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RECENT AVIFAUNISTIC ANALYSIS IN THE FLOODPLAINS OF THE KARA YERTIS (BLACK IRTYSH) AND YERTIS RIVER IN THE PAVLODAR REGION

This research focuses on studying the avian populations in the floodplains of the Kara Yertis and Yertis River in the Pavlodar region, Kazakhstan. There are notable gaps in our understanding of the avifauna in these areas, highlighting the need for continued ornithological research. The primary goal is to address these limitations, with a focus on the Zaysan depression in the East Kazakhstan region and the Pavlodar region. Global climate change and anthropogenic impacts, such as hydroelectric power stations and reservoir construction, are identified as potential contributors to environmental changes in the region. One significant impact is the potential shift in the timing of spring nesting due to climate change, affecting different bird species in varying ways. To investigate these dynamics, field studies were conducted in May and June of 2023, covering seven sites along the Kara Yertis and Yertis River in the Pavlodar region. The study adhered to standardized protocols, taking into account the phenological aspects of bird life cycles. The density of bird species was estimated using route accounting on permanent inventory plots. The study identified a total of 127 bird species across 16 orders in the two model areas. This included species listed in the Red Book, highlighting the importance of conservation efforts. In the Irtysh River of the Pavlodar region with a high humidity level, compared with the Kara Yertis, there were fewer anthropogenic impacts and more bird species (103 species). This study shows that, taking into account climate change and anthropogenic impacts, it is necessary to constantly monitor this region and develop conservation and adaptation strategies.

Key words: Birds, Avifauna, Biodiversity, Yertis River, Zaysan depression, Kara Yertis, Pavlodar region.

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Қара Ертіс пен Павлодар облысындағы Ертіс алқабының авифаунасын талдау

Бұл жұмыс Қара Ертіс пен Павлодар облысындағы Ертіс өзені құстарының популяциясын зерттеуге арналған. Бұл аймақтардағы құстар фаунасы туралы мәліметтер толық емес, сондықтан орнитологиялық зерттеулерді жалғастыру керек. Негізгі мақсат – Шығыс Қазақстан және Павлодар облыстарындағы Зайсан ойпатына назар аудара отырып, авифаунасы туралы білімді толықтыру. Жаһандық климаттың өзгеруі, гидроэлектростанциялар мен су қоймаларының құрылысы сияқты антропогендік факторлар аймақтағы экологиялық өзгерістерге әсер ететін ықпалды факторлар саналады. Маңызды салдардың бірі – климаттық өзгерістерге байланысты әртүрлі құстардың көктемгі ұялау уақытының өзгеріп кетуі. 2023 жылдың мамыр және маусым айларында Қара Ертіс пен Павлодар өңірінің Ертіс өзені бойындағы жеті аймақты қамтитын далалық зерттеу жүргізілді. Зерттеу құстардың өмірлік циклінің фенологиялық ерекшелігін ескере отырып, стандарт әдістер бойынша жүргізілді. Құс түрлерінің тығыздығы тұрақты санақ аумағында маршруттық санақ жүргізу бойынша бағаланды. Зерттеу барысында екі модельдік аумақта 16 отрядқа жататын 127 құс түрі анықталды. Олардың арасында Қызыл кітапқа енгізілген түрлердің болуы – оларды сақтауға күш салудың маңызын көрсетеді. Ылғал деңгейі жоғары Павлодар облысының Ертіс өзенінде Қара Ертіспен салыстырғанда, антропоген әсері

аздау және құс түрі көбірек (103 түр) кездесті. Бұл зерттеу климаттың өзгеруі мен антропогендік әсерді ескере отырып, аталған аймақты үнемі бақылап, табиғатты қорғау және бейімделу стратегияларын жасау керегін көрсетеді.

Түйін сөздер: Құстар, Авифауна, Биоалуандық, Ертіс өзені, Зайсан ойпаты, Қара Ертіс, Павлодар облысы.

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Современный авифаунистический анализ в поймах Чёрного Иртыша и Павлодарского Прииртышья

Это исследование посвящено изучению популяций птиц в поймах Чёрного Иртыша и Павлодарского Прииртышья. Существуют значительные пробелы в нашем понимании фауны птиц в этих регионах, что подчеркивает необходимость продолжения орнитологических исследований. Основная цель – заполнить эти пробелы, уделяя внимание Зайсанской впадине в Восточно-Казахстанской и Павлодарской областях. Глобальное изменение климата и антропогенные воздействия, такие как строительство гидроэлектростанций и водохранилищ, определены как потенциальные факторы, влияющие на экологические изменения в регионе. Одним из существенных последствий является потенциальное изменение сроков весеннего гнездования из-за климатических изменений, которое в разной степени воздействует на разные виды птиц.

Для изучения этой динамики в мае и июне 2023 года были проведены полевые исследования, охватывающие семь участок вдоль Черного Иртыша и Павлодарского Прииртышья. Исследование проводилось по стандартизированным протоколам с учетом фенологических аспектов жизненного цикла птиц. Плотность видов птиц оценивалась с помощью маршрутного учета на постоянных учетных площадках.

В ходе исследования было выявлено общее количество 127 видов птиц из 16 отрядов на двух модельных территориях. Среди них были виды, внесенные в Красную книгу, что подчеркивает важность усилий по их сохранению. Павлодарского Прииртышья с более высоким уровнем влажности, по сравнению с Черным Иртышом, было меньше антропогенных воздействий и привлек более разнообразное сообщество птиц (103 вида). Это исследование показывает, что с учетом изменения климата и антропогенного воздействия необходимо постоянно наблюдать за указанным регионом и разрабатывать стратегии сохранения и адаптации.

