ANALYSIS OF THE BIRD FAUNA IN TWO GREEN AREAS OF CRAIOVA MUNICIPALITY SUBJECT TO SIGNIFICANT ANTHROPOGENIC MODIFICATIONS

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Abstract. The study renders an analysis of the dynamics of bird fauna in two important green areas of Craiova Municipality: Lake Craiovița and the Botanical Garden "A. I. Buia", during the years 2000 - 2024. The two areas (close as location, but very different in terms of significance and ecosystem composition) have undergone extensive transformations, especially in the last 10 years. The transformations have been more radical in the perimeter of Lake Craiovița (between the years 2021 - 2024 about 85% of its surface was drained and then covered by a group of buildings that together make up the largest commercial complex in the city), so the impact on biodiversity, in particular on the bird fauna in this area, is significant. In the area covered by Lake Craiovița before the major anthropogenic interventions, there were recorded 109 bird species (43 typically aquatic and 62 typically terrestrial, 4 eurytopic) of which about 45 were nesting species. After the reconfiguration of this wetland, about 76 bird species have completely disappeared, no longer finding adequate conditions for their bioecological requirements. Different interventions took place in the Botanical Garden perimeter in 2015 - the beginning of 2016. Until then, about 84 species (21 typically aquatic, 59 typically terrestrial, 4 eurytopic) were recorded in this area, 28 of which being nesting species; the new ecosystems resulting from the reorganization and modernization of the Botanical Garden shelter about 54 species, approximately 17 of them breeding in their habitats. In each of the two studied green areas, we observe that anthropogenic interventions led to the reduction or disappearance of a part of the mosaics of biotopes or heterogeneous environments (surfaces covered by trees, alternations of grass and/or aquatic vegetation, water). The impact of these interventions resulted in a considerable decrease in the number, frequency, and density of the wild bird species up to the total disappearance of some bird fauna communities**.**

Keywords: bird fauna dynamics, anthropogenic modifications, Craiova.

Rezumat. Analiza avifaunei din două zone verzi ale municipiului Craiova, supuse unor modificări antropice majore. Studiul cuprinde o analiză a dinamicii avifaunei din două zone verzi importante ale municipiului Craiova, respectiv Lacul Craiovița și Grădina Botanică ″A. I. Buia ″, în cursul anilor 2000 - 2024. Cele două zone (apropiate ca locație, dar foarte diferite ca semnificație și compoziție ecosistemică) au fost supuse unor ample transformări, mai ales în ultimii 10 ani. Transformările au fost mai extinse în perimetrul Lacului Craiovița (între anii 2021 - 2024 circa 85% din suprafața acesteia a fost asanată și apoi acoperită de un ansamblu de construcții care alcătuiesc împreună cel mai mare punct comercial din oraș – moll Promenada), astfel că impactul asupra biodiversității, în speță asupra avifaunei din această arie este unul semnificativ. Din rezultatele studiului constatăm că înainte de intervențiile antropice, în arealul ocupat de Lacul Craiovița, au fost consemnate 109 specii (43 tipic acvatice și 62 tipic terestre, 4 euritope), din care circa 45 erau cuibăritoare. După noua reconfigurare a arealului acestei zone umede circa 76 specii de păsări au dispărut complet, nemaigăsind condiții adecvate cerințelor lor bio-ecologice. În perimetru Grădinii Botanice au avut loc intervenții în anii 2015 - 2016. Până atunci, în acest spațiu au fost înregistrate circa 84 de specii (21 tipic acvatice, 59 tipic terestre, 4 euritope), din care 28 erau cuibăritoare; în noile ecosisteme rezultate după reorganizare și modernizare, Grădina Botanică adăpostește circa 54 de specii, din care cca. 17 se reproduc în habitatele pe care le deține. În fiecare din cele două zone verzi studiate observăm că în urma impactului antropic prin care s-au redus sau au dispărut o parte din mozaicurile de biotopuri sau mediile eterogene (suprafețe acoperite cu arboret, alternate de suprafețe cu vegetație ierboasă și/sau acvatică, suprafețe cu luciu de apă), s-a ajuns la diminuarea considerabilă a numărului, frecvenței și densității speciilor de păsări sălbatice, până la îndepărtarea totală a unor comunități ornitofaunistice.

Cuvinte cheie: dinamica avifaunei, modificări antropice, Craiova.

INTRODUCTION

Craiova Municipality is located between the Oltenia Plain (a subunit of the Romanian Plain) and the Getic Piedmont, along the left bank of the Jiu River, at altitudes between 75 and 116 m. It is the largest and most important urban settlement in southwestern Romania (http://ro.wikipedia.org/wiki/Craiova#cite_). Due to the fact that the city serves as the cultural, historical, and economic center of Oltenia, the area of the municipality has constantly expanded and urban development has increased in complexity and impact, significantly modifying the previous natural landscape.

