

Diversity and sustainability of bird communities in the Irtysh River valley (the Tyumen Oblast, Russia)

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This study investigates the avifauna of the Irtysh floodplain from June 1 to September 1, 2022–2023, revealing a rich diversity of 117 bird species across 14 groups. A notable discovery was the first documented nesting of the blackbird *Turdus merula* in the Uvat region. Additionally, the presence of 11 rare and declining bird species, as listed in the Red List of the Russian Federation and the Tyumen Oblast, was confirmed. The research delves into the ecological and faunal characteristics of bird communities within the key biotopes of the Uvat region, analyzing species composition, total bird population, diversity indices, and community stability. The findings indicated a direct correlation between these parameters and the heterogeneity of plant cover, spatial distribution, and food availability in critical habitats. Despite various anthropogenic activities like habitat fragmentation, tree and shrub cutting, burning, oil field operations, and recreational pursuits observed in the surveyed areas of the Irtysh floodplain, the overall stability of the bird community remained intact.

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Keywords

Uvat region, floodplain of the River Irtysh, species composition, biodiversity and stability of bird communities, rare and protected bird species

Introduction

Birds, known for their remarkable mobility among vertebrates, demonstrate rapid responses to environmental changes and ecological influences, particularly those of anthropogenic and climatic origins. These responses at the population level encompass shifts in range boundaries, alterations in migration patterns, adjustments in the timing of seasonal activities and life stages, as well as processes of synanthropisation (Lupinos 2013).

The interplay of modern climate change and human-induced landscape modifications in the Western Siberian Forest zone, coupled with the urbanization of new areas, triggers structural and spatial reconfigurations within avifauna, impacting biodiversity levels and the stability of ornithocenosis (Gashev et al. 2017; Kurkhinen et al. 2021).

While a wealth of data on fauna and bird populations has been amassed, particularly in the West-Siberian Plain, research in the floodplain of the River Irtysh in the Uvat region remains relatively scant (Ravkin and Lukyanova 1976; Bobkov et al. 1997; Toropov et al. 2012; Odintsev and Odintseva 2014; Nizovtsev 2021, 2023). The need for systematic organization of this information underscores the relevance of this study.

The southern taiga represents the most typical forest zone in the West-Siberian Plain, yet investigations into territorial shifts in bird populations within this subzone are largely unexplored. In contrast, the ornithological complexes of the northern taiga of Western Siberia have been more thoroughly examined (Gyngazov and Milovidov, 1977; Ravkin 1978; Vartapetov 1984, 1998; Ravkin et al. 1994).

Over the past four decades, the landscapes of the southern taiga in Western Siberia, including ornithological complexes, have undergone significant anthropogenic pressures due to the intensive development of the Uvat region. Consequently, there is a pressing need to evaluate the current status of southern taiga birds in the Tyumen Oblast, analyze ongoing changes, and forecast future trends to prevent the irreversible loss of valuable biodiversity information.

Addressing these critical issues is not only essential from an ornithological standpoint but also crucial for tackling regional ecological and geographical challenges, particularly those linked to preserving the biodiversity of ornithological complexes. Therefore, the primary objective of this study was to identify the diversity of birds and evaluate the stability of their communities in the Irtysh River floodplain within the Uvat region.

Materials and methods

Ornithological surveys were carried out on the territory of the Uvat region of the Tyumen region from 1 June to 1 September 2022–2023. Both riversides of the River Irtysh were investigated, from Demyanskoye village in the north to Gornoslinkino village in the south (where it was possible to travel by car) (Fig. 1). The total length of the auto and walking routes was around 1600 km.

We utilized a method of bird counting along designated routes without restricting the counting strip width, followed by recalculating the area based on the bird detection range using the interval

method as outlined by Ravkin (1967). Adjustments for the speed of birds in flight were accounted for based on previous studies (Ravkin 1963, 1967; Siegel 2009, Gregory, Richard D 2004). The bird communities in the selected habitats were analyzed using indices of diversity, dominance, and stability (Odum 1986; Gashev 2000; Bibi F 2013, Maisyaroh 2021). To describe bird distribution, we employed a scale of abundance ratings developed by Kuzyakin (1962). A species was considered dominant if its presence in the community accounted for 10% or more of the total bird population. Photographs and videos of bird species and their numbers at gathering sites were captured using Nikon D7100 cameras with 150mm to 600mm lenses and Canon 550D cameras with 70mm to 300mm lenses. The author's own photographs validated most of the rare bird sightings.