Ключевые слова: Птицы, Орнитофауна, Биоразнообразие, Река Иртыш, Зайсанская котловина, Черный Иртыш, Павлодарская область.

Introduction

The floodplains of the Kara Yertis (Black Irtysh) and Yertis (Irtysh) River in the Pavlodar region serve as crucial habitats for diverse avian species of Kazakhstan. The choice of this topic is substantiated by the fact that, despite prior research efforts, there are notable limitations in our understanding of the avian populations in these floodplains. Taking into account the discovered problems and insufficiently studied aspects of the avifauna's state, the continuation of ornithological research in the Zaysan depression of the East Kazakhstan region and in the Pavlodar region seems relevant and important for the development of strategies for the conservation and management of bird populations. Such strategies may include measures to protect and restore habitats, reduce human impacts, and improve the environmental situation.

Global climate change can significantly impact the populations of individual species [1]. Changing the timing of the beginning of spring may lead to a shift in the appearance of birds in the nesting territory and a change in the onset of nesting. In the case of a warm spring, certain bird species take advantage of more favorable conditions and begin breeding earlier than usual [2]. For some species, the early onset of spring is favorable for reproduction, but for others, it is not.

The change in the hydrological regime of the Yertis River, as a result of the construction of reservoirs in the recent past, has led to a process of change in the avifauna in the areas of the reservoirs. According to some studies, the avifauna of the Shulba Reservoir has been replenished with 7 new species of birds [3]. To understand qualitative and quantitative changes in avifauna parameters, monitoring of both individual species and bird populations as a whole is necessary.

Regular and long-term studies will provide a more complete understanding of the dynamics of changes in the avifauna associated with anthropogenic impacts and climate change, as well as assess the effectiveness of proposed measures for the conservation and management of bird populations [4]. The results of such studies will be useful for determining priorities in nature conservation and developing adaptive strategies for conserving biodiversity in a changing environment.

Research Question: How have the avifaunal species compositions in the floodplains of the Kara Yertis and Yertis River changed over the past decades, particularly with regard to Red Book-listed species.

Hypothesis: The avifaunal diversity in the Kara Yertis and Yertis River floodplains has significantly decreased over the past decades, with particular declines in Red Book-listed species, primarily due to anthropogenic changes such as construction of hydroelectric power stations and reservoirs, and global climate change impacts.

Materials and Methods

The study area was presented with two distinct model sites: the Kara Yertis and the Yertis River in the Pavlodar region. A total of seven specific locations within the study area were chosen for further investigation. The choice of the seven areas within the study region was strategic, ensuring a representative and diverse sample for detailed examination.

Field studies were executed, spanning from May 23 to 25, 2023, for the Kara Yertis model site, and from May 28 to June 1, 2023, for the Yertis River in the Pavlodar region model site. Each site underwent three-morning route surveys, complemented by evening surveys conducted on selected sites. The chosen timeframe for expeditionary studies, falling within May and June, aligns with key seasonal aspects of avian behavior, migration patterns, and breeding activities. This enhances the study's relevance and provides an understanding of the avian dynamics in the selected model sites. The detailed information is presented in Table 1.

To maintain methodological consistency, the morning route surveys adhered to standardized protocols, covering each site. Evening censuses were applied to capture potential variations in avian activity during different times of the day. All field activities adhered to the predetermined calendar plan and considered phenological aspects of bird life cycles.

The method used for estimating bird species density involved route accounting on permanent inventory plots without restriction on transect width, following the Hayne principle [5], and with detection distance groups [6]. For birds observed flying, adjustments were made based on their average movement speed [7]. The sizes of the inventory plots range from 1.5 km² to 6.0 km², with shapes being rectangular or close to rectangular. Inside each plot, a curvilinear route with constant geometry is laid out [8]. The length of one route is 5 km. Bird species identification was carried out according to the guide-determinant by V.K. Ryabtsev [9].

Table 1 – Dates and locations of route bird counts in the floodplain of the Yertis River on the territory of model areas, May – June 2023

Model Area*	Site	Route Number	Survey Date	Local Time	Coordinates	
					Latitude (N)	Longitude €
1	1	1.1	25.05.2023	5:10	47,9816	85,3041
		1.2	25.05.2023	5:10	47,9816	85,3041
		1.3	25.05.2023	5:10	47,9717	85,3149
		1.4	22.05.2023	17:05	47,9717	85,3149
	2	2.1	23.05.2023	5:00	47,9806	85,1748
		2.2	23.05.2023	5:00	47,9806	85,1748
		2.3	23.05.2023	5:00	47,9809	85,1671
		2.4	24.05.2023	17:50	47,9809	85,1671
	3	3.1	24.05.2023	5:20	47,9059	84,8883
		3.2	24.05.2023	5:20	47,9059	84,8883
		3.3	24.05.2023	5:20	47,9069	84,8899
		3.4	23.05.2023	17:35	47,9069	84,8899

Table continuation

Model Area*	Site	Route Number	Survey Date	Local Time	Coordinates	
					Latitude (N)	Longitude €
2	4	4.1	28.05.2023	5:25	50,8380	78,4375
		4.2	28.05.2023	5:25	50,8380	78,4375
		4.3	28.05.2023	5:25	50,8386	78,4389
		4.4	27.05.2023	17:20	50,8386	78,4389
	5	5.1	29.05.2023	5:15	51,2988	77,9489
		5.2	29.05.2023	5:15	51,2988	77,9489
		5.3	29.05.2023	5:15	51,2982	77,9532
		5.4	28.05.2023	17:10	51,2982	77,9532
	6	6.1	01.06.2023	5:15	52,5055	76,7490
		6.2	01.06.2023	5:15	52,5055	76,7490
		6.3	01.06.2023	5:15	52,5047	76,7384
	7	7.1	31.05.2023	5:15	53,5173	75,2049
		7.2	31.05.2023	5:15	53,5173	75,2049
		7.3	31.05.2023	5:15	53,5166	75,2026
		7.4	30.05.2023	16:00	53,5166	75,2026

*Note – 1 – Kara Yertis; 2 – Yertis River in Pavlodar region; the table provides coordinates of the centroids of route surveys with a reference length of 2.5–5.0 km.

