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FACTORS AFFECTING HOUSE SPARROW *PASSER DOMESTICUS* DISTRIBUTION IN THE KANNUR DISTRICT OF KERALA, INDIA

ABSTRACT

House Sparrows are urban birds which are thought to be declining in differnt countires. The House Sparrow population in the Kannur district of Kerala in India was studied from March to May 2021 to understand the change in population and to identify the habitat variables that predict their distribution. A total of 914 House Sparrows were recorded from 61 sites. Compared with a previous study, the overall House Sparrow population declined by 27%. The sites having ration, grocery and chicken shops were found to have good House Sparrow populations. The presence or absence of roosting trees, old buildings, agricultural areas, and mobile towers didn't affect House Sparrow populations.

Key words: House Sparrow, Population, Habitat, Decline, Urban-semi urban-rural region

INTRODUCTION

House Sparrows *Passer domesticus* have developed a close association with humans. They inhabit urban areas and usually stay in colonies of 10-20 individuals (Shaw *et al.* 2008, Bhattacharya *et al.* 2011). They show a historical and symbiotic relationship with humans and human settlements and play an important role in the ecological balance (Anandan *et al.* 2014, Jhajhria 2020). The existence of House Sparrows in any area indicates the region's environmental stability and sustainable development (Modak 2015). They are omnivorous birds that feed mainly on grains, cereals, seeds, fruits, fruit buds, flower nectar, food waste, insects and insect larvae (Rajashekar and Venkatesha 2008; Aheer *et al*. 2018). House Sparrows are sedentary birds and do not more than 1 or 2 km from their nesting colony (Robinson *et al*. 2005).

In India, House Sparrows number has been fairly stable overall during the past 25+ years except for cities where a gradual decline was noted (SoIB 2020). But few studies in Andhra Pradesh, Tamil Nadu, Karnataka and Uttarakand reported a decline in population (Gosh *et al.* 2010, Balaji *et al.* 2013, Hussain *et al.* 2014 Paul 2015, Naik 2018, Deepalakshmi and Salomi 2019, Sharma and Binner 2020, Renukadevi

et al. 2021). Studies in Kerala also indicated a decline (Dandapat *et al.* 2010). A study suggested the local extinction of House Sparrows in Trivandrum City of Kerala (Raju 2015). We have been monitoring the House Sparrow population in the Kannur district of Kerala and were working closely with the public, installing nest boxes each year to support the species (Roshnath *et al.* 2018).

Several factors are suggested to be responsible for the decline of House Sparrows, such as lack of food source (Jhajhria 2020), foraging area and habitat loss (Teotia *et al.* 2017, Anandan *et al.* 2014), and nesting space (Singh *et al.* 2013). Infrastructure development such as widening highways have caused the removal of roosting trees affecting the House Sparrow population highways (Singh et al. 2013; Balwan and Saba 2020). Also, intensive rates of pollution (Ghosh *et al.* 2010, Balmori and Hallberg 2007) and electromagnetic radiation from towers (Pradha 2015; Mahesh and Lanka 2021) were suggested to affect House Sparrows.

House Sparrows prefer urban and suburban areas to rural regions (Herrera-Dueñas *et al.* 2017, Moudrá *et al.* 2018). The extent of green cover which provides food, nesting and roosting places is an important factor in determining the House Sparrow distribution in urbanized regions (Chamberlain *et al.* 2007, Bernat-Ponce *et al.* 2018). Thus, the present study aims to understand and compare the House Sparrow population in the Kannur district of Kerala and the habitat variables that predict their distribution.

STUDY AREA

The study was carried out in the Kannur district (11.9709° N, 75.6208° E) of Kerala which is the second northernmost district of Kerala, with an area of 2,966 km^2 (Fig. 1). The land use or land cover in the Kannur district is residential with agriculture (44.56%), forest (14.69%), water bodies (2.69%) and built-up areas (8.20%) (District Urbanisation Report, 2011). The study was conducted from March to May 2021.

METHODS

A press release was published in all leading newspapers in the district (with the details of the project and contact numbers) to identify the

Fig. 1. Study area

potential House Sparrow areas in Kannur District (Roshnath *et al.* 2018). Locations of House Sparrows were also collected from the platform eBird where birdwatchers upload their findings. House Sparrows were counted in the morning from 6 to 8 a.m. by the same observer. The number of House Sparrows was then compared with the number found in a previous study in 2005 (Roshnath *et al.* 2018).

Binoculars (Celestron 8×45) were used when searching for House Sparrows and the total number of individuals (males and females separately, if possible) were noted. Further information collected concerned the type of study site, i.e., urban or semi urban according to the District Urbanisation Report, Kannur (2011). The absence or presence of old buildings, roosting trees, and food sources such as hotels, ration shops, grocery shops, chicken shops, residential areas, agriculture fields, and mobile towers was also noted (Fig. 3).

Old buildings are those constructed before 1990, with a tiled roof, shutters and other space for nests. Buildings with concrete roofs, walls made of glass and false celling were considered to be new buildings. Small and medium-sized trees (less than 5 m) are selected by House Sparrows for roosting (Dhanya and Azeez 2010). Thus, we have only noted the presence of such trees in each site. The presence of House Sparrows in each site was considered as a response variable in the models to predict the variables affecting the distribution. We used Generalized Linear Models (GLM) to compare the effects of variables on the House Sparrow count, with the lme4 package in R 3.2.1 (R Core Team 2014). The Shapiro-wilks test was employed for testing the normality of data. The difference in House Sparrow population from 2015 to 2021 was assessed by using Wilcoxon sign rank test. All the statistical procedures were carried out in R (version 4.0.3), considering a level of significance of $p <= 0.05$.

RESULTS

A total of 914 House Sparrows were recorded during the entire survey (220 individuals in urban and 694 in semi-urban areas) and the number of individuals varied across sites (Fig. 3). The House Sparrow population was found to be decline by 27% while comparing the previous study Roshnath *et al.*, (2018). Decline in House Sparrow population from 2015 (15.8±12.6SD) to 2021 (11.5±13.9SD) was significant ($p = 0.01$). A considerable increase in population was found only in three sites (Irrikur, Thaliparamba and Old Bus Stand-Kannur) while seven sites showed a marginal increase (< 10 individuals). A steady population decline was found in 9 sites (> 10 individuals) and a marginal decline (< 10 individuals) in 15 sites (Table 1).

The distribution of House Sparrows were predicted by the variables presence of ration shop ($R^2 = 0.005$, $p = 0.005$), grocery shops ($R^2 = 0.06$, $p = 0.04$), and chicken shop ($R^2 = 0.08$, $p = 0.02$) and the interaction between these factors ($F(3,55) = 5.30$, $P = 0.002$, $R^2 = 0.22$). Mobile towers were present in 41 sites (68.3%) but didn't have any influence on the presence of House Sparrows ($R^2 = 0.01$, $p = 0.38$).

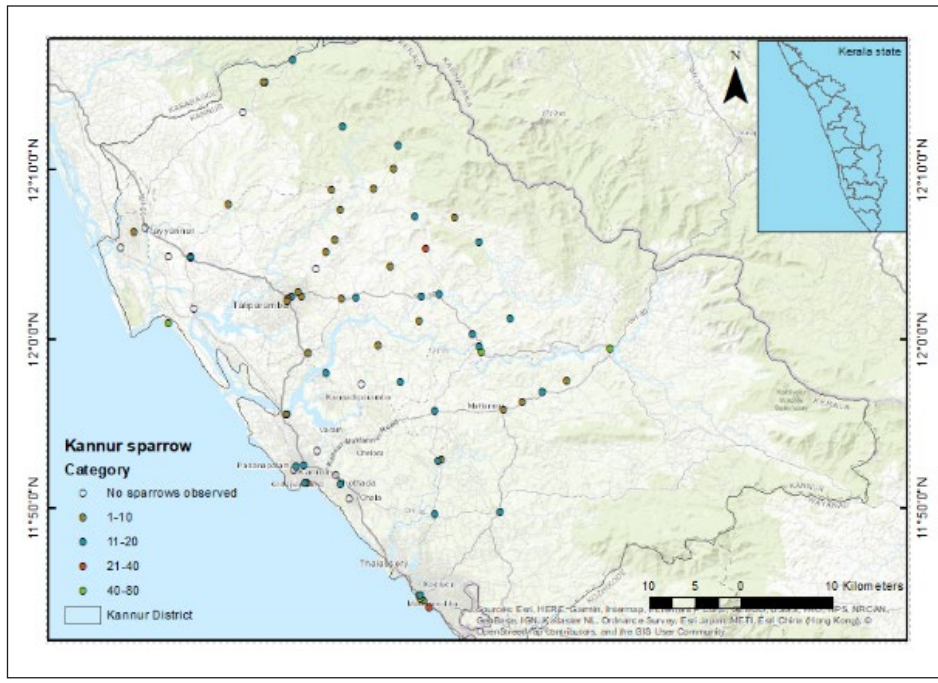

Fig. 2. House Sparrow distribution across the Kannur District of Kerala

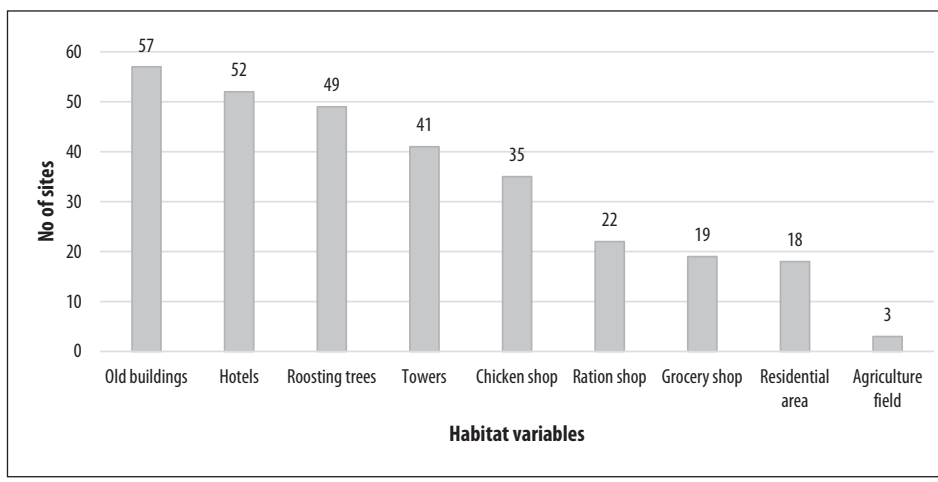

Fig. 3. Frequency of habitat types found on the House Sparrow study sites

Table 1. Number of House Sparrow individuals in all study sites investigated 2015 and 2021

