

Seasonal migrations, population dynamics and age structure of the Spotted Flycatcher *Muscicapa striata* (Aves, Passeriformes) according to trapping and ringing data for sixty-four years (1957–2020) in the Eastern Baltic

Vladimir A. Payevsky¹, Anatoly P. Shapoval²

1 Laboratory of Ornithology, Zoological Institute of the Russian Academy of Sciences, 1 Universitetskaya nab., St. Petersburg, 199034, Russia

2 Biological Station “Rybachy”, Zoological Institute of the Russian Academy of Sciences, 32 Pobedy str., Rybachy, Kaliningrad Oblast, 238535, Russia

Corresponding author: Anatoly P. Shapoval (apshap@mail.ru)

Academic editor: R. Yakovlev | Received 1 May 2024 | Accepted 9 May 2024 | Published 27 May 2024

<http://zoobank.org/5914DFB0-E3E8-44AC-9A4A-F45251F007A5>

Citation: Payevsky VA, Shapoval AP (2024) Seasonal migrations, population dynamics and age structure of the Spotted Flycatcher *Muscicapa striata* (Aves, Passeriformes) according to trapping and ringing data for sixty-four years (1957–2020) in the Eastern Baltic. Acta Biologica Sibirica 10: 533–545. <https://doi.org/10.5281/zenodo.11295748>

Abstract

The results of the trapping and ringing of the Spotted Flycatcher at the “Fringilla” field station in the Courish (Curonian) Spit, Eastern Baltic, for the period 1957–2020, in the number of 7984 individuals are presented. The annual number of birds caught has varied for 64 years, while the period since the mid–1980s has been characterized by a downward trend in numbers. Due to the “coastal effect”, the proportion of adult birds averaged 3%, varying by year from 1% to 14%. The recoveries of our rings during the spring arrival and breeding of birds are concentrated in the coastal northern parts of the Baltic Sea and the Gulf of Bothnia, in the territories of Denmark, Sweden and Finland. The recoveries of our rings during the autumn migration are from Italy. The average daily speed of autumn movement is 66–87 km per day. The age (in years) at the discovery time of the bird with the ring was from one to five years old.

Keywords

Courish (Curonian) Spit, longevity, migration routes, number dynamics, Spotted Flycatcher, wintering sites

Introduction

Spotted Flycatcher is a common polytypical species of the flycatcher family, widely distributed during the breeding season in Europe, western Asia and partly in north-western Africa. It lives in a wide variety of natural conditions, from the northern taiga to the southern semi-deserts. It spends the winter in the subtropics of Africa up to the southernmost parts of this continent (Blagosklonov 1954; Peklo 1987; Glutz von Blotzheim 1993; Cramp and Perrins 1993; Stepanyan 2003).

Migrations and wintering sites of western European populations of this nocturnal migrant are well known from the results of observations and ringing (Zink 1975; Bairlein et al. 1984; Cramp and Perrins 1993; Spina et al. 2022). From eastern European populations of the Spotted Flycatcher, detailed information on migrations is known for birds of Finland (Valkama et al. 2014) and Sweden (Jonzen et al. 2006), and also a lot of information is known about summer movements and plumage moult for the birds of taiga zone of Northwestern Russia (Noskov et al. 2020). The coastal territories of the Eastern Baltic, including the Courish Spit, are the paths of seasonal migrations of birds flying along Europe's largest White Sea-Baltic migration route. The Spotted Flycatcher is one of more than a hundred species of birds that are regularly caught and ringed on the Courish Spit by employees of the Biological Station “Rybachy” (Zoological Institute, Russian Academy of Sciences) in order to study migrations by the ringing. The information obtained on the ways of movement and annual changes in the numbers of these populations of birds caught here was the basis for writing this article.

Materials and methods

The Courish Spit is a narrow strip of land stretched in the direction from northeast to southwest, which coincides with the main direction of bird migration in the Eastern Baltic. Trapping and ringing of birds by the staff of the Biological Station “Rybachy” has been carried out since 1957 to the present time in two sites: at the field station “Fringilla” (55°05'N, 20°44'E) and at Rossitten Cape (55°09'N, 20°51'E). In the first of them, birds are caught in the so-called “Rybachy-type” traps, in the second one - with mist nets. Rybachy-type traps and their structure and mechanism of action are described in detail (Dolnik and Payevsky 1976). Traps are active for 7 months of the year, from the end of March to the beginning of November. Duration of work by each trap (unchanged design) varied very slightly over the years, due to several days of the beginning of spring and the end of autumn trapping. In the sum-

mer, local birds nesting on the spit are trapped. Many of them are caught repeatedly and so local populations are regularly monitored.

In order to analyze the variations in the number of Spotted Flycatchers, we use here the quantitative data of trapping only at the “Fringilla” field station (a total of 7984 individuals were caught here over 64 years), since trapping at the field station was more standard in all years of research, which is important when discussing population dynamics. In total, 11669 individuals of this species have been caught and ringed by all means of catching over the years.