Literature review

The East Kazakhstan and Pavlodar regions are among the regions of Kazakhstan characterized by rich species diversity of birds [10, 11]. This diversity is attributed to the variety of landscapes, climatic conditions, and ecosystems [12]. The wetlands of the Zaysan depression and the floodplain of the Yertis River provide a convenient habitat for nesting birds and serve as convenient stopping places for migrants during the migration period [13, 14, 15].

According to literary sources, the Zaysan depression hosts 176 bird species that nest in the area. Additionally, there is information about 22 bird species for which the confirmation of nesting is required. In the Kara Yertis floodplain, there are 122 species with confirmed permanent nesting and 15 species for which the nesting status is yet to be precisely established [16]. The Pavlodar region is reported to be home to 253 bird species throughout the year [17]. However, the nature of their presence is not clear for all species. For the territory of the Pavlodar region, the number of nesting species is not known for certain. In subsequent years, data were published only on certain species.

One of the primary anthropogenic factors influencing the species composition and size of bird populations in the study area is the exploitation of the Yertis River's water resources through the construction of hydroelectric power stations and reservoirs. The construction of the Bukhturma hydroelectric power station dam led to a sharp rise in the water level on Lake Zaysan and the Kara Yertis delta, impacting colonial and semi-aquatic bird species. Consequently, this led to a decrease in their species diversity—in meadows, it decreased from 58 to 26 species, and in reed areas, it decreased from 35 to 26 species [18].

By the end of the 1970s, the delta of the Kara Yertis had formed within the currently existing boundaries. However, annual fluctuations in water levels caused by backwater and the release of water at the Bukhturma hydroelectric station led to the destabilization of the ecological situation along the entire coast of the reservoir. This phenomenon caused the death of waterfowl and semi-aquatic bird clutches, and a delay or even cessation of their nesting [19].

The flooding of the Yertis River valley after the creation of the Shulbinsky reservoir resulted in a reduction in the area of the floodplain with poplar-willow groves, wooded islands, and mixed-grass meadows. However, it increased the reed-cattail thickets with willow and poplar groves. Changes in the water regime of the Yertis River and adjacent water bodies brought alterations to the

ornithocomplex composition, making the territory more attractive for nesting shorebirds [20].

The shallowing of the Yertis River bed in the second decade of the 21st century led to a deterioration in the habitat conditions of birds in the floodplain area between Oskemen and the Shulbinsk reservoirs [21]. Increased exploitation of the coastal zone, associated with the development of residential and non-residential buildings, construction of recreational facilities, grazing of livestock, and active use of the river water area by small vessels, increases the level of disturbance among nesting birds. An additional factor reducing the water level in the Yertis River is an increase in water intake upstream of the river [22].

The processes of aridization, gaining relevance since the end of the 20th century, together with global climate change and the level of climate continentality, lead to changes in the phenological timing of bird migrations [23]. For several birds, trends in the timing of spring arrival and the beginning of breeding have been described [24]. For certain semi-aquatic bird species, the inability of the species to adapt to the changing timing of the spring season is indicated as the reason for the decline in numbers [25].

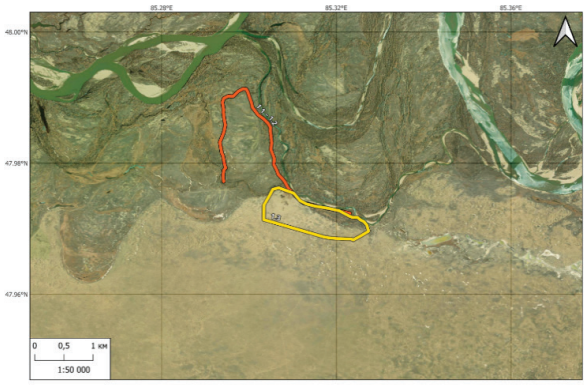
In anthropogenic landscapes, significant changes in the species composition of birds are often associated with significant changes in the biotope. For example, in the city of Pavlodar over the past five decades, its green zone adjacent to the Yertis River has shrunk by five times. Of the 38 bird species that previously lived in this area, only 7 remain today [26].

Results and Discussion

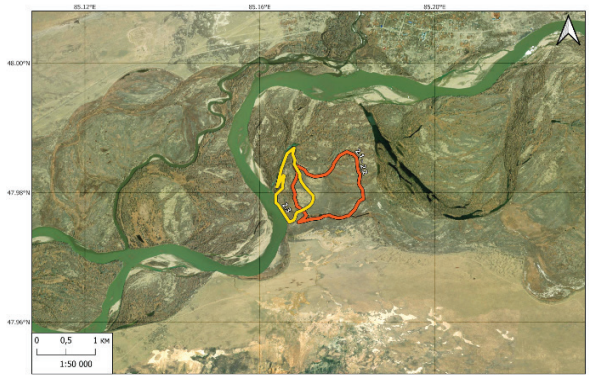
Sites and Routes

Favorable weather conditions were exploited for supplementary bird counts, resulting in a total of 27 route surveys, exceeding the initially planned 14. The morning route surveys covered an average distance of 5.15 kilometers, with an average duration of 3 hours and 32 minutes.

