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Some Aspects of the Synanthropization of Nine Species of the Turdidae Family in Kaliningrad

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Abstract—Numbers, dynamics of distribution for ten years, and relations between density and the rate of urbanization in nine species of Turdidae are calculated. During the last ten years the area of spatial distribution of most species increased by 2–15 times. A positive relationship between the numbers of birds and the rate of urbanization is revealed in the Redstart ($R_{N\,142} = 0.16$; $p = 0.049$) and the Black Redstart ($R_{N\,134} = 0.25$; $p = 0.03$), a negative relationship was observed in the Nightingale ($R_{N\,134} = -0.23$; $p = 0.006$) and the Robin ($R_{N\,43} = -0.28$; $p = 0.06$). The numbers of Whinchat, Wheatear, and thrushes does not depend on the rate of urbanization.

Key words: Turdidae, Kaliningrad city, synanthropization, distribution, population density.

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One of the stages of the transition of birds to a synathropic mode of life is the occupation of the urban environment. This phenomenon is a sum of many issues—ecological, behavioral, spatial, etc. (Erz, 1966; Luniak, 1990, 2004). The first stage of investigations usually is the elucidation of the level of urbanization understood as the concentration of humans and economics within a limited space with a population of birds (Petelka, 1942; Batten, 1972). This is facilitated by the publication of atlases of nesting birds of West Berlin (*Brutvogelatlas*, 1984), Sofia (Iankov, 1992), Brussels (Oiseaux de Bruxelles, 1995), London (Hewlett, 2002), Warsaw (Luniak et al., 2001). In Russia, there are the atlases of St. Petersburg (Khrabryi, 1991) and Kaliningrad (Grishanov, 1999). The atlases of Moscow (Kalaykin and Voltsit, 2007), Voronezh (Numerov and Kiselev, 2001), etc. are being elaborated. The cities situated along the border of densely populated and relatively little changed regions of Central and Eastern Europe provide rich material for investigations of the formation and distribution of urban morphs and populations of birds. We believe that Kaliningrad (former Königsberg) is such city.

In the present study are the quantitative and spatial parameters of colonization by nine species of birds belonging to the family Turdidae of variously transformed urban territories of Kaliningrad. Turdidae differ in their ethology and ecology, and many of them are able to start the urban mode of life. The blackbird has become a classic object of investigations of this phenomenon (Luniak, 1970; Luniak et al., 1990; etc.).

The area of Kaliningrad is approximately 220 km^2, its population is over 450000. During the postwar period buildings were built on 36 km^2, while the density of buildings significantly decreased. A characteristic feature is the abundance of water bodies, vacant lots, forest parks, orchards, and swampy territories (*Administrativno-territorialnoe...*, 1989). The climate in this region is transitional between marine and continental; winter is mild and often without stable snow cover. A characteristic feature is inconstant weather and strong winds, which are predominantly western and southern (Barinova, 2002; Isachenko et al., 1999).

Ornithological investigations in Eastern Prussia, where Kaliningrad is situated, were started in the beginning of the 20th century by Tischler (1914, 1941) and are carried out in Kaliningrad from 1974 by G.V. Grishanov et al. (1991, 1994 a, 1994 b, 1997; etc.). In 1991–1995 the first survey (Grishanov, 1999) and in 1999–2003 a repeated survey of the city territory were made for the preparation of the atlas of nesting birds. The present article is based on the materials of the last survey.

MATERIAL AND METHODS

The main part of the territory of the city was subdivided into 167 squares with a 1 km side. They were survey by the route method during field seasons (April–June) of 1999–2003. Nesting birds were recorded visually and by songs. The birds were attributed to nesting ones with the consideration of the criteria of potential, probable, and confirmed nesting elaborated by the European Committee on the elaboration of ornithological atlases (EOAC) (Table 1).

