

**Andrzej WĘGRZYNOWICZ**

Museum and Institute of Zoology, Polish Academy of Science  
ul. Wilcza 64, 00-679 Warsaw  
e-mail: awegrzynowicz@op.pl

## **IMPORTANCE OF NEST SITES AVAILABILITY FOR ABUNDANCE AND CHANGES IN NUMBER OF HOUSE- AND TREE SPARROW IN WARSAW**

### **ABSTRACT**

House- and Tree Sparrows were censused on 55 plots (684 ha), representing 3 habitats: housing estates, parks and allotment gardens in Warsaw from 2005-2009 and in 2012. Also, the data on nest sites of both species were gathered. Data from 70s/80s of the other authors enabled to determine the changes in number of sparrows. The population of House Sparrow decreased on average by 48% and the sharpest decline was found in allotment gardens. The decline continued in the period of studies, i.e. in 2005-2012. Tree Sparrow showed an increase from 70s/80s by 68% although in 2005-2012 the population was stable or even decreased. House Sparrows nested mainly in crevices in buildings, and suboptimal nest sites – such as nest-boxes and holes in trees – were occupied only in these areas where food condition were particularly good. Resources of optimal nest sites on studied area was almost entirely sufficient for House Sparrows population. Number of House Sparrow was related to area/presence of buildings. Renovations of buildings strongly influenced local number of this species, however they were not the main cause of its decline. Although nest-boxes were occasionally used by H. Sparrow, their presence could not stop the decrease in numbers caused by loss of nest sites. Tree Sparrow showed greater plasticity in their choice of nest sites. In parks their abundance was correlated with the number of nest boxes. It was suggested that in this habitat, the observed decrease of House Sparrow with simultaneous abandonment of nest-boxes (and other nest sites) may have contributed to the increase in Tree Sparrows.

**Key words:** House Sparrow, Tree Sparrow, breeding densities, population dynamics, changes in number, nest sites.

### **INTRODUCTION**

Populations of House- and Tree Sparrow decreased considerably during the past few decades. The signals of House Sparrow decline comes from countries of Western Europe, from Finland, Austria, Great Britain, Spain, Belgium and Germany (Väisänen & Solonen 1997, Weggler & Widmer 2000, Gil-Delgado *et al.* 2002, De Laet & Summers-

Smith 2007), North America (Bosakowski 1986, Larivée 1991) and recently also from India (Bhattacharya *et al.* 2011). Particularly sharp declines have been observed in big European cities, such as Glasgow, Edinburgh, London, Ghent, Brussels or Hamburg (Dott and Brown 2000, Mitschke & Mulsow 2003, De Laet & Summers-Smith 2007).

Data from Eastern and Central-Eastern Europe are sparse, however they also indicate a decline of this species (Biaduń 2004, Janiszewski *et al.* 2004, Bokotey & Gorban 2005, Konstantinov & Zakharov 2005).

The decline of Tree Sparrow populations is revealed mostly in Western Europe – for example in England in 1977-2005 by as much as 94% (Baillie *et al.* 2007) and moreover in Germany, French, Swiss, Nederland and Italy (Blattner & Speiser 1990, Summers-Smith 1995, Dinetti 2007). In contrast, in north and, locally, eastern part of Europe, its population recently increased (Summers-Smith 1995, Vepsäläinen *et al.* 2005). Situation of Tree Sparrow in Eastern Europe is insufficiently recorded; nevertheless most of data indicate a decrease in numbers (e.g. Tomiałołć & Stawarczyk 2003, Reif *et al.* 2008).

Possible causes of decrease in number of both sparrow species are: shortage of food for nestlings and adult birds, increase of predation and – particularly in the case of House Sparrow – lack of nest sites, related to renovations of buildings and introducing of modern architecture (Siriwardena *et al.* 2002, Summers-Smith 2003, Bell 2011).

