

A comparative study of spring avifauna in natural biotopes and agricultural landscapes of the Tashkent Region, Uzbekistan

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Between 2014 and 2022, a comprehensive analysis was conducted to compare the spring diversity of avifauna, including bird occurrence, density, similarity, and differences between natural biotopes and agrarian landscapes in the Tashkent region. This study assessed changes in avifauna composition resulting from the conversion of natural biotopes into cultivated areas and evaluated the influence of anthropogenic factors on bird behavior. During the spring months of March, April, and May, approximately 205 bird species were recorded. Of these, 186 species were observed in natural biotopes, while 162 species were identified in agrarian landscapes. Notably, 143 species were common to both biotopes, whereas 43 species were exclusive to natural biotopes, and 19 species were found only in agrarian landscapes. The spring avifauna was classified into six categories based on their occurrence: Resident (51 species), Breeding-Migratory (75 species), Migratory-Wintering (34 species), Migratory (25 species), Breeding-Migratory-Wintering (11 species), and Wintering (9 species). The study included a comparative evaluation of bird diversity in natural biotopes and agrocenoses.

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Keywords

Spring avifauna, natural biotopes, agricultural landscapes, diversity indices, occurrence characteristics

Introduction

Throughout human history, our dependence on natural phenomena has diminished as we began to alter our living environments to meet our needs. Consequently, natural biotopes have increasingly been replaced by agrarian landscapes, villages, megacities, artificial reservoirs, and various anthropogenic ecosystems. These alterations have compelled bird species, which have historically thrived in these areas, to either adapt to the changes, suffer due to their inability to do so, or migrate elsewhere (Azimov 2022; Chalikova 2023).

The rapid increase in global population, coupled with urbanization, climate change, and desertification – often triggered by the unsustainable use of natural resources – has significantly reduced the natural habitats available to many species, consequently affecting avifauna (McKinney 2002; Ali 2005; Akhrorov et al. 2022; Chalikova 2023). These anthropogenic alterations in bird habitats negatively impact species survival (Andren 1994; Recher 1999). Furthermore, Fischer and Lindenmayer (2007) emphasized that changes in landscapes can reduce species diversity, while birds serve as key indicators for assessing environmental health (Rajashekara and Venkatesha 2011; Colwell 2010; Ganiev et al. 2022).

The first studies focused on avifauna in the Tashkent region began in the second half of the 19th century (Severtsov 1873; Russov 1878; Smirnov 1883; Loudon 1909, 1910; Severtsov et al. 1866). Existing research has primarily examined natural areas (Korelov 1956; Mitropolsky 2002, 2005, 2008; Kovshar 2002; Gritsyna et al. 2020; Ganiev 2022), the region's avifauna (Matyakubov 1970; Azimov 2020, 2022), or specific bird groups (Fundukchiev et al. 2004; Mitropolsky 2008). However, there is a notable lack of studies providing estimates of relative abundance or density of bird populations in the Tashkent region. The only available data regarding bird density in agrarian landscapes within Northeastern Uzbekistan was published by Azimov (2022). Moreover, there have been no comprehensive studies analyzing the similarities and differences in bird diversity between natural and agricultural landscapes in Uzbekistan.

This article aims to determine the species composition of the avifauna in the Tashkent region, analyze and compare its spring diversity, and assess the impact of anthropogenic factors on the behavior of bird species in both natural biotopes and agricultural landscapes.

Materials and methods

Study Area

The total area of the Tashkent region is 15,585 km², of which 40.56% are natural areas and 25.13% are agrarian landscape (Land Fund of the Republic of Uzbekistan 2015). The Qurama, Chatkal, Pskom, Maidontol, Ugom, and Karjantog ridges of western Tien-Shan, consisting of mountain and submountain regions, are located in the northeast and eastern parts of the region and occupy almost half of the territory. The southwest part consists of a plain descending to the Syrdarya River. The difference in height compared to sea level is more than 4 km. The coast of the Chirchik River starts at 250 meters, and the Adelunga peak of the Pskom ridge reaches 4300 meters.

The Tashkent region is located on the border of a harsh continental climate. Annual precipitation is up to 440 mm. The average annual air humidity is 56%, the wind speed is 1.4 m/s, and the temperature is +14.8 °C. In winter, the temperature can drop as low as -34 °C, while in summer it can rise as high as +43 °C (National Encyclopedia of Uzbekistan 2002). The study of the avifauna of the region was carried out during the years 2014–2022. Field research was carried out at 15 observation stations selected from standard biotopes in plain, sub-mountain, mid-mountain and

high mountain zones of the region. Observation stations include areas with a radius of 2.5-10 km. The avifauna of the agricultural landscape was studied in wheat fields, cotton fields, and orchards, which comprised a large part of it. 20 wheat fields, 14 cotton fields, and 13 orchards were designated as observation stations. They consist of an area of 0.6-2.7 km² (Fig. 1).