Table 1. Criteria of nesting composed by the European Committee on the elaboration of ornithological atlases (EOAC)

Probability level of nesting	By which signs nesting is recorded
A – nesting possible	1 – the bird was observed in the nesting period in the supposed nesting biotope
	2 – singing male in the nesting period (or voice characteristic of the nesting period)
B – nesting probable	3 – a pair of birds was observed in the nesting period in a suitable nesting biotope
	4 – permanent territory, with consideration of the behavior of birds (singing, etc.) twice noted as the nesting territory with the interval not less than one week
	5 – courtship and lekking
	6 – visiting by birds of the supposed nesting place was noted
	7 – agitated behavior or alarmed voice of adult birds
	8 – brood-spot in adult birds
	9 – nest building
C – nesting proved	10 – the bird decoys away from the nest, attacks, etc.
	11 – empty nest or egg shells, etc.
	12 – recently reared chicks (in altricial birds) or chicks in down
	13 – behavior of adult birds, approaching the nest indicates that the nest is occupied
	14 – adult bird bearing feces, or bearing feed for chicks
	15 – nest with eggs is found
	16 – nest with chicks is found

For each square the level of urbanization of the city territory was estimated in points (Table 2), by analogy with the estimation of the level of the disturbance of landscape (Reimers and Shtilmark, 1978).

The relation of each species to the urbanization level was checked statistically applying the nonparametric Spearman correlation index and Kruskal-Wallis test for the comparison of multiple independent groups using the software package Statistica 6.0.

RESULTS

Nine species of Turdidae nest in the Kaliningrad territory (Table 3). The following species are abundant and widely distributed, including the city center: thrush nightingale, two species of redstarts, and blackbird. Wheatear, robin, and fieldfare are not numerous, while whinchat and song thrush are scarce species occupying the periphery of the city.

Nesting of robin (*Erithacus rubecula* L.) occupies 26.3% of the city and 20% in the city center (Table 3) with a low density but a wide occupation of space (Figure A). A high density is recorded in the northwestern and western parts of the city, in areas with large parks, forest parks, and forests.

Nightingale (*Luscinia luscinia* L.) is distributed much wider than robin (Table 3), both in the city center and generally. The highest density is recorded in the western, northwestern, and northeastern parts. The highest density is in the west of the city at Mendeleevo settlement (Figure B).

Common Redstart (*Phoenicurus phoenicurus* L.) is the most abundant and widely distributed bird of this family (Table 3). It is distributed really everywhere. In the city center up to 25 pairs/square are nesting; in the northwest, east, and southeast of the city in garden plots and in orchards at low buildings there are up to 60–80 pairs/square.

The abundance of black redstart (*Phoenicurus ochruros* L.) is lower than that of nightingale, though it is distributed not less widely, especially in the southern part of the city among industrial and transport enter-

Table 2. Estimation in points of the urbanization level of the city territory

Points	Structure of territory	Number (%) squares
0	Major part of the square is occupied by self-reproducing relatively stable phytocenoses (forest parks, bush, meadow, etc.) Buildings, asphalt, etc. are absent	5 (3.0)
1	Up to 80% of the square is occupied by relatively permanently functioning phytocenoses; built up areas occupy up to 20%	26 (15.6)
2	60-80% of the square is occupied by self-reproducing phytocenoses; built up areas occupy 21–40%	30 (18.0)
3	Built up areas occupy 41–60%	53 (31.7)
4	Vegetation occupies 20–40%; built up areas occupy 61–80% of the square	49 (29.3)
5	Built up areas occupy over 80% of the square	4 (2.4)

Table 3. Abundance and spatial distribution of birds of Family Turdidae in Kaliningrad

Species	Total number of nesting pairs	%	Population density, pairs/km^2			Number of populated squares	
			min	max	median	total/center	% in the city/% in the center
Robin	239	4.1	1	20	5	44/4	26.3/16
Nightingale	1120	19.3	1	30	7	134/11	80.2/44
Black Redstart	833	14.4	1	20	7	133/19	79.6/76
Common Redstart	2235	38.5	1	80	10	142/19	85.0/76
Whinchat	45	0.8	1	8	2	17/0	10.2/0
Wheatear	164	2.8	1	7	2	60/6	35.9/24
Blackbird	965	16.6	1	40	6	121/17	72.5/68
Fieldfare	173	3	1	15	4	34/7	20.4/28
Song Thrush	29	0.5	1	4	1	16/1	9.6/4

prises. In the city center it, similarly to common redstart, occupies a relatively larger part of territory than generally over the city (Table 3). The population density of black redstart is lower than in common redstart but it is more common in averagely or highly developed sites (Figure C, D).

