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Bio-Damaging Bird and Mammal Species in Urban Landscapes of Kyrgyzstan: Damage and Mitigation Measures (Osh City Case Study)

Abdimannap Abdykaarov [1]* , ***Kutmanaly Stamaliev*** [1] , ***Gulbaira Tolokova*** [1], ***Bakhtiyor Sheraliev*** [2]

[1] *Department of Zoology, Ecology and Bioengineering of the Institute of Natural Science, Tourism and Agricultural Technologies, Osh State University, Osh 723500, Kyrgyzstan*

[2] *Department of Zoology and General Biology, Faculty of Biology, Fergana State University, Fergana 712000, Uzbekistan*

ABSTRACT

Under conditions of increasing urbanization, the problem of studying the impact of synanthropic animal species on the functioning of urban ecosystems is becoming increasingly important. The purpose of this study was to identify and analyze the species composition of synanthropic birds and mammals in the urban area of Osh (Kyrgyzstan), assess the degree of their bio-damaging activity, and develop recommendations to minimize their negative impact on various sectors of the urban environment. Field studies conducted in 2023–2024 revealed 22 species of synanthropic birds and 7 species of synanthropic mammals. Among birds, representatives of *Columbiformes* (3 species), *Apodiformes* (2 species), and *Passeriformes* (18 species) were identified, including families *Hirundinidae, Motacillidae, Sturnidae, Corvidae, Turdidae, Paridae, Passeridae, Fringillidae*, and *Emberizidae*. All recorded mammal species belonged to *Rodentia*, represented by the families *Gliridae*, *Cricetidae*, *Gerbillidae*, and *Muridae*. Most of these species are closely related to human activities, including obligate and facultative synanthropes (23 species) successfully adapted to anthropogenic landscapes. There are also pseudosynanthropes (6 species) that occur in populated areas but are not directly dependent on humans. The analysis showed hat synanthropic species cause considerable damage to urban agriculture, infrastructure, and utilities. Major impacts include crop destruction, deterioration of monuments, damage to networks, and disease transmission. Special attention was paid to *Meriones libycus*, *Ellobius tancrei*, and *Dryomys nitedula*, recently identified as synanthropic species in Kyrgyz cities. Their inclusion provides new insights into urban ecosystem dynamics. The study proposes integrated control measures, including mechanical, chemical, and biological methods for effective management of bio-damaging species.

*CORRESPONDING AUTHOR:

Abdimannap Abdykaarov, Department of Zoology, Ecology and Bioengineering of the Institute of Natural Science, Tourism and Agricultural Technologies, Osh State University, Osh 723500, Kyrgyzstan; Email: aabdykaarov@oshsu.kg

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Q52 — Pollution and Environmental Protection (our research studies biodegradation of urban environments and proposes environmental regulation measures);

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1. Introduction

The relevance of this study is determined by the need for a comprehensive assessment of the impact of urbanization on biodiversity and the spatial organization of vertebrate animal populations, particularly birds, in the rapidly transforming urban environment. In this regard, it is currently of particular relevance to conduct targeted scientific research and develop effective measures to regulate the number of bio-damaging synanthropic species that have a significant negative impact on the quality of life of the urban population and are characterized by high density within urbanized areas. At the same time, the implementation of conservation measures aimed at preserving and supporting fauna, which plays an essential role in maintaining the ecological balance and sustainability of urban ecosystems, is becoming an important area of environmental policy and practice.

The city of Osh is located in the southeastern part of the Fergana Valley at the foot of the Alai Range, which occupies a commanding position in one of the most densely populated agricultural areas of Kyrgyzstan and includes Central Asia, in the so-called Osh-Karasu oasis. The Ak-Buura River flows from south to north, dividing the city into eastern and western parts. It crosses the city and forms a floodplain composed of boulder-pebble deposits with conglomerate interlayers. Several canals flow within the city, the largest of which are the Aravan, Uvam, and Kayryma canals, which belong to the Ak-Buura River. In the center of the city is located Sulaiman-Too mountain, with many caves, karst tunnels, and tree and shrub plants growing on its slopes. All of them create a positive microclimate for the city.