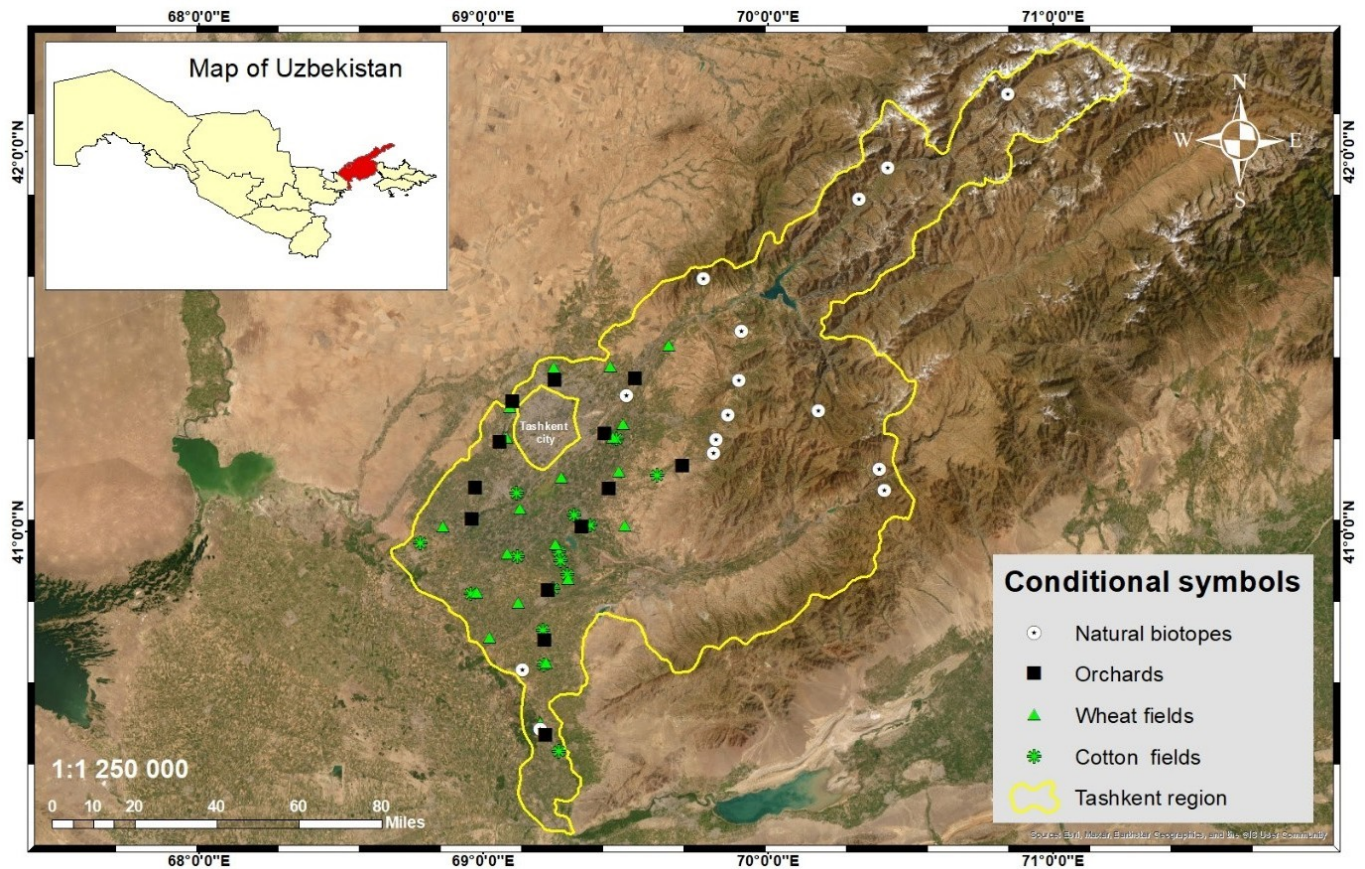


Figure 1. The map of the research observation stations in the Tashkent region.

In this study, we classified natural biotopes as areas unaffected by human activity and agricultural landscapes as the various agrocenoses formed by anthropogenic influences. To examine the avifauna, we employed the route method as outlined by Bibby et al. (1998). In natural biotopes, the survey routes spanned 2.5 to 10 kilometers in length, with a width of 100 meters in flat terrains and up to 30 meters in mountainous regions, particularly in forested areas. In contrast, the routes in agricultural landscapes varied from 300 meters to 2 kilometers in length, with widths of 20 meters in orchards and up to 100 meters in cotton and wheat fields.

During the research, we utilized several observation tools, including Viking (10x50) and Swarovski SLS (15x56) binoculars, as well as Viking (20x60) and Swarovski ATX (30-70x95) spotting scopes. We employed a mechanical counter to tally bird sightings, a Garmin GPS navigator to record the coordinates of observation sites, and a Canon camera with a 400 mm lens for capturing images of the birds. For bird identification, we referred to the field guide "Birds of Central Asia" by Raffael Aye et al. (2012).

Statistical analysis

Following the methodology outlined by Bibby et al. (1992), encounter rate values were categorized into five abundance categories: <0.1, 0.1-2.0, 2.1-10.0, 10.1-40.0, and >40. Each category was assigned an abundance score: 1 for rare, 2 for uncommon, 3 for frequent, 4 for common, and 5 for abundant. Although data collection was conducted across all biotopes during the spring season,

variations in the length of observation routes made direct comparisons challenging. To ensure accuracy, bird counts were standardized as averages per 10-hectare area.

Additionally, previous studies were referenced to determine the characteristics of bird occurrence in the Tashkent region (Korelov 1956; Sagitov et al. 1987; Mitropolsky et al. 1990; Kashkarov et al. 1995; Mitropolsky 2005; Kovshar 2019a, 2019b). The species list generated from our research utilized Koblik and Arkhipov's taxonomy (2014) and followed the systematic rankings and nomenclature standards set by the International Ornithological Congress World Bird List v 9.2 (Gill and Donsker 2019). We used MS Excel 2013 for statistical data processing.

Results and discussion

Diversity, richness, and density

We found that 387 species occur on the territory of the Tashkent region. In the process of our research, in the spring season, a total of 205 species belonging to 16 orders and 39 families were recorded in the natural biotopes and agrarian landscapes of the Tashkent region. Of these, 186 species were found in natural biotopes and 162 species were found in the agrarian landscape. 43 species of birds were found only in natural biotopes, 19 species were found only in fields, and 143 species were found in both areas (Table 1).