The ringing of birds is accompanied by their lifetime examination according to the standard methodology developed at our Biological Station. This is, if possible, determination of sex and age, analysis of the state of plumage, as well as measurements of wing length and body weight (Vinogradova et al. 1976). As for subspecific differences, according to information on the distribution of subspecies, migratory Spotted Flycatchers in the Eastern Baltic may belong only to a nominative subspecies.

Lists of all quantitative data on trapping, ringing and reports of the recoveries of ringed birds have been published (Payevsky 1971; Bolshakov et al. 1999, 2000, 2001, 2002a, 2002b, 2002c, 2003, 2004, 2005, 2008, 2009a, 2009b, 2009c, 2010, 2011, 2012, 2013, 2014; Shapoval et al. 2017, 2018a, 2018b, 2019, 2021, 2022a, 2022b). In these publications, with information about the recoveries, the coordinates of the points of location, the time elapsed since the day of the ringing, the distance and the azimuth are given.

Results

Variations in the number of migrating Spotted Flycatchers. The distribution by year of the number of birds caught in the Courish Spit is shown at the Fig. 1. Unlike a number of other, much more abundant species, the annual number of Spotted Flycatchers trapped is low. However, this can be used as a relative indicator of population variation. It is known that the number of migratory birds regularly caught on migration routes may reflect long-term fluctuations in their numbers if standard catch dates and methods are followed in the same place (Berthold et al. 1986; Busse and Cofta 1986; Payevsky 2008).

Population trends based on bird trapped data were determined by two criteria: Spearman's rank correlation coefficient and the coefficient of determination, where one set of variables is represented by consecutive years, and the other by the number of birds caught. The coefficient of determination showed a weak linear relationship between the two variables, and the coefficient of rank correlation showed a moderate negative relationship (Fig. 1). The period since 1986 has been characterized by a tendency towards a decrease in the number of migratory Spotted Flycatchers compared to the previous period of capture. This is also evidenced by the trapping materials analyzed in this regard (1980–1999) at the Swedish ornithological station

Falsterbo, where the Spearman correlation coefficient for the Spotted Flycatcher for autumn trapping data was -0.65 (Karlsson et al. 2002).

The commitment of the Spotted Flycatcher, as a catcher of flying insects, to open places among the forest biotopes that existed on the Courish Spit in the 1950s and 1960s coincides with a higher number of captured birds of this species, and the gradual change of this biotope – the overgrowth of the spit with dense pine forest in subsequent years – with a decrease in their number. However, it can be assumed that not only this circumstance acted in relation to the dynamics of the number. It is known that the population size of this species in large areas of Europe has experienced significant fluctuations over the years. Population declines have been observed in different periods since the 1960s in Great Britain, Ireland, the Netherlands, Sweden, Germany, the Czech Republic, and Spain (Cramp and Perrins 1993; Hagemeyer and Blair 1997). According to bird records in 1986–2020 in the Kivach Nature Reserve (Karelia), its number has sharply decreased over the past decade (Yakovleva and Sukhov 2020). In Finland, according to the records, unlike in other countries, the number of Spotted Flycatchers has not decreased (Valkama et al. 2014). In terms of this discussion, attention should be paid to the analysis of possible mechanisms of changes in the number of 18 species of trans-Saharan migrants, including the Spotted Flycatcher (Payevsky 2006). The reason for the decrease in the number of studied populations was not a violation of the breeding process, but a dramatic decrease in the survival rate of birds in the territories of African flyways and wintering grounds. This was due to a lack of precipitation, especially severe droughts in the Sahel zone, where Spotted Flycatchers also migrate.

Seasonal dynamics of spring and autumn migration. The effectiveness of the Rybachy-type traps consists not only in the mass trapping of migratory birds, but also in the accurate registration of the dates of spring arrival and autumn departure of those bird species that can simply be overlooked by visual observations, especially in early spring and late autumn. The picture of the dynamics of seasonal movements of the Spotted Flycatcher by the timing of their capture on the Courish Spit shows that the first trapping in spring in some years took place from May 1 to May 9 (the very first bird caught on April 30, 2020), and in other years – only in the period from 12-th to May 18th (Fig. 2).

The mass arrival in spring falls on the second and third ten-days of May. These dates are the same as the dates of the spring arrival to Finland on the Baltic Sea coast, on average on May 26 (Valkama et al. 2014). In autumn, the largest number of migrants of this species in the Courish Spit flies in the period from August 19 to September 17, with the main peak in the first week of September. The last autumn migrants were caught at the end of October, the most recent two Spotted Flycatchers were ringed by us on October 26 and 28, 1982. At the Ottenby ornithological station (the southern tip of the island of Eland, southeastern Sweden), the timing of the autumn migration of this species was almost the same: the average date was September 1, and the latest bird caught on October 24 (Enquist and Petterson 1986).