In general, the city has a continental climate with hot summers and mild winters. During the year, temperatures usually range from -5 °C to 32 °C and rarely fall below -11 °C or above 35 °C. The average annual precipitation is 310 mm, of which 200 mm falls during the warm period. Fertile sulfur soils formed on loess segments are widespread in the city, and there are areas of alluvial-meadow soils in the immediate vicinity of the river. Among the vegetation in the city, such woody plants as *Pópulus álba*, *Ulmus parvifolia*, *Quercus robur*, *Fráxinus excelsior*, *Ácer platanoídes*, *Salix alba* and the city of Osh is famous for *Sálix babylónica* are widespread. In the floodplains of the Ak-Buura River grow shrubby plants like *Rosaceae* and *Hippóphae*.

Urbanization, as a complex set of environmental impacts, is one of the most important phenomena in the system of human-nature relations. Anthropogenic impacts, destroying natural habitats, form a new environment in which a number of species successfully coexist with humans [1]. At the same time, the city of Osh, like other cities, has undergone strong anthropogenic impact due to population growth. Thus, high-rise buildings are being built at a rapid pace, urban areas are being expanded, swampy and marshy landscapes are being drained, reconstruction work is being carried out in the floodplain parts of the Ak-Buura River, trees are being cut down for further improvement and road widening, etc. All these impacts lead to the destruction of habitual habitats of animals, including birds, resulting in changes in their species composition and bioecology. For example, 30-40 years ago, the vertebrate fauna in urban and suburban areas consisted of animals characteristic of forested areas at the foot of mountains, coastal ecotones of

rivers, wetlands, and shrublands. Nowadays, the fauna of urban ecosystems is mainly composed of synanthropic species. Some species inhabiting natural landscapes in recent years are inclined to inhabit urban and rural landscapes. For example, it has been observed that *Dryomys nitedula* has moved from forests to multi-storey houses, and *Meriones libycus* is moving from fields to rural houses [2].

Currently, urbanized areas, including Osh city, are considered transitional ecosystems in which natural and anthropogenic factors jointly form a variety of biotic communities. Analysis of the impact of anthropogenic factors on the fauna of urban ecosystems allows us to draw two opposite conclusions. On the one hand, human economic activity has a destructive impact on the remaining natural habitats of animals (e.g., the ecotones of the Ak-Buura River) - this includes cutting down trees, draining wetlands, soil compaction, and other forms of environmental transformation, which together lead to a decrease in species diversity and a reduction in the number of species that prefer natural landscapes. On the other hand, the urban environment creates conditions favorable for the existence of certain animal species. The presence of shelters from unfavorable climatic factors, reduced pressure from predators, as well as easily accessible food sources (food waste, feeders, plantings of fruit trees and shrubs) contribute to the increase in the number of synanthropic species.

The hypothesis of the study is the assumption that increasing urbanization in the city of Osh contributes to the displacement of indigenous species and the formation of a community dominated by synanthropic species with high ecological plasticity.

The aim of the study is to analyze the species composition of synanthropic birds and mammals in urbanized landscapes of Osh city, with their inventory, assessment of the level of bio-damaging impact, as well as consideration of the issues of protection and possible ways to regulate the number of mass species.

2. Materials and Methods

Over the past 20 years, the fauna and biotopic distribution of synanthropic species of birds and mammals in urban ecosystems of Kyrgyzstan have been studied by zoologists. In particular, we have studied the avifauna of the city of Osh and its environs, and their ways of formation [3], presented an assessment of the results of anthropogenic impact through changes in the fauna and ecology of birds [4], and provided faunistic characteristics of 22 synanthropic bird species in the city of Osh [5]. K.Y. Stamaliev studied the distribution of distribution of passerine birds by biotopic complexes [6]. The fauna of passerine birds (*Passeriformes*) inhabiting biotopes of urban ecosystems in one and two-storey dwellings was studied [7]. The fauna of birds living in the Issyk-Kul Basin was studied by Kendirbaeva S.K. [8], and the fauna of birds in Bishkek city was studied by Zhusupbaeva A.A. [9]. The bioecology of the gray rat (*Rattus norvegicus*) in Kyrgyzstan has been studied for many years by A. Alymkulova [10], and rodents of southern Kyrgyzstan have been studied by Atabekov U.A. for many years [11].