Site	No of Individuals (percentage)		Difference
	2015	2021	
Irikkur	6 (1.0)	60 (14.8)	54
Thaliparamba	13 (2.3)	43 (10.6)	30
Old bus stand (Kannur)	5 (0.9)	16 (4.0)	11
Thalassery old bus stand	17 (3.1)	25 (6.2)	8
Cherupuzha	8 (1.4)	13 (3.2)	5
Chuzhali	3 (0.5)	7 (1.7)	4
Mambaram	8 (1.4)	11 (2.7)	3
Mattannur	5 (0.9)	8 (2.0)	3
Kambil	10 (1.8)	12 (3.0)	2
Therthally	19 (3.4)	20 (4.9)	1
Madarisa (Thaliparamba)	3 (0.5)	3 (0.7))	0
Anjarakkandy	15 (2.7)	14 (3.5)	-1
Ayikkara	36 (6.5)	35 (8.7)	-1
Thazhechovva	2 (0.4)	0	-2
Pallipparamba	3 (0.5)	0	-3
Shoprix – thaliparamba	7 (1.3)	4 (1)	-3
Kakkad	5 (0.9)	0	-5
Muzhappilangad	5 (0.9)	0	-5
Kannur market	6 (1.1)	0	-6
Koottupuzha	6 (1.1)	0	-6
Parassinikadavu	6 (1.1)	0	-6
Kurumathur	20 (3.6)	13 (3.2)	-7
Kanjirangad (Thaliparamba)	8 (1.4)	0	-8
Peringome	8 (1.4)	0	-8
Manna	22 (4.0)	12 (3.0)	-10
Blathoor	25 (4.5)	15 (3.8)	-10
Sreekandapuram	30 (5.4)	19 (4.7)	-11
Mattambram mosque	16 (2.9)	2 (0.5)	-14
Chalil (Thalassery)	49 (8.86)	35 (8.7)	-14
Payyanur	22 (4.0)	5 (1.2)	-17
Chemberi Town	30 (5.4)	11 (2.7)	-19
Chalode	33 (6.0)	13 (3.2)	-20
Malapattam	30 (5.4)	8 (2.0)	-22
Nedumpoyil	30 (5.4)	0	-30
Thottada	42 (7.6)	0	-42
Total	**553**	**404**	**-149**

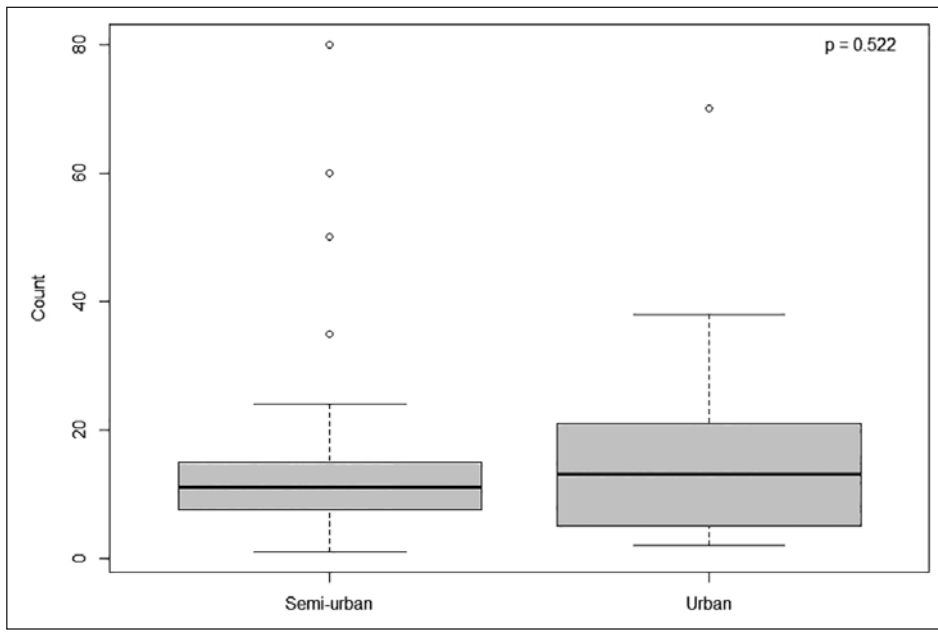

Fig. 4. Box plot showing the House Sparrow count across different sites

DISCUSSION

Urban areas of low socioeconomic status were extensively used by House Sparrows due to the availability of food, foraging ground and nesting space (Choudhary *et al.* 2019). Urbanization and industrialization, leading to the loss of suitable foraging and nesting spaces have contributed much to the declining House Sparrow populations (Pineda *et al.* 2013, Choudhary *et al.* 2019). The presence of grocery shops, ration shops and chicken stalls positively influenced habitat selection by House Sparrows, while agricultural areas, old buildings, hotels, roosting trees and residential areas showed a negative correlation with habitat selection.

Grocery shops and ration shops are very important sources of food, where cereals, millets and food waste are easily available for the House Sparrows. Apart from eating grains openly available for sale, fallen or discarded, House Sparrows pick insects from the grain and vegetables. Chicken shops mostly have fallen feeds under the cages which is another food source. We found a comparatively high population of House Sparrows associated with these shops.

Terminalia catappa, *Trema orientalis*, *Mimusops elengi*, *Samanea saman, Cassia fistula*, Ficus spp., *Mangifera indica*, *Macaranga peltata*, *Tamarindus indica*, *Psidium guajava*, Bougainvillea spp., etc. were the common roosting trees found in study sites. House Sparrows are known to roost in trees with a height of less than 5 m (Dhanya and Azeez 2010). The availability of roosting trees was suggested to be a factor limiting the

House Sparrow population (Patel and Dodia 2021), but we didn't find any significant relationship between the presence of roosting trees and House Sparrow numbers.

Towns in Kannur are rapidly being renovated and modernised. Old buildings with crevices and holes in walls, gaps under the roofs or on shutter's roller boxes offer the most suitable nest sites for House Sparrows (Paul 2015). Even though most of the sites surveyed had old-fashioned buildings, we couldn't find any hike in population when compared with sites having new buildings.

Even though House Sparrows are granivorous, they are not observed near agricultural fields, which may be simply due to the lack of agricultural fields in urban areas or the presence of predators (Choudhary *et al.* 2019). House Sparrows are found mostly in urban areas, and the reason for the decline House Sparrow numbers in human settlement in India has not yet been identified (Sudhira and Gururaja 2013). Residential areas with preferred trees, shrubs and the presence of a home garden will attract the House Sparrows (Kanaujia *et al.* 2014). In this study, the residential areas didn't have any influence on the House Sparrow population, maybe due to the lack of the above mentioned components.

Radiation from the mobile tower was suggested to be one of the reasons for the decline of House Sparrows, but there is no serious evidence for this assumption (Samson and Ramakrishnan 2020). The continuous exposure of higher degree of electro magnetic radiations from mobile towers was suggested to affect House Sparrow behaviour, as well as the abundance of House Sparrows and can result in a decline (Everaert and Bauwens 2007) and embryo mortality (Singh *et al.* 2017). But some studies also suggested House Sparrows are known to withstand electromagnetic radiations (Mahesh and Lanka 2021). 41 out of our 60 study sites had mobile towers and we couldn't find any significance relationship between the number of House Sparrows and presence of towers.

House Sparrows have been studied in urban study for quite some time, and most studies suggest a population decline all over India and elsewhere. The results of the present study fit into this general picture. Sites with provision for food such as ration, grocery and chicken shops had high House Sparrow numbers. The presence of roosting trees and old buildings are generally thought to positively influence House Sparrow populations was found to be of less significance in our investigation. More intensive studies on tree abundance and nest site selection can help in better understanding basic ecological requirements of the House Sparrow. Urbanisation will adversely affect overall biodiversity, including the House Sparrow. An increase in green areas and provision of nest sites and food would help to sustain the House Sparrow populations.

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REFERENCES

Aheer M.W., Nazish H., Shah F. and Baloch W.A. 2018. First time record of house sparrow species occurs in different areas of province Sindh, Pakistan. International Journal of Scientific & Engineering Research, 9(7): 1601-1611.

Anandan G., Kumaresan M., Thomas A., Benickson C., Devi R.C., Geethu M., Augustine J., Kavipriya J., Mithun Raj M. and Shiva R. 2014. The house sparrow is homeless: a small attempt to conservation. Journal of Biodiversity & Endangered Species, 2(2): 2-5. https://doi: 10.4172/2332-2543.1000124.