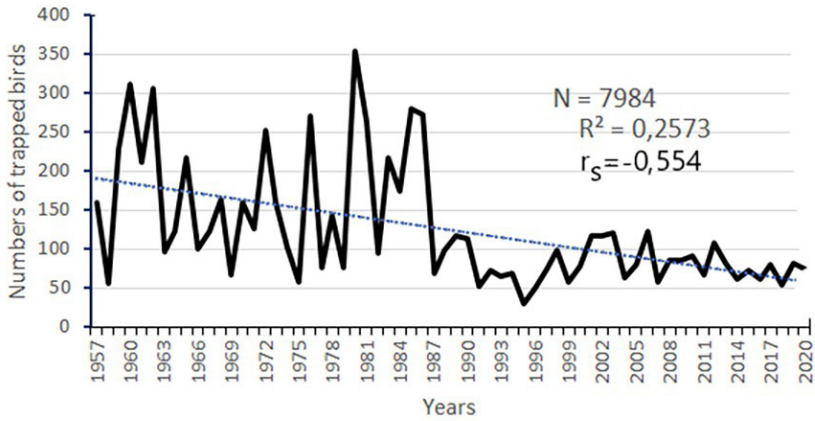


Figure 1. Annual numbers of captured and ringed Spotted Flycatchers in the Courish Spit (Eastern Baltic) for 64 years at the “Fringilla” field station. R^2 is coefficient of determination, r_s is Spearman's correlation coefficient.

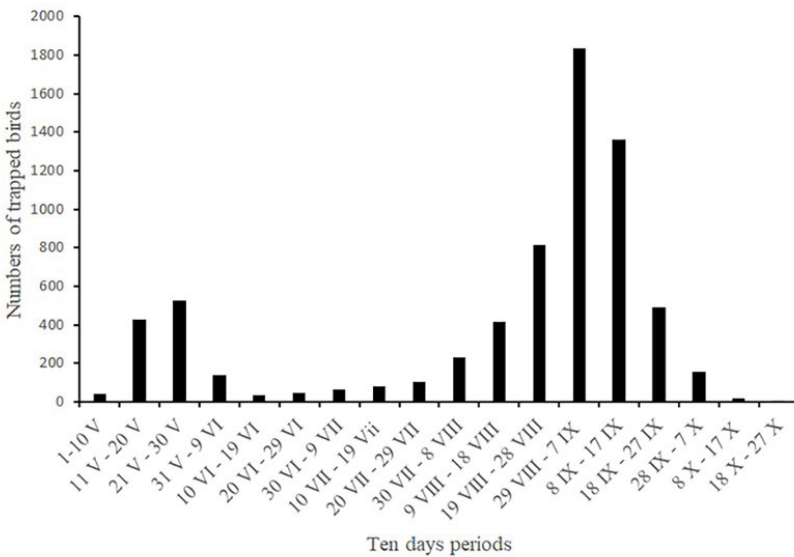


Figure 2. The dynamics of seasonal movements of Spotted Flycatchers in the Courish Spit according to the data of trapping at the “Fringilla” field station.

The effectiveness of ringing. In total, 14 recoveries of our rings were received from ringed 11669 Spotted Flycatchers, and 3 individuals of this species with rings from Finland, Sweden and Lithuania were caught. In addition, over the years, 490 repeated catches (4.2%) of individuals ringed here have obtained at the site of ring-

ing. 14 recoveries of our rings obtained amount to $0.12 \pm 0.01\%$ of the number of ringed ones, which is among the lowest efficiency of bird ringing in the Eastern Baltic, where the range of average values varies from 0.06% in the Willow Warbler *Phylloscopus trochilus* to 2.6% in the Song Thrush *Turdus philomelos* (Payevsky and Shapoval 1998). Indeed, it is widely known that the proportion of ring recoveries is significantly higher in large birds and especially in hunting species than in small songbirds. Our calculation of the dependence of the number of recoveries on the number of ringed individuals showed the absence of a direct relationship by the rank correlation coefficient. However, the proportion of ring recoveries is significantly higher when migration routes and wintering sites are in densely populated areas (Bub 1969; Payevsky 1973), and not in regions such as the African savannas, where the Spotted Flycatcher migrates after crossing the Mediterranean. Among passerines like short-distant migrants (21 species), the proportion of ring recoveries was almost 3 times higher compared to 26 species of long-distant migrants flying to Africa (Shapoval 1994). In addition, since the eighties of the last century, information has appeared in the ornithological literature about a significant decrease in the proportion of ring returns compared to previous decades. An analysis of this phenomenon allowed us to conclude that the reason for the decrease in the proportion of ring returns is a change in people's attitude to the need to report a ringed bird and the absence of an e-mail address on the rings (Payevsky and Shapoval 2013).