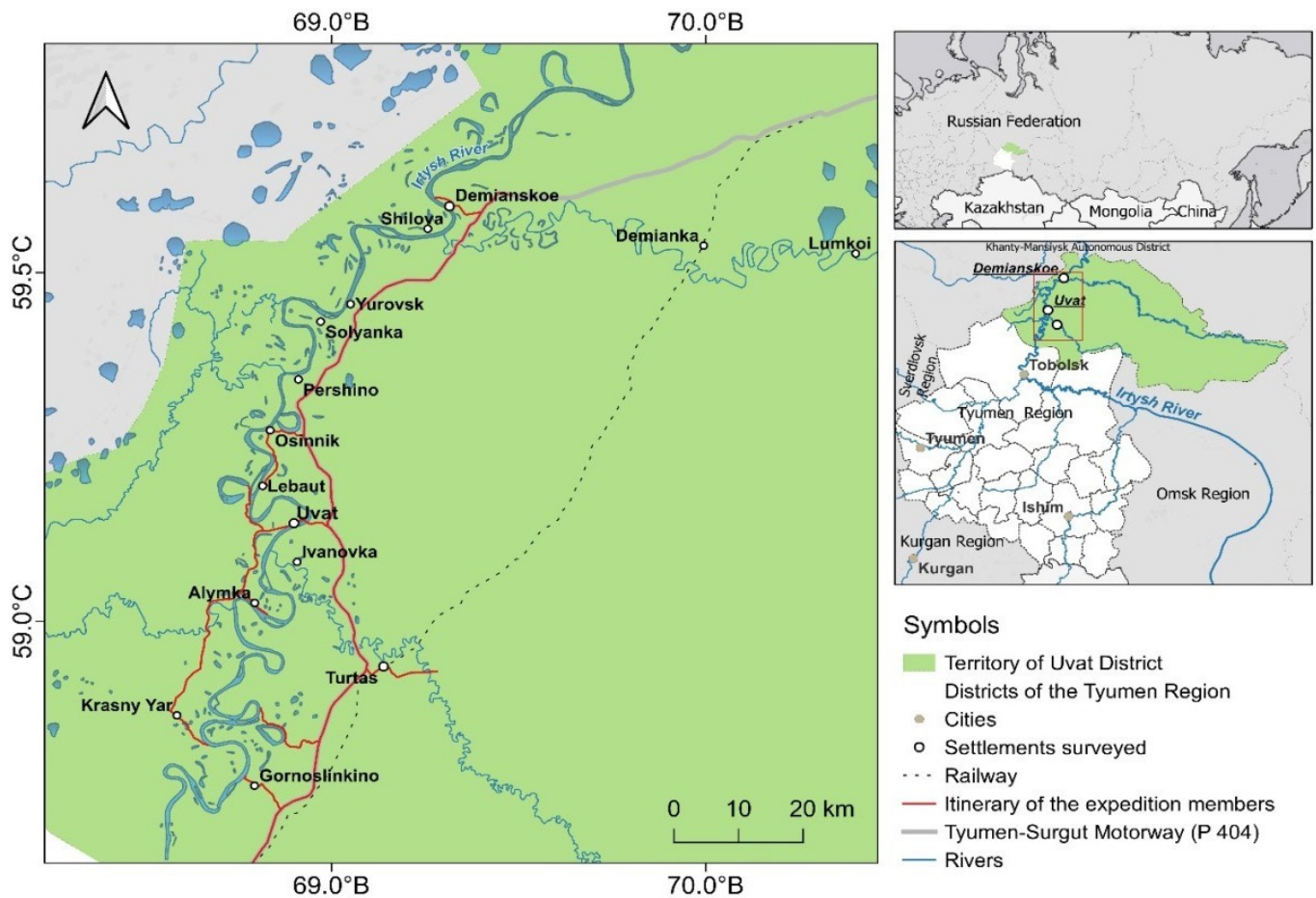


Figure 1. A schematic map of the research area.

Taxonomic information on bird species was sourced from the reference book "List of Birds of the Russian Federation" (Koblik et al. 2006). Nesting bird fauna was analyzed based on faunal groups (Stegman 1938), while the distribution of birds in ecological and trophic groups was determined using data from the ornithological report "Birds of Siberia" (Ryabitsev 2014).

We applied the criteria recommended by the European Ornithological Atlas Committee (EOAC 1992) to assess the reliability of breeding bird records. Data analysis was conducted using STATAN 2009 (Gashev 2009), Statistica 13.3 (TIBCO Software Inc), and Microsoft Excel (Gashev et al. 2002).

Characteristics of the Study Area

The study area falls within the southern taiga subbands, encompassing the Demyan-Turtasky swamp plateau and the right bank of the Irtys' River (Gvozdetsky 1973). The primary industry in

the research area is oil production, with estimated total hydrocarbon reserves of 1.2 billion tons in the Uvat region. RN-Uvatneftegaz, a limited liability company, is the main mineral resource operator responsible for exploring and developing the Uvat region's oilfield complex. The Kalchinsky oilfield in the Uvat region commenced oil production in 1991, with the majority of oil production in 2015 coming from the Ust-Tegussky and Urnensky oilfields. Recoverable oil reserves in the field are currently estimated at 360 million tons. Oil from the Uvat oilfields is transported via main oil pipelines operated by PJSC Transneft. Anthropogenic factors, predominantly related to oil production, forest complexes, and urbanization, dominate the floodplain of the River Irtysh (PJSC NK Rosneft 2024). Various bird habitats were identified during the research, including small-leaved birch and aspen woods, mixed deciduous coniferous forests, marsh complexes, meadows-coppices, water inundation meadows, and water biotopes such as the inundated complexes of the River Irtysh and lake complexes. Settlements and villages were also part of the surveyed areas (Fig. 2).

The deciduous forests in the Uvat region, growing on well-watered and humus-rich soils, are characterized by dense undergrowth and a variety of herbaceous and cereal species. Mixed coniferous forests dominate the floodplains of the River Irtysh and River Turtas, with thick moss under the canopy and diverse ground cover. Meadows in the area include flooded types, sedge meadows, and herbaceous meadows with a variety of predominant plant species. The River Irtysh, with a width ranging from 100-350 meters in the research area, features flat, shallow banks alternating with abrupt and high banks. Small sandy islands dot the water surface, and the river frequently meanders around settlements and villages. The riverbanks are predominantly covered by coniferous and mixed forests, with sedge meadows in flooded areas (Fig. 2).

On both banks of the River Irtysh lie several settlements and villages in the Uvat region, including Demyanskoye, Solyanka, Uvat, Ivanovka, Osinnik, Uki, Turtas, Red Yar, and Gornoslinkino. These communities are surrounded by islands of dark coniferous and small-leaved deciduous forests, along with flooded meadows. The majority of houses in these areas are constructed from wood, typically one to three stories high, with only a few reaching five stories. Each household occupies an area ranging from 0.15 to 0.20 hectares, delineated by wooden fences and featuring buildings and kitchen gardens within their boundaries. The roads in these villages are generally 20-40 meters wide, some lined with deliberately planted trees and bushes, while others boast natural fir and spruce plantations. Residents of these households engage in year-round livestock rearing, including cattle, sheep, and poultry. The population size varies across the villages, with Uki housing 221 people and Uvat hosting 5414 individuals (UVATREGION 2024).

