

Composition and characteristics of the avifauna of the town of Kičevo (North Macedonia)

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Abstract



In this paper I present an analysis of the avifauna of the town of Kičevo. The ornithological investigations were carried during a three years period, from January 2020 to February 2023. The qualitative investigations showed presence of 88 species of birds. They belong to 67 genera, 37 families and 13 orders. The most representative order is *Passeriformes*, with 14 families (62.2%) and 60 species (68.2%). The richest with species are the families *Muscicapidae*, *Fringillidae*, *Corvidae* and *Paridae*. The breeding avifauna is represented by 47 species (53.4 %). According to the seasonal status, the most numerous are residents (STAT) with 37 species (42.1%), then summer visitors (AEST) with 18 species (20.4%). Wintering (HIEM), transient (TRANS), and vagrant (VAG) species follow. The faunistic analysis show the domination of Palearctic (PA) type of fauna before the European (Ev) and European-Turkestanic (ET) type among the total avifauna, as they also do in the single groups by seasonal status. Comparing qualitative composition of the avifauna of Kičevo with Skopje and Đakovo, showed a low index of similarity 0.55 and 0.50 respectively, which is due to: geographical position, level of urbanization, coverage of green areas, position along important migratory routes, presence of water bodies and orography.

Key words: avifauna, breeding avifauna, seasonal status, faunistic analysis, Kičevo, North Macedonia.

Introduction

More than 50% of the world population today lives in the cities (Turner et al. 2004), and the speed of expanding of the urban environments is greater of the speed of population growth (Clergeau et al. 2006). The urban ecosystems viewed from an ecological point of view are characterized with a high degree of dynamicity, fragmentation of natural habitats, changed availability and arrangement of resources, and also different shapes of pollution and disturbance (Savard et al. 2000). The species that do not have time and possibility to adapt towards the new specific are forced to leave their habitats. On the contrary of them, there are species that are completely adaptable and are experiencing a real population expansion, and there is a third group of species that will succeed to survive in

the partially changed and newly created environments (Micevski, 1990a).

Avian composition, especially their seasonality and biogeography are important in perceiving all the consequences of increasingly intensifying processes of urbanization and high levels of destruction of natural habitats.

Our research aimed to investigate current composition and characteristics of the avifauna of town Kičevo, in order to see all effects of urbanization in the future.

Study area

The study area is represented by Kičevo, a small town situated in a valley in the south-western part of the

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Republic of North Macedonia. The minimum altitude of the town is 608 m, and the maximum altitude is 690 m (Ivani Dol).

Kičevo is located in the zone of continental climate with average annual temperature of 10.7°C. The maximum average yearly temperature is 17.1°C and the minimum average yearly temperature is 5.0°C. January is the coldest month with average temperature of -0.1°C, and July is the warmest month with average temperature of 20.6°C. According to the rain frequency, the research area is located in the Mediterranean pluviometric zone, which means that the biggest rainfall is in the winter period. The average amount of precipitation is 761.7 mm (Filipovski et al. 1996).

Hydrographic network is made of small number of rivers, which poor in water because of weak sources and lack of rainfall. The largest rivers are Zajaska and Treska.

From a biogeographical point of view, Kičevo is located in the biome of southern-European deciduous forests (Matvejev & Puncer, 1989).

The town is dominantly surrounded by natural forest ass. *Quercetum frainetto-cerris macedonicum* Em and planted coniferous forest with *Pinus nigra* L. On the northern and southern sides it is partially surrounded by neglected grass areas. The green areas consist of greenswards, tree lines, gardens, parks and park-forest. In the Kitino Kale park-forest (7.5 ha) the commonest tree species are the Black Pine *Pinus nigra* L. and the Black Locust *Robinia pseudoacacia* L. In the yards of the houses there are many fruit-trees (*Malus sp.*, *Prunus sp.*, *Juglans regia* L.). The area covered with shrubs has decreased recently in Kičevo. Shrubs are partially formed by native species such as: *Prunus cerasifera* Ehrh., *Prunus spinosa* L. subsp. *dasyphylla* Schur (Domin), *Cornus mas* L., *Rosa canina* L., *Sambucus ebulus* L.