Status	Species number and % indicator	Found only in natural biotope	Only in the agrarian landscape	Found at the same time in both
BM	75 (37%)	14	3	58
BMW	11 (5%)	0	2	9
M	25 (12%)	5	2	18
MW	34 (17%)	9	6	19
R	51 (25%)	15	3	33
W	9 (4%)	0	3	6

Table 1. Status of species presence

Note: B - breeding, M - migration, W - wintering, R - resident.

Natural biotopes include broad-leaved mountain forests, a middle stream valley, juniper mountain forest, mountain steppe, rocks and scree, plain water reservoirs, tugai forests, and sand dunes in the desert zone. In these biotopes, the average number of birds per 10 hectares is 841.74. It is equal to $H' = 4.32$ according to the Shannon Wiener index, $SR = 27.47$ according to the Margalef diversity index, $D = 0.98$ according to the Simpsons index, and $J = 0.83$ according to the Pielou index (Table 2).

Types of biotopes	Number of species	The average sum of individuals in 10 hectares	H'	D	SR	J
Natural biotopes	186	841.74	4.32	0.98	27.47	0.83
Agrarian landscape	162	290.66	3.98	0.97	28.38	0.78

Table 2. Number of species and diversity indices

According to the Shannon Wiener index, the composition of the broad-leaved mountain forest is equal to $H = 3.7$, middle stream river valley avifauna is $H' = 3.39$, the juniper mountain forest avifauna is $H' = 3.43$, the mountain steppe avifauna is $H = 3.26$, rocks and scree avifauna is $H' = 2.73$, the desert avifauna is equal to $H' = 3.3$. The biotope sequences are $SR = 16.32$, $SR = 12.17$, $SR = 11.34$, $SR = 7.7$, $SR = 7$, and $SR = 18$ according to the Margalef diversity index, respectively. In

Simpsons index, $D=0.96$, $D= 0.94$, $D= 0.96$, $D= 0.94$, $D= 0.92$, and $D= 0.93$. Under Pielou's index, $J = 0.79$, $J = 0.77$, $J = 0.79$, and $J = 0.69$ (Table 3).

In the agriculture fields, the average number of birds per 10 hectares is 290.66. It is equal to $H = 3.98$ according to the Shannon Wiener index, $SR = 28.38$ according to the Margalef index, $D = 0.97$ according to the Simpsons index, and $J = 0.78$ according to the Pielous index (Table 2). According to the Shannon Wiener index, the composition of the avifauna of the wheat fields in the agrarian landscape is $H'= 3.41$, the avifauna of the cotton fields is $H'= 3.63$, and the avifauna of the orchards is $H'= 3.59$. According to Margalef's diversity index, it is equal to $SR= 25.3$, $SR = 14.85$, and $SR = 18.58$ according to the sequence of fields. According to the Simpsons index, $D= 0.932$, $D= 0.964$, and $D= 0.947$. According to the Pielou index, it is equal to $J = 0.71$, $J = 0.83$, and $J = 0.76$ (Table 3).

Ecosystems	Biotores and fields	Number of species	Number of birds per 10 ha	H'	D	SR	J
Natural biotores	Broad-leaved mountain forest	107	663.2	3.7	0.96	16.32	0.79
	Middle stream river valley	80	658.73	3.39	0.94	12.17	0.77
	Juniper mountain forest	74	625.18	3.43	0.96	11.34	0.79
	Mountain steppe	51	223.34	3.26	0.94	7.77	0.83
	Rocks and scree	32	83.69	2.73	0.92	7	0.79
	Desert (plain biotores)	117	630.62	3.3	0.93	18	0.69
Agrarian landscape	Wheat fields	122	119.46	3.41	0.932	25.3	0.71
	Cotton fields	81	218.53	3.63	0.964	14.85	0.83
	Orchards	113	414.94	3.59	0.947	18.58	0.76

Table 3. Species habitat distribution

In addition to natural biotores, the average number of species found in the agrarian landscape per 10 ha is not the same. For example, the number of 34 species in natural biotores is higher than in the agrarian landscape: On the contrary, in the agricultural landscape, compared to natural biotores, there are 12 species with greater abundance. Additionally, 10 species (Glossy Ibis, Eurasian Hobby, Jack Snipe, Solitary Snipe, etc.) were found in similar numbers in both areas (Table 4).

Abundant status of avian fauna in Tashkent region

The occurrence rates of birds in natural biotores and agrarian landscapes were categorized based on the classification system developed by Bibby et al. (1992). In natural biotores, two species - Black-throated Thrush and Common Chaffinch - were classified as abundant. In contrast, no species in the abundant category were recorded in agrarian landscapes.

In the common category, 23 bird species were identified in natural biotores, while only 5 species were found in agrarian landscapes. For the frequent category, 52 species were present in natural biotores compared to 27 in the agrarian landscape. The uncommon category included 99 species in natural biotores and 110 species in agrarian habitats. Additionally, 10 rare species were observed in natural biotores, with 20 identified in agrarian landscapes.

These findings highlight the significance of natural biotopes as crucial habitats for a majority of avifauna species. The absence of abundant species in agrarian land-scapes, alongside a marked increase in species classified as common and rare, suggests that agrarian environments serve as secondary habitats for many birds.

Spring is a particularly notable season for bird observation and study, not just in the Tashkent region but across the Republic. This season allows for the observation of wintering, migratory, nesting, and vertically migrating species. Within the study area, of the recorded species, 75 (37%) were classified as breeding migrants (BM), 51 (25%) as residents (R), 34 (17%) as migratory and wintering (MW), 25 (12%) as migrants (M), 11 (5%) as breeding-migratory-wintering (BMW), and 9 (4%) as wintering (W) species, as summarized in Table 1.