The aim of the study was to determine the changes in House- and Tree Sparrow number from 70s/80s to 2000s in Warsaw – one of the biggest cities in Central-Eastern Europe. Also the impact of nest-site availability on abundance and changes in number of both species was considered.

## METHODS

The studies were carried out from 2005-2009 and 2012. Sparrows were censused on 55 plots (684 ha total): 23 housing estates (327 ha), 25 park areas (parks, cemeteries, zoological garden; 271 ha) and 7 allotment gardens (86 ha) each year. In March to April, three or four counts were conducted on each plot. Sparrows were indicated on maps. Birds that showed territorial behavior (chirping, carrying of nest material, copulation, nest-site defense etc.) were recorded as breeding pair. During censuses nest sites of both species were noted.

Thirtysix of the 55 plots studied in 2000 were previously investigated in 70s and 80s by the other authors (Luniak 1980, 1981, 1994, Luniak *et al.* 1986, Nowicki 1992). This enabled us to determine changes in sparrow numbers over time. Sparrows were counted on most plots in one year only, but some repeat counts were made. In some of the plots the availability of nest sites changed during studies (usually as a result of renovations of buildings or introducing of nest-boxes – see *Results*).

In order to analyze the factors influencing the occurrence of sparrows, maps on which birds were indicated were divided into 1-hectare squares.

## RESULTS AND DISCUSSION

**Abundance and changes in numbers of sparrows**

House Sparrow occurred in almost all housing estates, about ¼ of parks and in 4 of 7 allotment gardens (Table 1). The average density in housing estates was 6 times higher than in parks, and 40 times higher than in allotment gardens. The maximal density reached 117 pairs/10 ha in housing estates, 56 pairs/10 ha in parks and only 6 pairs/10 ha in gardens.

On 27 of 36 plots studied in 70s/80s and again in 2000s, the number of House Sparrow decreased, numbers increased in 4 plots and no change was found in 5 others (Table 1). The sharpest decline took place in allotment gardens, although House Sparrows also disappeared from 57% of parks, where it was present during previous investigation. The total number of House Sparrows on studied plots decreased from 70s/80s to 2000s by 48%.

On 4 plots that were monitored in 2005-2009, the number of House Sparrow pairs decreased from 81 to 44. On 8 plots investigated in 2012 the total number of pairs were lower by a half than in 2005-2009.

Table 1. Abundance and changes in number of House Sparrow

Parameter	Housing estates	Parks	Allotment gardens
Frequency	96%	28%	4/7
Density range (pairs/10 ha)	2.9-116.7	0.5-55.5	1.2-6.2
Mean density (pairs/10 ha)	40.2 (SD = 27.7; N = 23)	5.9 (SD = 13.3; N = 25)	1.0 (SD = 2.2; N = 7)
Changes from 70s/80s to 2000s	- 33% (↓ on 4 plots, ↑ on 2)	- 45% (disapp. from 13 plots, ↓ on 3, ↓ on 1, ↑ on 2)	- 95% (disapp. from 3 plots, ↓ on 4)
Changes from 2005 to 2009	- 46% (↓ on 3 plots)		
Changes from 2005-2009 to 2012	- 58% (↓ on 7 plots, ↑ on 1)		

The results from Warsaw confirm a decline of urban House Sparrow populations in Central-Eastern Europe. However, the decrease in this region seems to be less pronounced than in cities of Western Europe. For example, in Edinburgh, the number of House Sparrows decreased tenfold over 15 years (Dott & Brown 2000) and in Hamburg from 60s to the end of 90s – by 75% (Mitschke & Mulsow 2003). In some areas in Europe the decline has recently stopped or slowed down (e.g. Sanderson 2001, De Laet & Summers-Smith 2007). Censuses carried out in 2005-2009 and 2012 suggest that in Warsaw the decline is continuing and probably has even accelerated.

The frequency of breeding Tree Sparrows was high in all habitats (Table 2). Mean

density of this species grew from housing estates to allotment gardens, although the maximal value found was in one of the parks.