Materials and methods

The investigations of the avifauna of town Kičevo were carried during a three years period, from January 2020 to February 2023. As part of my field activities, I observed all synanthropic biotopes located with in the study area: residential blocks with green areas between them, private houses with gardens, areas in the process of urbanization, industrial areas, tree lines, neglected grass areas, park-forests, ponds and rivers (Micevski, 1990b). Observations were made from fixed points or in motion, with naked eye or by means of a binocular (MaiFeng 8x30) and a telescope (Svbony 20x60), mainly in the morning from 6.30 to 11:00 and in the late afternoon from 15:00 to 18.30, when the activity of birds is prominent (Bibby et al. 2000). Several night observations were done in order to register nocturnal species. Observations were made in the all seasons two time in the week. The most intensive observations three times on the week, were made in the months with the greatest

dynamics of birds, March-June and September-October, which are characterized by breeding and seasonal migration. The distribution of registered bird species in the investigated area is presented on UTM map with 1x1 km squares (Supplement). The scientific names of the species as well their systematic order follow Dickinson & Remsen (2013) and Dickinson & Christidis (2014). Types of fauna of the species are according to Voous (1962). Index of similarity was calculated according to Marcewzski & Steinhaus (1958). Taking into consideration the specifics of the avifauna of the town of Kičevo, the classification of Micevski (1990a) was used for determining the seasonal status of the birds, with the small modification by Velevski (2005), where:

STAT (residents) present throughout the year, but not necessarily breeding;

AEST (summer residents) present during the reproductive period, but not necessarily breeding;

HIEM (wintering) during the winter period;

TRANS (transient) on migration period;

VAG (vagrants) in the breeding (VAG-AEST), wintering (VAG-HIEM) and migration period (VAG-TRANS).

For determining the breeding status was used a criteria described in "The European Breeding Bird Atlas 2" (Keller et al. 2020), where:

0. Non breeding: The species has been observed, but it is suspected that it is still migratory or summer non breeder;

A. Possible breeder:

A1 Species observed in breeding season in suitable nesting habitat;

A2 Singing male present (or breeding calls heard) in breeding season in suitable breeding habitat;

B. Probable breeding:

B3 Pair observed in suitable nesting habitat in breeding season;

B4 Permanent territory presumed through registration of territorial behavior (song etc.) on at least two different days a week or more part at the same place;

B5 Courtship and display;

B6 Visiting probable nest site;

B7 Agitated behavior or anxiety calls from adults, suggesting probable presence of nest or young nearby;

B8 Brood patch on adult examined in the hand, suggesting incubation;

B9 Nest building or excavating nest-hole;

C. Confirmed breeding:

C10 Distraction-display or injury feigning;

C11 Used nest or eggs hells found (occupied or laid within period of survey);

C12 Recently fledged young (nidicolous species) or downy young (nidifugous species).

C13 Adults entering or leaving nest-site in circumstances indicating occupied nest (including high nests or nest holes, the contents of which can not be seen) or adults seen incubating;

C14 Adult carrying fecal sac or food for young;

C15 Nest containing eggs;

C16 Nest with young seen or heard;

Results

A total of 88 species of birds were registered within the study area (Table 1). They belong to 67 genera, 37 families and 13 orders. They represent 27.7 % of the total number of registered birds' species on the territory of the Republic of North Macedonia (Velevski & Vasić, 2017). The most representative order was *Passeriformes*, with 23 families (62.2 %) and 60 species (68.2 %). The richest with species are the families: *Muscicapidae*, *Fringillidae*, *Corvidae* and *Paridae*.

“Breeding avifauna” (term usually refers to confirmed, probable and possible breeders, Keller et al.

2020) is represented by 47 species (53.4%) in avifauna of the town Kičevo. According to the seasonal status the most numerous are the resident birds (STAT) with 37 species (42.1%), than the summer residents (AEST) with 18 species (20.4%). Significantly less represented are wintering (HIEM) with 14 species (15.9%), transient (TRANS) with 12 species (13.6%), and vagrants (VAG) with 7 species (8.0%).

Faunistical analysis (Table 2) showed absolute dominance of Palearctical (PA) elements with 39.8% while on the second and third place are European elements (Ev) and European-Turkestanic elements (ET) with 15.9% and 14.8% respectively.

Comparing the avifauna of Kičevo with Skopje (Micevski, 1990a) and Đakovo (Micevski, 1989) according to the seasonal representation (Table 3) the resident birds (STAT) and the spring-summer visitors (AEST) show dominance in all compared cities. There is a noticeable difference in domination of wintering (HIEM) and transient birds (TRANS) in Skopje compared with Kičevo and Đakovo.