Notably, 14 species from the BM group – including Black Stork, Egyptian Vulture, Short-toed Snake-eagle, Eurasian Oystercatcher, Common Tern, Alpine Swift, Eurasian Crag Martin, Rufous-tailed Rock-thrush, Blue-headed Redstart, Northern Wheatear, Sulphur-bellied Warbler, Hume’s Whitethroat, Eastern Rock-nuthatch, and Grey-necked Bunting – were found exclusively in natural biotopes. Conversely, species such as Little Bittern, European Turtle-dove, and Pied Bush Chat were uniquely identified in agrarian landscapes, while 58 species were recorded in both environments (see Table 4).

Scientific name	English name	Status	Natural biotope	H'	Agrarian landscape	H'
<i>Alectoris chukar</i>	Chukar	R	1..8	-0.0131	-	-
<i>Perdix perdix</i>	Grey Partridge	R	0.4	-0.0036	0..8	-0.0023
<i>Coturnix coturnix</i>	Common Quail	BM	1..2	-0.0093	1..01	-0.0197
<i>Phasianus colchicus</i>	Common Pheasant	R	0..6	-0.0052	1..14	-0.0217
<i>Anas crecca</i>	Common Teal	MW	0.295	-0.0028	-	-
<i>Anas platyrhynchos</i>	Mallard	BMW	2,06	-0.0147	0.26	-0.0063
<i>Phalacrocorax pygmaeus*</i>	Pygmy Cormorant	MW	0.7	-0.0059	0.49	-0.0108
<i>Phalacrocorax carbo</i>	Great Cormorant	MW	0.9	-0.0073	0.05	-0.0015
<i>Ixobrychus minutus</i>	Little Bittern	BM	-	-	0.11	-0.0030
<i>Nycticorax nycticorax</i>	Black-crowned Night Heron	R	0.1	-0.0011	1.07	-0.0206
<i>Casmerodius albus</i>	Great Egret	MW	0.7	-0.0059	0.34	-0.0079
<i>Ardea cinerea</i>	Grey Heron	MW	0.9	-0.0073	-	-
<i>Ardea purpurea</i>	Purple Heron	MW	0.4	-0.0036	-	-
<i>Ciconia nigra*</i>	Black Stork	BM	0.09	-0.0010	-	-
<i>Ciconia ciconia*</i>	White Stork	R	0.94	-0.0076	0.51	-0.0111
<i>Plegadis falcinellus*</i>	Glossy Ibis	M	0.43	-0.0039	0.44	-0.0098
<i>Falco naumanni*</i>	Lesser Kestrel	BM	0.03	-0.0004	0.09	-0.0025
<i>Falco tinnunculus</i>	Common Kestrel	R	0.46	-0.0041	0.79	-0.0161
<i>Falco columbarius</i>	Merlin	W	-	-	0.1	-0.0027
<i>Falco subbuteo</i>	Eurasian Hobby	BM	0.28	-0.0027	0.32	-0.0075

<i>Falco cherrug</i> ***	Saker Falcon	R	0.05	-0.0006	-	-
<i>Falco peregrinus</i> *	Peregrine Falcon	MW	-	-	0.17	-0.0044
<i>Falco pelegrinoides</i> *	Barbary Falcon	MW	0.01	-0.0001	-	-
<i>Pandion haliaetus</i> *	Western Osprey	M	-	-	0.06	-0.0018
<i>Pernis apivorus</i>	European Honey- buzzard	M	-	-	0.4	-0.0091
<i>Milvus migrans</i>	Black Kite	MW	1.46	-0.0110	0.77	-0.0157
<i>Gyps himalayensis</i> ***	Himalayan Vulture	R	0.03	-0.0004	-	-
<i>Gyps fulvus</i> *	Griffon Vulture	R	0.34	-0.0032	-	-
<i>Aegypius monachus</i> ***	Cinereous Vulture	R	0.24	-0.0023	-	-
<i>Gypaetus barbatus</i> ***	Bearded Vulture	R	0.22	-0.0022	-	-
<i>Neophron percnopterus</i> ***	Egyptian Vulture	BM	0.53	-0.0046	-	-
<i>Circaetus gallicus</i> *	Short-toed Snake- eagle	BM	0.5	-0.0044	-	-
<i>Circus aeruginosus</i>	Western Marsh Harrier	R	1.17	-0.0091	0.23	-0.0057
<i>Circus cyaneus</i>	Hen Harrier	MW	0.87	-0.0071	0.44	-0.0098
<i>Circus macrourus</i> ***	Pallid Harrier	MW	-	-	0.03	-0.0009
<i>Accipiter badius</i>	Shikra	BM	0.67	-0.0057	0.16	-0.0041
<i>Accipiter nisus</i>	Eurasian Sparrowhawk	R	1.06	-0.0084	0.05	-0.0015
<i>Accipiter gentilis</i>	Northern Goshawk	MW	0.27	-0.0026	-	-
<i>Buteo buteo</i>	Common Buzzard	MW	0.7	-0.0059	-	-
<i>Buteo rufinus</i>	Long-legged Buzzard	R	1.05	-0.0083	0.1	-0.0027
<i>Aquila clanga</i> ***	Greater Spotted Eagle	M	0.07	-0.0008	-	-
<i>Aquila nipalensis</i> ***	Steppe Eagle	M	0.08	-0.0009	-	-
<i>Aquila chrysaetos</i> *	Golden Eagle	R	0.79	-0.0065	-	-
<i>Hieraetus pennatus</i> *	Booted Eagle	BM	0.95	-0.0077	0.33	-0.0077
<i>Rallus aquaticus</i>	Water Rail	BMW	0.17	-0.0017	0.05	-0.0015
<i>Gallinula chloropus</i>	Common Moorhen	BM	0.26	-0.0025	0.24	-0.0059
<i>Fulica atra</i>	Common Coot	MW	3.45	-0.0225	-	-
<i>Haematopus ostralegus</i>	Eurasian Oystercatcher	BM	0.02	-0.0003	-	-
<i>Himantopus himantopus</i>	Black-winged Stilt	BM	1.3	-0.0100	0.17	-0.0044
<i>Vanellus vanellus</i> **	Northern Lapwing	MW	0.7	-0.0059	0.41	-0.0093
<i>Vanellochettusia leucura</i>	White-tailed Lapwing	BM	0.5	-0.0044	0.05	-0.0015