Winchat (*Saxicola rubetra* L.) is an abundant species distributed over the periphery of Kaliningrad, predominantly in the northwestern and southeastern parts where there are extensive meadows with groups of shrubs. Its abundance is lower than that of all other species (Table 3). Winchat does not nest in the urbanized center of the city (Figure E).

Wheatear (*Oenante oenante* L.) makes less than 3% of all Turdidae. It is distributed over the city territory more homogeneously than winchat (Figure F) both in the periphery, in the zone of industrial and garage construction and in the center, on vacant lots and building sites (Table 3).

Table 4. Dynamics of spatial distribution of Turdidae species in Kaliningrad

Species	Number of populated squares		State as of the first half of the 20th century*
	1991–1995 (Grishanov, 1999)	1999–2003 (Lykov)	
Robin	23	44	+
Nightingale	140	134	+
Black Redstart	45	133	+
Common Redstart	83	142	+
Whinchat	17	17	+
Wheatear	4	60	+
Blackbird	119	121	+
Fieldfare	4	34	+
Song Thrush	2	16	+

* Tischler, 1914, 1941; (+) @@@.

Among species of the genus *Turdus*, blackbird (*Turdus merula* L.) is the most widely distributed in Kaliningrad territory (Figure, G). Forests, city forest parks and parks are densely populated, with up to 40 pairs/square. In the city center the blackbird occupies a relatively larger area than generally over the city (Table 3).

Fieldfare (*T. pilaris* L.) also is wider represented in the center than on the whole territory (Table 3) and nests here by 3–5 pairs/square. In the northern, southwestern, and eastern parts of the city its density attains 10–15 pairs/square (Figure H).

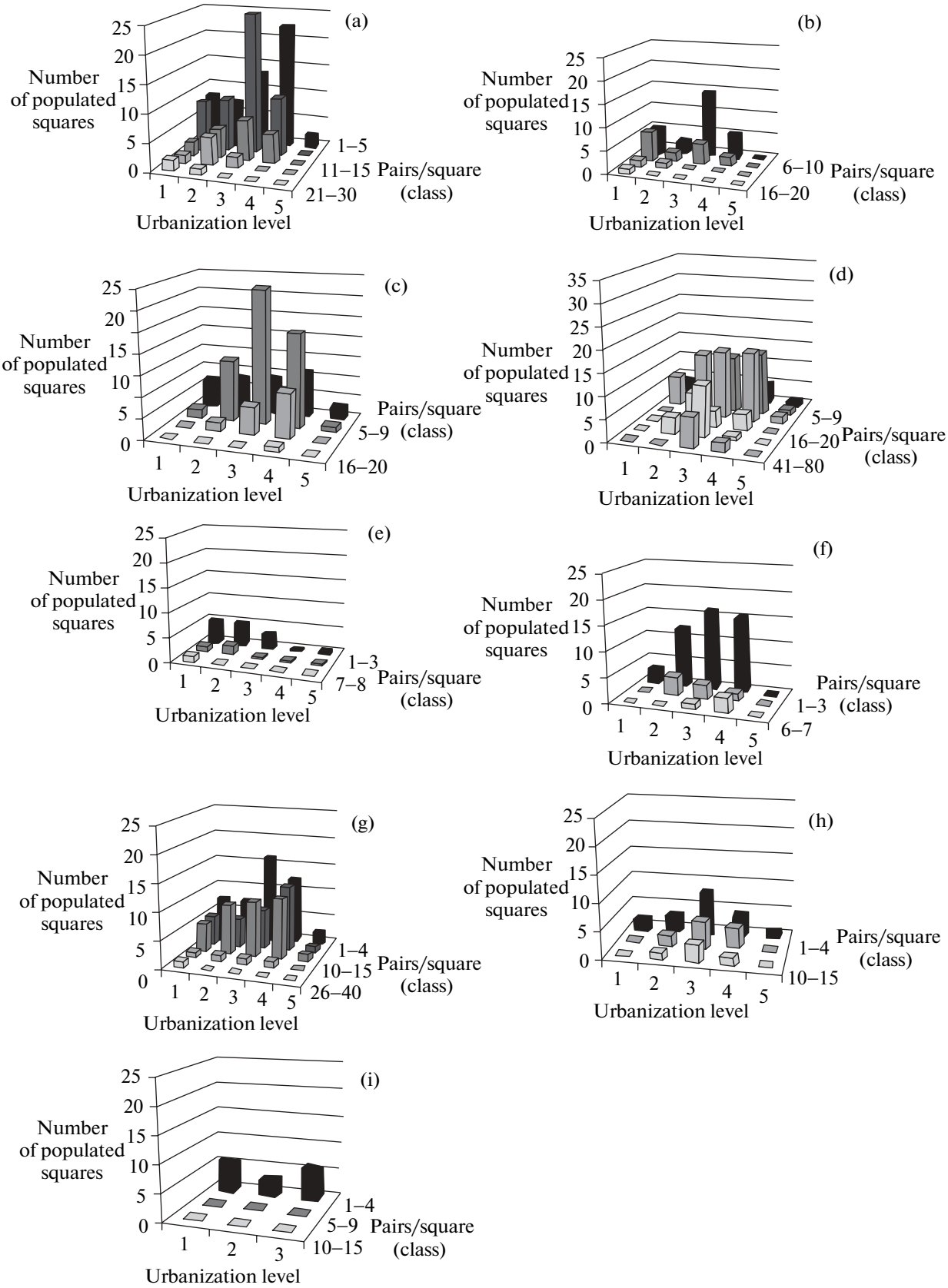
Song thrush (*T. philomelos*) is not abundant in Kaliningrad and keeps at peripheral areas (Table 3, Figure I). Thus, 3–4 pairs/square are recorded in a damp mixed forest at the Chkalovsk settlement in the northwestern part of the city. It nests also in old forest parks and swampy alder forests, and in the city center it is recorded in one square only.