While in the Sahel of West Africa, climate change has a devastating impact on biodiversity through extreme weather events and reduction of water resources [12], in Kyrgyzstan the impact of climatic and anthropogenic factors is manifested in a different aspect - through the increase in the number of bio-damaging synanthropic species in urban ecosystems, as shown in the example of the city of Osh. In winter, relatively mild climatic conditions and abundant food resources are observed in the cultural landscapes of southern Kyrgyzstan, which facilitates the transition of some migratory species to a sedentary lifestyle. For example, *Sturnus vulgaris*, despite its migratory nature, demonstrates a density of sedentary population in urbanized areas, comparable to that of summer indicators. A similar trend is observed in representatives of *Motacilla personata* species, some individuals of which can be observed in winter. The impact of climate change on the fauna of passerines (*Passeriformes*) in urbanized ecosystems of southern Kyrgyzstan, where the formation of avifauna of urban ecosystems is mainly due to birds inhabiting natural and transformed biotopes of the urban environment, such as the abundance and nature of food, the presence of nesting sites, and “disturbance factors”. Their adaptation to the urban landscape is directly related to the species composition of birds coming from the nearest agricultural areas, steppe and coastal biotopes, etc. [13].

The analysis of general trends in the development of human civilization, shows that the negative interaction of humans with the environment is constantly expanding - primarily due to the increase in capacity and expansion of

industry and agriculture into previously undeveloped territories [14]. Therefore, as a result of anthropogenic impacts, natural landscapes are increasingly shrinking, while the area of cultural landscapes is expanding. Of course, this will lead to an increase in synanthropic species and enhance their bio-damaging effect. Barotov A., Tursunov O., Shodieva F., and Kholboev F. investigated the ecology and values of synanthropic species of mammals and birds occurring in the desert zones of Uzbekistan, where the levels of association with human economy, the degrees of human proximity, and the importance of synanthropic species in human economy were determined based on the analysis of their participation in biodamage [15]. Population growth has contributed to active urbanization, which, in turn, has exacerbated a number of environmental problems. One of the most urgent is the problem of municipal solid waste (MSW) management, since almost every item consumed in everyday life eventually turns into waste [16]. There is an increasing amount of plastic waste in urban landfills, which increasingly has a negative impact not only on marine and coastal animals, but also on terrestrial animals, including synanthropic species. Injuries, digestive, and reproductive disorders due to ingestion of or contact with plastic materials have been reported in such animals [17].

Based on the above, it is currently relevant today to study ways to protect domestic structures of residential houses, gardens, orchards, and similar areas from bio-damaging species of birds and mammals living in cultural landscapes, although regulation of their numbers may be inappropriate. Biodiversity issues remain at the center of conservation efforts, including the management of urban ecosystems and conflicts with wildlife, which is analyzed in detail in the scientific article by Jean-Pierre L Savard, Philippe Clergeau, and Gwenaelle Mennechez [18]. In this context, the article by Elizarov V.V. considers the problem of crop loss and spoilage caused by synanthropic birds. The existing methods of bird control are analyzed, and the advantages of using the electrophysical method of controlling synanthropic birds at agroindustrial complexes (AIC) are highlighted [19]. Davis S., Guerreiro Milheiras S., Olivier P.L., et al. examined the effects of land use change on biodiversity and ecosystem services in agro-landscapes and concluded that management strategies to maintain trees and shrubs, and improve tree cover within an agricultural landscape, can be effective approaches to maintain bird diversity and services. However, this issue needs further study to mitigate the negative impact of birds on crop yields [20].

Many zoologists study the degree of attachment of synanthropic bird species to human life. According to the degree of dependence on humans, synanthropic birds, as defined by Dorzhiev C.Z., Saai A.T. and Gulgenov S.J., are divided into three main types: synanthropic (obligate, stable, conditional synanthropes), semi-synanthropic (characteristic, stable semi-synanthropes) and pseudo-synanthropes [21].

Ornithological and theriological materials were collected by the authors through route surveys and scientific expeditions, where the study included an investigation of species composition, abundance, seasonal changes and bio-damaging characteristics. The method of trap lines, widely used in zoological and ecological studies, was used to determine the abundance of synanthropic rodents. Standard traps were used as trapping devices, with abundance indicators calculated in trap-days. The abundance of the eastern blind mole rat (*Spalax leucodon*) was counted using the route-line method adapted for counting subterranean rodents [22, 23]. To determine the abundance of synanthropic rodents, the trap-night method was applied. The systematic list of species was compiled according to the "Cadastre of the gene pool of Kyrgyzstan" [24] and "Systematic list of vertebrates of Kyrgyzstan [25].