Table 1. List of bird species registered in the town of Kičevo

Number	FAMILY/Species	Type of fauna	Seasonal status	Breeding	EBBA2 CODE
ANATIDAE					
1	<i>Anas platyrhynchos</i> L.	HA	STAT	+	C12
PHASIANIDAE					
2	<i>Perdix perdix</i> L.	ET	HIEM	-	
COLUMBIDAE					
3	<i>Columba livia</i> J. F. Gmelin	TM	STAT	+	C13
4	<i>Columba palumbus</i> L.	ET	STAT	+	A1
5	<i>Streptopelia turtur</i> L.	ET	AEST	+	B4
6	<i>Streptopelia decaocto</i> Frivaldszky	IA	STAT	+	B4
APODIDAE					
7	<i>Apus apus</i> L.	PA	AEST	+	B4
CUCULIDAE					
8	<i>Cuculus canorus</i> L.	PA	AEST	+	B4
CICONIDAE					
9	<i>Ciconia ciconia</i> L.	PA	AEST	+	C16
ARDEIDAE					
10	<i>Ardea cinerea</i> L.	PA	VAG-AEST	-	
ACCIPTRIDAE					
11	<i>Pernis apivorus</i> L.	Ev	VAG-TRANS	-	
12	<i>Circetus gallicus</i> J. F. Gmelin	IA	VAG-TRANS	-	
13	<i>Aquila chrysaetos</i> L.	HA	VAG-TRANS	-	
14	<i>Accipiter nisus</i> L.	PA	HIEM	-	
15	<i>Buteo buteo</i> L.	HA	HIEM	-	
STRIGIDAE					
16	<i>Athene noctua</i> Scopoli	TM	STAT	+	A1
17	<i>Otus scops</i> L.	AW	AEST	+	B4
18	<i>Asio otus</i> L.	HA	STAT	+	C16

Number	FAMILY/Species	Type of fauna	Seasonal status	Breeding	EBBA2 CODE
UPUPIDAE					
19	<i>Upupa epops</i> L.	AW	AEST	+	A1
PICIDAE					
20	<i>Jynx torquilla</i> L.	PA	AEST	+	C14
21	<i>Picus viridis</i> L.	Ev	STAT	+	B4
22	<i>Dendrocopos minor</i> L.	PA	STAT	-	
23	<i>Dendrocopos major</i> L.	PA	STAT	+	C13
MEROPIDAE					
24	<i>Merops apiaster</i> L.	TM	AEST	+	A1
ALCEDINIDAE					
25	<i>Alcedo atthis</i> L.	AW	STAT	-	
FALCONIDAE					
26	<i>Falco tinnunculus</i> L.	AW	STAT	+	B6
27	<i>Falco columbarius</i> L.	HA	HIEM	-	
28	<i>Falco subbuteo</i> L.	PA	VAG-AEST	-	
ORIOOLIDAE					
29	<i>Oriolus oriolus</i> L.	AW	AEST	+	B4
LANIDAE					
30	<i>Lanius collurio</i> L.	PA	AEST	+	C14
CORVIDAE					
31	<i>Garrulus glandarius</i> L.	PA	STAT	+	B4
32	<i>Pica pica</i> L.	PA	STAT	+	C13
33	<i>Corvus monedula</i> L.	PA	STAT	+	C13
34	<i>Corvus corax</i> L.	HA	STAT	-	
35	<i>Corvus corone</i> L.	PA	STAT	+	C13
PASSERIDAE					
36	<i>Passer domesticus</i> L.	PA	STAT	+	C12
37	<i>Passer montanus</i> L.	PA	STAT	+	C13
MOTACILLIDAE					
38	<i>Anthus trivialis</i> L.	ET	TRANS	-	
39	<i>Motacilla cinerea</i> Tunstall	PA	STAT	+	C14
40	<i>Motacilla alba</i> L.	PA	STAT	+	C14
FRINGILLIDAE					
41	<i>Fringilla coelebs</i> L.	Ev	STAT	+	B4
42	<i>Coccothraustes coccothraustes</i> L.	PA	STAT	+	A1
43	<i>Chloris chloris</i> L.	ET	STAT	+	C12
44	<i>Linaria cannabina</i> L.	ET	HIEM	-	
45	<i>Carduelis carduelis</i> L.	ET	STAT	+	C11
46	<i>Serinus serinus</i> L.	Me	STAT	+	A1
47	<i>Spinus spinus</i> L.	PA	HIEM	-	
EMBERIZIDAE					
48	<i>Emberiza calandra</i> L.	ET	AEST	+	B4
49	<i>Emberiza cirius</i> L.	Me	STAT	+	C12
50	<i>Emberiza citrinella</i> L.	PA	HIEM	-	
PARIDAE					
51	<i>Periparus ater</i> L.	PA	HIEM	-	
52	<i>Poecile lugubris</i> Temminck	Me	STAT	-	
53	<i>Poecile palustris</i> L.	PA	HIEM	-	
54	<i>Cyanistes caeruleus</i> L.	Ev	STAT	+	B4
55	<i>Parus major</i> L.	PA	STAT	+	C16