With each new artificial structure created in the urban landscape, the plant and animal associations included in the related ecosystems have changed their composition and the biological diversity has gradually reduced. Bird fauna is among the groups of wild animals disturbed and affected by urbanization. The present study documents this state of affairs, presenting the succession of bird communities in two important green areas of the city (Lake Craiovița – located in the northwestern part of the city and the Botanical Garden "A. I. Buia" – located in the central-western part of the city), which have undergone extensive transformations, especially in the last 10 years.

The ornithological collection preserved in the heritage of the Oltenia Museum in Craiova and processed in various studies (BAZILESCU 1980; RIDICHE 2000, 2005, 2011; RIDICHE & BOTOND KISS, 2011) offers the oldest and most illustrative evidence regarding the diversity of bird fauna in the former green habitats of Craiova municipality.

During the years 2000-2021, BĂLESCU (2000, 2002, 2003, 2004, 2005, 2006, 2007, 2008 a,b, 2013, 2016, 2021), BĂLESCU & RIDICHE, 2001, BĂLESCU & ȘTEFĂNESCU, 2017 updated the ornithological spectrum of the green areas in Craiova.

Several important aspects of the bird fauna of Craiova emerge from the migration studies which, although little debated, emphasize that the location of the city in the proximity of the Jiu River (migration corridor for some bird species: POPESCU, 1974; RIDICHE & BOTOND KISS, 2011; RIDICHE & SÁNDOR, 2016) contributes to the avifaunistic diversity and richness of the green areas within the city and its peri-urban area (BĂLESCU & RIDICHE, 2020).

The climate of the city and of the region is also a factor that can influence the composition and stability of urban biocenoses. Craiova has a temperate continental with sub-Mediterranean influences. Summers are long, warm, and dry, while winters are mild and short. Besides the influence of the baric centers developed in the Mediterranean Sea, the influence of the Eastern European Anticyclone is also felt in winter (MARINICĂ, 2006).

MATERIALS AND WORKING METHODS

The two studied areas, namely Lake Craiovița – located in the northwestern part of the city and the Botanical Garden "A. I. Buia" – located in the central-western part of the city, are close as location, but very different in terms of significance and ecosystem composition – Fig. 1.