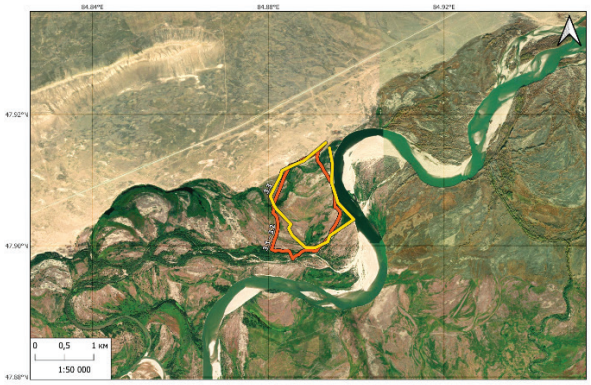
Below are maps of sites, routes 1 and 2 in each profile are indicated in orange, route 3 is in yellow.



Site 1



Site 2



Site 3

Figure 1 – Bird survey routes on Sites of the first Model Area

The Figure 2 shows the routes of bird counts on the sites of the Yertis River of the Pavlodar region. Orange indicates routes 1 and 2 in each site, yellow indicates route 3.

Avifauna of Yertis River

Based on the outcomes of field studies conducted in the two model areas, the habitats of a total of 127 bird species were identified, as detailed in Table 2. These species span 16 different orders. Specifically, within the floodplain of the Kara Yertis, observations revealed the presence of 74 bird species representing 11 distinct orders. Individual profile analyses further specified the habitat range for each profile, ranging from 39 to 52 bird species.

In the Yertis River in Pavlodar region, a diverse avian community was documented, encompassing 103 bird species across 15 orders. Individual profile assessments provided a more granular understanding, identifying habitat preferences for each profile with species counts ranging from 44 to 64.

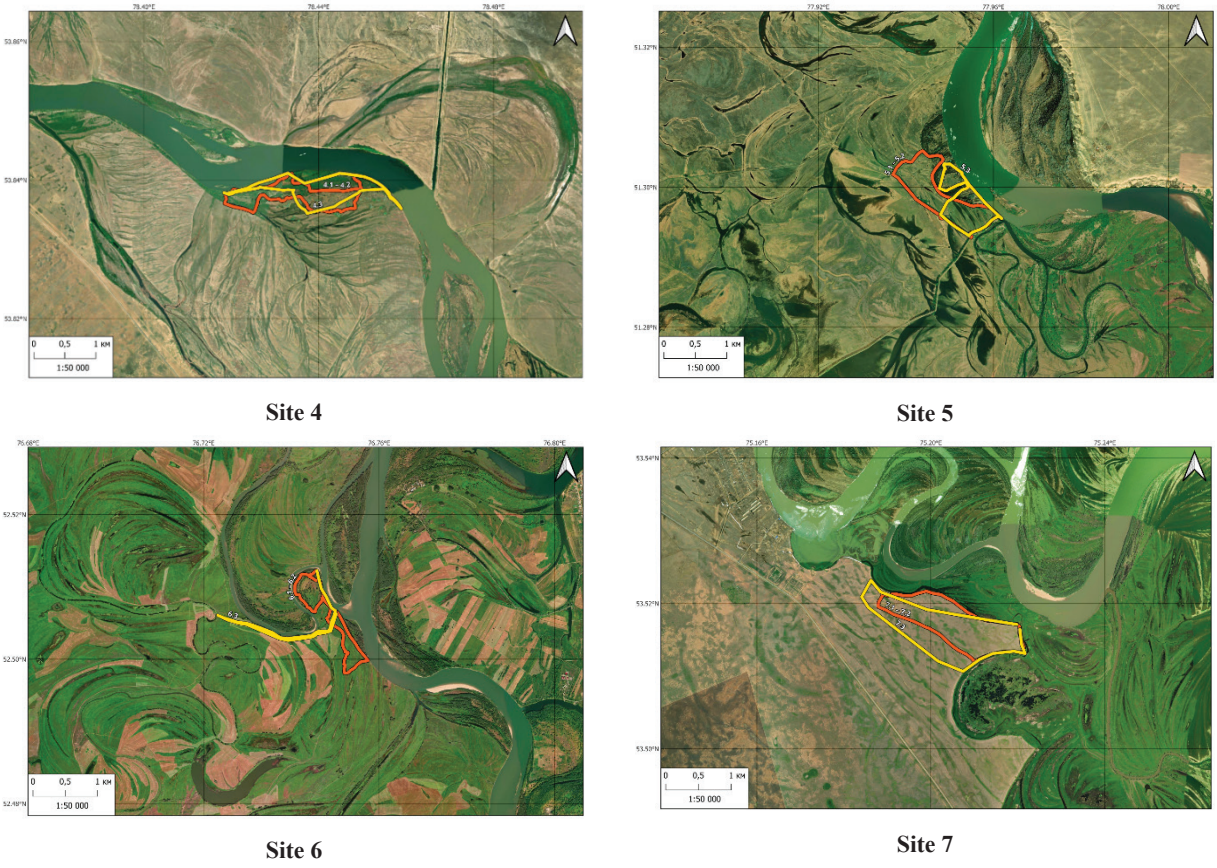


Figure 2 – Bird survey routes on Sites of the second Model Area (Yertis River in Pavlodar region), May – June 2023