Number	FAMILY/Species	Type of fauna	Seasonal status	Breeding	EBBA2 CODE
	REMIZIDAE				
56	<i>Remiz pendulinus</i> L.	PA	AEST	+	A1
	ALAUDIDAE				
57	<i>Galerida cristata</i> L.	PA	STAT	+	
	ACROCEPHALIDAE				
58	<i>Hippolais icterina</i> Vieillot	Ev	TRANS	-	
	HIRUNDINDAE				
59	<i>Delichon urbicum</i> L.	PA	AEST	+	C13
60	<i>Hirundo rustica</i> L.	HA	AEST	+	C16
61	<i>Riparia riparia</i> L.	HA	TRANS	-	
	PHYLLOSCOPIIDAE				
62	<i>Phylloscopus trochilus</i> L.	PA	TRANS	-	
63	<i>Phylloscopus collybita</i> Vieillot	PA	TRANS	-	
	AEGITHALIDAE				
64	<i>Aegithalos caudatus</i> L.	PA	HIEM	-	
	SYLVIDAE				
65	<i>Sylvia atricapilla</i> L.	Ev	AEST	+	A1
66	<i>Curruca curruca</i> L.	ET	TRANS	-	
67	<i>Curruca communis</i> Latham	ET	AEST	+	A1
	REGULIDAE				
68	<i>Regulus regulus</i> L.	PA	HIEM	-	
69	<i>Regulus ignicapilla</i> Temminck	HA	HIEM	-	
	CERTHIIDAE				
70	<i>Certhia brachydactyla</i> C. L. Brehm	Ev	STAT	-	
	SITTIDAE				
71	<i>Sitta europaea</i> L.	PA	STAT	-	
	TROGLODYTIDAE				
72	<i>Troglodytes troglodytes</i> L.	HA	HIEM	-	
	STURNIDAE				
73	<i>Sturnus vulgaris</i> L.	ET	STAT	+	C12
	CINCLIDAE				
74	<i>Cinclus cinclus</i> L.	PM	STAT	+	C14
	MUSCICAPIDAE				
75	<i>Muscicapa striata</i> Pallas	ET	TRANS	-	
76	<i>Erithacus rubecula</i> L.	Ev	HIEM	-	
77	<i>Luscinia megarhynchos</i> C. L. Brehm	Ev	AEST	+	B4
78	<i>Ficedula hypoleuca</i> Pallas	Ev	TRANS	-	
79	<i>Ficedula albicollis</i> Temminck	Ev	TRANS	-	
80	<i>Phoenicurus phoenicurus</i> L.	Ev	AEST	+	A2
81	<i>Phoenicurus ochrurus</i> S. G. Gmelin	PxM	TRANS	-	
82	<i>Saxicola rubetra</i> L.	Ev	TRANS	-	
83	<i>Saxicola rubicola</i> L.	PA	TRANS	-	
84	<i>Oenanthe oenanthe</i> L.	PA	VAG-AEST	-	
	TURDIDAE				
85	<i>Turdus viscivorus</i> L.	ET	STAT	+	B4
86	<i>Turdus philomelos</i> C. L. Brehm	Ev	STAT	+	C15
87	<i>Turdus iliacus</i> L.	Si	VAG-HIEM	-	
88	<i>Turdus merula</i> L.	PA	STAT	+	B4

Table 2. Faunistical analysis of the avifauna of the town of Kičevo

Type of fauna	Species	%	
Palaearctic	PA	35	39.8
European	Ev	14	15.9
European-Turkistan	ET	13	14.8
Holarctic	HA	10	11.3
Old World	AW	5	5.7
Turkistan-Mediterranean	TM	3	3.4
Mediterranean	Me	3	3.4
Indo-African	IA	2	2.3
Paleo-montane	PM	1	1.1
Paleo-xero-montane	PxM	1	1.1
Siberian	Si	1	1.1
T o t a l		88	100

Table 3. Comparative percentage participation according to seasonal status in Kičevo, Skopje and Đakovo

Seasonal status	KIČEVO		SKOPJE		ĐAKOVO	
	Species	%	Species	%	Species	%
STAT	37	42.1	22	17.3	22	37.3
AEST	18	20.4	20	15.7	12	20.3
HIEM	14	15.9	39	30.7	4	6.8
TRANS	12	13.6	26	20.5	10	16.9
VAG	7	8.0	17	13.4	11	18.6
T o t a l	88	100	127	100	59	100

Comparative faunistical analysis (Table 4) shows a dominant representation of the Palaearctic (PA), European (Ev), and European-Turkestanic (ET) type of fauna in all compared cities. Among the Mediterranean (Me) elements, the equal representation is noticeable in almost all groups of birds in the avifauna of Skopje, compared to Kičevo and Đakovo where they occur only in the group of residents (STAT).