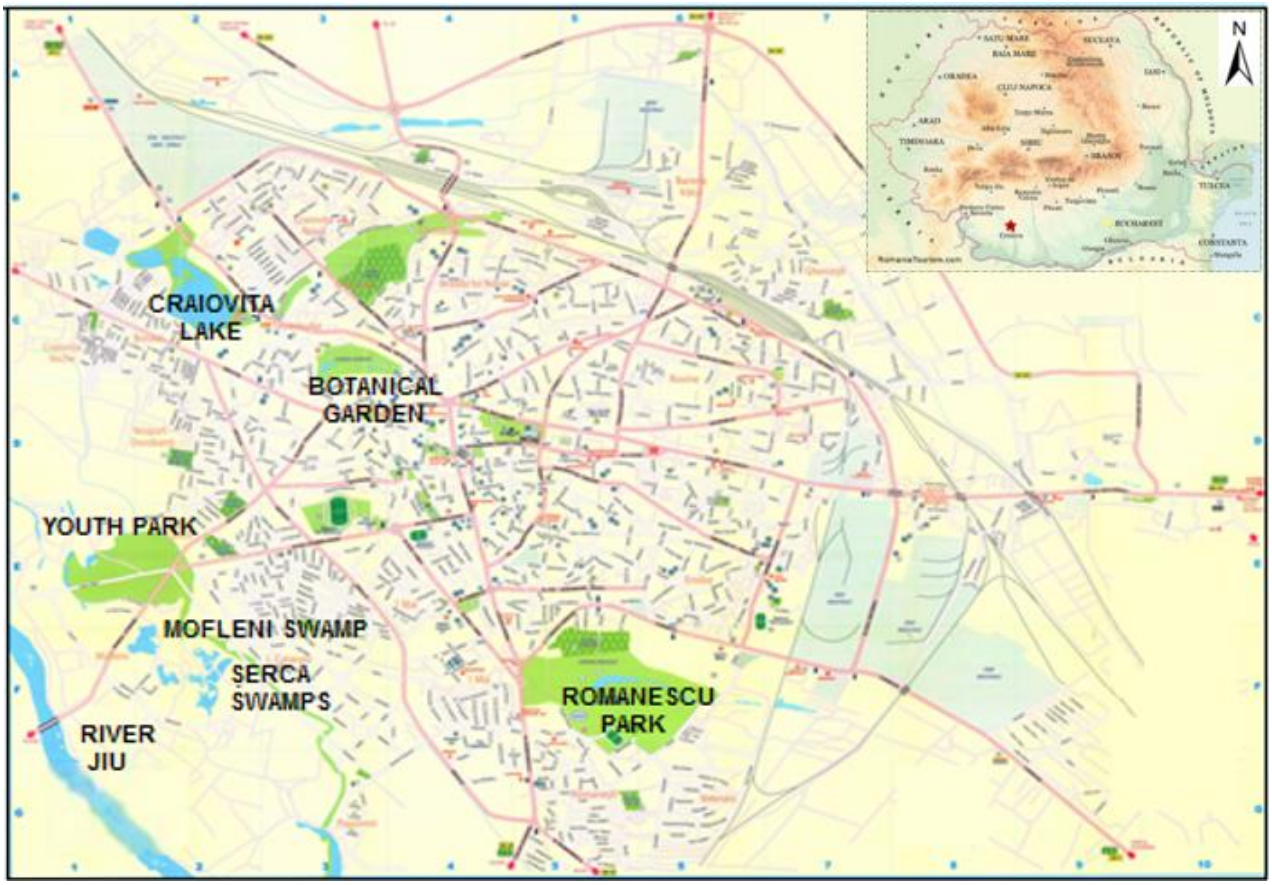


Figure 1. Location of Craiova within Romania (https://romaniatourism.com/craiova.html) and the map of the green areas of the city (including Lake Craiovița and the Botanical Garden) (product: SC InDesign SRL Craiova). Scale 1:190000.

Lake Craiovița represented the most significant body of water from Craiova (CIOBOTEA et al., 1999). In its northern part, it was supplied with water by the Cornițoiu stream which, downstream, is presently diverted underground, through circular tubes, and is drained to the southwest by the collector channel flowing into the Jiu River. For a short period of time (1985-2000), the lake and its surroundings were used for recreation. Its total surface was of about 85 ha, of which the water surface represented about 32 ha distributed between two lakes, unequal in size (separated by an isthmus). The area displayed characteristics specific to the floodplain ponds: large surfaces with reed, rush, willows; the terrestrial surroundings of the two lakes were covered by a mosaic of trees and shrubs. After 2000, the entire surface of the wetland Lake Craiovița became private property, and from that moment on, a succession of major transformations followed: in the first stage, there were built several marginal buildings (hotels, hypermarket, etc.), and starting with 2020, about 85% of the surface of this wetland was drained and transformed into the largest commercial complex in the city (Promenada Mall) – Fig. 2.

Figure 2. Lake Craiovița – the area subject to transformation into a commercial area is delimited by the red line. (Processed image; source: https://craiovacetateabaniei.blogspot.com/2013/06/craiova-un-oras-ale-carui-spatii-verzi.html).

The Botanical Garden "Alexandru Buia" covered a surface of 17 ha; it was divided into distinct sectors comprising about 6.000 taxa (POPESCU et al. 2002). From east to west, it is crossed by a stream, which starts from Iancu Jianu Fountain, located at the main entrance. 3 lakes with a total surface of about 0.3 ha were created along the stream. They are surrounded or partially covered by specific aquatic vegetation (reed - *Phragmites australis*, cattail – *Typha* sp., water lily - *Nymphaea* sp., etc.). The tree vegetation within the Botanical Garden perimeter is made up of various native gymnosperm (*Taxodium* sp., *Abies* sp., *Picea* sp., *Thuja* sp., *Juniperus* sp.) and angiosperm (*Quercus* sp., *Acer* sp., *Platanus* sp. *Betula* sp, *Fraxinus* sp., *Populus* sp., *Salix* sp., etc.) species.

In 2015-2016, the Botanical Garden underwent a project of rehabilitation and reconfiguration of the green areas; several recreational areas were made available to the public (running track, playgrounds, relaxation areas). In addition, part of the initial surface of the Garden was lost to private ownership, so the current area is estimated at approximately 12.8 ha. (https://cdst.ro/index.php/location/gradina-botanica/;

https://www.ucv.ro/campus/puncte_de_atractie/ gradina_botanica/prezentare.php).

This paper summarizes the results of observations made by the authors during the years 2000-2024, in all seasons and in all biotopes in the two green areas described above.

In order to identify the bird species in the investigated areas, we used binoculars (Zeiss Jena 10x50 and Buchnell 12x40) and field guides (BRUUN et al., 1999). Observations were made at fixed points (at ground level – flat or at specific heights, near the feeding, resting or stationary spots of the birds) and in motion, on predetermined routes; along the route, we noted all species observed or heard and made estimations regarding their number. These methods allowed us to create an image of the frequency (and abundance) of the reported birds.

The observations duration was, on average, 4 hours/day, in the first part of the day (between 7.30 a.m. and 12 p.m.) or in the afternoon (between 3.00 p.m. and 6.00 p.m.), depending on the season. Most observations were made in the warm season months.

The systematic list of species is given in Table 1. Each species entry includes data regarding the place and period when it was documented, the frequency category, the type of biotope, and the phenological category.

The systematic classification and nomenclature of the species was made according to Avibase – the world bird database (https://avibase.bsc-eoc.org/checklist.jsp?region=RO).