The swamp complexes in the area consist of extensive oligotrophic bogs, both open and forest-covered. These bogs typically feature suppressed bog moss pine forests and are among the least flooded areas of the raised bogs. At the edges of the raised bogs, transitional mesotrophic bog sites are often found. Characterized by a homogeneous or mosaic plant cover with a plano-convex surface, these swamps exhibit a well-developed sub-shrub and grass layer. Dominant plant species include *Ledum palustris*, *Chamaedaphne calyculata*, *Andromeda polifolia*, and *Rubus chamaemorus*, while the woody layer is primarily composed of *Pinus sylvestris*, with occasional presence of *Pinus sibirica* (Drachev 2010).



Figure 2. Biotopes of the Uvat region: A – mixed dark coniferous forests, B – floodplain meadows near the Duvanka channel, C – floodplain of the River Irtysh near the village Demyanskoe, D – meadows-coppices. Photos by N.G. Bogomyakova and M.Yu. Ivanova.

Result

Taxonomic, ecological, and faunal structure of the avifauna

During the research period of 2022–2023, a total of 117 bird species from 14 orders were documented in the floodplain of the River Irtysh within the Uvat region. The taxonomic composition of the ornithological complexes in the study area is diverse, with Passeriformes representing the largest proportion at 48.7% of the recorded species, followed by Charadriiformes at 16.2% and Falconiformes at 8.5%. Other bird orders are present in smaller numbers: Anseriformes at 6.8%, Piciformes at 5.1%, Galliformes at 3.4%, and Columbiformes at 2.6%. Gruiformes, Cuculiformes, and Strigiformes each account for 1.7%, while the smallest orders—Gaviiformes, Podicipediformes, Ciconiiformes, and Caprimulgiformes—each make up only 0.9% of the bird species.

In 2023, the list of birds in the Uvat region was updated to include *Turdus merula*, a blackbird not previously observed nesting in the area. N.G. Bogomyakova documented both juvenile and adult individuals in the mixed coniferous forest near the hunting ground "Iltymsky" on July 11, 2023. The presence of young blackbirds at this time confirms the successful nesting of this species in the Uvat region (Fig. 3).



Figure 3. Juvenile *Turdus merula* – new species for the Uvat region. Photo by N.G. Bogomyakova.

An analysis of faunal groups inhabiting key sites in the Uvat region during the nesting period of 2022–2023 revealed the dominance of trans-Palearctic species (44 species, 37.6%) and representatives of European fauna (40 species, 34.2%). Siberian fauna followed with 23 species (19.6%), while Arctic fauna accounted for 2.6% of the avifauna, including species like *Charadrius hiaticula*, *Phalaropus lobatus*, and *Calidris minuta*. The proportions of bird species belonging to Holarctic, Mediterranean, and Chinese faunal types are insignificant at 1.7% each, with one bird species representing the Mongolian faunal type at 0.9%.

The Uvat region exhibits a higher representation of trans-Palearctic, European, and Siberian fauna compared to other bird fauna groups, attributed to its location in the northernmost part of the Tyumen Oblast. The distribution of Arctic, Mongolian, Holarctic, Mediterranean, and Chinese bird species in the region is primarily influenced by the presence of small open areas, forb vegetation, and various water bodies.

Bird life processes are significantly influenced by nutritional conditions, impacting reproduction rates, distribution within a study area, and migration patterns. The trophic structure of the avifauna in the Uvat region includes phytophages, zoophages, myophages, ichthyophages, entomophages, and euryphages. Mixed eaters are the most common group, followed by zoophages, entomophages, phytophages, and euryphages.

An analysis of bird nesting types in the riverine part of the River Irtysh revealed eight categories. Birds nesting in tree crowns and trunks show the highest species diversity, followed by semi-

aquatic birds, ground-nesting birds, hollow nest birds, scrub vegetation nesters, species using human structures for nesting, nest parasites, and burrow nesters. Each nesting type reflects the diverse habitat preferences and nesting behaviors of the avifauna in the Uvat region.

Biological diversity and structural organization of bird communities

The avifauna across the various key biotopes in the Uvat region displays a rich diversity. Among the studied biotopes, swamps exhibit the lowest number of bird species at 14, along with small-leaved birch and aspen forests at 28, and meadows at 27. Lake biotopes, settlements, and the floodplain of the River Irtysh present an average number of bird species ranging from 33 to 38. In contrast, mixed coniferous forests boast the highest number of bird species at 52, followed closely by flooded meadows at 54, as illustrated in Suppl. material 1: Tables 1 & 2.

When considering bird density, mixed dark-coniferous forests have 468.99 individuals per square kilometer, while small-leaved birch and aspen woods and water meadows have densities of 312.02 and 322.40 individuals per square kilometer, respectively. Swamp complexes exhibit the lowest bird density at 111.30 individuals per square kilometer, with oxbow rivers, lakes, and small reservoirs following closely at 72.20 individuals per square kilometer (Suppl. material 1: Tables 1 & 2).

Analyzing bird community structures solely based on the number and abundance of species within the community may overlook crucial information regarding species rarity and commonness. To address this, quantitative relationships between species are essential for a comprehensive assessment of ornithocenoses in the Uvat region. Utilizing statistical indices and indicators of community stability, we gain valuable insights into the diversity and composition of bird communities across different biotopes.

Specific diversity indices reveal that flooded meadows exhibit the highest value of Shannon's diversity index at $N=3.08$, indicating a rich variety of species in this habitat. Overall, specific diversity indices across all biotopes in the Uvat region are relatively high, with values typically not exceeding 4.5 for animal communities. The Simpson dominance index highlights the distribution uniformity of individuals across species, with water inundation meadows and mixed deciduous-coniferous forests showing lower dominance values, suggesting a more even distribution.

Conversely, urbanized areas demonstrate a higher Simpson dominance index and a lower Pielou evenness index, indicating an uneven distribution of individuals among species and the prevalence of certain bird species. This disparity underscores the polydominance of bird species in urban environments, as illustrated in Table 1.