Balaji S., Baskaran S., Rajan M.K. and Pavaraj M. 2013. Investigating the causes for the decline and strategies to conserve house sparrow, Passer domesticus in Sivakasi taluk, Virudhunagar district, Tamil Nadu, India. World Journal of Zoology, 8(3): 278-284.

Balmori A. and Hallberg Ö. 2007. The urban decline of the house sparrow (Passer domesticus): a possible link with electromagnetic radiation. Electromagnetic Biology and Medicine, 26: 141-151.

Balwan W.K. and Saba N. 2020. Decline of house sparrow and common myna population in doda region of Jammu and Kashmir, India. International Journal of Biological Innovations, 2(1): 20-24. https://doi.org/10.46505/IJBI.2020.2103.

Bernat-Ponce E., Gil-Delgado J.A. and Guijarro D. 2018. Factors affecting the abundance of house sparrows passer domesticus in urban areas of southeast of Spain areas of southeast of Spain. Bird study, 65(3): 404-416. https://doi.org/10.1080/00063657.2018.1518403.

Bhattacharya R., Roy R. and Goswami C. 2011. Studies on the response of house sparrows to artificial nest. International Journal of Environmental Science, 1(7): 1574-1581. https://doi: 10.1080/15368370701410558.

Chamberlain D.E., Toms M.P., Cleary-McHarg R. and Banks A.N. 2007. House sparrow (Passer domesticus) habitat use in urbanized landscapes. Journal of Ornithology. https://doi.org/10.1007/s10336-007-0165-x.

Choudhary S., Singh N. and Kalsi R. 2019. Seasonal habitat selection by house sparrows across the urbanization matrix in Delhi, India. Journal of Wildlife and Biodiversity, 3(4): 57-65. https://doi.org/10.22120/jwb.2019.113270.1084.

Dandapat A., Banerjee D. and Chakraborty D. 2010. The case of the disappearing house sparrow (Passer domesticus Indicus). Veterinary World, 3(2): 97-100.

Deepalakshmi S. and Salomi A.A. 2019. Impact of urbanization on house sparrow (Passer domesticus) diversity from Erode and Namakkal districts, Tamilnadu, India. International Journal of Advanced Research in Biological Sciences, 6(11): 22-27. http://doi.org/10.22192/ijarbs.2019.06.11.004.

District Urbanisation Report, Kannur 2011. Department of town & country planning, Kerala.

Dhanya R. and Azeez P.A. 2010. The house sparrow Passer Domesticus population of Arakku township, Andhra Pradesh, India. Indian Birds, 5(6): 180-181.

Everaert J. and Bauwens D. 2007. A possible effect of electromagnetic radiation from mobile phone base stations on the number of breeding house sparrows (Passer Domesticus). Electromagnetic Biology and Medicine, 26: 63-72.

Ghosh S., Ki-Hyun K. and Bhattacharya R. 2010. A survey on house sparrow population decline at Bandel, West Bengal, India. Journal of the Korean earth science society 31(5): 448-453.

Herrera-Dueñas A., Pineda-Pampliega J., Antonio-García M.T., Aguirre J.I. 2017. The influence of urban environments on oxidative stress balance: a case study on the house sparrow in the Iberian Peninsula. Frontiers in Ecology and Evolution, 5(106): 1-10. https://doi.org/10.3389/fevo.2017.00106.

Hussain A., Dasgupta S. and Bargali H.S. 2014. Case of house sparrow (Passer domesticus) population decline: role of semi nomadic pastoralist community (Van Gujjar) in their community. International Journal of Conservation Science, 5(4): 493-502.

Jhajhria A. 2020. A review on the need for conserving the house sparrow in India. Journal of Entomology and Zoology Studies, 8(2): 1157-1159.

Kanaujia A., Kumar A. and Kumar A. 2014. Spatial distribution and habitat preference of the house sparrow (Passer Domesticus) in urban, semi-urban and rural landscape of Lucknow and Its Neighboring Areas, Uttar Pradesh, India. Biodiversity and Environment.

Mahesh V. and Lanka S. 2021. Global scenario and conservation status of house sparrow (Passer Domesticus). Food and Agriculture: 528-47.

Modak B.K. 2015. Impact of Urbanization on House Sparrow Distribution: A Cae Study from Greater Kolkata, India. Proceeding of the Zoological Society., 70(1): 21-27.

Moudráa L., Zasadilb P., Moudrýa V. and Šálekb M. 2018. Landscape and urban planning what makes new housing development unsuitable for house sparrows (Passer domesticus)?. Landscape and Urban Planning, 169: 124-130. http://dx.doi.org/10.1016/j.landurbplan.2017.08.017.

Naik S.P. 2018. Rapid study of house sparrows (Passer Domesticus) in Moodbidri. conference on conservation and sustainable management of ecologically sensitive regions in Western Ghats: 290-293. http://ces.iisc.ernet.in/energy.

Patel F.P. and Dodia P.P. 2021. Roosting patterns of house sparrow Passer domesticus linn., 1758 (aves: passeridae) in Bhavnagar, Gujarat, India. Journal of Threatened Taxa, 13(14): 20209-20217. https://doi.org/10.11609/jott.6631.13.14.2020920217.

Paul M.R. 2015. A review of house sparrow population decline in India. Asia Pacific Journal of Research, 1(29): 38-40.

Pineda J., Herrera A., Antonio M.T. and Aguirre J.I. 2013. Urban models and their effects on immune system of house sparrow (Passer Domesticus L.) populations in central Spain. Vertebrate Biology and Conservation: 185.

Pradha L. 2015. Impact of electromagnetic radiations on house sparrows (Passer domesticus). International Journal of Engineering Research & Technology (IJERT), 4(07): 93-96.

Rajashekar S. and Venkatesha M.G. 2008. Occurrence of house sparrow, Passer domesticus Indicus in and around Bangalore. Current Science, 94(4): 446-449.

Raju S. 2015. Population trend of the common birds in a residential area of Thiruvananthapuram city, Kerala. Indian Birds, 10(2): 40-45.

Renukadevi K., Maxmillion M.E., Angayarkanni P.S. and Rajendran P. 2021. Exploratory data analytics to study the impact of parameters to enhance the population of house sparrow (Passer domesticus). Research Square: 1-21. https://doi.org/10.21203/rs.3.rs-440060/v1.

Robinson R.A., Siriwardena G.M. and Crick H.Q.P. 2005. Size and trends of the house sparrow passer domesticus population in Great Britain. British Ornithologists' Union, Ibis, 147: 552-562.

Roshnath R., Arjun C.P., Ashli J., Sethu D. and Gokul P. 2018. Short communications status survey and conservation of the house sparrow Passer domesticus (Aves: passeriformes: passeridae) through public participation in Kannur, Kerala, India status survey and conservation of the house sparrow. Journal of Threatened Taxa, 10(8): 12098-12102. http://doi.org/10.11609/jott.3528.10.8.1209812102.

Samson A. and Ramakrishnan B. 2020. Conservation of house sparrow (Passer domesticus): people perception in upper Nilgiris, Tamil Nadu, India. Ambient Science, 7(2). https://doi.org/10.21276/ambi.2020.07.2.

Sharma P. and Binner M. 2020. The decline of population of house sparrow in India. International Journal of Agricultural Science, 5: 1-4.

Shaw L.M., Chamberlain D. and Evans M. 2008. The house sparrow Passer domesticus in urban areas: reviewing a possible link between post-decline distribution and human socioeconomic status. J Ornithol. http://doi.org/10.1007/s10336-008-0285-y.

Singh R.K., Durgam D.K. and Sao S. 2017. Effect of mobile tower radiation on birds in Bijapur district, Chhattisgarh. World Journal of Pharmacy and Pharmaceutical Sciences, 6(9): 1221-1229. http://doi.org/10.20959/wjpps20179-9989.

Singh R., Kour D.N., Ahmad F. and Sahi D.N. 2013. The causes of decline of house sparrow (Passer domesticus, linnaeus 1758) in urban and suburban areas of Jammu region, J & K. Munis Entomology and Zoology, 8(2): 803-811.

SoIB. 2020. State of India's Birds, 2020: Range, trends and conservation status. The SoIB partnership: 50.

Sudhira H.S. and Gururaja K.V. 2013. Of house sparrows and human settlements-distribution of house sparrows in Bangalore, India.

Teotia D.S., Yadav A., Kumar V. and Kumar A. 2017. Study of the declining population of 'house sparrow' (Passer domestics) in urban and suburban areas of India. Life Science Leaflets, 4297: 1-11. http://lifesciencesleaflets.petsd.org/.

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BREEDING ECOLOGY OF THE TREE SPARROW IN WESTERN POLAND

ABSTRACT

From 2013 to 2015, the Lubuskie Landscape Parks Complex implemented a project for the active protection of the Tree Sparrow (*Passer montanus*). Nest boxes were installed in all Lubuskie Landscape Parks, and the rate of occupancy as well as the breeding process was monitored. The aim of the study was to describe selected parameters of biology and reproductive ecology of the Tree Sparrow population breeding in the nest boxes. The most important parameters for the development of the Tree Sparrow population in the study are as follow: Egg laying started from mid-April, exceptionally in early April, with the 02.04.2013 as earliest date; analysis of the first-egg laying date showed a significant difference between years; clutch size varied between 2 and 8 eggs, and was most often 4-6; mean clutch size was 5.0; breeding success was 73.0%; overall, 393 broods could be monitored completely, with a total of 1,973 eggs and 1,518 nestlings (76.9%). 1,215 fledglings left the nest, corresponding to 61.6% of all eggs laid and 80.0% of all nestlings. Approximately 27% of all nestlings (N=113) did not survive. The basic breeding parameters, such as beginning of egg laying, clutch size, breeding success and reasons for breeding failure of the study reported here do not differ significantly from the results of other studies.