Table 2 – The avifauna species richness in the model areas of the Yertis River Basin during May-June 2023

Order name		Number of Species		Total Species
		Kara Yertis	Yertis River in Pavlodar region	
Podicepediformes	Grebes	–	4	4
Pelecaniformes	Pelicans	–	1	1
Ciconiiformes	Storks	–	2	2
Anseriformes	Waterfowl	6	12	12
Falconiformes	Birds of Prey	7	6	9

Table continuation

Order name		Number of Species		Total Species
		Kara Yertis	Yertis River in Pavlodar region	
Galliformes	Fowl-like birds	1	1	2
Gruiformes	Cranes	1	3	4
Charadriiformes	Shorebirds	8	13	14
Pterocletiformes	Sandgrouse	–	1	1
Columbiformes	Pigeons and doves	3	2	4
Cuculiformes	Cuckoos	–	1	1
Strigiformes	Owls	1	–	1
Apodiformes	Swifts	1	1	1
Coraciiformes	Kingfishers	2	1	2
Piciformes	Woodpeckers	1	2	2
Passeriformes	Passerines	43	53	67
Total:		74	103	127

We identified six Red Book listed bird species, constituting 4.7% of the total bird count [27]. These species include the Whooper swan *(Cygnus cygnus)* recorded in 6 out of 7 sites, White-tailed eagle *(Haliaeetus albicilla)* appearing in sites 1, 3 and 6, Peregrine falcon *(Falco peregrinus)* observed in site 2, Common crane *(Grus grus)* noted in the 7th site, Demoiselle crane *(Grus virgo)* documented in the 2nd site, and Pallas's sandgrouse *(Syrrhaptes paradoxus)* identified in the 7th site.

Game birds, as defined by the approved rules [28], constitute a total of 19 species, representing 15.0% of the overall bird species list. These include the following species: Ruddy shelduck *(Tadorna ferruginea),* Common shelduck *(Tadorna tadorna),* Mallard *(Anas platyrhynchos),* Gadwall (*Mareca strepera*), Eurasian wigeon *(Mareca penelope),* Northern pintail *(Anas acuta),* Garganey *(Spatula querquedula),* Northern shoveler *(Spatula clypeata),* Common goldeneye *(Bucephala clangula),* Smew *(Mergellus albellus),* Common quail *(Coturnix coturnix),* Pheasant *(Phasianus colchicus),* Northern lapwing *(Vanellus vanellus),* Ruff *(Philomachus pugnax),* Common snipe *(Gallinago gallinago),* Woodpigeon *(Columba palumbus),* Rock pigeon *(Columba livia),* Turtle dove *(Streptopelia turtur*), and Oriental dove *(Streptopelia orientalis)* (see Appendix, Figure 3).

To deepen the examination of avifauna, an analysis was conducted using data retrieved from the Global Biodiversity Information Facility (GBIF) database [28], encompassing bird observations spanning the period from 2010 to 2022. It is noteworthy that the dataset for the territory of the Republic of Kazakhstan is conspicuously less extensive within the GBIF compared to observations from neighboring countries.

Birds of Kara Yertis

During the fieldwork conducted in the Kara Yertis region, a total of 74 bird species were discovered. The most numerous species encountered in the Kara Yertis region include the Hume's leaf warbler *(Phylloscopus humei),* Common nightingale (*Luscinia megarhynchos*), Azure tit (Cyanistes cyanus), Great tit *(Parus major),* and Chaffinch *(Fringilla coelebs).* These species inhabit riparian thickets and nest both in woody vegetation and in steppe and desert landscapes, actively utilizing the water resources of the river. Red Book species include the White-tailed eagle, Peregrine falcon, Demoiselle crane. In the GBIF database, the bird species listed above are listed for adjacent territories, but are not observed directly in the Kara Yertis floodplain.

Birds of Pavlodar region's Yertis

According to GBIF, there are records of 119 bird species in this area. The potential emergence of 100 additional species is conceivable. However, due to the absence of observations, the exact count of breeding bird species cannot be ascertained. Notably, 47% of the total identified breeding species were discovered in 2023, and 87% from the entire potential breeding species list.

The most numerous bird species in the Pavlodar region's Yertis include the Skylark *(Alauda arvensis),* Tree pipit *(Anthus trivialis)*, Golden Oriole *(Oriolus oriolus)*, Booted warbler *(Iduna caligata)*, Common whitethroat *(Curruca communis),* Greenish warbler *(Phylloscopus trochiloides),* Common rosefinch *(Carpodacus erythrinus).*

Compared to the Kara Yertis, the higher moisture levels in the Pavlodar region's Yertis attract a greater variety of steppe bird species. The presence of thickets also facilitates the breeding of woody and shrub species.

Among the rare species, it is noteworthy to highlight the Yellow-breasted Bunting the global abundance of which has significantly declined in recent years [29]. The reasons for the decline in the species' numbers remain poorly understood. However, we have identified a relatively high density of these species (10–53 individuals/km²) in this region.

As a result of our work, we calculated the population density indicators for each species, which are presented in Table 3.