Comparing qualitative composition of avifauna of the town Kičevo with Skopje and Đakovo, we found a low index of similarity of 0.55 and 0.50 respectively.

Discussion

Based on data collected from 2020 to 2023, it was concluded that in the avifauna of town of Kičevo order *Passeriformes* is dominant. This dominance also exists in the bird faunas of Skopje and Đakovo, which is in agreement with results cited for other European cities (Torun - Strawinski, 1963; Belgrade - Vasić, 1970; Warsaw - Luniac, 1996; Lviv - Bokotey, 1998). With analysis of the representation of families of this order, domination of *Fringillidae*, *Corvidae*, and *Turdidae* is shown, which are characterized by fast process of sinurbanization (Micevski, 1989).

In all compared avifauna, the majority of nesting species are residents (STAT), which can be considered a general rule for urban ecosystems (in Čulina, 2008).

The high level of breeding avifauna in Kičevo (53.4%) and Đakovo (57.6%) compared to Skopje (33.1 %) is on correlation with intermediate level of urbanization (Blair, 2004) and high representation of green areas. The composition of green areas also has significant role in the enrichment of the nest fauna in urban areas (Goddard et al. 2010, 2013). Namely, Kičevo and Đakovo are characterized by a high representation of individual house gardens in which various fruit trees are grown, which offer nesting and foraging opportunities. From this, in our opinion it is a very important to maintain and preserve these gardens how to support a bird diversity in the urban settlements.

According to the seasonal representation, the high domination of wintering (HIEM) and transient birds (TRANS) in Skopje, compared to Kičevo and Đakovo, confirms the importance of migratory route and presence of the large water bodies, which is important for enriching and attracting various species of avifauna in the urban environments (Strawinski, 1963; Micevski, 1989; Bokotey, 1998;).

The domination of the Palaearctic (PA), European (Ev), and European-Turkestanic (ET) type of fauna in the compared cities, is in agreement with results cited for other European cities (Strawinski, 1963; Vasić, 1970; Luniac, 1996; Bokotey, 1998). This is explained by the fact that the first two are eurivalents that formed on European continent, and the subdominance of the third

Table 4. Comparative percentage participation of the fauna types in different bird groups according to the seasonal status in Kičevo, Skopje and Đakovo

	STAT			AEST			HIEM			TRANS			VAG			
	KIČEVO	SKOPJE	ĐAKOVO	KIČEVO	SKOPJE	ĐAKOVO	KIČEVO	SKOPJE	ĐAKOVO	KIČEVO	SKOPJE	ĐAKOVO				
Palearctic	PA	40.5	40.9	50.0	38.9	25.0	41.7	50.0	56.4	-	25.0	32.1	40.0	42.8	45.0	72.7
European	Ev	13.5	13.6	13.6	16.7	10.0	16.7	7.1	7.7	20.0	33.3	26.9	10.0	14.3	10.0	9.1
Euro-Turkistan	ET	13.5	18.2	13.6	16.7	25.0	8.3	14.3	5.1	-	25.0	15.4	40.0	-	5.0	-
Holarctic	HA	8.1	-	-	5.5	10.0	8.3	28.6	7.7	20.0	8.3	19.2	-	14.3	15.0	9.1
Old World	AW	5.4	9.1	4.5	16.7	20.0	16.7	-	5.1	-	-	-	10.0	-	-	-
Turkistan-Mediterranean	TM	5.4	9.1	4.5	5.5	5.0	-	-	-	-	-	-	-	-	5.0	-
Mediterranean	Me	8.1	4.5	9.0	-	5.0	-	-	2.6	-	-	3.8	-	-	5.0	-
Indo-African	IA	2.7	4.5	4.5	-	-	-	-	-	40.0	-	3.8	-	14.3	-	-
Paleo-montane	PM	2.7	-	-	-	-	-	-	-	20.0	-	-	-	-	-	-
Paleo-xero-montane	PxM	-	-	8.3	-	-	-	-	2.6	-	8.3	-	-	-	5.0	-
Siberian	Si	-	-	-	-	-	-	-	7.7	-	-	-	-	14.3	-	9.1
Cosmopolite	Ko	-	-	-	-	-	-	-	-	-	-	7.7	-	-	5.0	-
Arctic	Arc	-	-	-	-	-	-	-	-	-	-	-	-	-	5.0	-
Sarmatian	Sar	-	-	-	-	-	-	-	5.1	-	-	-	-	-	-	-

element is a sign of penetration of the Asian steppe elements during the tertiary (Micevski, 1990a).