In the period of surveys, three species of Turdidae retained the size of their distribution area and in six species the distribution area increased within the city limits (Table 4).

In three species, nightingale and two species of redstarts, correlation analysis and Kruskal-Wallis test revealed a significant, though weak, relationship between the number in the square and the urbanization level of the territory. In robin the relationship is close to significant (Table 5).

DISCUSSION

Generally, in every bird family there are several species easily passing over to the environment transformed by man (Leonovich, 1991; Moskvitin, 2001). However, potential urban residents are much more numerous and such tendencies are observed in the



Abundance and distribution of nine Turdidae species in Kaliningrad on territories with different urbanization level. A is Robin, B is Nightingale, C is Common Redstart, D is Black Redstart, E is Whinchat, F is Wheatear, G is Blackbird, H is Fieldfare, and I is Song Thrush.

Table 5. Parameters of Turdidae population (pairs/square) and their relationship with the urbanization level of the territory

Species	N of records	Spearman coefficient	*P*	Kruskal-Wallis test (H)	*P*
Robin	44	–0.28	0.06	7.3	0.12
Nightingale	134	–0.23	0.006	19.27	0.017
Black Redstart	134	0.25	0.003	18.06	0.012
Common Redstart	142	0.16	0.049	24.10	0.0001
Whinchat	17	–0.02	@@@	0.24	0.89
Wheatear	59	–0.03	@@@	5.65	0.23
Blackbird	121	–0.07	@@@	1.92	0.86
Fieldfare	34	0.06	@@@	0.89	0.92
Song Thrush	16	–0.32	@@@	6.83	0.77

increasing number of species (Fridman et al., 2006; Luniak, 2004).

The positive relationship with the urbanization level is found in Common Redstart ($R_{N\,142} = 0.16$; $p = 0.049$) and Black Redstart ($R_{N\,134} = 0.25$; $p = 0.03$, Table 5). Redstarts nest predominantly in buildings (Black Redstart only in buildings) and collect feed on disturbed bared areas. Therefore, the occupation of urban territory by them is directly connected with the improvement of feeding and nesting situations. Common Redstart populated Kaliningrad more homogeneously than Black Redstart, attaining the record density (40–80 pairs/square). In Lublin and in Berlin, where Common Redstarts (1300 pairs) are nesting on 69% of the city area, the numbers of Common Redstart began growing since the beginning of the 20th century (Biadin, 2005; Witt, 2005). In Bratislava the birds nest in empty metal tubes of fences (Feriancova-Masarova and Kadorova, 2005). Still, in ten European cities the numbers decreased (Luniak, 1990). Recently, in Moscow it sharply decreased; in 2006, per 20 km^2, two singing males were noted (Kalyakin and Voltsit, 2007).