Table 3 – Population density of bird species (individuals/km²) in the model areas of the Yertis River basin, May – June 2023

Species	Areas						
	Kara Yertis			Pavlodar region's Yertis			
	1	2	3	4	5	6	7
Order Podicepediformes							
Tachybaptus ruficollis (Pallas, 1764)	0	0	0	0	0	0,21	0
Podiceps nigricollis C.L. Brehm, 1831	0	0	0	0	0	0,82	0
Podiceps auritus L., 1758	0	0	0	0	0	0,21	0
Podiceps cristatus (L., 1758)	0	0	0	0	0	0	0,46
Order Suliformes							
Phalacrocorax carbo (L., 1758)	0	0	0	1,08	0	0	0,03
Order Ciconiiformes							
Botaurus stellaris (L., 1758)	0	0	0	0	0	0,42	0,38
Ardea cinerea L.,1758	0	0	0	0	0	0	0,01
Order Anseriformes							
Cygnus cygnus L.,1758 [II]	0	0	0	0	0	0,14	0,28
Tadorna ferruginea (Pallas, 1764) [1]	0,66	0,27	3,15	0	0,03	0	0
Tadorna tadorna L.,1758 [1]	0	0	0	0	0	0,02	0
Anas platyrhynchos L.,1758[1]	0,06	0,71	0,11	4,99	1,67	0,03	5,54
Anas strepera L.,1758 [1]	0	0,02	0	2,63	8,81	4,86	1,19
Anas penelope L.,1758[1]	0	0	0	0,10	0	0	0
Anas acuta L., 1758[1]	0	0	0	0,11	0	0	0
Anas querquedula L.,1758[1]	0	0	1,04	6,11	1,30	2,83	2,08
Anas clypeata L.,1758[1]	0,08	0,04	1,66	3,44	5,01	0	0
Aythya ferina L., 1758 [1]	0	0	0	0	0	0,35	0
Bucephala clangula L., 1758 [1]	0,23	0	0,17	0	0,61	0,21	0
Mergus albellus L., 1758[1]	0	0	0	0	0	0,49	3,58
Order Falconiformes							
Milvus migrans Boddaert, 1783	2,17	0,71	1,12	0,46	0,68	0,01	0,05
Circus cyaneus L., 1766	0	0	0,64	0	0	0	0
Circus aeruginosus L., 1758	0	0	0	0	0	0	0,02
Accipiter nisus L., 1758	0	0	0	0,37	0	0	0
Buteo buteo L., 1758	0,05	0	0	0	0	0	0

Table continuation

Species	Areas						
	Kara Yertis			Pavlodar region's Yertis			
	1	2	3	4	5	6	7
Haliaeetus albicilla L., 1758 [II]	0,60	0,01	0,53	0	0	0,14	0
Falco peregrinus Tunstall, 1771[I]	0	0,02	0	0	0	0	0
Falco subbuteo L., 1758	0,20	0,72	0,84	0,77	0,02	0,88	0,05
Falco tinnunculus L., 1758	0,57	0,03	0,51	0,01	0,01	0	0
Order Galliformes							
Coturnix coturnix L., 1758 [1]	0	0	0	0,39	3,92	1,88	7,93
Phasianus colchicus L., 1758[1]	1,50	4,56	0,41	0	0	0	0
Order Gruiformes							
Grus grus L., 1758[III]	0	0	0	0	0	0	0,01
Anthropoides virgo L., 1758[VI]	0	0,01	0	0	0	0	0
Porzana porzana L., 1766	0	0	0	0	0	0,14	0
Crex crex L., 1758	0	0	0	0	0	0,35	0
Order Charadriiformes							
Charadrius dubius Scopoli, 1786	0,56	0,28	0	0	0,62	0	0
Vanellus vanellus L., 1758[1]	0	0,02	0,01	0	0	0,18	0,05
Himantopus himantopus L., 1758	0	0	0	0	0	0,07	0
Haematopus ostralegus L., 1758	0,05	0	0	0	0,02	0,56	0
Actitis hypoleucos L., 1758	0,03	0	0	0	0	0	0
Philomachus pugnax L., 1758[1]	0	0	0	0	0	0	0,13
Gallinago gallinago L., 1758[1]	0	0	0	0	0	1,12	1,90
Larus minutus Pallas, 1776	0	0	0	0	0	0	0,01
Larus ridibundus L., 1766	0,04	1,56	0	0,03	0,03	0,44	0,07
Larus heuglini Bree, 1876	0	0	0	0,02	0	0,01	0,17
Larus cachinnans Pallas, 1811	0	0,01	0	0,02	0,01	0,68	0,01
Chlidonias leucopterus Temminck, 1815	0,02	1,04	0,02	0	0	0,87	0,44
Sterna hirundo L.,1758	0,05	0,05	0,04	0,08	0,03	0,93	0,04
Sterna albifrons Pallas, 1764	0	0	0	0	0,01	0	0
Order Pterocletiformes							
Syrrhaptes paradoxus Pallas, 1773[IV]	0	0	0	0	0	0	0,09
Order Columbiformes							
Columba palumbus L., 1758[1]	0	0	0	0	0	0	0,15
Columba livia Gmelin, 1789[1]	0	0	0,15	0	0	0	0
Streptopelia turtur L., 1758[1]	0	0,03	0	0	0	0	0
Streptopelia orientalis Latham, 1790[1]	0,04	2,02	0,11	0,12	0,58	0,05	0
Order Cuculiformes							
Cuculus canorus L., 1758	0	0	0	2,56	4,53	1,72	3,65
Order Strigiformes							
Otus scops L., 1758	0	0,68	0	0	0	0	0
Order Apodiformes							
Apus apus L., 1758	0	0	0,01	0,48	0	0	0