Key words: Tree Sparrow *Passer montanus*, Landscape Parks, Lubuskie Province (Western Poland), breeding ecology (laying date, clutch size, breeding success)

INTRODUCTION

The Eurasian Tree Sparrow *Passer montanus* is found throughout almost all of Europe and Asia, reaching the Far East and south-east Asia, but avoids the northern parts of the continents (del Hoyo, Collar 2016). The species is strongly associated with humans,

inhabiting the edges of human settlements bordering agricultural areas, gardens, and orchards. It avoids dense forest complexes (Kuczyński, Chylarecki 2012). Its number in Poland was estimated at 1.2-1.7 million pairs (Chodkiewicz et al. 2015). Between 2010 and 2016, the abundance index in Poland showed a moderate increase (Chylarecki et al. 2018). In western Europe, the number of Tree Sparrows decreased significantly at the end of the 20th century, but such pronounced changes were not recorded in the central part of the continent. Currently, since the beginning of the 21st century, the decline is still observed in western Europe, in contrast to the northern and central-eastern part of the continent, where stable and increasing trends prevail. However, the overall trend for Europe indicates a decline (Chylarecki et al. 2018).

Fluctuations in the size of the Polish Tree Sparrow population are coupled to weather conditions in the winter preceding the breeding season. Decreasing numbers of the Tree Sparrow during harsh winters are probably related to unsufficient availability of basic food, i.e. seeds of weeds typical of root crops. It is generally assumed that the intensification of agriculture, and particularly the increase in pesticide use, will have a negative impact on the numbers of the Tree Sparrow in Poland. However, with progressive climate warming, the Tree Sparrow population may be more limited by the availability of nesting sites and may benefit from an increase in the proportion of built-up areas in the rural landscape (Kuczyński, Chyralecki 2012). From 2013 to 2015, the Lubuskie Landscape Parks Complex implemented a project for the active protection of the Tree Sparrow. Nest boxes for the species were installed in all Landscape Parks, and rate of occupancy as well as breeding process was monitored. The aim of the study was to describe selected parameters of biology and reproductive ecology of the Tree Sparrow population breeding in the nest boxes.

STUDY AREA

The study was conducted in seven Landscape Parks of the Lubuskie Province (Western Poland): GPK – Gryżyński, BGPK – Barlinecko-Gorzowski, KPK – Krzesiński, ŁSPK – Łagowsko-Sulęciński, PKŁM – Łuk Mużakowa, PKU-W – Ujście Warty, PPK – Pszczewski Landscape Park. The Lubuskie Province is locatedin West-Central Poland, in a lowland area with morinal geological structures. The main rivers are Odra, Nysa Łużycka, Bóbr, Warta, Noteć, and Obra. The province is one of the most densely wooded (49%) areas of all Polish provinces. A mosaic structure dominates, with large agricultural areas with settlements occurring in forests. The climate is one of the mildest in Poland, with mean annual temperature of 8.5°C, mild winters, and and an average annual precipitation of 500-600 mm. Only two-fifths of the Lubuskie Province is arable. The main crops cultivated are cereals, sugar beets, rapeseed, hops, and potatoes. In each of the investigated Landscape Parks, one village mainly located in agricultural landscape and/or partly forested area was selected for the study. Nest boxes formed seven colonies.

The area of the Gorzowski Landscape Park is 12,261.8 ha. It reached its present size in 2021 by the transformation of a part of the Barlinecko-Gorzowski Landscape Park, also located in the Lubuskie Province. The park lies entirely in the Gorzów Plain (macro-region), which is a vast, slightly undulating sand land, characterised by dry and sandy ground. Forests dominate and cover about 81% of the area. These are mainly fresh mixed forests and fresh mixed coniferous forests, but vibrant wetlands with the typical fauna and flora can also be found. In the Gorzowski Landscape Park the settlement Łośno (Kłodawa commune) was chosen for the study. Łośno is located in a forest landscape. The village consists of semi-detached housing estates with farm buildings, small gardens and only one tree cluster in a centre of the village, but no tree lines. Pine trees dominate in waste grounds of the village. 33 nest boxes were put up on pine trees on the hill in the village centre, and 10 on pine trees near the forest edge.

The Gryżyński Landscape Park covers an area of 3,064.8 ha. The aim of the park is to protect and preserve the landscape and its natural values of the post-glacial trough and ponds, lakes and valley of the Gryżyński Creek (Gryżynka). 86.6% of the Park's area is covered by forest. There are five lakes in the park area, with Jelito (49.9 ha) being the largest, followed by Kałek (24.3 ha), Jatnik (12 ha), Grabinek (8 ha), and Bagienko (2.2 ha), as well as a dozen fish ponds. Nest boxes in the Gryżyński Landscape Park were put up on oak trees in the village of Grabin (Bytnica commune). Characteristic of the village is an oval development with the manor house in the centre. Oak, lime and elm trees with sloe and snowberry shrub surround the village.

The Krzesiński Landscape Park, with an area of 8,564.0 ha, is located in the middle course of the Oder River,. It is a breeding ground for numerous bird species, and has a specific flora and wetland vegetation. The village of Kłopot harbors one of the largest White Stork colonies in Poland. The park includes the dry floodplain Krzesin-Bytomiec (about 1,600 ha), as well as the glacial lake Krzesińskie, located in the southern part of the park. In the Krzesiński Landscape Park, nest boxes were put up in the village of Kłopot (municipality of Cybinka) with its compact terraced housing. The village trees form roadside avenues and a line along the drainage canal. Lime, alder and poplar species dominate.

The Pszczewski Landscape Park covers an area of 9,724.0 ha and includes numerous lakes in the Obra River valley, such as Lubikowskie (327 ha), Wielkie, Konin, Piecniewo, Rybojadło, Chłop and Szarcz. The relief of the area is varied. There are various types of landscape (moraine, sandstone, valley) with post-glacial lakes, eskers, sandstone, river valleys with oxbow lakes and others. Most of the Park's area is covered by national forests. The main purpose of establishing the park was to protect and preserve the landscape with its natural, cultural and didactic values. The village of Stołuń with its spotty semidetached houses (Pszczew commune) was chosen for the study. In the village exist tree lines, house gardens and a pine forest near lake Stołuń. Nest boxes were placed in three groups on pine trees, alders and acacia clusters.

The Ujście Warty Landscape Park covers an area of 17,697.9 ha to protect plant communities characteristic of riverine ecosystems. Two large rivers, the Oder and the Warta, intersect in the park, shaping the character of the area. The landscape is dominated by extensive meadows , pastures and arable fields. It is a sanctuary for, among others, wetland birds and birds of prey. For the study, an open area between the two settlements Białczyk and Pyrzany was chosen. In this study site two pine tree forest fragments exists, each covering an area of 4 ha. The nest boxes were placed on the pine-forest wall in four rows.

The Łagowsko-Sulęciński Landscape Park, with an area of 5438.5 ha, includes forests (over 65% of the area), lakes (Trześniowskie, Łagowskie, Buszno, Buszenko, Linie, Bobrze, Czarne, and Majątkowe), arable land (approx. 18%), meadows (approx. 5%) and built-up areas (approx. 4%). The park was created to preserve and protect the natural post-glacial landscape, fauna, flora, their natural habitats, as well as the cultural values of its area. In the Łagowsko-Sulęciński Landscape Park the study was carried out in a buffer zone in Jemiołów (Łagów commune). Characteristic are semi-detached houses with a manor house near a pond. There is one lime tree and 40 m^2 of bushes near the kindergarten square.

The Łuk Mużakowa Landscape Park covers 18,714.0 ha. The purpose of the park is to protect the Polish part of the end moraine, shaped by glaciation. The park abounds in many natural peculiarities, as a result of the diversity of natural habitat conditions, such as relief, significant water resources, and the clash of different microclimates. The nest boxes in the Łuk Mużakowa Landscape Park were hung up in the village of Cielmów (Tuplice commune), characterized by loose terraced housing. Trees growing in the village have a park-like arrangement or grow in single groups. Linden, maple trees and pine dominate.

MATERIAL AND METHODS

In the seven Landscape Parks a total of 300 nest boxes for the Tree Sparrow were installed. At each study site 43 nest boxes (except Łuk Mużakowa: 42) were placed in colonies 4-5 m high on trees, with a minimum distance of 5 m between trees. The study was carried out in each breeding season, i.e. from April to July, of 2013, 2014 and 2015. Each year, all nest boxes were controlled at least 16 times. Recorded for each nest were date of the first egg laid and the clutch size. After each breeding season all nest boxes were cleaned. The study was approved by the Regional Director of Environmental Protection (Regionalny Dyrektor Ochrony Środowiska) in Gorzów Wielkopolski under WPN-I.6401.56.2013.KA, 22.02.2013.