Species diversity indices	MCF	SLF	SW	FR	LK	FM	MC	SL
Number of species (S)	52	28	14	38	33	37	54	27
Abundance, ind./km ² (N)	468.99	312.02	111.30	590.33	72.22	771.12	322.40	219.93
Species richness Index (R)	8.29	4.70	2.76	5.80	7.48	5.41	9.18	4.82
Shannon's diversity index (H)	2.92	2.51	2.04	2.62	2.61	2.16	3.08	2.41
Simpson's diversity index (D)	0.92	0.88	0.85	0.88	0.89	0.80	0.99	0.86
Simpson's dominance	0.08	0.11	0.14	0.12	0.10	0.19	0.01	0.14

index (C)								
Pielou's uniformity Index (E)	0.74	0.75	0.77	0.72	0.74	0.60	0.77	0.75

Table 1. Parameters of bird communities in the study biotopes of the Uvat region

Notes: MCF – mixed dark coniferous forests; SLF – small-leaved birch-aspen forests; SW – swamps; FR – floodplain of the River Irtysh; LK – lakes; FM – flood meadows; MC – meadows-coppices; SL – Settlements.

The influence of anthropogenic factors on bird communities in settlements is evident through habitat transformation and close proximity to human activities. Notably, three dominant bird species in the investigated settlements and villages of the Uvat region are *Sturnus vulgaris* (38.1%), *Motacilla flava* (16.2%), and *Passer montanus* (12.7%).

Changes in species diversity within bird communities serve as indicators of restructuring in species composition and disruptions in species abundance relationships. Species diversity is closely linked to stability, which reflects the structural complexity of a biological community and can indicate the level of disturbance, energy availability, and environmental stability. To complement the characteristics of bird communities, sustainability indicators such as Simpson's Species Diversity Index, Species Richness Index, and specific coefficients for each terrestrial ecosystem type are utilized (Gashev 2000).

The analysis reveals that floodplain meadows, mixed coniferous forests, and lake complexes exhibit the highest elastic stability values, denoted as UU. On the other hand, settlements display the lowest elastic stability value. The resistance stability indicator, denoted as UR, shows slight increases across different biotopes, with bogs exhibiting a significant rise in this metric.

Overall, the stability of bird communities in various biotope groups of the Uvat region remains relatively high, ranging from $U=4.74$ in settlements to $U=8.94$ in water meadows (Fig. 4). Despite anthropogenic transformations like habitat fragmentation and human activities, the overall stability of bird communities has not significantly decreased.

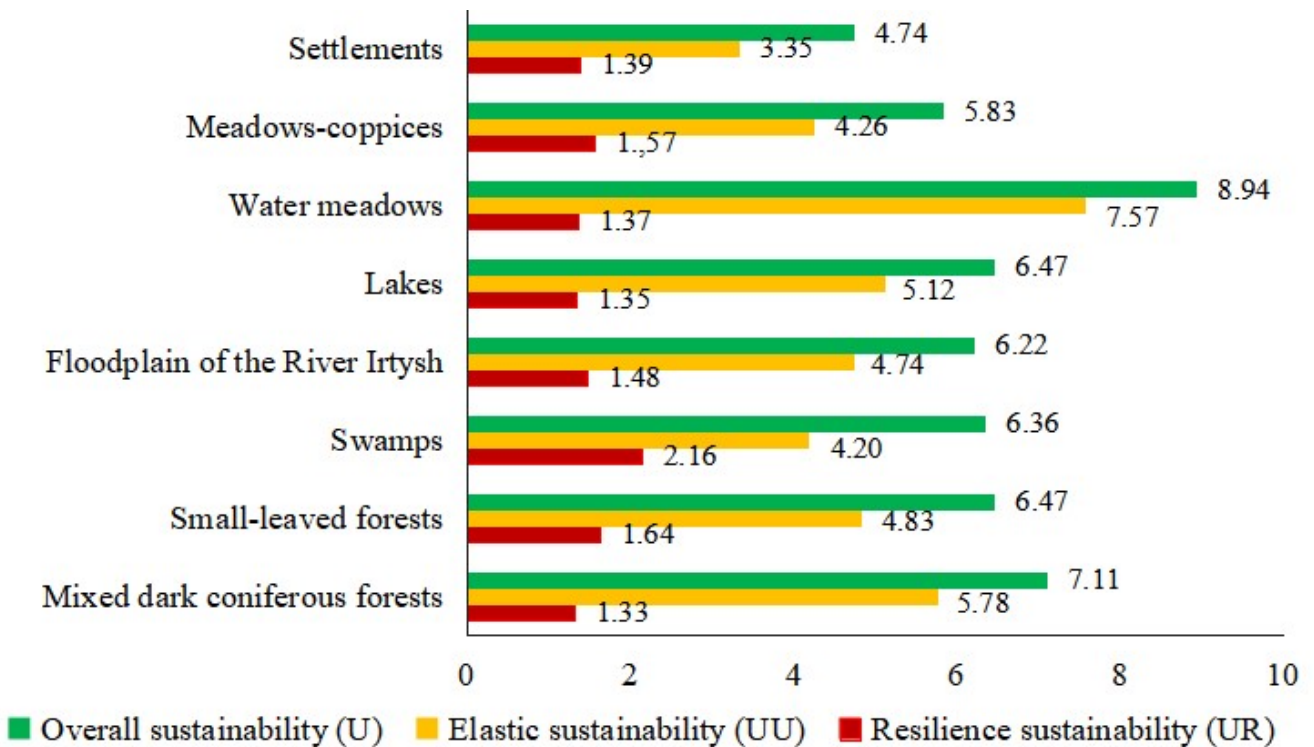


Figure 4. Indicators of the sustainability of bird communities in the study biotopes of the Uvat region.

The analysis of bird community structures identifies dominant species comprising more than 10% of the total abundance. The number of dominant species varies across different bird communities, with *Parus montanus* being dominant in all forest types. Additionally, other dominant species are identified in specific habitats, contributing significantly to the bird community composition.