Table continuation

Species	Areas						
	Kara Yertis			Pavlodar region's Yertis			
	1	2	3	4	5	6	7
Order Coraciiformes							
Alcedo atthis L., 1758	0	0,23	2,67	0	0	0	0
Merops apiaster L., 1758	0	0,01	0,05	0	0	0	0,02
Order Piciformes							
Junx torquila L., 1758	0	0	0	0	0,52	0	0
Dryocopus martius L., 1758	0	4,33	0,66	0	0	0,21	0,19
Order Passeriformes							
Riparia riparia L., 1758	0	0	0,15	0	8,03	2,08	0
Hirundo rustica L., 1758	5,63	0	0,78	9,08	0,11	0,02	0
Melanocorypha yeltoniensis J.R. Forster, 1768	0	0	0	0	0	0	0,19
Alauda arvensis L., 1758	2,26	1,51	0,50	5,46	17,40	10,86	3,27
Anthus campestris L., 1758	2,31	0,72	2,46	0	1,24	0	0
Anthus trivialis L., 1758	0	0	0	9	9,66	5,12	17,31
Motacilla flava L., 1758	0	0	0	0,37	0	0,42	13,72
Motacilla citreola Pallas, 1776	0	0	0	0	0	0	1,09
Motacilla alba L., 1758	0	0	0	0	0	0	2,37
Motacilla personata Gould, 1861	0	0	1,25	0	0	0	0
Lanius cristatus L., 1758	0	1,04	0	0	0	0	0
Lanius collurio L., 1758	0	1,04	0	0	0	0,04	0
Lanius minor Gmelin, 1788	0	2,08	0	0	0	0	0
Oriolus oriolus L., 1758	1,88	7,36	3,43	2,58	4,98	6,9	1,55
Sturnus vulgaris L., 1758	0	1,61	0,41	0	0	0	0,03
Sturnus roseus L., 1758	0	0,04	1,54	0	0	0	0
Acridotheres tristis L., 1766	0	0	1,25	0	0	0	0
Pica pica L., 1758	0,23	4,28	0,02	0	0,31	0,14	0,02
Corvus monedula L., 1758	0	0	3,09	0,01	0	0	0
Corvus frugilegus L., 1758	0	0,05	0,03	0	0	0	0,5
Corvus corone L., 1758	0,60	10,32	11,99	0,38	0,37	0,07	6,69
Corvus cornix L., 1758	0	0	0	1,12	0,03	1,20	1,51
Cettia cetti Temminck, 1820	0	0	0	4,31	0	0,68	0
Locustella certhiola Pallas, 1811	0	0	0	0	1,85	0	0
Locustella naevia Boddaert, 1783	5	12,5	0	6,76	9,03	5,63	8,16
Acrocephalus schoenobaenus L., 1758	0	0	0	0	2,99	2,09	10,08
Acrocephalus dumetorum Blyth, 1849	12,31	14,73	4,64	2,50	15,60	0	0
Acrocephalus palustris Bechstein, 1798	0	0	0	4,35	2,99	0,70	13,54
Acrocephalus scirpaceus Hermann, 1804	0	0	0	1,45	0	0	0
Acrocephalus arundinaceus L., 1758	0	0	0	0	0	5,15	0
Hippolais icterina Vieillot, 1817	0	0	0	5,88	0	0	10,40
Hippolais caligata Lichtenstein, 1823	0	0	0	66,36	47,33	16,57	0,46
Sylvia atricapilla L., 1758	0	1,04	0	3,27	5,30	0	12,31

Table continuation

Species	Areas						
	Kara Yertis			Pavlodar region's Yertis			
	1	2	3	4	5	6	7
Sylvia communis Latham, 1787	5,20	2,85	0,02	40,98	58,83	26,94	4,40
Sylvia curruca L., 1758	0	0	0	7,41	16,13	14,21	1,42
Phylloscopus collybita Vieillot, 1817	0	0	0	3,51	0	16,17	0
Phylloscopus trochiloides Sund., 1837	5	5,40	0	19,39	52,14	0	2,94
Phylloscopus humei Brooks, 1878	21,75	14,51	7,37	7,60	0,02	0	2,51
Muscicapa striata Pallas, 1764	2,33	0	0	0	0	0	0
Saxicola torquata L., 1766	0	0	0	0	0	0	11,03
Monticola solitarius L., 1758	0	0	0,15	0	0	0	0
Phoenicurus phoenicurus L., 1758	0	0,32	0	1,82	0,60	0	0
Luscinia megarhynchos C.L. Brehm, 1831	16,89	6,10	16,51	0	0	0	0
Luscinia luscinia L., 1758	0	0	0	1,53	0	0	0
Luscinia svecica L., 1758	0	4,15	0	1,82	14,4	4,05	4,66
Turdus pilaris L., 1758	0,02	0	0	1,84	3,35	9,32	5,83
Turdus merula L., 1758	0	0	0,99	0	0	1,37	0,71
Turdus iliacus L., 1766	0,15	0	0	0	0	0	0
Turdus philomelos C.L. Brehm, 1831	0,65	0	1,92	1,45	0	0	0
Remiz pendulinus L., 1758	4,30	0	0	0	0	0	0,42
Remiz coronatus Severtzov, 1873	3,66	1,28	0	0	0	0	0
Parus caeruleus L., 1758	0	1,04	2,95	0	0	0	0
Parus cyanus Pallas, 1770	10,51	24,23	5,07	1,25	0	0	0
Parus major L., 1758	40,21	41,38	20,90	0,80	0,62	0,68	0
Sitta europaea L., 1758	0	0,68	0,99	0	0	0	0
Passer domesticus L., 1758	0	0	0,05	0	0	5,39	0,84
Passer montanus L., 1758	0	0	5,89	0	0	0	0
Fringilla coelebs L., 1758	39,18	41,11	13,21	1,15	19,59	18,19	9,17
Carduelis carduelis L., 1758	0	0	0	1,25	0	0	0
Carduelis caniceps Vigors, 1831	1,16	3,94	0	0	0	0	0
Acanthis cannabina L., 1758	0	5,7	1	1,45	2,99	0	0
Carpodacus erythrinus Pallas, 1770	0	5,69	0	35,19	34,71	6,57	4,89
Uragus sibiricus Pallas, 1773	0	0	0	0	0	5,39	0,84
Emberiza citrinella L., 1758	0	0	0	0	0	0	1,92
Emberiza schoeniclus L., 1758	0	0	0	0,73	0	0	0,98
Emberiza aureola Pallas, 1773	0	0	0	0	2,46	23,57	21,06
Emberiza hortulana L., 1758	0	0	0	1,09	0	0	1,01
Total	39	52	48	53	47	58	63