Table 2. Abundance and changes in number of Tree Sparrow

Parameter	Housing estates	Parks	Allotment gardens
Frequency	74%	88%	7/7
Density range (pairs/10 ha)	0.6-13.3	0.8-64.4	13.3-49.0
Mean density (pairs/10 ha)	2.3 (SD = 3.5; N = 23)	9.9 (SD = 14.2; N = 25)	31.9 (SD = 11.7; N = 7)
Changes from 70s/80s to 2000s	increase from 4 to 29 pairs (coloniz. of 5 plots, ↑ on 1)	+ 85% (coloniz. of 2 plots, ↑ on 11, ↓ on 3, ↓ on 4, disapp. from 1)	+ 30% (↑ on 4 plots, ↓ on 2, ↓ on 1)
Changes from 2005 to 2009	- 30% (↓ on 3 plots, ↑ on 1)		
Changes from 2005-2009 to 2012	- 6% (↓ on 1 plots, ↓ on 3, ↑ on 1)		

From 70s/80s to 2000s the number of Tree Sparrows increased by 68%. The species colonized new habitat – housing estates, and numbers increased markedly in two others, particularly in parks (Table 2). However from 2005 to 2009 total density on 4 monitored plots decreased by  $\frac{1}{3}$ . On the other hand, number of breeding pairs on 8 plots studied in 2005-2009 and in 2012 was relatively stable.

The increase of Tree Sparrow in Warsaw contradicts trends of this species in most parts of Europe (Summers-Smith 1995), as well as in other cities of Poland, where considerable decreases have been found (e.g. Biaduń 2004, Tomiałojć 2007, 2011). Moreover, number of this species decreased in the area surrounding Warsaw (J. Pinowski – pers. comm.) One of possible explanation for the observed increase in Warsaw is that Tree Sparrows from agricultural areas near Warsaw, where some disadvantageous habitat changes took place, moved to the city, where they found better conditions to live.

### Choice of nest sites

House Sparrows showed preferences for nesting in crevices in buildings (optimal nest sites), then, in order: in metal constructions, summer-houses/sheds, tree holes and nest-boxes (suboptimal sites). In housing estates they nested almost entirely in shelters and crevices in buildings (Table 3). In parks, half of pairs occupied tree holes and from 7 to 20% the other types of nest sites. It is characteristic, that suboptimal nest-sites, such as nest-boxes and tree holes, were used only in 3 park areas with particularly rich resources of food. One of them was the zoological garden, where sparrows benefited from the food for animals. Two further areas (Saxon Garden and Krasińscy Garden) were old downtown parks surrounded by closely built-up areas. These parks were characterized

by relatively high frequency of people. Blair (1996) and Fernández-Juricic *et al.* (2003) stated that the presence of people is a key factor for House Sparrows in finding food. The more people that visit a park, the greater is the amount of food waste. Thus, the area visited by many people is more attractive for sparrows. Also, Summers-Smith (1958) and Dawson (1972) stated that suboptimal nest sites were used more readily in places, where food conditions were particularly good.

Table 3. Nest sites of House Sparrow

Nest site (N)	Housing estates (539)	Parks (203)
Buildings	97.2%	20.2%
Summer-houses, sheds etc.	0.2%	13.8%
Metal constructions	0.2%	11.3%
Nest-boxes	2.4%	7.4%
Tree holes	–	47.3%

On the basis of observation and experiments with nest-site availability (see below) it was established that Tree Sparrows preferred nesting in buildings and summer-houses/sheds, than in nest-boxes and were least likely to nest in tree holes. Tree Sparrows occurring in housing estates nested mostly in buildings, and were a little less numerous in tree holes and nest-boxes (Table 4). In parks and in allotment gardens most pairs occupied nest-boxes and in the former habitat – also tree holes, and in the latter – summer-houses.