The frequency of the bird species was calculated based on the formula F% = p x 100/P, where p = number of observations when the respective species was recorded and P = total number of observations (GOMOIU & SKOLKA, 2001). Based on this relationship, there results the following four groups of species: EC – euconstant species / very common (frequency between 75.1% and 100% of the total number of observations); C – constant species (frequency between 50.1% and 75% of total observations); R – rare species (frequency between 25.1% and 50% of all observations); Acc – accidental species (frequency between 1% and 25% of the total number of observations).

For the ecological classification, we referred to the specialized literature: (CĂTUNEANU et al., 1978; MUNTEANU, 2012) and the phenological classification is consistent with our own reports in the two analyzed areas.

Table 1. The dynamics of the bird fauna in two green areas of Craiova municipality subjected to major changes.

No.	SPECIES	FREQUENCY; NESTING				BIOTOPE		PHENOLOGICAL CATEGORY				
		BOTANICAL GARDEN		LAKE CRAIOVIȚA		T	A	S	PM	SV	W	P
		2000-2014	2015-2024	2000-2020	2021 -2024							
1	*Cygnus olor*	Ac	C ●	R	Ac	-	t			x	x	x
2	*Spatula querquedula*	-	-	C	-	-	t					x
3	*Spatula clypeata*	-	-	C	-	-	t					x
4	*Anas platyrhynchos*	Ec ●	Ec ●	Ec ●	R	-	t	x	x			
5	*Anas crecca*	R	-	C	-	-	t				x	x
6	*Aythya ferina*	-	-	C ●	-	-	t			x		x
7	*Aythya nyroca*	-	-	C ●	-	-	t			x		
8	*Phasianus colchicus*	Ac	-	C	R	t	-	x	x			
9	*Columba livia*	Ec ●	Ec ●	Ec ●	Ec ●*	-	-	x				
10	*Columba palumbus*	R ●	Ec●	C ●	C	t	-	x				
11	*Streptopelia decaocto*	Ec ●	Ec ●	Ec ●	C ●*	t	-	x				
12	*Cuculus canorus*	R	Ac	C ●	-	+	+			x		x
13	*Rallus aquaticus*	-	-	Ac	-	-	t				x	
14	*Gallinula chloropus*	Ec ●	Ec ●	Ec ●	C ●?	-	t	x	x			
15	*Fulica atra*	Ec ●	-	Ec ●	R	-	t	x	x			
16	*Himantopus himantopus*	-	-	C ●	-	-	t			x		
17	*Charadrius dubius (Thinornis dubius)*	-	-	R	-	-	t					X
18	*Vanellus vanellus*	-	-	Ac	-	+	t			x		X
19	*Tringa stagnatilis*	-	-	R	-	-	t					X
20	*Tringa ochropus*	C	C	C	-	-	t				x	x
21	*Calidris minuta*	-	-	C	-	-	t					x
22	*Calidris pugnax*	-	-	Ac	-	-	t					x
23	*Chroicocephalus ridibundus*	C	-	C	-	-	t			x	x	
24	*Larus cachinnans/ L. michahellis*	R	C	C	C	-	t			x	x	
25	*Chlidonias hybrida*	Ac	-	C ●	-	-	t			x		
26	*Chlidonias niger*	-	-	Ac	-	-	t			x		x
27	*Tachybaptus ruficollis*	R	R	C ●	-	-	t			x	x	
28	*Podiceps cristatus*	-	-	R ●	-	-	t			x		x
29	*Podiceps nigricollis*	Ac	-	-	-	-	t				x	x
30	*Ciconia ciconia*	-	-	Ac	-	+	t					x
31	*Microcarbo pygmaeus*	C	R	Ec ●	R ●	-	t			x	x	
32	*Phalacrocorax carbo*	-	-	R	Ac	-	t			x	x	x
33	*Botaurus stellaris*	Ac	-	Ac	-	-	t			x		
34	*Botaurus minutus (Ixobrychus minutus)*	C	-	C ●	-	-	t			x		
35	*Nycticorax nycticorax*	-	-	C ●	-	-	t			x		
36	*Ardeola ralloides*	-	R	R		-	t			x		
37	*Egretta garzetta*	R	R	Ec ●	R ●	-	t			x		
38	*Ardea alba*	R	-	R	-	-	t				x	
39	*Ardea cinerea*	R	-	C	-	+	t			x	x	
40	*Ardea purpurea*	-	-	Ac	-	-	t					x
41	*Accipiter gentilis (Astur gentilis)*	Ac	-	Ac	-	t	+				x	x
42	*Accipiter nisus*	Ac	-	-	-	t	+				x	x
43	*Circus aeruginosus*	-	-	C	-	+	t			x		x
44	*Buteo buteo*	Ac	-	C	-	t	+			x	x	x
45	*Otus scops*	-	-	R	-	t	-			x		
46	*Asio otus*	-	-	-	R	t	-			x	x?	
47	*Athene noctua*	R	-	Ec ●*	Ec ●*	t	-	x				
48	*Upupa epops*	-	-	R	-	t	-					x
49	*Merops apiaster*	-	-	Ac	-	t	-					x
50	*Alcedo atthis*	R	R	Ac	-	-	t				x	x
51	*Dryocopus martius*	Ac	-	-	-	t	-				x	x
52	*Dendrocoptes medius*	R	-	Ac	-	t	-	x				
53	*Dendrocopos major*	C ●	C	C●	-	t	-	x				
54	*Dendrocopos syriacus*	C ●	C	C ●	-	t	-	x				
55	*Picus viridis*	C ●	R	R	-	t	-	x				
56	*Falco tinnunculus*	-	Ac	C	C ●*	t	+			x		x
57	*Falco subbuteo*	-	-	Ac ●	-	t	+			x		
58	*Lanius collurio*	C ●	R	C ●	-	t	-			x		x
59	*Pica pica*	Ec ●	Ec ●	Ec ●	C ●*	t	-	x				
60	*Garrulus glandarius*	C ●	R	R	-	t	-	x				
61	*Corvus monedula (Coloeus monedula)*	Ec ●	Ec ●	Ec ●*	Ec ●*	t	-	x				
62	*Corvus frugilegus*	Ec ●	Ec ●	Ec ●	Ec ●*	t	-	x				