The age structure of migrating birds. It is known that the proportion of young birds among nocturnal migrants caught on sea coasts, unlike birds on the continental parts, is unnaturally high (from 85 to 97%) and significantly higher than that of day-time migrants. This phenomenon has been called the "coastal effect" (Ralph 1978; Dunn and Nol 1980; Payevsky 1998). Hypotheses that have been put forward to explain this effect have concerned differences in the behavior of adult and young birds during migratory flight and landing. For the Courish Spit, the hypothesis is most likely valid that after a night flight over the sea, young birds land on the first land they see, whereas most adults fly further over the continent (Payevsky 1998, 2008). The age structure of Spotted Flycatchers migrating in the Courish Spit during autumn was calculated based on the data from entries in bird ringing record logs for 45 years, 1962–2006. The proportion of adult birds varied by year from 1% to 14%, and averaged $2.99 \pm 1.70\%$.

Migration movements. Of the 14 long-range recoveries of our rings, 4 birds were found in autumn and winter, and ten birds were found during the spring arrival and breeding period. Three birds with rings from other countries were caught in the Courish Spit during the spring and autumn migration. The recoveries of our rings from northern Italy in September and October presumably indicate that Spotted Flycatchers migrating through the Eastern Baltic on their way to wintering places in Africa cross the Mediterranean in these areas (Fig. 3).

As for the recovery of our ring from northern Spain in the third year after ringing, the January date of the discovery of an adult bird in this place alive (up to this point) is still unexplained.

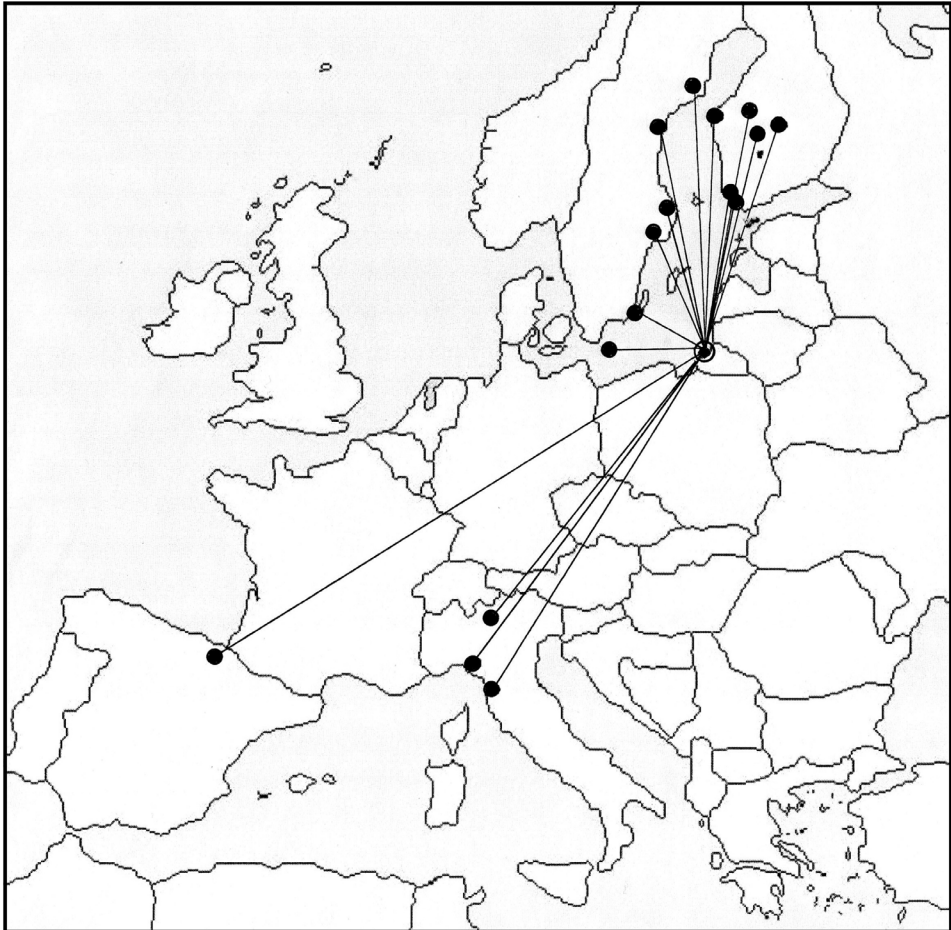


Figure 3. Recoveries of Spotted Flycatchers ringed in the Courish Spit, in the migration routes (Italy and Spain), and in breeding territories (Denmark, Sweden and Finland).

Recoveries of our rings during the spring arrival and breeding of birds are concentrated mainly in the coastal parts of the Baltic Sea (Fig. 3), including the Gulf of Bothnia, in the territories of Denmark (Bornholm Island), Sweden (Eland Island and the provinces of Södermanland, Uppsala, Västerbotten, Västernorrlands) and Finland (regions of Turku-Pori, Häme, Karstula, Vaasa). Such a dense location of Spotted Flycatcher detection points in spring and summer in regions adjacent to the seashores may presumably indicate that such places with more sparse forests are most convenient for this species during nesting due to the extraction of flying insects.