The total number of Tree Sparrow nest box broods that could be analyzed was 419. The respective number for each separate study site was: KPK – 180, ŁSPK – 74, PKUW – 63, GPK – 41, PKŁM – 26, GPK – 18, and PPK 17. A nest with at least 1 egg was considered as a breeding attempt and included in the analysis. The date of the

first egg laid in the nest was considered as the start of breeding. That date could be determined directly in cases when boxes were checked during the period of egg laying. It was extrapolated if the first check could only be done later, i.e. during incubation stage or when already nestlings had hatched, on the basis of the nestlings' age. In the latter case, the following assumptions were made (Summers-Smith 1989): The Tree Sparrow lays one egg per day, and incubation (the period from laying of the last egg to hatching of the last nestling) lasts 11-14 days. The number of eggs in nests found during the incubation period was recorded as the complete clutch size. Broods were considered successful when at least one nestling fledged, or when a nestling at the time of the last inspection was capable of leaving the nest during an assumed predator attack. Overall breeding success was measured as the ratio of the number of successful nests, i.e. when nestlings fledged, to the number of all nests in which at least one egg was laid. Nesting success (the ratio of hatched nestlings and fledglings leaving the nest to the number of eggs laid) was only analyzed for nests which could be checked several times and for which clutch size, number of nestlingss and number of fledglings were determined. As nest failures were considered cases in which entire clutches or broods were lost or with clear indication that the nest had been abandoned. Cases when single eggs of nestlings disappeared between inspections were recorded as partial losses. Semi-monthly periods or decades from the beginning of April to the end of July were used for an analyses of seasonal variation in clutch size, breeding success, and breeding productivity. Individual broods were assigned to a particular period based on the date of clutch initiation. For the analysis of the timing of first egg laying, only first broods were used, assuming that they had started by the end of the second decade of May. The following statistical tests were used: one-way ANOVA, chi-square test, and Kruskal--Wallis test (each done with STATISTICA 13.3 PL).

RESULTS

Laying date

The breeding season for the Tree Sparrow varied considerably over the three study years, and some birds produced two to three broods per season. Egg laying started at mid-April, exceptionally in early April, with the 02.04. as the earliest date recorded, in 2013 (LSPK). The last broods started in mid-July. The latest date of the first egg layed was the 17.07., in 2014 (KPK). Two breeding peaks were recorded, in the second and third decade of April (presumably first broods) and the first decade of June (presumably second broods). A slight increase in breeding accessions was also recorded in the first decade of July (probably third and repeated broods) (Fig. 1). An analysis of the date of clutch initiation (first egg) of the first brood (started by the end of the second decade of May) showed a significant difference between years ($H_{2,13} = 45.6$; $p < 0.001$, Fig. 2).

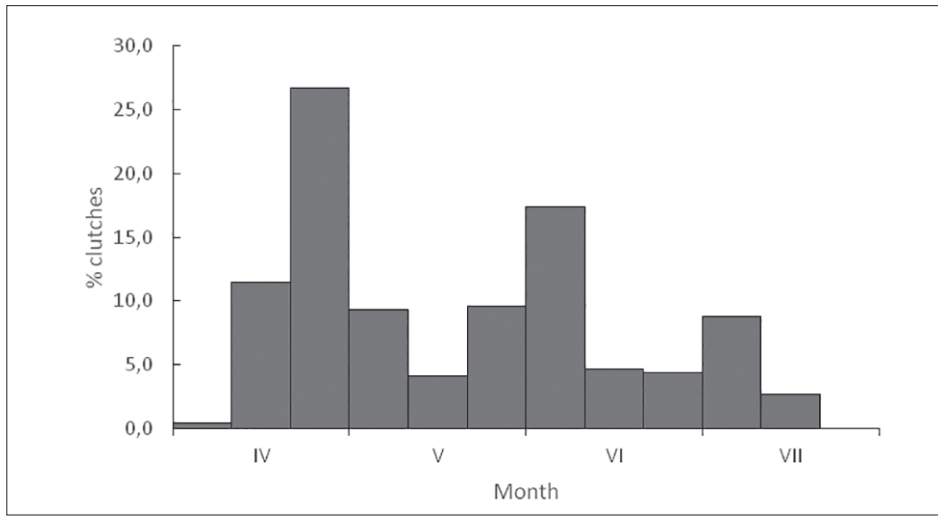

Fig. 1. Distribution of clutch initiation (first egg) over decades in Landscape Parks of Lubuskie Province (N = 407)

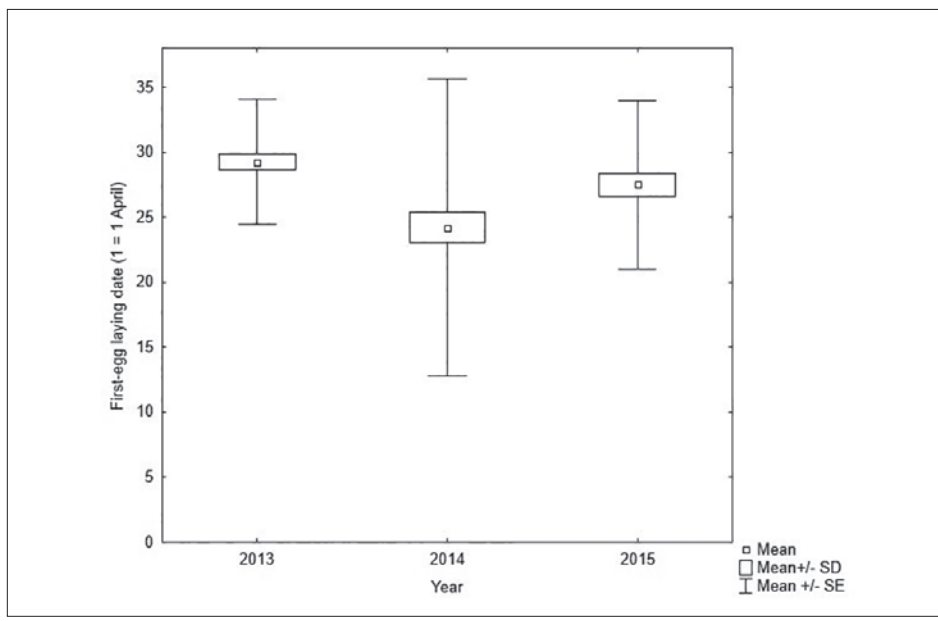

Fig. 2. Mean date (+/- SD and SE) of clutch initiation (first egg) in the three study years

Clutch size

Most often clutches had 4-6 eggs (96.7% of all cases), with 2 and 8 eggs as extreme values (Fig. 3). Mean clutch size was 5.0 (SD = 0.8; N = 393). Clutch size varied within the breeding season (Tab. 1), with significant differences between half-month periods ($F_{7,373} = 4.7556$, $p = 0.00004$; Fig. 4). There were no differences in clutch size between the three study years ($F_{2,378} = 0.18534$, $p = 0.83$ (Tab. 2).

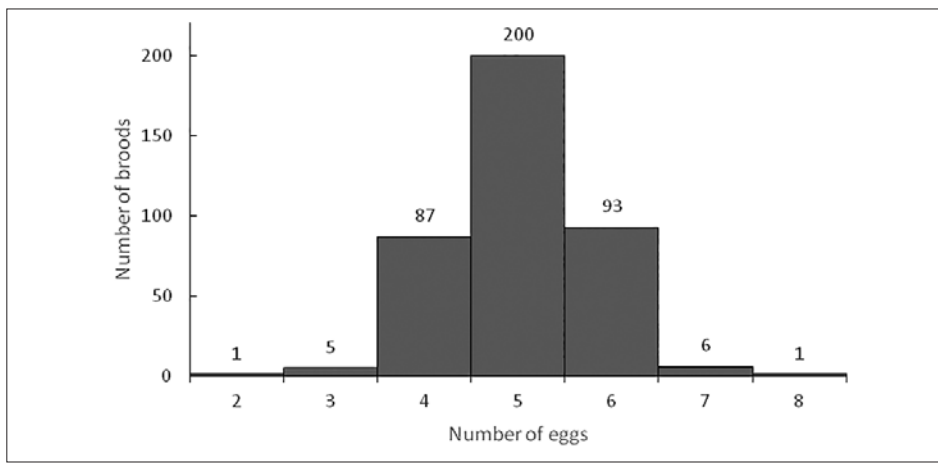

Fig. 3. Distribution of clutch sizes of the Tree Sparrow in Landscape Parks of Lubuskie Province (N = 394)

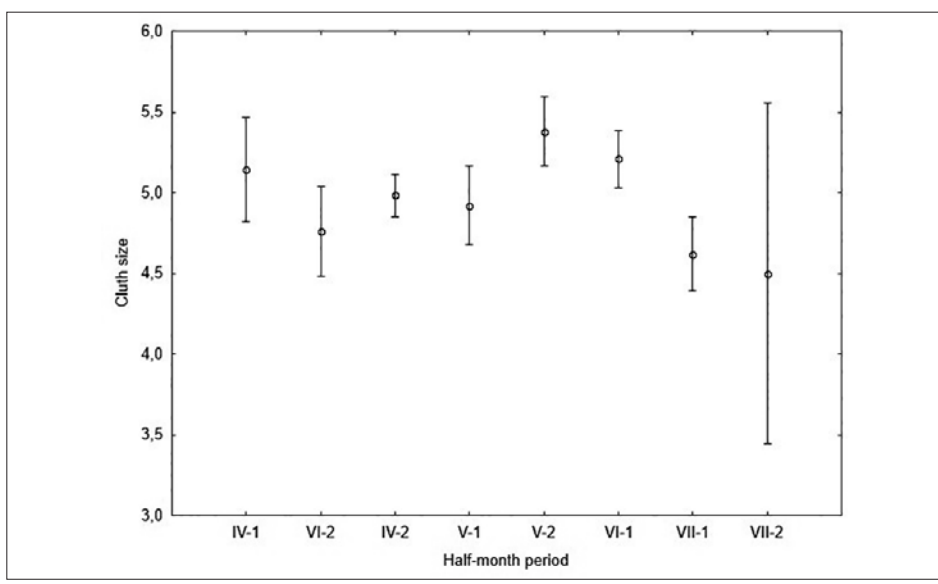

Fig. 4. Mean clutch size (+ 95% confidence interval) of the Tree Sparrow in the first and second half of consecutive months of the laying period in Landscape Parks of Lubuskie Province

Table 1. Clutch size of the Tree Sparrow in Landscape Parks of Lubuskie Province in the first (I) and second (II) half of consecutive months of the laying period