<i>Charadrius alexandrinus</i>	Kentish Plover	BM	2.1	-0.0150	0.05	-0.0015
<i>Scolopax rusticola</i>	Eurasian Woodcock	MW	0.46	-0.0041	0.16	-0.0041
<i>Lymnocyptes minimus</i>	Jack Snipe	MW	0.04	-0.0005	0.05	-0.0015
<i>Gallinago solitaria</i>	Solitary Snipe	MW	0.21	-0.0021	0.12	-0.0032
<i>Gallinago gallinago</i>	Common Snipe	MW	0.37	-0.0034	0.2	-0.0050
<i>Tringa ochropus</i>	Green Sandpiper	MW	1.01	-0.0081	0.2	-0.0050
<i>Tringa glareola</i>	Wood Sandpiper	MW	0.29	-0.0027	0.28	-0.0067
<i>Philomachus pugnax</i>	Ruff	M	0.6	-0.0052	0.34	-0.0079
<i>Glareola pratincola</i>	Collared Pratincole	BM	0.8	-0.0066	0.08	-0.0023
<i>Sterna hirundo</i>	Common Tern	BM	1.03	-0.0082	-	-
<i>Columba livia</i>	Rock Dove	R	3.3	-0.0217	5.4	-0.0740
<i>Columba palumbus</i>	Common Wood-pigeon	R	5.86	-0.0346	4.82	-0.0680
<i>Streptopelia turtur***</i>	European Turtle-dove	BM	-	-	0.9	-0.0179
<i>Streptopelia orientalis</i>	Oriental Turtle-dove	BM	2.17	-0.0154	0.86	-0.0172
<i>Streptopelia decaocto</i>	Eurasian Collared Dove	R	1.11	-0.0087	4.15	-0.0607
<i>Streptopelia senegalensis</i>	Laughing Dove	R	0.23	-0.0022	0.38	-0.0087
<i>Cuculus canorus</i>	Common Cuckoo	BM	1.2	-0.0093	0.4	-0.0091
<i>Otus brucei</i>	Pallid Scops-owl	BM	0.2	-0.0020	0.38	-0.0087
<i>Otus scops</i>	Eurasian Scops-owl	BM	1.38	-0.0105	0.11	-0.0030
<i>Strix aluco</i>	Tawny Owl	R	0.07	-0.0008	-	-
<i>Athene noctua</i>	Little Owl	R	1.4	-0.0106	0.41	-0.0093
<i>Asio otus</i>	Northern Long-eared Owl	BMW	-	-	0.49	-0.0108
<i>Asio flammeus</i>	Short-eared Owl	W	-	-	0.05	-0.0015
<i>Caprimulgus europaeus</i>	European Nightjar	BM	0.95	-0.0077	0.38	-0.0087
<i>Caprimulgus aegyptius</i>	Egyptian Nightjar	BM	1.6	-0.0119	0.15	-0.0039
<i>Apus melba</i>	Alpine Swift	BM	5.71	-0.0339	-	-
<i>Apus apus</i>	Common Swift	BM	13.2	-0.0652	39.4	-0.2709
<i>Coracias garrulus</i>	European Roller	BM	2.86	-0.0193	0.85	-0.0171
<i>Alcedo atthis</i>	Common Kingfisher	R	0.8	-0.0066	0.3	-0.0071
<i>Merops persicus</i>	Blue-cheeked Bee-eater	BM	20.42	-0.0902	8.7	-0.1050
<i>Merops apiaster</i>	European Bee-eater	BM	15.38	-0.0731	8.2	-0.1007
<i>Upupa epops</i>	Common Hoopoe	BM	0.96	-0.0077	0.75	-0.0154
<i>Jynx torquilla</i>	Eurasian Wryneck	M	0.33	-0.0031	0.38	-0.0087