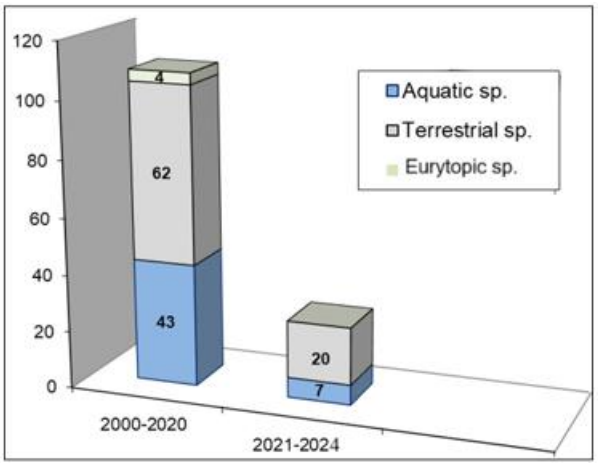
63	*Corvus cornix*	Ec●	Ec ●	Ec ●	Ec ●*	t	-	x				
64	*Poecile palustris*	-	Ac	-	-	t	-					x
65	*Periparus ater*	Ac	-	-	-	t	-				x	x
66	*Cyanistes caeruleus*	C●	R	C●	-	t	-	x				
67	*Parus major*	Ec ●	Ec ●	Ec ●	C ●*	t	-	x				
68	*Galerida cristata*	-	-	C ●	-	t	-			x	x	
69	*Iduna pallida*	R	R	R	-	t	-					x
70	*Hippolais icterina*	C	C	C	-							x
71	*Acrocephalus schoenobaenus*	-	-	C ●	-	+	t			x		x
72	*Acrocephalus palustris*	-	-	R	-	+	t					x
73	*Acrocephalus scirpaceus*	Ac	-	C ●	-	+	t			x		x
74	*Acrocephalus arundinaceus*	R	-	C ●	-	+	t			x		x
75	*Locustella luscinioides*	-	-	R ●	-	+	t			x		x
76	*Hirundo rustica*	Ec ●	C ●	Ec ●	R	t	-			x		
77	*Delichon urbicum*	C ●*	R	C ●*	-	t	-			x		
78	*Phylloscopus sibilatrix*	C	R	R	-	t	-					x
79	*Phylloscopus trochilus*	C	C	C	-	t	-					x
80	*Phylloscopus collybita*	C	C	C	-	t	-					x
81	*Aegithalos caudatus*	Ac	Ac	-	-	t	-					x
82	*Sylvia atricapilla*	C ●	C	-	-	t	-			x		x
83	*Sylvia borin*	R	-	R	-	t	-			x		x
84	*Curruca curruca*	C ●	-	-	-	t	-			x		
85	*Curruca communis*	C	R	C	Ac	t	-					x
86	*Regulus regulus*	Ac	-	Ac	-	t	-				x	x
87	*Regulus ignicapilla*	Ac	-	Ac	-	t	-				x	x
88	*Sitta europaea*	C ●	R	Ac	-	t	-	x				
89	*Certhia familiaris*	Ac	Ac	Ac	-	t	-				x	x
90	*Troglodytes troglodytes*	C	C	C	Ac	t	-				x	
91	*Sturnus vulgaris*	Ec ●	Ec ●	Ec ●	Ec ●*	t	-			x		
92	*Turdus merula*	Ec ●	Ec ●	C ●	-	t	-		x			
93	*Turdus viscivorus*	Ac	-	Ac	-	t	-				x	x
94	*Turdus philomelos*	R	R	Ac	-	t	-				x?	x
95	*Turdus iliacus*	Ac	-	Ac	-	t	-				x	x
96	*Turdus pilaris*	R	R	R	-	t	-				x	x
97	*Muscicapa striata*	C ●?	C	C ●?	-	t	-			x		
98	*Ficedulla parva*	-	-	Ac	-	t	-					x
99	*Ficedula hypoleuca*	R	-	R	-	t	-					x
100	*Ficedula albicollis*	R	Ac	-	-	t	-					x
101	*Erithacus rubecula*	C	C	C	Ac	t	-				x	
102	*Luscinia megarhynchos*	C ●	C ●*	C ●	-	t	-			x		
103	*Phoenicurus phoenicurus*	-	-	Ac	-	t	-					x
104	*Phoenicurus ochruros*	-	-	R ●	Ac	t	-			x		x
105	*Saxicola rubetra*	-	-	Ac	-	t	-					x
106	*Saxicola rubicola (Saxicola torquatus)*	-	-	Ac	-	t	-					x
107	*Passer domesticus*	Ec ●	Ec ●	Ec ●	Ec ●*	t	-	x				
108	*Passer montanus*	Ec ●	Ec ●	Ec ●	Ec ●*	t	-	x				
109	*Motacilla cinerea*	C	R	Ac	-	+	+				x	
110	*Motacilla flava*	-	-	R ●	-	+	+			x		
111	*Motacilla alba*	Ac	-	C ●	-	+	+			x		
112	*Fringilla coelebs*	R	R	R	-	t	-				x	x
113	*Fringilla montifringilla*	Ac	-	Ac	-	t	-				x	x
114	*Coccothraustes coccothraustes*	R	Ac	R	-	t	-				x	x
115	*Pyrrhula pyrrhula*	R	-	Ac	-	t	-				x	x
116	*Chloris chloris*	R ●	R	R ●	-	t	-	x				x
117	*Carduelis carduelis*	R	-	C ●	-	t	-	x				x
118	*Spinus spinus*	-	-	Ac	-	t	-				x	x
119	*Emberiza citrinella*	-	-	Ac	-	t	-				x	x
120	*Emberiza hortulana*	Ac	-	-	-	t	-					x
121	*Emberiza schoeniclus*	Ac	-	C	-	-	t				x	x
	TOTAL = 121 species	**83 sp.**	**54sp**	**110**	**28?**							