Period		Mean	SD	N	Range	Median	Sample size
April	I	5.1	1.16	21	4-8	5	9
	II	5.0	0.7	127	3-6	5	69
May	I	4.9	0.6	38	4-6	5	23
	II	5.4	0.9	50	3-7	5	22
June	I	5.2	0.7	72	4-7	5	38
	II	4.8	0.8	29	3-6	4 and 5	11 and 11
July	I	4.6	0.8	42	2-6	5	20
	II	4.5	0.7	2	4-5	4 and 5	1 and 1

Table 2. Clutch size in the Tree Sparrow in Landscape Parks of Lubuskie Province in 2013-2015 years

Year	Mean	SD	N	Range
2013	5.0	0.7	130	3-7
2014	5.0	0.9	157	3-8
2015	5.1	0.8	106	2-7

Breeding success

Breeding success amounted to 73.0% (N = 419). In each month of the breeding period it was higher in the second half (Tab. 3), but the differences were not significant ($\chi2 = 8.674$, df = 7, P = 0.54). Breeding success varied from year to year (2013 – 76.8%, 2014 – 71.5% and 2015 – 70.7%), but again differences were not significant ($\chi2 = 1.5168$, df = 2, P = 0.47) in the 393 completely recorded clutches a total of 1,973 eggs were laid and 1,518 nestlings hatched (76.9%). 1,215 fledglings left the nests (61.6% of all eggs laid) and 80.0% of the chicks hatched. Breeding success differed slightly between the half-month periods (Tab. 4), but there were no significant differences in the proportion of hatchlings ($\chi2 = 0.6663$, df = 7, P = 0.99) or fledglings in relation to the number

Tab. 3. Breeding success of the Tree Sparrow (proportion of successful nests to all nests) in the first (I) and second (I) half of successive months of breeding season in Landscape Parks of Lubuskie Province

Period		Number of broods	% of successful broods
April	I	21	61.9
	II	137	67.2
May	I	41	68.3
	II	53	75.5
June	I	79	75.9
	II	29	86.2
July	I	45	82.2
	II	2	100.0
Total		407	73.0

of eggs laid ($\chi 2 = 4.094$, df = 7, P = 0.76). Also, there were no differences in the percentage of fledglings leaving the nests in relation to the number of hatched nestlings ($\chi 2 = 2.813$, df = 7, P=0.90).

Tab 4. Parameters of reproduction of the Tree Sparrow in Landscape Parks of Lubuskie Province. Data refer to clutches started in the first and second half of consecutive months of the breeding season. [1] – Proportion of hatched eggs; [2] – proportion of eggs that produced fledglings; [3] – proportion of hatched nestlings that fledged successfully.

Period		N	Number of eggs	Number of nestlings	% of hatched eggs[1]	Number of fledglings	% of hatched eggs[2]	% hatched nestlings[3]
April	I	21	108	79	73.1	59	54.6	74.7
	II	127	633	498	78.7	380	60.0	76.3
May	I	38	187	148	79.1	112	59.9	75.7
	II	50	269	205	76.2	167	62.1	81.5
June	I	72	375	279	74.4	215	57.3	77.1
	II	29	138	107	77.5	94	68.1	87.9
July	I	42	194	154	79.4	140	72.2	90.9
	II	2	9	6	66.7	6	66.7	100.0
Total		381	1913	1476	77.2	1173	61.3	79.5

Breeding failures

Total losses

Approximately 27% of all hatchlings (N = 113) died or disappeared, and the proportion was related to the breeding stage. 16.5% of all clutches (N = 70) were destroyed, including 6.2% (N = 26) at the egg-laying stage. At the nestling stage, a further 10.5% (N = 43) were destroyed. However, this difference was not significant ($\chi 2 = 2.178$, df = 1, P = 0.14). The most common causes of total losses (Tab. 5) were brood abandonment, death of nestlings, loss of nestlings from an unknown cause and an unspecified predator.

Tab. 5. Reasons for breeding failure of the Tree Sparrow in in Landscape Parks of Lubuskie Province

Reason for losses	N = 113	[%]
Clutch/brood desertion	70	61.9
Death of nestlings	19	16.8
Partial losses	17	15.0
Predator	5	4.4
Nestbox damadged	2	1.8

Partial losses

Partial losses in the Tree Sparrows broods were significant, as indicated by the difference between the mean number of eggs, nestlings and fledglings in the broods for

which these three parameters were known (N = 306). The mean values were, respectively: number of eggs – 5.0 (SD = 0.8), number of nestlings – 3.9 (SD = 1.8), and number of fledglings – 3.1 (SD = 2.1). On average, therefore, 1.9 nestlings of a brood were lost until fledging.

The most common reason for partial losses were eggs from which no nestling hatched, usually 1-2 (N = 94), less frequently 3-4 (N = 26), and exceptionally 5 eggs (N = 1). In addition, death of nestlings was also recorded (N = 47), as a result of malnutrition, bad weather conditions (rain) or damage of the nest box.

DISCUSSION

The breeding season of the Tree Sparrow lasts from April to August, and the species can produce 2-3, exceptionally 4 broods per year (Pinowski 1968, García-Navas et al. 2008). Intensive nest building begins when the average daytime temperature reaches 8-10°C, hence the timing of breeding may vary from year to year. Reproductive behaviour is interrupted when the temperature drops below 0°C (Pinowski 1966). The number of early broods depends most strongly on the average temperature of the week preceding the laying of the first egg. In addition, it has been shown that Tree Sparrows lay the first eggs on average six days after air temperature reaches about 10°C (Pinowski 1968). In the present study, egg laying started at the beginning of April but most often between 20 and 30 of April. Differences in the timing of breeding between years are also shown. A study of the Tree Sparrow population nesting in nest boxes around Warsaw in 1960-1965 showed that birds started breeding as early as 18 April, with a peak at the end of April and the beginning of May (Pinowski 1968). In Warsaw, in 1986-1989 and 2006-2009, the median beginning of breeding was 25 April (21.-29.04.) and 20 April (17.-23.04.), respectively (Węgrzynowicz 2017). In north-eastern Spain, between 1982 and 1986, the first eggs were laid between 15 and 24 April (Cordero, Salaet 1990). In central and southern Moravia in the Czech Republic, between 1968 and 1969, the first eggs were recorded between 19 and 20 April (Balát 1971), and in northern Italy breeding started on 12 April (Brichetti, Caffi 1995). One of the reasons for the differences in the start of egg laying may also be the contents of the nestbox. A study in Spain showed that earlier broods were more often found in empty boxes than in those containing old nesting material (García-Navas et al. 2008).

In Poland, clutch size ranged of 2-8 eggs in the three populations investigated so far, including the study described here (Pinowski 1968, Węgrzynowicz 2017). A range of 3-7 eggs was found in the Czech Republic (Balát 1971) and Turkey (Erdoğan, Kiziroğlu 1995), and 1-7 eggs in Spain (Cordero, Salaet 1990). Clutches of less than 3 eggs and more than 7 eggs are very rare, with 0.0-2.1% and 0.0-0.2%, respectively (Pinowski 1968, Balát 1971, Cordero, Salaet 1990, Węgrzynowicz 2017, this study). Studies of Tree Sparrow populations in southern Germany (Swabian Jura) showed a very large range

of clutch sizes, from 1 to 10 eggs, with 1, 2, 8, 9 and 10 eggs in a clutch accounting for 0.6, 0.9, 0.4, 0.0, and 0.2%, respectively, of all clutches (Reyher 2003).

The average clutch size of the Tree Sparrow in the Lubuskie Landscape Parks was 5.0 but differed between months. Clutches were largest in the second half of May and (second broods) the first half of June. In the vicinity of Warsaw, Pinowski (1968) showed that the mean clutch size was 5.0, but first clutches with, on average, 4.8 eggs, were smaller than second clutches with 5.1 eggs. In Warsaw, Węgrzynowicz (2017) showed that from 1986 to 1989, the average clutch size was 4.8, and between 2005 and 2009 5.2 eggs. In the Czech Republic, the average clutch size was 4.8 eggs (Balát 1971), in southern Germany 5.2 (Reyher 1983), in Turkey 5.3 (Erdoğan, Kiziroğlu 1995), and in northern Italy 5.4 (range 4-7) (Brichetti, Caffi 1995). In different regions of Spain, the average clutch ranged from 4.5 (Cordero, Salaet 1990) and 4.8 (Garcia-Navas et al. 2008) to 5.00 (Garcia-Navas, Sanz 2008). Tree Sparrow clutches in the aforementioned studies (where this parameter was reported) usually contained 5 eggs (Pinowski 1968, Balát 1971, Reyher 1983, Cordero, Salaet 1990, Węgrzynowicz 2017, the present study). Pinowski (1968), referring to the results of studies on the Tree Sparrow populations in different regions of the world, points out that clutch size increases towards the north and east, and is lowest in the tropics.

Hatching success of the Tree Sparrow varies from region to region, and the value recorded in the present study (76.9%) is similar to the results of other investigations. A very similar level with 78.7% was recorded by Pinowski (1968) near Warsaw. Lower values for this parameter were found, for example, in Germany, with 58.4 (Reyher 2003) and 60.2% (Creutz 1949), and in Belgium with 57.7% (Bethune 1961). On the other hand, it is higher in Italy with 82.3% (Brichetti, Caffi 1995), China with, on average, 85% (Chia et al. 1963), Turkey with 86.7% (Erdoğan, Kiziroğlu 1995), the Czech Republic with 88.6 (Balát 1971) and in the UK with 90.9% (Seel 1964). Another parameter describing reproductive success is the ratio of the number of young leaving the nest to hatched nestlings. In Lubuskie Landscape Parks, the respective value was 80.0% and, therefore, lower than in Turkey (91.2%; Erdoğan, Kiziroğlu 1995), Italy (85.6%; Brichetti, Caffi 1995) or Germany (84.8%; Reyher 2003). In the Czech Republic, only 63% of all hatchlings left the nest (Balát 1970), and in the UK 76.7% (Seel 1964). In contrast, when breeding success expressed as the ratio of successful broods (at least one fledgling) to all broods started, was 73% in the present study, and, therefore, was similar to results from the Czech Republic with 71% (Balát 1971) or Italy with 70.5% (Brichetti, Caffi 1995).