<i>Dendrocopos leucopterus</i>	White-winged Woodpecker	R	1.68	-0.0124	1.47	-0.0267
<i>Melanocorypha bimaculata</i>	Bimaculated Lark	BM	2.51	-0.0173	1.75	-0.0308
<i>Calandrella brachydactyla</i>	Greater Short-toed Lark	BMW	0.94	-0.0076	0.65	-0.0136
<i>Galerida cristata</i>	Crested Lark	R	7.53	-0.0422	5.63	-0.0764
<i>Alauda arvensis</i>	Eurasian Skylark	BMW	1.12	-0.0088	0.34	-0.0079
<i>Riparia riparia</i>	Collared Sand Martin	M	24.17	-0.1019	6	-0.0801
<i>Riparia diluta</i>	Pale Martin	BM	5.9	-0.0348	2.72	-0.0437
<i>Hirundo rustica</i>	Barn Swallow	BM	11.8	-0.0598	13.19	-0.1403
<i>Cecropis daurica</i>	Red-rumped Swallow	BM	5.8	-0.0343	0.46	-0.0102
<i>Ptyonoprogne rupestris</i>	Eurasian Crag Martin	BM	2.03	-0.0145	-	-
<i>Delichon urbicum</i>	Northern House Martin	BM	12.5	-0.0625	0.9	-0.0179
<i>Anthus campestris</i>	Tawny Pipit	BMW	0.67	-0.0057	0.42	-0.0094
<i>Anthus trivialis</i>	Tree Pipit	BM	3.61	-0.0234	4.04	-0.0594
<i>Anthus spinoletta</i>	Water Pipit	BMW	2.13	-0.0151	0.28	-0.0067
<i>Motacilla flava</i>	Yellow Wagtail	M	39.3	-0.1431	5.17	-0.0717
<i>Motacilla citreola</i>	Citrine Wagtail	BM	0.29	-0.0027	0.08	-0.0023
<i>Motacilla cinerea</i>	Grey Wagtail	BMW	4.3	-0.0270	0.36	-0.0083
<i>Motacilla alba</i>	White Wagtail	MW	2.51	-0.0173	3.81	-0.0568
<i>Motacilla personata</i>	Masked Wagtail	BMW	1.8	-0.0131	2.91	-0.0461
<i>Cinclus cinclus</i>	White-throated Dipper	R	0.37	-0.0034	-	-
<i>Troglodytes troglodytes</i>	Eurasian Wren	R	1.56	-0.0117	0.11	-0.0030
<i>Prunella himalayana</i>	Altai Accentor	R	2.54	-0.0175	-	-
<i>Prunella atrogularis</i>	Black-throated Accentor	MW	3.03	-0.0203	-	-
<i>Turdus ruficollis</i>	Red-throated Thrush	MW	-	-	0.31	-0.0073
<i>Turdus atrogularis</i>	Black-throated Thrush	MW	42.7	-0.1512	4.83	-0.0681
<i>Turdus pilaris</i>	Fieldfare	MW	-	-	0.17	-0.0044
<i>Turdus merula</i>	Eurasian Blackbird	R	13.3	-0.0655	1.5	-0.0272
<i>Turdus iliacus**</i>	Redwing	MW	-	-	1.81	-0.0316
<i>Turdus viscivorus</i>	Mistle Thrush	R	11.9	-0.0602	0.22	-0.0054
<i>Myophonus caeruleus</i>	Blue Whistling Thrush	R	0.9	-0.0073	-	-
<i>Monticola saxatilis</i>	Rufous-tailed Rock-thrush	BM	1.67	-0.0123	-	-
<i>Phoenicurus caeruleocephala</i>	Blue-headed Redstart	BM	4.44	-0.0277	-	-

<i>Phoenicurus phoenicurus</i>	Common Redstart	M	0.7	-0.0059	0.41	-0.0093
<i>Phoenicurus ochruros</i>	Black Redstart	BM	1.54	-0.0115	0.32	-0.0075
<i>Phoenicurus erythronotus</i>	Eversmann's Redstart	MW	0.64	-0.0055	0.11	-0.0030
<i>Erythropygia galactotes</i>	Rufous-tailed Scrub Robin	BM	0.48	-0.0043	0.2	-0.0050
<i>Erithacus rubecula</i>	European Robin	MW	0.37	-0.0034	0.15	-0.0039
<i>Luscinia megarhynchos</i>	Common Nightingale	BM	3.67	-0.0237	0.99	-0.0194
<i>Luscinia luscinia</i>	Thrush Nightingale	M	1.05	-0.0083	0.07	-0.0020
<i>Luscinia svecica</i>	Bluethroat	M	4.1	-0.0259	1.39	-0.0256
<i>Saxicola maurus</i>	Siberian Stonechat	BM	6.18	-0.0361	2.12	-0.0359
<i>Saxicola caprata</i>	Pied Bush Chat	BM	-	-	0.1	-0.0027
<i>Oenanthe oenanthe</i>	Northern Wheatear	BM	2.66	-0.0182	-	-
<i>Oenanthe pleschanka</i>	Pied Wheatear	BM	3.98	-0.0253	0.72	-0.0149
<i>Oenanthe isabellina</i>	Isabelline Wheatear	BM	8	-0.0443	0.4	-0.0091
<i>Muscicapa striata</i>	Spotted Flycatcher	BM	11.3	-0.0579	0.96	-0.0189
<i>Cettia cetti</i>	Cetti's Warbler	BMW	0.29	-0.0027	0.4	-0.0091
<i>Locustella luscinioides</i>	Savi's Warbler	M	0.38	-0.0035	0.23	-0.0057
<i>Locustella naevia</i>	Common Grasshopper Warbler	M	0.63	-0.0054	0.18	-0.0046
<i>Locustella lanceolata</i>	Lanceolated Warbler	M	0.1	-0.0011	-	-
<i>Acrocephalus agricola</i>	Paddyfield Warbler	BM	0.12	-0.0013	0.04	-0.0012
<i>Acrocephalus dumetorum</i>	Blyth's Reed-warbler	M	0.64	-0.0055	0.13	-0.0034
<i>Acrocephalus scirpaceus</i>	Eurasian Reed Warbler	BM	15.2	-0.0725	0.41	-0.0093
<i>Acrocephalus stentoreus</i>	Clamorous Reed-warbler	BM	7.56	-0.0423	0.74	-0.0152
<i>Iduna caligata</i>	Booted Warbler	M	5.4	-0.0324	0.14	-0.0037
<i>Iduna rama</i>	Sykes's Warbler	BM	13.1	-0.0648	0.78	-0.0159
<i>Iduna pallida</i>	Olivaceous Warbler	BM	0.1	-0.0011	0.57	-0.0122
<i>Phylloscopus trochilus</i>	Willow Warbler	M	0.7	-0.0059	0.43	-0.0096
<i>Phylloscopus collybita</i>	Common Chiffchaff	MW	40	-0.1448	2.57	-0.0418
<i>Phylloscopus trochiloides</i>	Greenish Warbler	M	0.92	-0.0075	-	-
<i>Phylloscopus inornatus</i>	Yellow-browed Warbler	M	6.23	-0.0363	-	-
<i>Phylloscopus humei</i>	Hume's Leaf-warbler	BMW	9.5	-0.0506	0.2	-0.0050
<i>Phylloscopus</i>	Sulphur-bellied	BM	7.56	-0.0423	-	-