Table 4. Nest sites of Tree Sparrow

Nest site (N)	Housing estates (48)	Parks (195)	Allotment gardens (93)
Buildings	41.7%	4.6%	–
Summer-houses, sheds etc.	–	–	32.3%
Metal constructions	4.2%	1.0%	–
Nest-boxes	25.0%	74.9%	63.4%
Tree holes	29.2%	19.5%	4.3%

### Importance of number of nest-sites

The number of House Sparrow pairs in 1-hectare squares was significantly correlated with area covered by buildings ( $r = 0.38$ ;  $P < 0.001$ ;  $N = 319$ ). This relationship is most probably related to availability of nest sites – the larger the area of buildings, the higher is the potential number of holes and crevices suitable for sparrows. Similar relationship was found by Heij (1985), Bland (1998) or Summers-Smith (2009).

In park areas there were statistically important differences in frequency of House Sparrows in 1-hectare squares with- and without buildings ( $\chi^2 = 7.10$ ;  $df = 1$ ;

$P < 0.001$ ) – the birds occurred in 56% and 9% of them respectively. The presence of buildings in such habitats often predicted the occurrence of H. Sparrow (e.g. Bednorz *et al.*, 2000, Biaduń 2004).

There was no significant difference in the frequency of House Sparrows in squares with- and without nest-boxes in Warsaw parks.

The number of Tree Sparrows in 1-hectare squares in housing estates was not related to area covered by buildings. In parks, the number of pairs in squares was positively correlated with the number of nest-boxes ( $r = 0.49$ ;  $P < 0.001$ ;  $N = 249$ ). In old parks (tree stands over 80 years old) this relation was considerably weaker ( $r = 0.32$ ;  $P = 0.001$ ;  $N = 109$ ) than in younger ones ( $r = 0.60$ ;  $P < 0.001$ ;  $N = 140$ ). There was a lack of tree holes in the younger tree stands. The frequency of Tree Sparrows in squares with- and without buildings in parks was similar (62 and 53% respectively;  $\chi^2 = 0.33$ ;  $P = 0.743$ ; ns).

### **Changes in the number of sparrows in relation to renovations of buildings**

Renovations of buildings considerably influenced the local number of House Sparrows in housing estates. On two study plots (peripheral block of flats) – Chomiczówka and Wawrzyszew the number of breeding pairs decreased between 1983-1985 and 2005 by 75% and 44% respectively, after all the buildings had been insulated. Between 2005 and 2012 buildings were renovated again, and the number of pairs declined over this period by a further 75% and 84%. On plot Muranów (older, downtown estate) the population of House Sparrows decreased by 27% from 1985 to 2005 (no renovation in this period), and by a further 61% from 2005 to 2012, when approx. 1/3 of buildings were renovated. However, in two housing estates with older buildings, that were not renovated densities of House Sparrow increased from 1983 to 2005 by 13% and 47%.

One of the studied parks was abandoned by the species after renovation of small buildings, which was the only place where House Sparrows nested. Renovations of these buildings did not influence the number of Tree Sparrows.

### **Effect of the introduction or addition of nest-boxes**

In Wrzeciono (peripheral estates with blocks of flats), where buildings had been gradually renovated during the period of sparrow monitoring (2005-2009), 25 nest-boxes (8 on buildings, 17 on trees) were erected after the first season of studies. Although the number of House Sparrows declined as result of the loss of nest sites in buildings, nest-boxes were not occupied. However, in 2012, when another 34 nest-boxes were erected on buildings, 7 of them were occupied by House Sparrows.

In parks, where breeding House Sparrows were absent, the installation or addition of nest-boxes did not change the population of this species. However, in one of the parks where sparrows occurred as the breeding species (Kraśnińscy Garden), the population grew after introducing of nest-boxes. In a second one (Saxon Garden), the erection of

nest-boxes did not increase sparrow numbers, however they occupied some of them (11 of 43), after the loss of tree nest sites (holes in trees that had been trimmed).