From the results, we can note that the Mediterranean (Me) element in avifauna of Kičevo is dominantly represented in the group of resident birds (STAT) in comparison with Đakovo and Skopje. This is explained by the more southern position of Kičevo and with it the more pronounced influence of the Mediterranean. The fact that other seasonal groups of birds (AEST, HIEM, TRANS, VAG) do not include the Mediterranean (Me) element is a consequence of orographic isolation of Kičevo and the lack of important migration routes. This is an interesting result which requires further research and analysis.

And finally, the obtained results of qualitative comparative analysis of avifauna between Kičevo, Skopje and Đakovo, can be explained with the following:

Despite some similarities between Kičevo and Đakovo (same size of cities, low level of urbanization, domination of green areas, lack of large bodies of water and important migratory route), the low level of similarity (0.50) is due to a northern geographical position of Đakovo and the great distance from Kičevo (469 km). On the other hand, although Kičevo and Skopje are cities that are geographically at short distance (60 km), the lack of large bodies of water and important migratory routes in Kičevo are two important factors that contributed to a low index of similarity (0.55). It should be noted that the disproportional size of these cities is third factor that leads to these results.

Conclusion

In this study we investigated current composition, seasonality and biogeography of the avifauna of town Kičevo for the first time, and we can conclude:

1) That the avifauna of town Kičevo we found the presence of 88 species of birds. They represent 27.7 % of the total number of registered bird species on the territory of the Republic of North Macedonia.

2) The breeding avifauna (confirmed, probable and possible) is represented by 47 species (53.4 %).

3) Domination of families: *Fringillidae*, *Corvidae* and *Turdidae* in all compared avifauna is due to their fast process of sinurbanization.

4) The high representation of breeding avifauna in Kičevo is on correlation with intermediate level of urbanization and high representation of green areas.

5) The cause of smaller representation of wintering (HIEM) and transient (TRANS) birds is the topographic position of Kičevo, which is significantly far from important migratory routes and the absence of large water bodies.

6) The faunistic analysis show the domination of Palearctic (PA) type of fauna before the European (Ev) and European-Turkestanic (ET) type, as in the other European cities.

7) Mediterranean (Me) elements in Kičevo are more represented in the group of resident birds (STAT) in comparison with Đakovo and Skopje. This is explained by the more southern position of Kičevo and more pronounced influence of the Mediterranean. The fact that the other seasonal groups (AEST, HIEM, TRANS, VAG) of birds do not include the Mediterranean (Me) element is a consequence of orographic isolation and absence of important migratory routes.

8) Importance of these data lies in their applicability: to contribute to the knowledge in diversity and biogeography of avifauna of the Republic of North Macedonia, to monitor the negative effects of urbanization in the future, and they can also be useful for other analyzes and comparisons with other cities in the region.

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References

- Bibby, C.J., Burgess, N.D., Hill, D.A., Mustoe, S.H. (2000). *Bird Census Techniques* - 2nd edition. 302 p. Academic Press, London.
- Blair, R. (2004). The effects of urban sprawl on birds at multiple levels of biological organization. *Ecology and Society*, **9** (5):2
- Bokotey, A. A. (1998). *Ornitofauna of the city of Lvov, population, distribution and dynamics*. Doctoral dissertation. State Natural History Museum of the National Academy of Sciences of Ukraine. Lvov, 150 p. (in Russian).
- Čulina, A. (2008). *The comparative analysis of avifauna in four urban parks in Zagreb*. Graduation thesis. Faculty of Science, University of Zagreb. Zagreb, 62 p. (in Croatian).
- Clergeau, P., Jokimäki, J., Savard, J. L. (2001). Are urban bird communities influenced by the bird diversity of adjacent landscapes. *Journal of Applied Ecology*, **38**:1122-1134.
- Dickinson, E.C., Remsen, Jr. J. V. (2013). *The Howard and Moore Complete Checklist of the Birds of the World: Fourth edition, Vol.1: Non-passerines*. Aves Press.
- Dickinson, E.C., Christidis, L. (2014). *The Howard and Moore Complete Checklist of the Birds of the World: Fourth edition, Vol. 2: Passerines*. Aves Press.
- Filipovski, Đ., Rizovski, R., Ristevski, P., (1996). *Characteristic of climate - vegetation - soil zones (regions) in the Republic of Macedonia*. 119 p.