Further autumn migration of Spotted Flycatchers from the Baltic States after flying over the Mediterranean can be considered based on the total results of ringing in Finland (Valkama et al. 2014) and in Ottenby, Sweden (Jonzen et al. 2006) (Fig. 4).

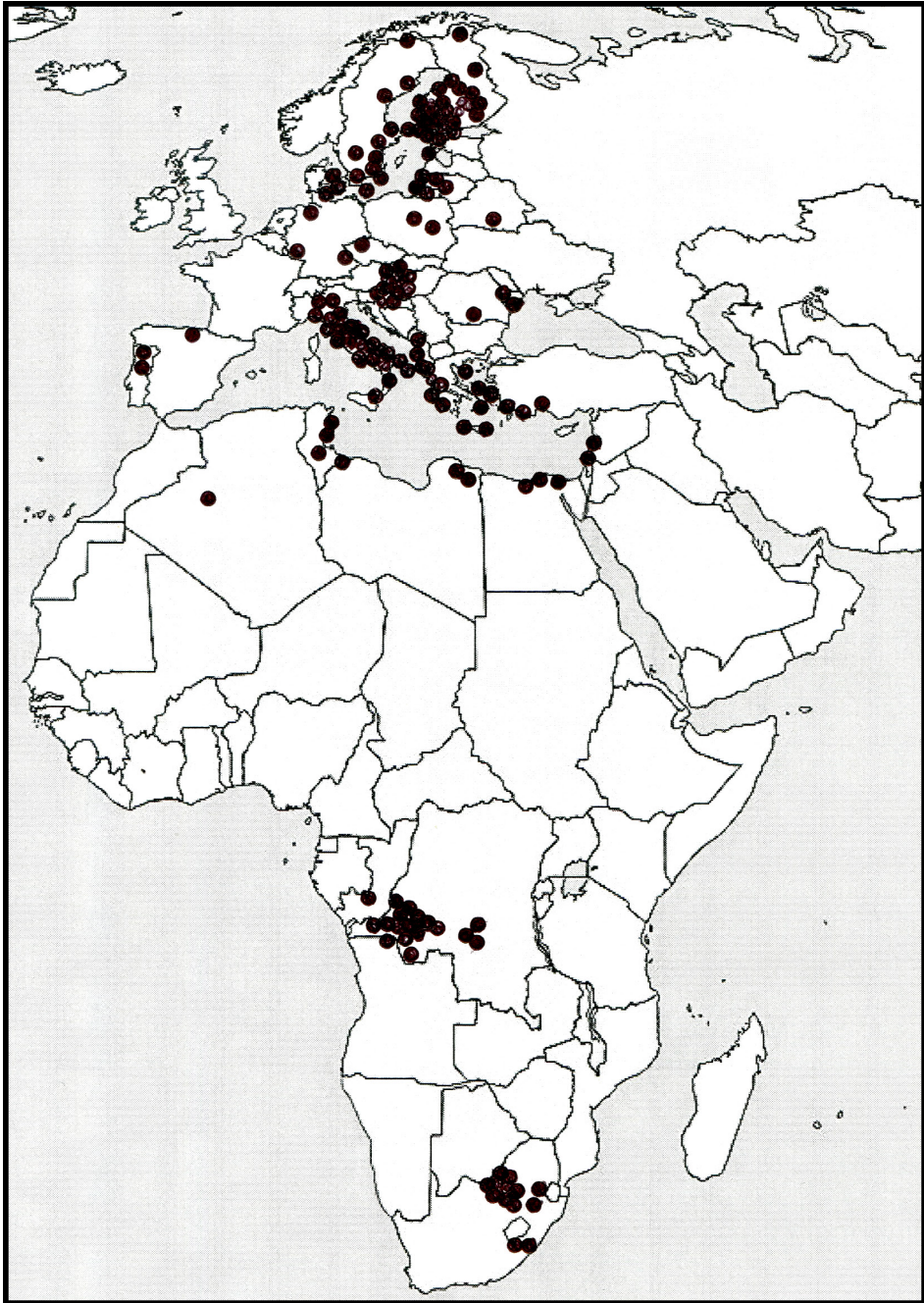


Figure 4. Recoveries of Spotted Flycatchers ringed in three banding regions: Finland (127 recoveries, Valkama et al. 2014), Ottenby, Sweden (17 recoveries, Jonzen et al. 2006) and the Courish Spit (14 recoveries, Bolshakov et al. 2001). These results are partially shown on the maps of the Eurasian-African Atlas of Bird Migration (Spina et al. 2022).

These results also partially exist on the maps of the Eurasian-African Atlas of Bird Migration (Spina et al. 2022). All these data indicate that these populations of the Spotted Flycatcher on the African continent partially stop on the southern shores of the Mediterranean, and winter in the very south of Africa, in the eastern part of the Republic of South Africa. On the way back during spring, in March and April, they stop in the western part of the Democratic Republic of the Congo for recreation. The longest distance to the wintering site is 10558 km (Valkama et al. 2014), but taking into account the northernmost summer point of one bird ringed in Ottenby (Jonzen et al. 2006), this distance may be greater, up to 11000 km.