Tree Sparrow positively responded to the introduction of nest-boxes in Wrzeciono: they occupied 2 of them and increasing the population from 3 to 7 pairs. However further erection of more nest-boxes did not influence the population and further on this plot. In all parks, where the number of nest-boxes was increased from 2005-2012, the densities of Tree Sparrows increased. For example in Powiśle Park, where in 2006 two nest-boxes were present and in 2007 – 16, number of breeding pairs of this species increased from 6 to 13.

### **Use of nest sites resources**

Optimal nest sites (in buildings) were common in housing estates and, in smaller number, in parks. In blocks of flats, that had been renovated, there were few unoccupied nest sites available in buildings. In housing estates that were not renovated (or only to a small degree), some (but not much) free nest sites were found in buildings. It is probable, that their presence enabled sparrows to move there from renovated built-up areas, which could explain the increase in the number of H. Sparrow in some elder estates (see Table 1). Suboptimal nest sites unoccupied by House Sparrows existed in all habitats. Small numbers of them were present in housing estates after renovation as well as in not renovated. In parks, where House Sparrows occurred, the numbers of such sites were moderate, and in parks without House Sparrows – availability was high. They were also numerous suboptimal nest sites in allotment gardens. Thus, in most cases, the number of House Sparrow was limited only by availability of optimal nest-sites. In housing estates it was also limited to some degree by general abundance of nest sites (optimal + suboptimal), as the holes in trees and nest-boxes were sparse in this habitat. However, there was a surplus in the total number of nest-sites in remaining habitats, indicating that the population of House Sparrows in Warsaw, as a whole, was not limited by a shortage of nest sites.

### **Importance of competition for nest sites**

Nesting niches of House- and Tree Sparrow overlap and in some areas both species compete for nest sites (Cordero & Rodriguez-Teijeiro 1990). The decrease in House Sparrows in housing estates in Warsaw probably did not influence the observed Tree Sparrow expansion. On plots, where the abundance of House Sparrows decreased thereby making the number of “free” nest-sites increase, there was no response in the Tree Sparrow population. Also, the situation of the Tree Sparrow on plot Wrzeciono (see above), where a lot of unoccupied nest-boxes existed suggest that the population in this habitat was not limited by availability of nest sites, but rather by the other factors (probably connected to food resources).

However, observations carried out in some parks, showed that House Sparrow declines could have an effect on Tree Sparrow increases. In Saxon Garden, the number of Tree Sparrows increased from 12 pairs in 2008 (it occupied then 5 of 43 nest-boxes) to 21 pairs in 2012 (17 in nest-boxes), while the number of House Sparrows decreased respectively from 57 pairs (11 in nest-boxes) to 20 (all out of nest-boxes).

## CONCLUSIONS

### House Sparrow

1. Number of House Sparrow declined by a half from 70s/80s, and the process is continuing
2. The species abandoned most urban green areas though in some of housing estates its number increased
3. Most pairs nested in crevices in buildings, and suboptimal nest sites were occupied only in cases of particularly attractive food conditions
4. Densities or occurrence of House Sparrows on particular plots were influenced by the area/presence of buildings
5. Insulation of buildings considerably reduced the number of local pairs in housing estates
6. Nest-boxes were rather meaningless for House Sparrow population, although, locally, they could increase in number or reduce to a some degree the rate of decrease caused by the loss of optimal nest-sites
7. On study plots there was a surplus of potential nest sites for House Sparrow, suggesting that a shortage of nest sites was not the main cause of the decline of the H. Sparrow in Warsaw

### Tree Sparrow

1. Number of Tree Sparrow increased by 70% from 70s/80s to the present and colonized the new habitat (housing estates)
2. It was more flexible in its choice of nest sites than House Sparrow
3. The abundance of Tree Sparrow was clearly influenced by the number of nest-boxes, particularly in younger parks
4. The area/presence of buildings was meaningless for this species
5. The decline of House Sparrow population probably contributed to the increase of Tree Sparrow number

## REFERENCES

Baillie S.R., Marchant J.H., Crick H.Q.P., Noble D.G., Balmer D.E., Barimore C., Coombes R.H., Downie I.S., Freeman S.N., Joys A.C., Leech D.I., Raven M.J., Robinson R.A., Thewlis R.M.