- Macedonian Academy of Sciences and Arts. (in Macedonian).
- Goddard, M., Dougill, A., Benton, T. (2010). Scaling up from gardens: biodiversity conservation in urban environments. *Trends in Ecology & Evolution*, 25 (2):90-98.
- Goddard, M., Dougill, A., Benton, T. (2013). Why garden for wildlife? Social and ecological drivers, motivations and barriers for biodiversity management in residential landscapes. *Ecological Economics*, 86:258-273.
- Keller, V., Herrando, S., Voříšek, P., et al. (2020). European Breeding Bird Atlas 2: Distribution, Abundance and Change. European Bird Census Council & Lynx Edicions, Barcelona.
- Luniak, M. (1996). Inventory of the avifauna of Warsaw - species composition, abundance and habitat distribution. *Acta Ornithologica*, 31(1):67-80. (in Polish).
- Matvejev, S.D., Puncer, I.J. (1989). Biome map - landscapes of Yugoslavia. 76 p. Museum of Natural History - Belgrade. (in Serbo-Croatian).
- Micevski, B. (1989). Birds of Đakovo (eastern Slavonia). *Larus*, 40:137-146. (in Serbo-Croatian).
- Micevski, B. (1990a) Birds of Skopje, Macedonia (1981-1989). *Larus*, 41-42:101-119. (in Serbo-Croatian).
- Micevski, B. (1990b). Sinantropization and classification of synanthropic bird areas. *Larus*, 41-42:121-133. (in Serbo-Croatian).
- Savard, J. L., Clergeau, P., Mennechez, G. (2000). Biodiversity concepts and urban ecosystems. *Landscape and Urban Planning*, 48:131-142.
- Strawinski, S. (1963). Birds of Torunia. *Acta ornithologica*, 7(5):115-156. (in Polish).
- Turner, W. L., Nakamura, T., Dinetti, M. (2004). Global Urbanization and the Separation of Humans from Nature. *BioScience*, 54:585-590.
- Vasić, V. (1970). Birds of Belgrade. *Larus*, 21-22:130-136. (in Serbo-Croatian).
- Velevski, M. (2005). Composition and characteristics of the bird fauna in the extensively managed plantations of vineyards and orchards at Vodno Mt., Macedonia. *Ecology and Environmental Protection*, 9:27-37. (in Macedonian).
- Velevski, M., Vasić, V. (2017). Annotated check-list of the birds of the Republic of Macedonia. *Acta Musei Macedonici Scientiarum Naturalium*, 20:53-76.
- Voous, K. (1962). Die Vogelwelt Europas. Verlag Paul, Hamburg & Berlin.

SUPPLEMENT
ATLAS OF THE BIRDS OF KIČEVO

The investigated territory of the town of Kičevo (9.3 km²), includes fourteen 1x1 km UTM-squares (DL9598 - DL9794). The study area is shown in Figure 1. With red line are marked administrative boundaries of the town where the research was done. The table 5 shows the distribution of registered bird species. The numbers refers position of the bird species in main list.

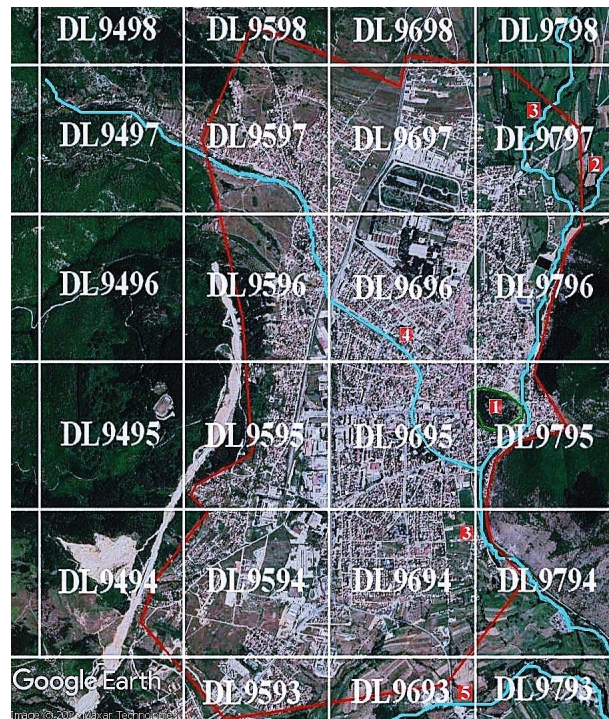


Figure 1. UTM map with resolution 1x1 km of the study area (Google Earth) Park-forest: 1. Kitino Kale; Rivers: 2. Temnica; 3. Zajaska; 4. Sušica; 5. Treska