The diversity of dominant species is particularly evident in swamps due to the proximity of wooded areas, creating an ecotone zone attractive to various bird species. Different habitats harbor distinct dominant species, such as *Motacilla flava* in open habitats, *Saxicola torquata* in water meadows, and *Anthus trivialis* in meadows-coppices. The composition of dominant species in floodplain-lake complexes includes *Motacilla alba*, *Riparia riparia*, and *Sterna hirundo*, each playing a vital role in these ecosystems.

In the settlements and villages of the Uvat region, the dominant bird species composition typically includes *Sturnus vulgaris* (38.1%), *Motacilla flava* (16.2%), and *Passer montanus* (12.7%). *Sturnus vulgaris*, known for its attraction to rural areas, is drawn by the abundance of food sources (such as insects around dairy complexes and farms) and suitable nesting sites (like artificial nesting boxes). During our observations in various settlements in the Uvat region, we frequently witnessed these birds foraging for insects near dairy complexes and private farms.

The analysis of bird population structure based on species relative abundance revealed distinct differences in the dominant species composition, primarily influenced by the diverse habitat qualities present in the study area.

Rare bird species of the Uvat region

The study also focused on identifying the habitats of 11 rare and declining bird species found in the Uvat region. These species are listed in the Red Data Book of the Tyumen Oblast (2020) and the Red Data Book of the Russian Federation (2021) (Table 2). Below, we provide a summary of our encounters with these rare species with description of their presence and significance in the

region.

Podiceps auritus. This species is widespread in Eurasia, from Scandinavia in the east to the Anadyr Basin, Kamchatka, and the coast of Okhotsk (Ryabitsev 2014). About 30–60 thousand pairs live in the Asian part of Russia. The main part of them (20–45 thousand pairs) is concentrated in Western Siberia, where it is common to see them in some places. But their number of them there is decreasing rapidly; in the last 2–3 decades it has decreased three times (Tarasov 2017). In the southern taiga of Western Siberia, the summer population in 1990–1994 was 9–48 thousand individuals; in Priobye and Priirtyshje it has decreased by 1.3 times since the end of the 1960s (Toropov Blinders Bochkaryov 2012).

The limiting factors are poorly understood. Perhaps, the main negative factors are the decrease in the number of aquatic invertebrates due to water pollution and climate change, hypereutrophication of water bodies, and excessive deposition of bottom sediments (Red Book of the Russian Federation 2021). Fishing nets and the pressure of feathered predators are serious threats to juvenile and adult birds. *Corvus cornix* and *Circus aeruginosus* can destroy up to a third of the clutches. *Podiceps auritus* is listed in the Red Book of the Russian Federation, Category 2 – a species in decline in number and distribution (Red Book of the Russian Federation 2021).

On 29.07.2023 an adult individual and a chick were recorded on an unnamed oxbow river near the village Osinniki. The adult *Podiceps auritus* was concerned about the chick and took it carefully into a thicket of semi-aquatic vegetation. In 2022 *Podiceps auritus* was not recorded in the Uvat region.

Species	Status in the Red Book of the Tyumen Oblast	Status in the Red Book of the Russian Federation	Number of individuals in 2022	Number of individuals in 2023
<i>Gavia arctica</i> (Linnaeus, 1758)	3	-	1	7
<i>Podiceps auritus</i> (Linnaeus, 1758)	-	2	-	2
<i>Cygnus olor</i> (J.F. Gmelin, 1789)	3	3	1	-
<i>Pandion haliaetus</i> (Linnaeus, 1758)	3	3	1	2
<i>Pernis apivorus</i> (Linnaeus, 1758)	3	-	3	2
<i>Aquila clanga</i> Pallas, 1811	3	2	1	2
<i>Haliaeetus albicilla</i> (Linnaeus, 1758)	3	5	5	16
<i>Falco vespertinus</i> Linnaeus, 1766	-	3	6	6
<i>Haematopus ostralegus</i> Linnaeus, 1758	3	3	1	1
<i>Numenius arquata</i> (Linnaeus, 1758)	3	-	1	1
<i>Lanius excubitor</i> Linnaeus, 1758	2	-	1	1

Table 2. Rare bird species of the Uvat region of the Tyumen Oblast

Notes: 0 – probably extinct species, 1 – endangered species, 2 – species declining in numbers, 3 – rare species, 4 – species of uncertain status, and 5 – restored and recovering species. If a species is

not included in the Red Book, it is marked with a «-».

Gavia arctica. In the southern regions of the Tyumen Oblast, 40–60 pairs of this species nested in 1977 and 30–90 pairs in 1980–1993 (Azarov 1996). In the taiga zone, it is very rare. In the last decades, its number has decreased 4–10 times (Toropov and Shor 2012).

The limiting factors affecting the population of *Gavia arctica* in the region are disturbances during the breeding season, mortality of juveniles and adults in fishing nets, and contamination of water bodies with oil products. At present, it is listed in the Red Book of the Tyumen Oblast, category 3 – a rare species (Red Book of the Tyumen Oblast 2020).

On 30 July 2023, five adults of *Gavia arctica* were observed on Lake Lebautsky Sor. The birds were actively feeding in the water column, diving for fish, and occasionally cruising from one part of the reservoir to another when fishers approached. Two more individuals were observed on an oxbow river near the village Uki. In 2022, an individual of *Gavia arctica* was recorded on an oxbow river near the Pervomaisky village.

Cygnus olor is found in Western Siberia up to 56°N and east of the River Ob valley. It does not nest in the Ob space between the River valley and Lake Baikal (Ryabitsev 2008). During migration, it flies to the forest zone and tundra up to the Arctic coast (Azarov 1996; Bayanov et al. 2013; Gashev et al. 2013; Tarasov and Primak 2013; Lupinos et al. 2016). The range of the species has recently expanded to the north, as reported in (Gashev et al. 2013; Tarasov and Primak 2013; and Lupinos 2014). Nesting has been recorded in the Beloozersky reserve (Tarasov and Primak 2013), as well as in the Kazansky, Sladkovsky and Armizonsky regions (Gashev et al. 2013; Tarasov and Primak 2013) and in the Tyumen region (Gashev et al. 2013; Tarasov and Primak 2013).