Legend:
Frequency: Ec - euconstant species / very common (frequency between 75.1% and 100% of the total number of observations); C - constant species (frequency between 50.1% and 75% of total observations); R - rare species (frequency between 25.1% and 50% of all observations); Ac - accidental species (frequency between 1% and 25% of the total number of observations). ● – nesting species.
Biotope: T – terrestrial, A – aquatic, t = typical species (addicted to a type of biotope/habitat, through the feeding and nesting needs); + = accessory species (which use only the trophic resources given by the respective biotope, having a short, temporary presence).
Phenological category: S – sedentary species; PM – partially migratory; SV – summer visitors; WV – winter visitors; P – passage species.

RESULTS AND DISCUSSION

The results of our investigations emphasize that 109 bird species (43 typically aquatic, 62 typically terrestrial, 4 eurytopic) were recorded before the anthropogenic interventions in the area occupied by **Lake Craiovița** until 2020 – Fig. 3. About 45 species (41.22%) of the total number of species were nesting species in the habitats within the lake perimeter and its surroundings. In the new ecosystems resulting from the latest urban interventions (period 2021-2024), only 28 species were identified (7 aquatic species and 20 terrestrial species), the remaining 82 species no longer finding adequate conditions for their bioecological requirements. We particularly mention the elimination of the colonies of *Himantopus himantopus, Chlidonias hybrida, Microcarbo pygmaeus, Botaurus minutus, Nycticorax nycticorax, Egretta garzetta* - vulnerable species protected by the Birds Directive of EC/2009. Other species protected by Annex I of the same Directive, such as *Aythya nyroca, Lanius collurio*, nesting within the wetland Lake Craiovița (BĂLESCU, 2002, 2021) disappeared after its conversion into a commercial urban complex.

In terms of frequency, most of the species identified until 2020 in the area of Lake Craiovița were constant species in the habitats of this wetland; accidental and rare species also had an important share – Fig. 4.



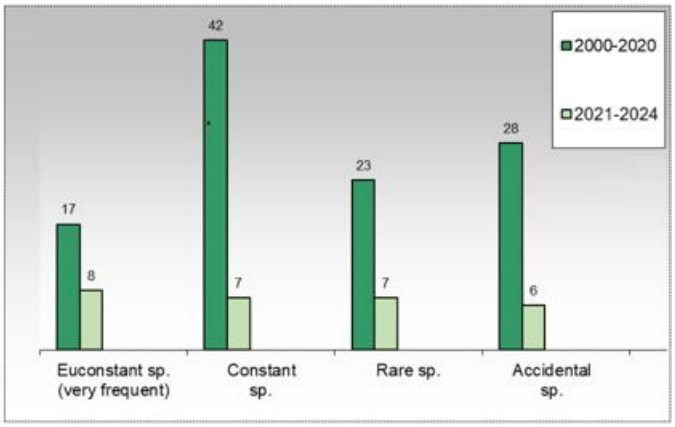


Figure 3 (left). Graphic representation of bird species in the area of Lake Craiovița according to preferred type of biotope.
Figure 4 (right). Graphic representation of bird species in the area of Lake Craiovița according to frequency categories.