The speed of migratory movement. According to our data, the speed of the autumn migration within Europe could be set only for two young birds of Spotted Flycatcher. One of them, ringed in September, was discovered 17 days later in Pisa, Italy, 1478 km southwest. The other one, ringed in Finland in August, was caught 8 days later in the Courish Spit, 530 km to the south. These data give the average daily speed of autumn movement, equal in the first case to 87 km, and in the second case to 66 km. Almost the same autumn migration speed is indicated for the results of ringing in Finland – 62–90 km per day. However, the speed of spring migration of Spotted Flycatchers turns out to be twice as high, up to 150 km per day (Payevsky 2013; Valkama et al. 2014).

Life expectancy according to ringing data. The age (young or adult bird) during our ringing was not known for all Spotted Flycatchers. Nevertheless, according to the time elapsed from the moment of ringing to the discovery of the bird, it was possible to calculate the number of years they lived in 15 individuals. According to these data, the age (in years) at the time of detection of the bird with the ring was from one to five years or more (+): up to 1 year or 1+ in nine individuals, 2+ in one, 3+ in two, 4+ in two and 5+ in two individuals. According to ringing data in Sweden, the maximum age was 8 years (Fransson et al. 2017), and in Finland, the longest-lived Spotted Flycatchers were at the ages of six, seven and eleven years (Valkama et al. 2014).

Acknowledgements

We are grateful to our colleagues – the staff of the Biological Station “Rybachy” of the Zoological Institute, for their friendly help in the work and for the opportunity to use collective materials – the results of trapping and ringing birds, in the collection of which we were directly involved. The study was carried out within the framework of state assignments for the projects "Animal migrations: physiology, orientation, navigation and parasitic load during climate change" No. 122031100261-7 and "Phylogeny, morphology, ecology and systematics of terrestrial vertebrates" No. 122031100282-2.

References

- Bairlein F, Beck P, Feiler W, Querner U (1984) Herbstbeobachtungen paläarktischer Zugvögel in der algerischen Sahara. *Vogelwelt* 105: 1–9.
- Berthold P, Fliege G, Querner U, Winkler H (1986) Die Bestandsentwicklung von Kleinvögeln in Mitteleuropa: Analyse von Fangzahlen. *Journal of Ornithology* 127(4): 397–437.
- Blagosklonov KN (1954) Family Muscicapidae. In: Dementiev GP, Gladkov NA (Eds) *Birds of the Soviet Union*. Vol. VI. Sovetskaya Nauka, Moscow, 73–118. [In Russian]
- Bolshakov CV, Shapoval AP, Zelenova NP (1999) Results of bird trapping and ringing by the Biological Station "Rybachy" on the Courish Spit in 1998. *Avian Ecology and Behaviour* 2: 102–150.
- Bolshakov CV, Shapoval AP, Zelenova NP (2000) Results of bird trapping and ringing by the Biological Station "Rybachy" on the Courish Spit in 1999. *Avian Ecology and Behaviour* 4: 85–145.
- Bolshakov CV, Shapoval AP, Zelenova NP (2001) Results of bird ringing by the Biological Station "Rybachy" on the Courish Spit: long-distance recoveries of birds ringed in 1956–1997. Part 1. *Avian Ecology and Behaviour, Suppl.* 1: 1–126.
- Bolshakov CV, Shapoval AP, Zelenova NP (2002a) Results of bird ringing by the Biological Station "Rybachy": controls of birds ringed outside the Courish Spit in 1956–1997. Part 1. *Avian Ecology and Behaviour, Suppl.* 5: 1–106.
- Bolshakov CV, Shapoval AP, Zelenova NP (2002b) Results of bird trapping and ringing by the Biological Station "Rybachy" on the Courish Spit in 2000. *Avian Ecology and Behaviour* 8: 109–166.
- Bolshakov CV, Shapoval AP, Zelenova NP (2002c) Results of bird trapping and ringing by the Biological Station "Rybachy" on the Courish Spit in 2001. *Avian Ecology and Behaviour* 9: 67–114.
- Bolshakov CV, Shapoval AP, Zelenova NP (2003) Results of bird trapping and ringing by the Biological Station "Rybachy" on the Courish Spit in 2002. *Avian Ecology and Behaviour* 10: 67–114.
- Bolshakov CV, Shapoval AP, Zelenova NP (2004) Results of bird trapping and ringing by the Biological Station "Rybachy" on the Courish Spit in 2003. *Avian Ecology and Behaviour* 12: 77–132.
- Bolshakov CV, Shapoval AP, Zelenova NP (2005) Results of bird trapping and ringing by the Biological Station "Rybachy" on the Courish Spit in 2004. *Avian Ecology and Behaviour* 13: 47–95.
- Bolshakov CV, Shapoval AP, Zelenova NP (2008) Results of bird trapping and ringing by the Biological Station "Rybachy" on the Courish Spit in 2005. *Avian Ecology and Behaviour* 14: 49–100.
- Bolshakov CV, Shapoval AP, Zelenova NP (2009a) Results of bird trapping and ringing by the Biological Station "Rybachy" on the Courish Spit in 2006. *Avian Ecology and Behaviour* 15: 49–85.