A small number of pairs and groups of single adults *Cygnus olor* are observed in the reservoirs of the southern region each year. In 1970, 16 pairs were recorded nesting on the lakes of the Armizonsky, Berdyuzhsky, and Kazansky regions. This number increased to 35 in 1977, 73 in 1978, and 178 in 1979. The nesting density was about 1 individual per square kilometer in 1984 for the large freshwater and saltwater lakes between the Tobol and Irtysh rivers (Blinova and Blinov 1997).

The number of *Cygnus olor* in the region is limited by several factors, including poaching, disturbance of breeding sites, early autumn cold snaps, and predation by gulls (Red Book of the Tyumen Region 2020).

A single individual of *Cygnus olor* was observed on an oxbow river near the village Pervomaisk in July 2022.

Pandion haliaetus is widespread in the Tyumen region from the southern forest zone up to the city of Salekhard. It nests near the fish-rich lakes in the Uvat region (the outskirts of the villages Gornoslino, Ust-Demyansk, Turtas), in the Vagaisky region (Lake Urashnoye, the upper reaches of the River Tsenga, system of small lakes in the upper reaches of the River Ik), in the Abatsky region (Lake Marukhi), in the Tobolsky region (River Alymka), in the Nizhnetavdinsky region (Lake Ivashkino), in the Yarkovsky region (the outskirts of the villages Bor, Varvara) (Azarov 1996; Bayanov 2013; Gashev et al. 2013).

Pandion haliaetus is a rare species found only in a few places. There are no accurate data on the number of species in the region, but recent evidence suggests that about 20–25 pairs may be nesting in the area. *Pandion haliaetus* is classified as a rare species in the Tyumen Region Red Book (2020) and in the Red Book of the Russian Federation (2020), category 3. Factors that limit the population of the species include a limited number of suitable habitats, as well as pollution of the water bodies.

Pandion haliaetus has been observed on one of the Irtysh oxbow rivers of the River near the village

Burenki (07/29/2023) (Fig. 5A) and on the River Noska near the village Krasny Yar (07/30/2023). S.A. Bayanov discovered *Pandion haliaetus* on Lake Goluboe near the village of Solyanka.

Pernis apivorus was common in the floodplain of the River Irtysh near the village Uki and near the village Gornoslinkino, as well as near the 'Mission' Research Station of the TKNS Ural Branch of the Russian Academy of Sciences (Bobkov et al. 1997; Toropov and Shor 2012). There are no direct data on the frequency of species in the region. In the central and southern Irtysh taiga in 1990–1991 it was very rare in the first half of summer (0.05 individuals/km²) and rare in the second half (0.2 individuals/km²). Compared to the late 1960s, *Pernis apivorus* became much more abundant in the southern Irtysh taiga by the end of the 20th century (Bobkov et al. 1997).

The main limiting factors are the numbers of wasps, which vary greatly from year to year, and poaching. The species is listed in the Red Book of the Tyumen Region, category 3, rare species (Red Book of the Tyumen Region 2020).

Aquila clanga is common throughout the Tyumen region and less common in the taiga zone (Toropov and Shor 2012). Numerous adult birds were observed in various regions, including Tyumen, Nizhnetavdinsky, Yarkovsky, Tobolsk, Uvatsky, Berdyuzhsky, Armizonsky, Isetsky, Yalutorovsky, Ishimsky, Kazansky, Vagaisky (Bayanov 2013; Gashev et al. 2013; Lupinos et al. 2016; Tarasov and Primak 2013).

The density of *Aquila clanga* ranged from 0.001 to 1 individuals/km² in the lowland swamps of the Tobolsk region in 2011. Between 1967–1982 and 2006–2011, the number of individuals per square kilometer in subtaiga forests decreased by half, from 0.1–0.2 to 0.02–0.05. In 1990–1991, during the first and second half of summer, the number of individuals per square kilometer in the Priirtyshye was 0.02 and 0.008, respectively (Toropov and Shor 2012).

The main limiting factors are low fertility, habitat alteration, land reclamation, poaching, and exposure to pesticides. Birds are sensitive to disturbance. *Aquila clanga* is listed as a rare species in the Red Book of the Tyumen Region (category 3) and as a species declining in number and distribution in the Red Book of the Russian Federation (category 2) (Red Book of the Russian Federation 2021).

On the territory of the Povarovsky nature reserve, 2 resting individuals of *Aquila clanga* were observed on power lines on 07/30/2023. In the area near the Demyanskoye 1 individual of *Aquila clanga* was recorded in 2022.

Haliaeetus albicilla is widespread in Eurasia from Scandinavia, Denmark, and the Czech Republic east to Kamchatka. On the territory of the Tyumen Oblast, it nests in river valleys and fish-rich reservoirs. *Haliaeetus albicilla* breeds in the Uvatsky, Tobolsky, Yarkovsky, Nizhnetavdinsky, Tyumensky, Armizonsky, and Ishimsky regions. During the seasonal migration, it is observed everywhere (Azarov 1996; Gashev et al. 2013; Lupinos et al. 2016; Tarasov and Primak 2013). The species was common until the middle of the twentieth century, but then its numbers began to decline. Currently, it is increasing again. According to the results of observations in recent years, about 50–60 pairs nest in the region, up to 500 birds are recorded regularly during the migration period, and no more than 100 birds spend the winter (Azarov 1996; Mitropolsky et al. 2016). The population of *Haliaeetus albicilla* is limited by several factors, including lack of suitable nesting sites, water pollution, and regular illegal hunting. The species is listed in the Red Book of the Russian Federation (category 5, recovery species) and in the Red Book of the region (category 3, rare species). White-tailed eagles were repeatedly observed during the research in the summer of 2023. For example, on the morning of the 30th of July 2023 we witnessed a pair of eagles (adult and juvenile) hunting for fish on the River Lebautsky Sor; one of their attempts was successful. During an expedition, 16 individuals of *Haliaeetus albicilla* were observed (07/11/2023: 2 individuals near the village Solyanka, 07/28/2023: 3 individuals near the village Demyanskoye, 07/30/2023: 4 individuals on Lake Lebautsky Sor, 5 individuals on the River Alymka, 07/31/2023: 1