- 2007 – Breeding Birds in the Wider Countryside: their conservation status 2007 – BTO Research Report No 487. BTO, Thetford.
- Bednorz J., Kupczyk M., Kuźniak S., Winięcki A. 2000 – (The birds of Wielkopolska region. Faunistic monograph) – Bogucki Wyd. Nauk., Poznań (in Polish).
- Bell C.P. 2011 – Misapplied ecology: investigations of population decline in the House Sparrow – Intern. Stud. Sparrows 35: 24-34.
- Bhattacharya R., Roy R., Goswami C. 2011 – Studies on the response of House Sparrows to artificial nest – International Journal of Environmental Sciences 1: 1574-1581.
- Biaduń W. 2004 – (The birds of Lublin) – Akademia Medyczna, Lublin (in Polish).
- Blair R.B. 1996 – Land use and avian species diversity along an urban gradient – Ecol. Appl. 6: 506-519.
- Bland R.L. 1998 – House Sparrow densities in Bristol – Avon Bird Report 1988: 145-148.
- Blattner M., Speiser C.T. 1990 – Schwankungen und langfristige Trends der Nistkasten-Besetzungsanteile von Singvögeln in der Region Basel und ihre Aussagekraft – Der Ornithologische Beobachter 87: 223-242.
- Bokotey A.A., Gorban I.M. 2005 – Numbers, distribution and ecology of the House Sparrow in Lvov (Ukraine) – Intern. Stud. Sparrows 30: 7-22.
- Bosakowski T. 1986 – Winter population trends of the House Finch and ecologically similar species in northeastern New Jersey – American Birds 40: 1105-1110.
- Cordero P.J., Rodriguez-Teijeiro J.D. 1990 – Spatial segregation and interaction between House Sparrow and Tree Sparrow (*Passer* spp.) in relation to nest site – Ekol. Pol. 38: 443-452.
- Dawson D.G. 1972 – The Breeding Biology of House Sparrow – PhD Thesis, University of Oxford.
- De Laet J., Summers-Smith J.D. 2007 – The status of the urban house sparrow *Passer domesticus* in north-western Europe: a review – J. Ornithol. 148: 275-278.
- Dinetti M. 2007 – I passeri *Passer* spp. nelle aree urbane e nel territorio in Italia. Distribuzione, densità e status di conservazione: una review – Ecologia urbana 19: 11-42.
- Dott H.E.M., Brown A.W. 2000 – A major decline of House Sparrows in central Edinburgh – Scot. Birds 21: 61-68.
- Fernández-Juricic E., Sallent A., Sanz R., Rodriguez-Prieto I. 2003 – Testing the risk-disturbance hypothesis in a fragmented landscape: nonlinear responses of House Sparrows to humans – Condor 105: 316-326.
- Gil-Delgado J.A., Vives-Ferrándiz C., Tapiero A. 2002 – Tendencia decreciente de una población de Gorrión Común *Passer domesticus* en los naranjales del este de España – Ardeola 49: 195-209.
- Heij C.J. 1985 – Comparative ecology of the House Sparrow, *Passer domesticus*, in rural, suburban and urban situations – Thesis, Vrije Universiteit te Amsterdam.
- Janiszewski T., Wojciechowski Z., Markowski J. (eds.) 2009 – Atlas of breeding avifauna in Łódź – Wyd. Uniw. Łódzkiego, Łódź (in Polish).
- Konstantinov V. M., Zakharov R. 2005 – Moscow – In: Birds in European cities, Eds. J.G. Kelcey, G. Rheinwald – Ginster Verl., St. Katharinen, Germany.
- Larivée J. 1991 – Le Moineau domestique est de moins en moins observé au Québec – Québec Oiseaux 2: 24-25.
- Luniak M. 1980 – Birds of allotment gardens in Warsaw – Acta Ornithol. 1: 297-320.
- Luniak M. 1981 – The birds of the park habitats in Warsaw – Acta Ornithol. 18: 335-374.
- Luniak M. 1994 – The development of bird communities in new housing estates in Warsaw. Memorabilia zool. 49: 257-267.