In the 1940s–1950s, in the Czech Republic, Black Redstart lived in rocky biotopes more often than in settlements. Nesting in yards, cottages, and "dormitory" districts is a secondary new phenomenon (Stastny et al., 2005). In Bratislasva a brood survived in the nest on a building while another brood on a tree perished (Feriancova-Masarova and Kadorova, 2005). In Berlin (Wit, 2005), Black Redstart populates industrial zones. During the latest ten years its abundance has reached 3000 pairs and comprises 66% of the city territory. The area expands to the east: in Moscow attempts at nesting started in the 1980s, in 2006 in the eastern margin of Moscow, only two pairs were noted, in the northern margin up to ten pairs/km^2 were noted (Kalyakin and Voltsit, 2007).

A weak negative relationship with the urbanization level is revealed in nightingale ($R_{N\,134} = -0.23$; $p = 0.006$) and robin ($R_{N\,43} = -0.28$; $p = 0.05$, Table 5). Over the period of ten years nightingale retained a wide distribution in the city attained in previous years (Table 4) related not so much to built up areas as with coastal vegetation which are built up last. In Berlin, 1500 pairs of nightingales populate 60% of the territory (Win, 2005). In Warsaw, its abundance decreases (Luniak, 2005); in Moscow, it is stable, with up to 20 pairs/km^2 (Kalyakin and Voltsit, 2007). Of 27 European cities, the numbers decrease in seven and only in one city it increases (Luniak, 1990).

Robin increases its life zone in Kaliningrad (Table 4) and is limited in its distribution by fragments of forests and forest parks. In Warsaw, this is one of the dominant species; in urban forests 4.1 pairs/10 ha nest, in cemeteries there are over 10 (Luniak, 2005). In Berlin, robins occupied secondary biocenoses on overgrown vacant lots. Together with nightingales they occupy right-of-way areas along railways (Muslow, 2005). In Sofia, robin was not nesting until 1970 but now it is quite common (Iankov, 2005). In Moscow it tends to increase its abundance (Eremkin and Ochagov, in press); its density on forest parks attains 50 pairs/km^2 (Kalyakin and Voltsit, 2007).

The abundance of whinchat, wheatear, and of other Turdidae species is not related to the urbanization level (Table 5). Winchat is a vulnerable "relic" species remaining at the periphery of the city as long as natural habitats remain there (Luniak, 2005). In Sofia, winchat was nesting until 1930 and then disappeared gradually (Iankov, 2005). In Kaliningrad, its distribution does not decrease (Table 4). In Moscow, it rapidly disappears following the reduction of the area of meadows and vacant lots. In 2006, only one pair was recorded per 20 km^2 (Kalyakin and Voltsit, 2007). Wheatear is distributed in Kaliningrad rather widely and the occupation in the city is rapidly growing (Table 4). However, its density remains at a low level as the birds populate temporary habitats in the course of the transformation of natural landscapes into development zones and industrial landscapes. In spite of a manifold increase of its residence zone the population of wheatear is unstable due to the brief and local exist-

ence of disturbed sites. In Moscow, some groups of wheatear disappeared due to local development but other groups appeared—from one to ten pairs/km^2 (Kalyakin and Voltsit, 2007).

A high nesting density of blackbird is recorded in Kaliningrad everywhere including zones with an urbanization level of three and four. Its invasion to cities of Central Europe was recorded in the middle of the 19th century. By the middle of the 20th century it spread to 1000 km and by the beginning of the 21st century it spread to 2000 km to the east (Luniak, 1990, 2005; Wit, 2005). In Berlin, 50 000 pairs of blackbirds are nesting, this species is a second to house sparrow in abundance. In the central part of Vienna, the density of nests exceeds two per 1 ha (Sziemer and Thomas, 2005). The size of the population nesting in Warsaw is 2000–4000 pairs (Luniak, 2005), its population density is comparable with that in Kaliningrad. Evidently, in these cities blackbird already has occupied principal types of available habitats. Therefore, over ten years its distribution did not change (Table 4). In Moscow, blackbird is a forest bird populating only large green areas at the city periphery where its density reaches 50 pairs/km^2 (Kalyakin and Voltsit, 2007).