individual near the village Uki, 08/18/2023:1 individual near the village Gornoslinskino). An abandoned nest was discovered in the Turtas floodplain of the River on a tall pine tree on 19 August 19, 2023. In 2022 S.A. Bayanov noted a pair of eagles nesting near the oxbow river near the village Pervomaisk; one bird near the oxbow river of the River Lebauskoy Sor; one individual on the riverside of the River Irtysh; one more bird in the outskirts of the village Pershino.

Falco vespertinus inhabits the forest zone, the forest-steppe, the steppe, and the northern part of the desert zone of Eurasia from Hungary and the Baltics up to the River Vilyuy and the upper reaches of the River Lena. Beyond the Urals, the boundary of the range passes through the headwaters of the Konda and Malaya Sosva rivers to the village Numto on the northern border of the Khanty-Mansiysk Autonomous District and further to the mouth of the Podkamennaya Tunguska and the upper reaches of the River Chambe (Red Book of the Russian Federation 2021).

In total, there are at least 45–70 thousand pairs of *Falco vespertinus* in Russia. In most regions, the bird population continues to decline. 865–1100 pairs inhabit the Urals and Trans-Urals, and 9–15 thousand pairs live in Siberia (Red Book of the Russian Federation 2021).

At the end of the 20th century, the bird population density was 0.05–3.5 pairs/100 km² in the forest zone and 0.1–12 pairs/100 km² in the forest-steppe and steppe zones. The population in most forest and forest-steppe zones had declined sharply by the end of the 1990s. There was a sharp decline in population in the forest-steppe of western and central Siberia, also. *Falco vespertinus* is listed in the Red Book of the Russian Federation – class 3, rare species (Red Book of the Russian Federation 2021).

At present, the main limiting factors are the use of toxic chemicals and pesticides on farmland, a reduction in the number of corvid nesting sites, deforestation and burning of forests and other woody vegetation, climate change, and illegal shooting of birds on migratory routes.

A nesting colony of *Falco vespertinus* was discovered for the first time by N.G. Bogomyakova in 2022 in the flood plain of the River Irtysh in the Uvat region near the village Solyanka. The ornithologist noticed three nesting pairs on an old burned area close to the river Duvanka channel (Fig. 5B). On 29 July 2023, a falcon's nest was discovered in a burned willow cavity in a floodplain near the village Solyanka with two fully grown flightless chicks inside it. Male and female were actively feeding them by various Orthoptera. Near the discovered nest, 3 other birds were hunting for insects. A male falcon was spotted on a power line near the River Alymka on 30 July 2023.

Numenius arquata occurs in temperate and partly northern latitudes of Eurasia. Their nesting is common in swamps in the Uvat, Tobolsk, and Vagai regions within the Tyumen Oblast (Tarasov and Primak 2013). Migrating flocks can be found all over the region (Ryabitsev 2008).

Rare single pairs nest in the southern parts of the region. It is common in the vast open peat bogs and interfluvial dry grasslands of the northern parts of the Tyumen Oblast (Yudkin 2002; Toropov and Shor 2012). During the migration period, flocks up to a few dozen individuals can be found (Azarov 1996; Tarasov and Primak 2013; Lupinos et al. 2016).

The species is rare in the Tyumen Oblast, and there are no accurate data on breeding numbers (Red Book of the Tyumen Region 2020). *Numenius arquata* was recorded in the Uvat region on 11 July 2023 in a water meadow near the village Solyanka. One individual was recorded in a swamp close to the oxbow river Lebauskoy Sor in 2022.

Haematopus ostralegus nests from the Ob source of the River up to Salekhard, as well as along the Rivers Irtysh, Ishim, Tobol, and on the lower reaches of their main tributaries. Their nests have been observed on Lake Chany and the River Chulym also (Gyngazov and Milovidov 1977). The number of pairs is estimated to be 7–10 thousand within range. The status of the Ob population in the River basin is relatively good. In the northern taiga subzone of the river Ob floodplain, the

density in nesting habitats reaches 21 individuals/km² in the northern taiga subzone of the River Ob floodplain. Currently, the species is listed in the Redbook of the region and the Redbook of the Russian Federation, category 3, rare species.

The main factors that reduce their number are disturbance and shooting at nesting and wintering sites, death of clutches due to trampling by livestock, destruction by humans, wild and domestic animals (dogs, foxes, gulls, and corvids). *Haematopus ostralegus* was recorded only once in 2023 in the floodplain of the River Irtysh, near the village of Osinnik. In 2022, Bayanov observed an individual in the surroundings of the village Alymka in the Irtysh floodplain of the River Irtysh (Fig. 5C).

The *Lanius excubitor* occurs in Western Siberia, from its southern tundra island forests to steppe forests. In the southern and middle latitudes (up to the middle taiga), it lives all the year round, but migrates from the northern parts of its range to spend the winter closer to the south (Ryabitsev 2014). On the territory of the Tyumen Oblast, it has a mosaic distribution (Lupinos et al. 2016). There are known cases of individual pairs meeting and nesting in the Abatsk, Armizon, Berdyuzh (Toropov and Shor 2012), Ishim, Nizhnetavdinsk, Sladkov, Tobolsk, Tyumen, Uvat and Yalutorovsk regions (Gashev et al. 2013; Bayanov 2013; Lupinos et al. 2016).

The main limiting factors are hunting pressure on migration routes and wintering grounds, poaching in nesting areas, destruction of nesting sites because of spring fires and agricultural development of the territory, death of clutches under the hooves of grazing cows and during haymaking, disturbance of birds during the incubation period (Red Book of the Tyumen Region 2020).