- Luniak M., Jabłoński P., Marczak P. 1986 – (Birds of the Łazienki Królewskie park (Warsaw) in the years 1954-84) – Acta Ornithol. 22: 23-50 (in Polish).
- Mitschke A., Mulsow R. 2003 – Düstere Aussichten für einen häufigen Stadtvogel – Vorkommen und Bestandentwicklung des Haussperlings in Hamburg – Artenschutzreport, (Sonderheft) 14: 4-12.
- Nowicki W. 1992 – (Changes in the breeding avifauna of the parks of Warsaw (1975-1985), and the use of nest-boxes to manage it) – Acta Ornithol. 27: 65-92 (in Polish).
- Reif J., Voříšek P., Štastný K., Bejček V., Petr J. 2008 – Agricultural intensification and farmland birds: new insights from a central European country – Ibis 150: 596-605.
- Sanderson R.F. 2001 – Further declines in an urban population of House Sparrows – Br. Birds 94: 507.
- Siriwardena G.M., Robinson R.A., Crick H.Q.P. 2002 – Status and population trends of the house sparrow *Passer domesticus* in Great Britain – In: Investigation into the causes of the decline of starlings and house sparrows in Great Britain, Eds. H.Q.P. Crick, R.A. Robinson, G.F. Appleton, N.A. Clark, A.D. Rickard. BTO, Thetford.
- Summers-Smith J.D. 1958. Nest-site selection, pair formation and territory in the HS (*Passer domesticus*). Ibis 100: 190-203
- Summers-Smith J.D. 1995 – The Tree Sparrow – J. Denis Summers-Smith, Guisborough.
- Summers-Smith J.D. 2003 – The decline of the House Sparrow: a review – Br. Birds 96: 439-446.
- Summers-Smith J.D. 2009 – House Sparrow densities in different habitats in a small town in NE England – Meeting on the decline of the urban House Sparrow *Passer domesticus*: Newcastle 2009 (24-25 Feb) – Intern. Stud. Sparrows 33: 22-23.
- Tomiałoć L. 2007 – (Changes in the breeding avifauna of two urban parks of Legnica after 40 years) – Not. Orn. 48: 232-245 (in Polish).
- Tomiałoć L. 2011 – Changes in breeding bird communities of two urban parks in Wrocław across 40 years (1970-2010): before and after colonization by important predators – Ornis Pol. 52: 1-25.
- Tomiałoć L., Stawarczyk T. 2003 – (The Avifauna of Poland) – PTPP „pro Natura”, Wrocław (in Polish).
- Väisänen R.A., Solonen T. 1997 – (Population trends of 100 winter birds species in Finland in 1957-1996) – In: Linnut-vuosikirja 1999, Eds. T. Solonen, E. Lammi – BirdLife Suomi, Helsinki, Finland (in Finnish).
- Vepsäläinen V., Pakkala T., Tiainen J. 2005 – Population increase and aspects of colonization of the Tree Sparrow *Passer montanus*, and its relationships with the House Sparrow *Passer domesticus*, in the agricultural landscapes of Southern Finland – Ornis Fennica 82: 117-128.
- Weggler M., Widmer M. 2000 – Vergleich der Brutvogelbestände im Kanton Zürich 1986-1988 und 1999. II. Verstädterung der Siedlungsräume und ihre Folgen für die Brutvogelwelt – Ornithol. Beob. 97: 223-232.