Studies of populations of species breeding in nest boxes, including the Tree Sparrow, show that nestling mortality, despite difficult access for predators, is high (Kruszewicz et al. 1995, and studies cited therein). Apart from predation, which is not high in the case of the Tree Sparrow (e.g. Pinowski 1968, Balát 1971, the present work), insufficient food, competition between siblings (e.g. due to asynchronous hatching) are the most often mentioned causes of mortality (Pinowski 1968, Balát 1971, Reyher 2003). It has

been shown that nestling mortality can also be caused by pathogenic microorganisms (Kozłowski et al. 1991), fungi (Kruszewicz et al. 1995), or heavy metals (Romanowski et al. 1995). Reduced breeding success may also be due to the intensification of agriculture, especially the use of pesticides, and changes in land use (Wesołowski 1991, Reyhner 2003). Studies in Spain have also shown that the microclimate inside different types of nest boxes (wooden, sawdust concrete) may play a key role in nest site selection and subsequent reproduction (García-Navas et al. 2008).

In Lubuskie Landscape Parks, the reasons for nesting losses (total and partial) were similar to those in other studied populations. Among the most frequently observed were abandonment of the nest for an unknown reason, death of all or some of the nestlings, unhatched eggs, loss of eggs or nestlings (probably thrown out of the nest by adult birds) and, to the least extent, an unspecified predator and damage of the nest box. In a study of the Tree Sparrow near Warsaw, Pinowski (1968) mentioned unfertilized eggs, egg loss (ejection by adult birds), death of nestlings and whole broods due to poor weather conditions (low temperature and rainfall), competition between siblings (asynchronous hatching) and predators as causes of losses. For the Czech Republic, Balát (1971) reports unhatched eggs (unfertilized and dead embryos), destruction of the nest, death of nestlings (mainly asynchronous hatching, and hence insufficient food for the smallest and weakest nestlings), nestling loss and predation as the main causes of brood losses. Among the predators he mentions the Great Spotted Wodpecker *Dendrocopos major* and the Squirrel *Sciurus vulgaris* (Balát 1971). The author also notes hibernating Bumblebees *Bombus* sp. whose increased activity in the nest was thought to contribute to adult Tree Sparrows abandoning the nest (Balát 1971). In southern Germany, Reyhner (2003) mentions predator activity, nest abandonment, egg loss, nest destruction, and nestling death among the causes of brood losses. Mentioned mammals as likely predators of breeding Tree Sparrows include the Weasel *Mustela nivalis* and the Ermine *Mustela erminea* (although here the diameter of the nest box opening may strongly limit predation by both species), as well as two species of Mice, i.e. the Scrub Mouse *Apodemus sylvaticus* and the Wood Mouse *Apodemus flavicollis* (Balák 1971 and studies cited therein). In addition, representatives of the Dormice family (*Gliridae*), e.g. Eliomys *quericinus* and *Muscardinus* avellanarius, are recognised as predators of birds nesting in nest boxes, including the Tree Sparrow (Löhrl 1960, Balát 1971, Reyhner 2003).

The basic parameters of breeding, such as the date of clutch initiation, clutch size, breeding success and reasons for breeding losses recorded during the present study on the Tree Sparrow population in Lubuskie Landscape Parks do not differ significantly from the data of all the other investigations cited above. The slight differences are most likely the result of different local conditions.

CONCLUSIONS

1. The most important parameters of reproduction of the Tree Sparrow population in the Landscape Parks are as follows:

- Egg laying started from mid-April, exceptionally in early April (earliest 2.04.2013);
- The date of clutch initiation of the first brood, which started by the end of the second decade of May, differed significantly between years;
- Clutches contained 2-8, most often 4-6 eggs (96.7% of broods);
- Mean clutch size was 5.0 (SD = 0.8; N = 393; mode = 5; mode count = 200);
- Breeding success amounted to 73.0% (N = 419);
- 393 broods could be monitored completely, with overall 1,973 eggs and 1,518 hatchlings (76.9%). 1,215 fledglings left the nest, corresponding to 61.6% of all eggs laid and 80.0% of all hatchlings.
- Approximately 27% of all hatchlings (N = 113) died or disappeared, but this value was related to hatchling stage. 16.5% of all broods with eggs (N = 70) were destroyed, including 6.2% (N = 26) at the egg-laying stage.

2. The basic parameters of breeding, such as the date of clutch initiation, clutch size, breeding success and reasons for breeding losses recorded during the present study on the Tree Sparrow population in Lubuskie Landscape Parks do not differ significantly from the data reported in other investigations.

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REFERENCES

Balát F. 1971 – Clutch Size and Breeding Success of the Tree Sparrow, Passer montanus L., in Central and Southern Moravia – Zoologické Listy 20, 3: 265-280.

Bethune G. 1961 – Notes sur le Moineau Friquet *Passer montanus* L. – Gerfaut 51: 1-12.

Brichetti P., Caffi M. 1995 – Breeding biology of a tree sparrow, Passer montanus, population in a rural area of the Lombardy Plain Brescia Province Biologia riproduttiva di una popolazione di passera mattugia, *Passer montanus*, nidificante nella Pianura Lombarda – Rivista Italiana di Ornitologia 65, 1: 37-45.

Chodkiewicz T., Kuczyński L., Sikora A., Chylarecki P., Neubauer G., Ławicki Ł., Stawarczyk T. 2015 – Ocena liczebności ptaków lęgowych w Polsce w latach 2008–2012 – Ornis Pol. 56: 149-189.

Chylarecki P., Chodkiewicz T., Neubauer G., Sikora A., Meissner W., Woźniak B., Wylegała P., Ławicki Ł., Marchowski D., Betleja J., Bzoma S., Cenian Z., Górski A., Korniluk M., Moczarska J., Ochocińska D., Rubacha S., Wieloch M., Zielińska M., Zieloński P., Kuczyński L. 2018 – Trendy liczebności ptaków w Polsce – GIOŚ, Warszawa.

Cordero P.J., Salaet M. 1990 – Breeding season, population den sity and repreductive rate of the Tree Sparrow [*Passer montanus* (L.)] in Barcelona, NE-Spain – In: Granivorous Birds In the agricultural landscape, Eds. J. Pinowski & D. Summers-Smith, PWN-Polish Scientific Publishers, Warszawa, pp. 169-177.

Creutz G. 1949 – Untersuchungen zur Brutbiologie des Feldsperlings (*Passer montanus montanus* L.) – Zool. Jber. (Syst.) 78: 133-172.

Erdoğan A., Kiziroğlu I. 1995 – Brutbiologische Untersuchungen am Feld- *Passer montanus* und Haussperling *P. domesticus* in Beytepe/Ankara – Orn. Verh. 25: 211-218.

García-Navas V., Arroyo L., Sanz J.J. 2008a – Nesbox use and reproductive parameters of Tree Sparows Passer montanus : are they affected by the presence of old nests – Acta Ornithol. 43, 1: 1-11.

García-Navas V., Arroyo L., Sanz J.J., Diaz M. 2008b – Effect of nestbox type on occupancy and breeding biology of Tree Sparrow Passer montanus in central Spain – Ibis 150: 356-364, doi: 10.1111/j.1474-919x.2008.00799.x

del Hoyo. J., Collar N.J. 2016 – HBW and BirdLife International Illustrated Checklist of the Birds of the World Volume 2: Passerines – Lynx Edicions, Barcelona.

Kozłowski S., Małyszko E., Pinowski J., Bernacka B., Pepiński W., Kruszewicz A. 1991 – Pathogenic microorganism isolated from Passer domesticus and Passer montanus eggs and nestlings – In: Nestlings mortality of granivorous birds due to microorganism and toxic substances, Eds. J. Pinowski, B.P. Kavanagh and W. Górski, PWN-Polish Scientific Publishers, Warszawa, pp. 153-165.

Kruszewicz A.G., Pinowski J., Kruszewicz A.H., Mazurkiewicz M., Pawiak R., Małyszko E. 1995 – Occurrence of fungi in House Sparrow (Passer montanus) nestlings – In: Nestlings mortality of granivorous birds due to microorganism and toxic substances: synthesis, Eds. J. Pinowski, B.P. Kavanagh and B. Pinowska, PWN-Polish Scientific Publishers, Warszawa, pp. 283-290.

Kuczyński L., Chylarecki P. 2012 – Atlas pospolitych ptaków lęgowych Polski. Rozmieszczenie, wybiórczość siedliskowa, trendy – GIOŚ, Warszawa.

Löhrl H. 1960 – Säugetiere als Nisthöhlenbewohner in Südwestdeutschland mit Bemerkungen über ihre Biologie – Z. Säug-kunde. 25: 66-73.

Pinowski J. 1966 – Der Jahreszyklus der Brutkolonie beim Feldsperling (*Passer m. montanus* L.) – Ekol. Pol. Seria A 14: 145-174.

Pinowski J. 1968 – Fecundity, mortality, numbers nad biomass dynamics of a population of the Tree Sparrow (*Passer m. montanus* L.) – Ekol. Pol., Seria A, 16: 1-58.