Note* – Roman numerals indicate status categories of bird species according to the Red Book of the Republic of Kazakhstan: I – endangered or possibly already extinct, II – catastrophically declining, III – rare, found in small numbers, IV – uncertain (insufficiently studied) [Red Book, 2010]; 1 – hunting and commercial bird species [28].

During field studies of the avifauna of the Kara Yertis floodplain in 2023, 74 species of birds were identified, which is 54.0% of the total list of 137 species presented in the work of Berezovikov [16] for this area. In contrast to the 2004 data, the 2023 observations revealed the inability to detect several Red Book species, including the Great white pelican *(Pelecanus onocrotalus),* Dalmatian pelican *(Pelecanus crispus),* Eurasian spoonbill *(Platalea leucorodia),* Black stork *(Ciconia nigra),* Swan goose *(Anser cygnoides),* White-headed duck *(Oxyura leucocephala),* Osprey *(Pandion haliaetus),* Booted eagle *(Hieraaetus pennatus),* Great bustard *(Otis tarda),* Yellow-eyed pigeon *(Columba eversmanni),* and Eurasian eagle-owl *(Bubo bubo).*

It is significant to highlight species with uncertain nesting status in 2004 Berezovikov, but confirmed in 2023, such as the Common buzzard *(Buteo buteo),* Pheasant, Eurasian scops owl *(Otus scops),* Blyth's reed warbler *(Acrocephalus dumetorum),* and Fieldfare *(Turdus pilaris).* The verification of their presence allows for a definitive identification of their habitat within the floodplain of the Kara Yertis.

Of the six bird species previously recorded Berezovikov in Kara Yertis (Peregrine falcon, Pallas's fish eagle, White-headed duck, Whiskered tern, Merlin, Crested lark), we found only the Peregrine falcon.

In 2023, we discovered 25 species in Kara Yertis, which are not previously recorded by Berezovikov in 2004. These include the Hen harrier *(Circus cyaneus),* Peregrine falcon, Rock pigeon, Collared Dove *(Streptopelia decaocto),* Black Swift *(Apus apus*), Brown shrike *(Lanius cristatus),* Rosy Starling *(Pastor roseus),* Common Myna *(Acridotheres tristis),* Grasshopper Warbler *(Locustella naevia),* Blackcap *(Sylvia atricapilla),* Greenish Warbler, Hume's leaf warbler, Spotted flycatcher *(Muscicapa striata),* Blue rock thrush (Monticola solitarius), Common redstart *(Phoenicurus phoenicurus),* Blackbird *(Turdus merula),* Redwing *(Turdus iliacus),* Song thrush *(Turdus philomelos),* Blue tit *(Cyanistes caeruleus),* Eurasian Nuthatch *(Sitta europaea),* Chaffinch *(Fringilla coelebs),* Common linnet *(Linaria cannabina),* Common rosefinch (see Figure 5).

The relatively high population density of the Yellow-breasted bunting (*Emberiza aureola*) indicating successful reproduction within the Yertis River in the Pavlodar region in 2023 calls for attention to the imperative of habitat protection for this rare species, since this species has significantly decreased trends in neighboring region and this area if Yertis River may be an important reproduction site for this bird [24].

Conclusion

In summarizing our comprehensive study on the avifauna of the Yertis basin, we observed considerable shifts in species compositions over the past decades. Our survey documented a total of 127 bird species, a testament to the region's rich ecological diversity. Notably, 6 of these species are listed under the Red Book, highlighting their conservation significance. In the Kara Yertis region, we recorded 74 bird species, of which 25 were documented for the first time. This reflects a dynamic change in avifaunal diversity, possibly influenced by environmental factors and human activities.

The hypothesis positing a decline in avifaunal diversity, particularly among Red Book-listed species, is partially supported. While we observed a decrease in some Red Book species, the overall avifaunal diversity has not diminished significantly. The decline in certain Red Book species aligns with our hypothesis, indicating the adverse impacts of anthropogenic changes such as the construction of hydroelectric power stations, reservoirs, and global climate change. This observation is particularly evident in the Kara Yertis region, where habitat modifications have likely contributed to these shifts.

Conversely, the Pavlodar region's Yertis, with its lower human disturbance and varied biotopes, exhibited a more diverse avifaunal community, including 103 bird species. This underlines the critical role of habitat preservation in maintaining avian biodiversity.

Our findings underscore the importance of ongoing monitoring and research to understand the evolving dynamics of these ecosystems. The observed changes call for a reevaluation and strengthening of conservation strategies, particularly for the Red Book-listed species, to mitigate the impacts of anthropogenic and environmental changes. This study contributes insights for the sustainable management and conservation of avian populations in the Yertis basin, highlighting the need for adaptive strategies in the face of changing environmental conditions.

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