In Kaliningrad, the scarce fieldfare over ten years multiplied its distribution area (Table 4) and populated even small green areas among densely situated houses. In squares of an urbanization level of three and four, 75% of the fieldfare population is concentrated (as compared with 60% of blackbird and 57% of nightingale). Due to feeding in biotopes remote from nesting sites, the interrelations of fieldfare with the environment are different than those in species with territorial spatial organization. This fact introduces some accidentalness in comparison with species controlled by the presence of food resources at nesting sites. The area of fieldfare expands to the west. Its abundance in European cities increases beginning from the middle of the 20th century (Luniak, 1990). In Lublin and Warsaw since 1977, fieldfare has nested in parks and cemeteries. From the 1990s, they occupy central squares and public gardens and became settled; sometimes their solitary nesting is observed (Biadun, 2005; Luniak, 2005). In Moscow, the distribution of fieldfare is wider than that of other Turdidae species but abundance significantly fluctuates. Both colonies are up to 50 nests and isolated pairs are recorded (Kalyakin and Voltsit, 2007).

Song thrush in Kaliningrad multiplied its distribution (Table 4) though is still nesting at a low density almost solely in forest at the city periphery. It's abundance in some European cities tends to enhancement, though in other cities it tends to reduction (Luniak, 1990). In Vienna, there are 3–5 pairs per 54 ha of the park (Sziemer and Holzer, 2005). Song thrush penetrated Sofia since 1925 and Lublin since 1991 (Biadun, 2005; Luniak, 2005). In parks of Prague, the density is 8.3 pairs/10 ha, in cemeteries it is 18.8 pairs/10 ha (Stastny et al., 2005). In Berlin, 1700 pairs of song thrush occupy almost 50% of the city territory (Wit, 2005). In Bratislava, song thrush nests on buildings and, together with crows, accepts feed from people (Feriancova-Masarova and Kalivodova, 2005). In Moscow, forests song thrush is a rather rare nesting bird, as a rule its density is below ten pairs/km^2 (Kalyakin and Voltsit, 2007).

Bluethroat was nesting in Kaliningrad in the early 1990s (Grishanov, 1997, 1999). At present it is not nesting, similarly to Warsaw (Luniak, 2005). In Moscow, it is rather common, up to ten pairs/km^2 (Kalyakin and Voltsit, 2007) but its abundance does not increase. In Moscow, forest redwing is present whose abundance does not exceed several pairs/km^2 (Avilova, personal communication); it is absent in Kaliningrad.

Generally, in Kaliningrad the level of the abundance and dynamics of distribution in common redstart, black redstart, blackbird, nightingale, and robin are similar to those in other European cities. In fieldfare and song thrush these parameters did not yet attain the scale characteristic of many large Central-European cities.

On the other hand, in Moscow, situated to the east the abundance of redstarts, blackbird, and song thrush is low; robin and fieldfare are being distributed slowly and inhomogeneously. This is related both to the geographic situation of the city and to the absence in these species of stable urban groups in the eastern part of the area.

Urbanization of the territory is just one of the factors influencing the colonization of the city by birds. A fuller understanding of this phenomenon may be based on the analysis of ecological and behavioral aspects of the integration of birds into the urban environment.

CONCLUSIONS

The comparison of the population of Turdidae in Kaliningrad and in large cities of Central and Eastern Europe demonstrates that the majority of species of this family manifests a clear tendency to colonization of the urban environment. This tendency alleviated from the west to the east.

During the recent ten years, in six of nine Turdidae species the life area in Kaliningrad increased.

At the recent stage, the urbanization of Kaliningrad territory contributes to the distribution of two species of redstarts coinciding with their ecological requirements.

At the same time, urbanization constraints the distribution of nightingale and robin but not so much as to check it as the urban environment is formed of other factors attractive for these species.

In blackbird, fieldfare, and song thrush, any statistical relationship with urbanization is not revealed. At present, in these species, the colonization of the city

seems to be controlled by other and stronger factors than the level of transformation of the city territory.

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