Reyher H. 2003 – Zur Brutbiologie und Siedlungsdichte des Feldsperlings (*Passer montanus*) im mittleren Vorland der Schwäbischen Alb – Die Vogelwarte 42: 203-212.

Romanowski J., Pinowski J., Barkowska M., Kamiński P. 1995 – Age-related changes in the concentrations of calcium and heavy metals in House Sparrow (Passer domesticus) and Tree Sparrow (Passer montanus) nestlings – In: Nestlings mortality of granivorous birds due to microorganism and toxic substances: synthesis, Eds. J. Pinowski, B.P. Kavanagh and B. Pinowska, PWN-Polish Scientific Publishers, Warszawa, pp. 139-159.

Seel D. 1964 – An analysis of the nest record cards of the Tree Sparrow – Bird Study 11: 265-271.

Summers-Smith J.D. 1995 – Tree Sparrow – J.D. Summers-Smith, Guisborough.

Wesełowski T. 1991 – Bedeutung des Bruterfolges für die Abnahme des Feldsperlings (Passer montanus) in der Schweiz – Ornithol. Beob. 88: 253-263.

Węgrzynowicz A. 2017 – Breeding parameter changes in two syntopic urban Sparrow species with contrasting population trends – Ornis Fennica 94: 113-124.

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SHORT NOTE

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RAVENS BREEDING IN WARSAW IN THE 21TH CENTURY

ABSTRACT

In 2021, after a 65-year interruption, the Raven *Corvus corax* was found nesting again in the Royal Baths Park in central Warsaw, Poland. In addition, from 2021 to 2022, eight certainly or probably occupied breeding territories were found in forests and parks in the peripheral zone within the administrative borders of Warsaw. The synurbanization of the Raven in Warsaw is slow, as in other large Polish cities.

The Raven *Corvus corax* is a bird species widespread throughout Poland, showing a moderate increase in recent decades. Formerly it nested exclusively in forests, but now inhabits a diversity of landscapes and avoids only heavily urbanized areas (Chylarecki et al. 2018). As a result of intense persecution, the Raven became extinct in west and central Poland in the early 20th century, remaining sparse in the east. Due to protection in the 2nd half of the 20th century, the Raven recovered in numbers and colonized previously abandoned areas (Dobrowolski et al. 1962; Tomiałojć and Stawarczyk 2003; Zawadzka 2006). In the 1950s, the first breeding in the centre of large cities, including Warsaw and Krakow, was recorded (Dobrowolski et al. 1958), but synurbanization stalled and the Raven quickly abandoned breeding sites in the centre of large cities (Luniak et al. 2001), despite an evident increase in numbers and recolonization of the western part of Poland (Bednorz 1991; Zawadzka 2006).

For many decades, Ravens in Poland nested only in forests or extend parks in peripheral and suburban areas, without colonizing the inner city zone (Zawadzka 2006, Zawadzka and Zawadzki 2014). The number of breeding pairs was low, from a few to no more than a dozen. Such a stable long-term distribution was observed in Warsaw (Luniak et al. 2001), Łódź (Glubowski et al. 2009), Olsztyn (Nowakowski et al. 2006), Poznań (Ptaszyk 2003), Wrocław (Tomiałojć et al. 2020), Kielce (Wilniewczyc et al. 2022), and other cities (reviewed in Zawadzka and Zawadzki 2014), persisting through

the first two decades of the 21st century. The reasons for the lack of colonization of urban areas by such a highly adaptable species were not fully understood. One hypothesis suggested a strong competition with Crows *Corvus cornix*, whose synurbanization occurred much earlier and resulted in high densities in large cities (Tomiałojć 2009). On the other hand, for Ravens food is less abundant in the centre of large cities, due to regular cleaning by city services, than in peripheral zones (Zawadzka and Zawadzki 2014).

On May 18, 2021, we observed three young Ravens, just capable of flight, which were fed by a parent in the Royal Baths Park in Warsaw. The birds were in the vicinity of a nest located in the crown of a silver spruce near the Belvedere. In 2022, the Ravens began breeding again but failed. We found a second new breeding pair also in 2021 in the "Bielansky Forest" reserve, in the northern part of the city, and a third pair nesting in the "Stefan Starzyński Kabacki Forest" reserve. However, in 2022 only a pair of territorial Ravens was observed near the nest places in the last mentioned reserve. A fourth raven nest was found in summer 2021 in the "Sobieski Forest" Reserve, but it remained unclear whether it was actually occupied. Furthermore, occupied home ranges were observed from 2020 to 2021 in the Bródnowski Forest, the Młociński Forest, and in forest parks Henryków and Dąbrówka in Białołęka Dworska, but no nests could be detected. Except for the breeding site in the Royal Baths Park, and partially in the "Bielansky Forest" reserve, all other breeding sites of the Raven were located in forest complexes of the outskirts of Warsaw.

The last breeding of a Raven in the Royal Baths Park was recorded in 1956, and in the Bielański Forest in 1957, during the period of recovery of the Raven population after World War II (Dobrowolski et al. 1958). Therefore, Ravens returned to breed in the center of Warsaw after a 65-year interruption. Most of the nesting areas are forest complexes under reserve protection on the outskirts of Warsaw. The only place where breeding has been confirmed in the strict city center is the Royal Baths Park. The return of Raven to Warsaw may be related to lower human activity and less anthropopressure in 2020 and 2021, associated with the Covid-19 pandemic. It will be interesting to see whether the breeding of the Raven in Warsaw, especially in the Royal Baths Park, will again prove to be a short episode or whether the species has permanently settled in the center of the capital and more breeding pairs will follow.

REFERENCES

Bednorz J. 1991 – Die Wiederausbreitung des Kolkraben (*Corvus corax*) in Polen – Metelener Schriftenreihe für Naturschutz 2: 29-35.

Chylarecki, P., Chodkiewicz, T., Neubauer, G., Sikora, A., Meissner, W., Woźniak, B., Wylegała, P., Ławicki, Ł., Marchowski, D., Betleja, J., Bzoma, Sz., Cenian, Z., Górski, A., Korniluk, M., Moczarska, J., Ochocińska, D., Rubacha, S., Wieloch,, M., Zielińska M., Zieliński, P., Kuczyński, L., 2018 – Trendy liczebności ptaków w Polsce – GIOŚ, Warszawa.

Dobrowolski K.A., Pielowski Z., Pinowski J., Wasilewski A. 1958 – Einfluss der Änderung in der Biologie des Raben (*Corvus corax* L.) – Brüten in nächster Nähe des Menschen – auf Grösse und Verteilung der Population dieser Vogelart – Ekol. Pol. A 6, 5: 167-182.

Dobrowolski K.A., Pielowski Z., Pinowski J., Wasilewski A. 1962 – Das Vorkommen des Kolkraben (*Corvus c. corax* L.) in Polen im Zusammenhang mit seinen Areals- und Ouantitätsverändungen in Mitteleuropa – Ekol. Pol. A 10, 14: 375-456.

Glubowski M., Hejduk J., Janiszewski T., Kaczmarek K., Kaliński A., Markowski J., PędziwilkA., Podlaszczuk M., Topolski D., Włodarczyk R., Wojciechowski Z. 2009 – Atlas of breeding birds of Łódź – University of Łódź, Łódź.

Luniak M., Kozłowski P., Nowicki W., Plit J. 2001 – The birds of Warszaw 1962-2000 – Instytut Geografii i Przestrzennego Zagospodarowania PAN, Warszawa.

Nowakowski J., Dulisz B., Lewandowski K. 2006 – The birds of Olsztyn – „ElSet", Olsztyn.

Nowicki W. 2001 – The birds of downtown of Warsaw -MiIZ PAN, Warszawa

Ptaszyk J. 2003 – The birds of Poznań – qualitative and quantitative condition and its changes in the period 1850-2000 – Adam Mickiewicz University Press, Poznań.

Tomiałojć L. 2009 – A decline in the rural corvid populations of SW Poland – Chrońmy Przyr. Ojcz. 65, 6: 415-422.

Tomiałojć L., Orłowski G., Czapulak A., Jakubiec Z. 2020 – Birds of Wrocław – PTTP „pro Natura", Wrocław.

Tomiałojć L., Stawarczyk T. 2003 – Awifauna Polski. Rozmieszczenie, liczebność i zmiany – PTTP „pro Natura", Wrocław.

Wilniewczyc P., Szczepaniak W., Przybylska J., Maniarski R., Wachecki M., Dudzik K. 2022 – Birds of Kielce – Towarzystwo Badań i Ochrony Przyrody, Kielce.

Zawadzka D. 2006 – Kruk – Monografie przyrodnicze nr 15. Klub Przyrodników, Świebodzin.

Zawadzka D., Zawadzki G. 2014 – Synantropisation and synurbisation of raven *Corvus corax* in Poland: a review – International Studies on Sparrow 38: 11-16.

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2. Radkiewicz J. 1989 – (Distribution and number of the White Stork in Zielona Góra Provinnce in 1985) – Przyr. Środk. Nadodrza 1: 47-66 (in Polish).
3. Anderson T.R. 2006 – Biology of the ubiquitous House Sparrow from genes to population – Oxford Univ. Press, Oxford, New York.
4. Indykiewicz P. 2006 – House Sparrow *Passer domesticus*, Starling *Sturnus vulgaris*, Tree Sparrow *Passer montanus* and other residents of nests of the White Stork *Ciconia ciconia* – In: The White Stork in Poland: studies in biology, ecology and conservation, Eds. P. Tryjanowski, T.H. Sparks, L. Jerzak, – Bogucki Wyd. Naukowe, Poznań.

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