez tartozó időpontok alapján.

According to SCHENK's assumption (1924), migrating Woodcocks first reach the territory of the Kingdom of Hungary from the south-west (the Sava-Drava region), and then continue their north-eastern course, leaving the northern ranges of the Carpathians. This fits well with SZABOLCS' (1971) assumption that the spring migration takes place with a time shift throughout Hungary, starting in the Nagykanizsa-Barcs line and ending in the eastern part of the Transdanubian Mountains. The observations above – formulated in an empirical way – and the hypothesis of our own previous analyses have been confirmed and clarified by the results of the present study, thus clearly demonstrating that the migration of Woodcock in Hungary is phase delayed along the southwest-northeast axis (BENDE, 2021; BENDE *et al.*, 2023).

4. SUMMARY

In the framework of the Woodcock Bag Monitoring, we analysed the spatial and temporal pattern of Woodcock migration (n=23,539 specimens) bagged in Hungary between 2010 and 2019 during spring sampling. We assumed that there was a difference in the time course of spring migration of Woodcock between the south-western, central and north-eastern regions of Hungary. To confirm this, we analysed the spring migration dynamics of Woodcock in Somogy and Borsod-Abaúj-Zemplén counties. The analysis was based on the dates of the start and end of the main migration period, which are the dates associated with the 25% and 75% thresholds of the cumulative sampling rates of the migrating populations. We found that between 2010 and 2019, the main migration period of Woodcock in Borsod-Abaúj-Zemplén County started one week (3–10 days) later average than in Somogy County. In the south-western Hungarian counties, migration started earlier in all cases, with Baranya county typically reaching the first threshold first, so we examined the time shift relative to this start date in the other counties. We found that the main migration period started close to the first threshold in

the counties of the South-western Transdanubia region and in northwest Hungary, with a phase delay of at least two days in the Transdanubian Mountains, while in the North Hungarian Mountains there was a difference of up to 5 days, which confirms the time shift in the migration of Woodcock between the south-western and north-eastern regions of Hungary. Based on our results, it can be stated that the migration of Woodcock in Hungary occurs along a southwest-northeast axis with a phase delay.

5. ACKNOWLEDGMENT

The evaluation of Woodcock migration was made possible by the monitoring program coordinated by the *Hungarian Hunters' National Association*. Special thanks to the hunters participating in data providing, who – in addition to collecting the bagging data – also contributed to the *Hungarian Woodcock Bag Monitoring* by submitting wing samples for age determination.

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Összefoglaló

Az Erdei Szalonka Teríték Monitoring keretében tavaszi mintagyűjtés során a 2010–2019-es évek között Magyarországon terítékre került erdei szalonkák (n=23 539 pd.) vonulásának tér és idő mintázatát vizsgáltuk. Feltételeztük, hogy eltérés mutatkozik az erdei szalonka tavaszi vonulásának időbeli lefolyásában Magyarország délnyugati, középső és északkeleti régiója között, aminek igazolására megvizsgáltuk Somogy, valamint Borsod-Abaúj-Zemplén megyében zajló tavaszi erdeiszalonka-vonulás dinamikáját. A vizsgálat során a fő vonulási időszak kezdetének és végének dátumát vettük alapul, ami a vonuló állományok kumulált mintavételi arányainak 25%-os, illetve 75%-os küszöbértékéhez tartozó időpontokat jelenti. Megállapítottuk, hogy 2010 és 2019-es évek között Borsod-Abaúj-Zemplén megyében az erdei szalonka fő vonulási időszaka átlagosan egy hetes (3–10 nap) késéssel vette kezdetét Somogy megyéhez képest. A délnyugat-magyarországi megyékben a vonulás minden esetben korábban kezdődött, jellemzően először Baranya megye érte el az első küszöbértéket, így ehhez a kezdő dátumhoz képest vizsgáltuk a többi megyében jelentkező időbeli eltolódást.
Megállapítottuk, hogy a délnyugat-dunántúli régió megyéiben, továbbá Északnyugat-Magyarországon az első küszöbértékhez közeli időpontban kezdődött a fő vonulási időszak, aminek kezdetében a Dunántúli-középhegység térségében legalább két napos fáziskésés jelentkezett, míg az Északi-középhegység térségében akár 5 napot is meghaladó különbség mutatkozott, ami igazolja az erdei szalonka vonulásának időbeli eltolódását Magyarország délnyugat-dunántúli és északkeleti régiója között. Eredményeink alapján megállapítható, hogy az erdei szalonka vonulása Magyarországon délnyugat-északkeleti tengely mentén, fáziskéséssel zajlik le.