Lanius excubitor is an active predator that feeds on mouse-like rodents, shrews, small birds, amphibians, and large insects. It seeks prey from low high, captures it with a quick leap, and bites the victim's hind head (Fig. 5D). N.G. Bogomyakova recorded one individual shrike at the edge of a swamp in the valley of the River Alymka on 31 July 2022 (Fig. 5D).



Figure 5. **A.** *Pandion haliaetus* is on a food search flight. Photo by M.Yu. Ivanova. **B.** Male *Falco vespertinus* is near a nesting colony. Photo by N.G. Bogomyakova. **C.** *Haematopus ostralegus* is in the floodplain of the Irtysh River. Photo by S.A. Bayanova. **D.** *Lanius excubitor* watching over its prey. Photo by N.G. Bogomyakova.

Discussion

The ornithological study's results reveal that the spatial distribution of nesting birds is primarily influenced by the availability and accessibility of food resources, as well as the suitability of habitats for nesting (Vladyshevsky 1980; Ilyichev et al. 1982; Vartapetov 2004; Yudkin 2000; Lupinos 2013; Boldyrev et al. 2021). The River Irtysh floodplain serves as the habitat for 117 bird species, representing 31.5% of the bird population in the Tyumen Oblast.

In 2023, the first nesting record of *Turdus merula* was documented in the Uvat region of the Tyumen Oblast. According to the criteria established by the European Ornithological Atlas Committee (EOAC), a species is considered to have nested in an area if a juvenile or signs of the species, like fluff, are found (Breeding Bird Atlas of Europe 1992). While *Turdus merula* is a European species, its range has expanded north and east in recent years, with the closest boundary of its main range along the Ural Mountains just north of Ekaterinburg (Ryabitsev 2014). Previous sightings of the species include a male blackbird wintering near Yalutorovsk in 2016, another male recorded in the Golyshmanovsky region in 2021, and one observed nesting in the Samarovsky Chugas Natural Park in the Khanty-Mansiysk region in May 2021 (Bochkov 2022).

The presence of both a juvenile and an adult *Turdus merula* in the Uvat region signifies an expansion of the species' range, marking the first documented instance of nesting in this region.

The analysis of research results indicates a decline in key bird abundance indicators (species richness, total density, species diversity) from floodplain complexes to forested and open biotopes and swamps. Bird densities in human settlements are notably higher compared to natural landscapes.

The variations in species richness across different habitats in the Uvat region can be attributed to factors such as moisture distribution, heat, biological resources, and habitat structure. The high species diversity indices reflect the relatively undisturbed nature of the bird communities, with stability indicators emphasizing the importance of maintaining ecosystem balance.

Efforts for bird conservation in the Uvat region should focus on preserving unique natural areas and protecting 11 identified species requiring conservation measures. Special attention is required to restore populations of these birds, as well as those listed in the Red Books at regional and federal levels (Red Book of the Tyumen Region 2020; Red Book of the Russian Federation 2021).

In 2023, the highest number of rare species sightings were recorded, including 16 individuals of *Haliaeetus albicilla*, 7 of *Gavia stellata*, and 6 of *Falco vespertinus*. Additionally, single sightings of *Numenius arquata*, *Haematopus ostralegus*, and *Lanius excubitor* were reported.

Conclusion

The biodiversity research conducted on bird communities in the floodplain valley of the River Irtysh in the Uvat region revealed the presence of 117 species from 14 orders between 2022 and 2023. In 2023, a new species, *Turdus merula*, was documented in the Uvat region for the first time, expanding the region's list of bird species. The observation of both adult and juvenile blackbirds in the area signifies a range expansion for this species, marking the first confirmed nesting of *Turdus merula* in the Uvat region of the Tyumen Oblast.

The analysis of key parameters of biological diversity in bird communities within the Uvat region demonstrated that ornithological complexes in crucial biotopes exhibit high species diversity and community stability. Despite anthropogenic activities like habitat fragmentation, tree and bush clearing, construction, and oil field operations, there has not been a significant decrease in the overall stability of bird communities. The ecosystems remain stable in their current state.

For the first time, the ecological and faunal structure of the Uvat region's avifauna was examined. The majority of bird species belong to the transpalaeartic type (37.6%). The trophic structure reveals that birds with a mixed diet are the most common (32.5%), and crown-nesting birds dominate as nesters in the surveyed biotopes (26.5%).

During the ornithological research conducted from 2022 to 2023, the habitats of 11 rare bird species were identified, all of which are listed in the Red Book of the Russian Federation and the Red Book of the Tyumen Region, each with varying statuses and rarity categories.

The study findings highlight a high level of species diversity in the bird population of the main key habitats in the Uvat region, with significant variations in the qualitative composition of bird communities. This variation is attributed to the diverse biotopes present in the riverine floodplain of the River Irtysh. Factors such as the mosaic nature of forest communities in the southern taiga and human activities like urbanization, deforestation, fires, and oil field development have led to the creation of transformed biotopes.

The ongoing monitoring of these communities is crucial for observing changes in bird population composition over time, particularly in response to the exploitation of the Uvat region.

Thus, 117 bird species from 14 orders were identified between 2022 and 2023, including the new

species *Turdus merula*. Despite anthropogenic activities, bird communities in crucial biotopes show high diversity and stability. The majority of bird species in the region are transpalearctic, with birds having a mixed diet and crown-nesting birds dominating as nesters. 11 rare bird species were found, listed in the Red Books with varying statuses. The study emphasizes the diverse bird population and variations in community composition due to different biotopes. Ongoing monitoring is essential to track changes in bird populations over time, especially in response to region exploitation.

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Supplementary material 1

Table 1. Bird population in the forests, swamps and settlements of the Uvat region

Table 2. Avifauna of floodplain and meadow complexes in the riverine part of the River Irtysh

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Data type: tables

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