Table 2 renders the composition of bird communities by frequency categories, reported in the area of Lake Craiovița during the works or shortly after the construction of the commercial complex.

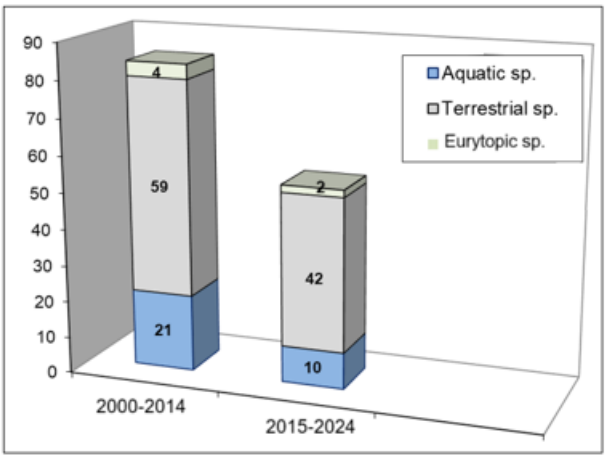
Table 2. Bird species (classified by frequency categories) reported in the area of Lake Craiovița in the period 2021-2024.

Nr. crt	Euconstant species (Very common species)	Constant species	Rare species	Accidental species
1.	*Columba livia domesticus*	*Columba palumbus*	*Anas platyrhynchos*	*Cygnus olor*
2.	*Athene noctua*	*Streptopelia decaocto*	*Phasianus colchicus*	*Phalacrocorax carbo*
3.	*Corvus monedula*	*Gallinula chloropus*	*Fulica atra*	*Curruca communis*
4.	*Corvus frugilegus*	*Larus cachinnans /*	*Microcarbo pygmaeus*	*Troglodytes troglodytes*
5.	*Corvus cornix*	*L. michahellis*	*Egretta garzetta*	*Erithacus rubecula*
6.	*Sturnus vulgaris*	*Falco tinnunculus*	*Asio otus*	*Phoenicurus ochruros*
7.	*Passer domesticus*	*Pica pica*	*Hirundo rustica*	
8.	*Passer montanus*	*Parus major*		

We mention that construction works in the area of Lake Craiovița continued after 2024; therefore, the anthropogenic pressure on bird species that we reported (Table 2) in the few natural habitats maintained until the end of 2024 continued, but the consequences will be rendered in future studies.

The research carried out in the **perimeter of the Botanical Garden** until the 2015-2016 interventions revealed the presence of about 84 species (21 typically aquatic, 59 typically terrestrial, 4 eurytopic), 28 of which being nesting species. After its reconfiguration and modernization, the Botanical Garden shelters about 54 species (10 typically aquatic, 42 typically terrestrial, 2 eurytopic) – Fig. 5. Only 17 of the total number of species reproduce in the habitats of this green area.

In terms of frequency, the number of constant and accidental species decreased significantly, the less affected category being the euconstant species that have largely regained their living conditions – Fig. 6.



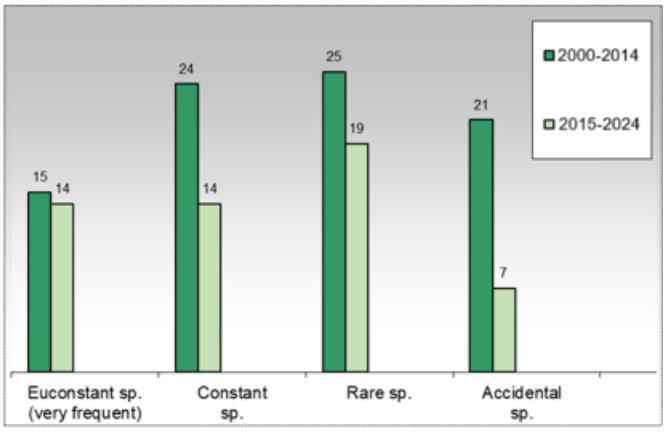


Figure 5 (left). Graphic representation of bird species in the Botanical Garden according to preferred type of biotope.
Figure 6 (right). Graphic representation of bird species in the Botanical Garden according to frequency categories.

Among the species affected by the reconfiguration of the Botanical Garden we mention: *Anas crecca, Fulica atra, Chroicocephalus ridibundus, Chlidonias hybrida, Podiceps nigricollis, Microcarbo pygmaeus, Botaurus stellaris, B. minutus, Ardea alba, A. cinerea, Dendrocoptes medius, Acrocephalus arundinaceus, Sylvia borin, Curruca curruca, Sitta europaea, Motacilla alba, M. cinerea, Carduelis carduelis, Emberiza hortulana, E. schoeniclus.*

The present species are mostly arboreal, but it is expected that their frequency and number will increase as the vegetation, both tree and aquatic vegetation, becomes more abundant and varied. At the same time, some good practices such as the installation of artificial nests and/or feeders to provide additional food sources in winter, could contribute to the improvement of the living conditions for the birds in this area.