- Bolshakov CV, Shapoval AP, Zelenova NP (2009b) Results of bird trapping and ringing by the Biological Station "Rybachy" on the Courish Spit in 2007. *Avian Ecology and Behaviour* 16: 21–51.
- Bolshakov CV, Shapoval AP, Zelenova NP (2009c) Results of bird trapping and ringing by the Biological Station "Rybachy" on the Courish Spit in 2008. *Avian Ecology and Behaviour* 16: 53–89.
- Bolshakov CV, Shapoval AP, Zelenova NP (2010) Results of bird trapping and ringing by the Biological Station "Rybachy" on the Courish Spit in 2009. *Avian Ecology and Behaviour* 17: 25–60.
- Bolshakov CV, Shapoval AP, Zelenova NP (2011) Results of bird trapping and ringing by the Biological Station "Rybachy" on the Courish Spit in 2010. *Avian Ecology and Behaviour* 20: 9–52.
- Bolshakov CV, Shapoval AP, Zelenova NP (2012) Results of bird trapping and ringing by the Biological Station "Rybachy" on the Courish Spit in 2011. *Avian Ecology and Behaviour* 22: 55–100.
- Bolshakov CV, Shapoval AP, Zelenova NP (2013) Results of bird trapping and ringing by the Biological Station "Rybachy" on the Courish Spit in 2012. *Avian Ecology and Behaviour* 23: 51–91.
- Bolshakov CV, Shapoval AP, Zelenova NP (2014) Results of bird trapping and ringing by the Biological Station "Rybachy" on the Courish Spit in 2013. *Avian Ecology and Behaviour* 25: 27–60.
- Bub H (1969) *Vogelfang und Vogelberingung. Teil IV. Neue Brehm Bucherei*. Wittenberg Lutherstadt, 207 pp.
- Busse P, Cofta T (1986) Population trends of migrants at the Polish Baltic coast and some new problems in the interpretation of migration counts. *Vår Fågelvärld, Suppl.* 11: 27–31.
- Cramp S, Perrins CM (1993) *The Birds of the Western Palearctic. Vol. VII. Flycatchers to Shrikes*. Oxford University Press, New York, 577 pp.
- Dolnik VR, Payevsky VA (1976) Rybachy-type trap. In: Ilyichev VD (Ed.) *Ringing in the study of avian migration in the USSR*. Nauka, Moscow, 73–81. [In Russian]
- Dunn EH, Nol E (1980) Age-related migratory behaviour of warblers. *Journal Field Ornithology* 51: 254–269.
- Enquist M, Pettersson J (1986) The timing of migration in 104 species at Ottenby – an analysis based on 39 years trapping data. Special Report from Ottenby Bird Observatory no. 8. [In Swedish with English summary]
- Fransson T, Jansson L, Kolehmainen T, Kroon C, Wenniger T (2017) EURING list of longevity records for European birds. <https://euring.org/data-and-codes/longevity-list>
- Glutz von Blotzheim, UN (1993) *Handbuch der Vögel Mitteleuropas. Bd. 13. Passeriformes. Teil 4*. Aula-Verlag, Wiesbaden, 808 pp.
- Hagemeijer EJM, Blair M (Eds) (1997) *The EBCC Atlas of European Breeding Birds: their Distribution and Abundance*. T & A.D. Poyser, London, 903 pp.
- Jonzen N, Piacentini D, Andersson A, Montemaggiori A, Stervander M, Rubolini D, Waldenström J, Spina F (2006) The timing of spring migration in trans-Saharan migrants:

- a comparison between Ottenby, Sweden and Capri, Italy. *Ornis Svecica* 16(1–2): 27–33. <https://doi.org/10.34080/os.v16.22412>
- Karlsson L, Ehnbohm S, Persson K, Walinder G (2002) Changes in numbers of migrating birds at Falsterbo, South Sweden, during 1980–1999, as reflected by ringing totals. *Ornis Svecica* 12(3): 113–137. <https://doi.org/10.34080/os.v12.22825>
- Noskov GA, Afanasieva GA, Rymkevich TA (2020) Spotted Flycatcher. In: Noskov GA, Rymkevich TA, Gaginskaya AR (Eds) Migration of birds in Nord-West of Russia. Passeriformes. Renome, St. Petersburg, 247–251. [In Russian]
- Payevsky VA (1971) Atlas of bird migration according to the data of the ringing on the Kurische Nehrung. In: Bychowsky BY, Potapov RL (Eds) Bird Migrations: Ecological and Physiological Factors. Proceedings of the Zoological Institute of the Academy of Science of the USSR. Vol. I. Nauka, Leningrad, 3–110. [In Russian]
- Payevsky VA (1973) Reliability of information on bird migration routes according to banding data. *Ekologia* 2: 98–100 [In Russian]
- Payevsky VA (1998) Age structure of passerine migrants at the eastern Baltic coast: the analysis of the “coastal effect”. *Ornis Svecica* 8(4): 171–178. <https://doi.org/10.34080/os.v8.22942>
- Payevsky VA (2006) Mechanisms of population dynamics in trans-Saharan migrant birds: A review. *Entomological Review* 86, Suppl. 1: 82–94. <https://doi.org/10.1134/S001387380610006X>
- Payevsky VA (2008) Demographic structure and population dynamics of song birds. Association of Scientific Publications of the KMK, Moscow, 235 pp. [In Russian]
- Payevsky VA (2013) Speed of bird migratory movements as an adaptive behavior. *Biology Bulletin Reviews* 3(3): 219–231. <https://doi.org/10.1134/S2079086413030079>
- Payevsky VA, Shapoval AP (1998) Ringing efficiency of birds depending on their species, sex, age, season, and place of ringing. *Ornitologia* 28: 212–218.
- Payevsky VA, Shapoval AP (2013) The decline in the share of ring recoveries from ringed birds over the past 50 years: what are the causes of this phenomenon? *Ornitologia* 38: 24–31. [In Russian]
- Peklo AV (1987) Flycatchers of the USSR fauna. Naukova Dumka, Kiev, 180 pp. [In Russian]
- Ralph CJ (1978). Disorientation and possible fate of young passerine coastal migrants. *Bird-Banding* 49(3): 237–247.
- Shapoval AP (1994) The main results of the 30-year banding of birds by the Rybachy Biological Station on the Courish Spit of the Baltic Sea. In: Sokolov VE (Ed.) Ringing and tagging of birds in Russia and neighboring countries. 1986–1987. Nauka, Moscow, 42–49. [In Russian]
- Shapoval AP, Leoke DY, Zelenova NP (2017) Results of trapping and ringing of birds by the Biological station “Rybachy” on the Courish Spit in 2014. *Russian Journal of Ornithology* 26(1549): 5605–5627. [In Russian]
- Shapoval AP, Leoke DY, Zelenova NP (2018a) Results of trapping and ringing of birds by the Biological station “Rybachy” on the Courish Spit in 2015. *Russian Journal of Ornithology* 27(1561): 441–464. [In Russian]

- Shapoval AP, Leoke DY, Zelenova NP (2018b) Results of trapping and ringing of birds by the Biological station “Rybachy” on the Courish Spit in 2016. *Russian Journal of Ornithology* 27(1712): 6191–6215. [In Russian]
- Shapoval AP, Leoke DY, Zelenova NP (2019) Results of trapping and ringing of birds by the Biological station “Rybachy” on the Courish Spit in 2017. *Russian Journal of Ornithology* 28(1850): 5365–5388. [In Russian]
- Shapoval AP, Leoke DY, Zelenova NP (2021) Results of trapping and ringing of birds by the Biological station “Rybachy” on the Courish Spit in 2018. *Russian Journal of Ornithology* 30(2067): 2155–2185. [In Russian]
- Shapoval AP, Leoke DY, Zelenova NP (2022a) Results of trapping and ringing of birds by the Biological station “Rybachy” on the Courish Spit in 2019. *Russian Journal of Ornithology* 31(2157): 511–546. [In Russian]
- Shapoval AP, Leoke DY, Zelenova NP (2022b) Results of trapping and ringing of birds by the Biological station “Rybachy” on the Courish Spit in 2020. *Russian Journal of Ornithology* 31(2204): 2933–2954. [In Russian]
- Spina F, Baillie SR, Bairlein F, Fiedler W, Thorup K (2022) The Eurasian African bird migration Atlas. <https://migrationatlas.org>
- Stepanyan LS (2003) Summary of the ornithological fauna of Russia and adjacent territories (within the borders of the USSR as a historical region). Akademkniga, Moscow, 808 pp. [In Russian]
- Valkama J, Saurola P, Lehikoinen E, Piha M, Sola P, Velmala W (2014) The Finnish Bird Ringing Atlas. Vol. 2. Finnish Museum of Natural History and Ministry of Environment, Helsinki, 784 pp.
- Vinogradova NV, Dolnik VR, Yefremov VD, Payevsky VA (1976) Identification of the sex and age of passerine birds of the USSR fauna. Guide. Nauka, Moscow, 192 pp. [In Russian]
- Yakovleva MV, Sukhov AV (2020). Birds of the Kivach Nature Reserve and its surroundings. Forever, Petrozavodsk, 383pp. [In Russian]
- Zink G (1975) Der Zug europäischer Singvögel. Ein Atlas der Wiederfunde beringter Vögel. Lieferung 2. Vogelzug-Verlag, Möggingen.