<i>griseolus</i>	Warbler					
<i>Sylvia crassirostris</i>	Eastern Orphee Warbler	BM	12.34	-0.0619	0.41	-0.0093
<i>Sylvia communis</i>	Common Whitethroat	BM	4.1	-0.0259	0.56	-0.0120
<i>Sylvia curruca</i>	Lesser Whitethroat	BM	17.6	-0.0809	1.74	-0.0306
<i>Sylvia althaea</i>	Hume's Whitethroat	BM	10.61	-0.0551	-	-
<i>Regulus regulus</i>	Goldcrest	W	2.1	-0.0150	1.55	-0.0279
<i>Remiz pendulinus</i>	Eurasian Penduline-tit	R	5.1	-0.0309	-	-
<i>Remiz macronyx</i>	Black-headed Penduline-tit	BMW	-	-	0.19	-0.0048
<i>Remiz coronatus</i>	White-crowned Penduline-tit	BM	7.03	-0.0400	1.03	-0.0200
<i>Parus rufonuchalis</i>	Rufous-naped Tit	R	1.85	-0.0135	-	-
<i>Parus flavipectus</i>	Yellow-breasted Tit	R	8.5	-0.0464	0.05	-0.0015
<i>Parus bokharensis</i>	Turkestan Tit	R	9.1	-0.0489	1.86	-0.0323
<i>Sitta tephronota</i>	Eastern Rock-nuthatch	R	1.94	-0.0140	-	-
<i>Lanius isabellinus</i>	Isabelline Shrike	BM	0.3	-0.0028	1.32	-0.0245
<i>Lanius phoenicuroides</i>	Red-tailed Shrike	BM	0.96	-0.0077	0.95	-0.0187
<i>Lanius collurio</i>	Red-backed Shrike	M	0.7	-0.0059	0.9	-0.0179
<i>Lanius schach</i>	Long-tailed Shrike	BM	0.46	-0.0041	0.76	-0.0155
<i>Lanius minor</i>	Lesser Grey Shrike	BM	1.53	-0.0115	0.13	-0.0034
<i>Lanius lahtora</i>	Asian Grey Shrike	MW	0.1	-0.0011	-	-
<i>Oriolus oriolus</i>	Eurasian Golden Oriole	BM	5.94	-0.0350	1.29	-0.0240
<i>Terpsiphone paradisi</i>	Indian Paradise-flycatcher	BM	0.88	-0.0072	0.49	-0.0108
<i>Pica pica</i>	Eurasian Magpie	R	7	-0.0398	4	-0.0590
<i>Corvus monedula</i>	Western Jackdaw	BMW	6.9	-0.0394	1.82	-0.0318
<i>Corvus frugilegus</i>	Rook	BMW	5.86	-0.0346	4.93	-0.0691
<i>Corvus orientalis</i>	Carrion Crow	R	3.1	-0.0206	0.94	-0.0185
<i>Corvus cornix</i>	Hooded Crow	W	0.78	-0.0065	1.28	-0.0239
<i>Corvus corax</i>	Northern Raven	R	0.76	-0.0063	0.05	-0.0015
<i>Acridotheres tristis</i>	Common Myna	R	13.8	-0.0674	7.28	-0.0923
<i>Pastor roseus</i>	Rosy Starling	R	18.4	-0.0836	12	-0.1316
<i>Sturnus vulgaris</i>	Common Starling	BMW	7.7	-0.0429	6.11	-0.0812
<i>Passer domesticus</i>	House Sparrow	R	-	-	0.61	-0.0129

<i>Passer indicus</i>	Indian Sparrow	BM	32.1	-0.1246	17.88	-0.1715
<i>Passer hispaniolensis</i>	Spanish Sparrow	BM	28.7	-0.1152	7.19	-0.0915
<i>Passer montanus</i>	Eurasian Tree Sparrow	R	10.53	-0.0548	13.95	-0.1457
<i>Petronia petronia</i>	Rock Sparrow	BMW	2.1	-0.0150	1.52	-0.0275
<i>Fringilla coelebs</i>	Common Chaffinch	W	42.76	-0.1514	4.81	-0.0679
<i>Fringilla montifringilla</i>	Brambling	W	30.56	-0.1204	0.8	-0.0162
<i>Serinus pusillus</i>	Red-fronted Serin	R	8.66	-0.0471	0.15	-0.0039
<i>Chloris chloris</i>	European Greenfinch	R	2.68	-0.0183	0.11	-0.0030
<i>Spinus spinus</i>	Eurasian Siskin	MW	1.4	-0.0106	0.34	-0.0079
<i>Carduelis carduelis</i>	European Goldfinch	W	-	-	0.05	-0.0015
<i>Carduelis caniceps</i>	Eastern Goldfinch	BMW	0.92	-0.0075	0.89	-0.0177
<i>Acanthis cannabina</i>	Common Linnet	R	0.92	-0.0075	2.23	-0.0374
<i>Bucanetes mongolicus</i>	Mongolian Finch	R	-	-	2.1	-0.0356
<i>Rhodospiza obsoleta</i>	Desert Finch	R	-	-	2.6	-0.0422
<i>Carpodacus erythrinus</i>	Common Rosefinch	BM	6	-0.0352	8.77	-0.0352
<i>Carpodacus rhodochlamys</i>	Red-mantled Rosefinch	R	1.85	-0.0135	-	-
<i>Carpodacus grandis</i>	Blyth's Rosefinch	R	0.68	-0.0058	0.11	-0.0030
<i>Coccothraustes coccothraustes</i>	Hawfinch	R	2.6	-0.0179	0.05	-0.0015
<i>Mycerobas carnipes</i>	White-winged Grosbeak	R	0.67	-0.0057	-	-
<i>Miliaria calandra</i>	Corn Bunting	R	3.6	-0.0233	5.25	-0.0725
<i>Emberiza citrinella</i>	Yellowhammer	W	1.02	-0.0081	2.05	-0.0349
<i>Emberiza stewarti</i>	White-capped Bunting	BM	7.9	-0.0438	1.7	-0.0301
<i>Emberiza cia</i>	Rock Bunting	BMW	11.4	-0.0583	0.1	-0.0027
<i>Emberiza hortulana</i>	Ortolan Bunting	M	0.2	-0.0020	0.32	-0.0075
<i>Emberiza buchanani</i>	Grey-necked Bunting	BM	2.6	-0.0179	-	-
<i>Granativora bruniceps</i>	Red-headed Bunting	BM	4.27	-0.0268	1.81	-0.0316
<i>Schoeniclus schoeniclus</i>	Reed Bunting	W	0.3	-0.0028	0.06	-0.0018
<i>Ocyris rusticus</i>	Rustic Bunting	MW	-	-	0.28	-0.0067