The Botanical Garden is also an attractive place for the city population as it provides various recreational activities. Therefore, we propose and encourage the practice of non-aggressive activities for the living creatures of this green area, especially bird-watching, which would improve the human-nature relationship and, implicitly, allow the long-term conservation of bird species.

In each of the two studied green areas, we observe the effects of the implementation of urban development projects that have led to the reduction or disappearance of a large part of the green spaces, representing mosaics of biotopes (surfaces covered by trees alternating with surfaces with herbaceous and/or aquatic vegetation, water surfaces); consequently, there has been a considerable decrease in the number and frequency of wild bird species, up to the total elimination of some bird communities. Similar situations are mentioned in countless urban areas around the world, which is why specialists from many countries (SANDSTRÖM et al, 2005; SULAIMANA et al, 2013; CRISTALDI et al, 2017, DRAGOȘ et al, 2018; RISQY & NURVIANTO, 2022) underline the role of green spaces in maintaining bird diversity in urban areas and the need to apply solutions that aim at moderating conflicts between development projects and the projects dedicated to the conservation of the ecological diversity and, implicitly, to the increase of bird diversity in urban areas. The most remarkable alternative is that the development projects to be based on an ecological approach, namely to include perimeters covered by native vegetation, knowing that this type of vegetation not only helps create habitats for birds, but also contributes to a better quality of the environment and human life.

Recent studies indicate that the reduction of green areas or their replacement with artificial structures entails not only the loss of biodiversity but also the decrease in the quality of the microclimate both in the area directly affected and in its surroundings. In addition, the people's exposure to stress factors (noise, air pollution, etc.) increases, generating mental fatigue and other disorders up to chronic fatigue, etc. In this context, there has been conducted a series of research studies which suggest that the psychological restoration of people is achieved by supporting human-nature contact, and, in this case, it is absolutely necessary to preserve and/or increase the surface of green spaces covered by native ornamental vegetation and/or of water bodies, especially in urban areas (Van Den BERG et al., 2007, TOROK et al, 2022).

CONCLUSIONS

In the present study, we highlight the changes in the structure and composition of the bird fauna in two reference green areas of Craiova city, namely: Lake Craiovița and the Botanical Garden ″A. I. Buia″, subject to intensive changes induced by urban projects in the last 10 years.

The most extensive and radical transformation took place in the wetland Lake Craiovița; approximately 85% of its surface, previously characterized by a mosaic of habitats (water surface, aquatic vegetation, trees), was drained and covered by artificial structures that make up the largest commercial complex in the city (Promenada Mall). As a result, most (75%) of the bird species that lived in these aquatic and terrestrial habitats are no longer found in the area. Some of the species affected by this extensive urbanization project are internationally threatened species that require special protection; among these, we mention the species protected by Annex I of the Birds Directive 2009/147/EC: *Aythya nyroca*,

Himantopus himantopus, Chlidonias hybrida, Microcarbo pygmaeus, Botaurus minutus, Nycticorax nycticorax, Egretta garzetta, Lanius collurio, which used to nest in this area until it was transformed into a commercial complex.

It is known that in order to maintain high biological diversity, it is necessary to have natural structures, namely habitats that support this biodiversity. Urban development projects can avoid eliminating or radically affecting biodiversity if urban planning integrate perimeters covered by native ornamental vegetation and/or water bodies, knowing that these types of green spaces not only help create habitats for birds, but also contribute to a better quality of the environment and human life.

The landscaping and reconfiguration works of the Botanical Garden ″Alexandru Buia″ have also reduced and modified some of the initial green areas, in order to make more recreational areas available to the public: running track, playgrounds, relaxation areas, etc. Among the species affected by these changes, we exemplify: *Anas crecca, Fulica atra, Chroicocephalus ridibundus, Chlidonias hybrida, Podiceps nigricollis, Microcarbo pygmaeus, Botaurus stellaris, B. minutus, Ardea alba, A. cinerea, Dendrocoptes medius, Acrocephalus arundinaceus, Sylvia borin, Curruca curruca, Sitta europaea, Motacilla alba, M. cinerea, Carduelis carduelis, Emberiza hortulana, E. schoeniclus.* It is expected that, in the heterogeneous environments (surfaces covered by trees, alternating with surfaces with herbaceous and/or aquatic vegetation, water surfaces) within the Botanical Garden area, the diversification of terrestrial and aquatic vegetation will favour the process of revitalization/restoration of biodiversity, especially of bird fauna components. Improving the human-nature relationship through good practices (artificial nests and feeders, non-aggressive bird-watching activities), could contribute to the improvement of the living conditions for the birds in this area.

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