Table 5. Distribution of registered avifauna in the study area

Quadrant title	Recorded species
DL9598	3, 4, 5, 6, 7, 8, 12, 15, 17, 19, 20, 21, 22, 23, 31, 32, 33, 34, 35, 36, 37, 41, 42, 43, 44, 45, 47, 52, 54, 55, 59, 60, 64, 67, 72, 73, 75, 76, 77, 80, 81, 86, 88
DL9597	3, 4, 5, 6, 7, 8, 11, 15, 17, 19, 21, 23, 30, 31, 32, 33, 34, 35, 36, 37, 41, 42, 43, 44, 45, 47, 52, 54, 55, 58, 59, 60, 62, 63, 64, 65, 72, 73, 75, 76, 77, 78, 80, 82, 83, 88
DL9596	3, 6, 7, 8, 15, 17, 21, 23, 30, 31, 32, 33, 35, 36, 37, 40, 41, 42, 43, 45, 51, 54, 55, 59, 60, 63, 67, 68, 69, 72, 73, 75, 76, 77, 82, 85, 88
DL9595	3, 6, 7, 8, 14, 15, 17, 23, 26, 27, 30, 31, 32, 33, 35, 36, 37, 38, 40, 41, 42, 43, 45, 46, 47, 49, 54, 55, 59, 60, 62, 63, 64, 65, 66, 67, 68, 72, 73, 75, 76, 77, 78, 79, 80, 81, 82, 83, 85, 88
DL9594	2, 3, 6, 7, 9, 14, 15, 27, 30, 31, 32, 33, 35, 36, 37, 41, 42, 43, 44, 45, 46, 48, 49, 50, 54, 55, 57, 59, 60, 67, 72, 73, 76, 77, 82, 84, 85, 87, 88
DL9593	3, 6, 7, 21, 26, 32, 33, 35, 36, 37, 41, 42, 43, 45, 54, 55, 59, 60, 64, 73, 76, 77, 85, 88
DL9697	3, 4, 6, 7, 24, 29, 30, 32, 33, 42, 43, 35, 36, 37, 41, 43, 45, 54, 55, 59, 60, 64, 72, 73, 76, 85, 88
DL9696	3, 6, 7, 26, 32, 33, 35, 36, 37, 41, 42, 43, 45, 54, 55, 59, 60, 63, 64, 68, 72, 73, 75, 76
DL9695	3, 6, 7, 14, 15, 18, 19, 26, 27, 31, 32, 33, 35, 36, 37, 39, 40, 41, 42, 43, 45, 46, 47, 54, 55, 57, 59, 60, 63, 68, 72, 73, 75, 76, 80, 81, 86, 88
DL9694	3, 6, 7, 21, 26, 32, 33, 35, 36, 37, 41, 42, 43, 45, 54, 55, 59, 60, 64, 72, 73, 76, 77, 79, 88
DL9797	1, 3, 5, 6, 7, 15, 19, 20, 21, 23, 24, 29, 32, 33, 35, 36, 37, 41, 43, 45, 54, 55, 59, 60, 61, 64, 73, 77, 85, 88
DL9796	1, 3, 6, 7, 15, 16, 17, 32, 33, 35, 36, 37, 39, 41, 42, 43, 45, 53, 54, 55, 59, 60, 61, 64, 73, 74, 77, 86, 88
DL9795	1, 3, 6, 7, 8, 10, 17, 19, 21, 22, 23, 25, 26, 28, 31, 32, 33, 35, 36, 37, 40, 41, 42, 43, 45, 53, 54, 55, 59, 60, 61, 64, 65, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 79, 80, 85, 88
DL9794	1, 3, 6, 7, 8, 13, 15, 19, 21, 26, 29, 30, 31, 32, 33, 34, 35, 36, 37, 39, 41, 43, 45, 53, 54, 55, 56, 59, 60, 72, 73, 75, 76, 77, 79, 81, 85, 86, 88