Table 4. Bird species recorded in the study area

Note: *- species that include in the red data book of the Republic of Uzbekistan, ** - species that include in the World Red List (IUCN), *** species that include in the red data book of the Republic of Uzbekistan and in the World Red List (IUCN).

In comparing the diversity of nesting species between natural biotopes and agricultural landscapes, we found that 29 species are exclusive to natural biotopes, while 8 species are unique to agricultural areas. Additionally, 100 species are present in both environments. Overall, a total of 52 nesting species were recorded in the agricultural landscape (Salikhbaev 1952, 1959; Matyakubov 1968, 1969, 1970; Azimov 2022). Among the 51 resident bird species, 15 were found only in natural biotopes, whereas 3 species – House Sparrow, Mongolian Finch, and Desert Finch – were exclusive to the agricultural landscape. The remaining 33 resident species were observed in both habitats.

For the 9 wintering species, 3 species – Merlin, Short-eared Owl, and European Goldfinch – were found exclusively in agricultural landscapes, while the other 6 species – Goldcrest, Hooded Crow, Common Chaffinch, Brambling, Yellowhammer, and Reed Bunting – were present in both environments.

Discussion

The following bird species are naturally absent from agrarian landscapes as they are specifically adapted to mountain ecosystems: Chukar, Black Stork, Himalayan Vulture, Griffon Vulture, Cinereous Vulture, Bearded Vulture, Egyptian Vulture, Tawny Owl, Eurasian Crag Martin, White-throated Dipper, Altai Accentor, Blue Whistling Thrush, Rufous-tailed Rock-thrush, Blue-headed Redstart, Greenish Warbler, Yellow-browed Warbler, Hume's Whitethroat, Rufous-naped Tit, Eastern Rock-nuthatch, Red-mantled Rosefinch, White-winged Grosbeak, and Gray-necked Bunting. Additionally, water-dependent species such as Common Teal, Gray Heron, Purple Heron, Common Coot, Eurasian Oystercatcher, and Common Tern were not recorded in agrarian landscapes during the spring season due to the lack of suitable aquatic habitats.

The absence of raptor species like Saker Falcon, Barbary Falcon, Northern Goshawk, Common Buzzard, Greater Spotted Eagle, Steppe Eagle, Golden Eagle, Alpine Swift, Eurasian Penduline-tit, and Asian Gray Shrike in agricultural fields can be attributed to the limited conditions necessary for their survival, primarily caused by human activities.

Rare species in the Tashkent region include Merlin, Western Osprey, European Honey-buzzard, Pallid Harrier, European Turtle-dove, Short-eared Owl, Red-throated Thrush, Fieldfare, Redwing, Pied Bush Chat, Black-headed Penduline-tit, House Sparrow, European Goldfinch, Desert Finch, and Rustic Bunting. Although Little Bittern is generally considered a common species, it was not observed in our study of natural biotopes due to its secretive behavior. Similarly, the Northern Long-eared Owl, which is a winter visitor and rarely nests, was not recorded during daytime surveys.

Our research revealed the occurrence of 186 species in natural biotopes compared to 162 species in agrarian landscapes, indicating a significant drop in species diversity in agricultural areas. It seems that certain species, such as Steppe Eagle, Eurasian Oystercatcher, and Asian Gray Shrike, which have been previously documented in the region, may have been displaced due to the expansion of agrarian land. Additionally, the population of Desert Finch has sharply declined and may even be facing extinction. Conversely, the expansion of habitats for synanthropic species, including Rock Dove, Eurasian Collared Dove, Laughing Dove, Long-tailed Shrike, Common Myna, and Eurasian Tree Sparrow, has facilitated their population growth.

In total, 54 species listed for regional and global protection were identified in the Tashkent region (Sagitov et al. 1987; Mitropolsky et al. 1990; Shernazarov et al. 2019; <https://www.iucnredlist.org>). During the spring season, 23 of these species were observed at the study sites (Table 4). Specifically, 13 rare and endangered birds were found exclusively in natural biotopes, while 4 species were limited to agrarian landscapes and 6 species were recorded in both areas. Overall, bird diversity is greater, and populations are more abundant in natural biotopes compared to agrarian landscapes. Even in areas where species overlap, natural biotopes consistently exhibited

higher bird densities. Nonetheless, the presence of 4 species unique to agrarian landscapes highlights their unique and important ecological roles in these environments.

Conclusions

This study marks the first assessment of bird fauna in the Republic of Uzbekistan using the aforementioned indices and the analysis of bird diversity across different biotopes. During the spring season, the variety and abundance of bird species in the Tashkent region are notably higher in natural biotopes compared to agrarian landscapes. Any alteration to a natural biotope impacts its components and disrupts the ecological balance. The expansion of agrarian landscapes promotes the proliferation of habitats, resulting in an increase in synanthropic species.

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