3. Results

3.1. Species Composition

According to the results of a study by K.Y. Stamaliev, 37 species of synanthropic birds live in urbanized landscapes in southern Kyrgyzstan [26]. The results of our research showed that 23 species of synanthropic birds are found in the city of Osh. At the same time, 16 species were not included in the list of synanthropic bird species of Osh city (*Cuculus canorus*, *Athene noctua*, *Otus scops*, *Merops apiaster*, *Merops superciliosus*, *Upupa epops*, *Galerida cristata*, *Motacilla flava*, *Motacilla citreola*, *Lanius collurio*, *Lanius schach*, *Lanius minor*, *Oriolus oriolus*, *Luscinia megarhynchos*, *Parus bokharensis*, *Tichodroma muraria*) as their presence does not show a stable association with human settlements. We added two species to the

list of synanthropic birds: *Passer indicus* and *Emberiza calandra*, as facultative breeding and pseudosynanthropic species. Both species are common but few in number in Osh city. *Passer indicus* is a nesting migratory bird and seasonal migrant; it flies to clay cliffs and settlements in the vicinity of the city during the nesting period. *Emberiza calandra* is a sedentary bird, flying short distances. It is usually found in parks, gardens and agricultural fields adjacent to the foothills.

Thus, as a result of our research, we have identified 23 species of birds and 6 species of mammals living in the city of Osh, whose life to a greater or lesser extent depends on human activity. Among them: from the order *Columbiformes* — 3 species, *Apodiformes* — 2 species, *Passeriformes* — 18 species. In the order *Passeriformes* the following families are distinguished: *Hirundinidae* — 3 species, *Motacillidae* — 1 species, *Sturnidae* — 3 species, *Corvidae* — 4 species, *Turdidae* — 1 species, *Paridae* — 1 species, *Passeridae* — 2 species, F*ringillidae* — 1 species and *Emberizidae* — 1 species, from the order *Rodentia* 6 species, of which: *Gliridae* — 1 species, *Cricetidae* — 1 species, *Gerbillidae* — 1 species and *Muridae* — 3 species.

3.2. Degree of Synanthropy

The degree of synanthropy of these identified species varies from pseudo-synanthropic to obligate forms and depends on the level of urbanization of the biotope (**Table 1**). As can be seen from the table, 7 bird species and 3 mammal species are obligate (typical) synanthropes, fully dependent on humans. Twelve species belong to facultative synanthropes, which we divided into two groups: facultative breeding and facultative non-breeding. The first group includes seven species that use urban and rural settlements as shelter from harsh climate conditions and as nesting habitat, although they may also inhabit natural habitats. The facultative non-breeders are 5 species that do not live predominantly in human settlements, but are dependent to some extent on humans for food. Pseudo-synanthropes include 3 species of birds and 3 species of mammals that occur in populated areas, but their lives are not closely related to humans.

Table 1. Synanthropic species of birds and mammals of Osh city and their degree of synanthropy.

№	Latin Name	Degree of Synanthropy
I	**Aves Linnaeus, 1758**	
1.1	***Columbiformes* (Latham, 1790)**	
1.1.1	***Columbidae (Leach, 1820)***	
1.	*Columba livia* Gmelin, 1789	Bonded
2.	*Streptopelia decaocto* (Frivaldszky, 1838)	Bonded
3.	*Streptopelia senegalensis* Bonaparte, 1856	Bonded
1.2	***Apodiformes* Peters, 1940**	
1.2.1	***Apodidae (Hartert, 1897)***	
4.	*Apus apus* Linnaeus, 1758	Optional breeders
5.	*Apus melba Linnaeus, 1758*	Optional breeders
1.3	***Passeriformes* Linnaeus, 1758**	
1.3.1	***Hirundinidae* Rafinesque, 1815**	
6.	*Hirundo rustica* (Linnaeus, 1758)	Optional breeders
7.	*Hirundo daurica* (Temminck, 1835)	Optional breeders
8.	*Delichon urbica* Linnaeus, 1758	Optional breeders
1.3.2	***Motacillidae* (Horsfield, 1821)**	
9.	*Motacilla personata (Gould, 1861)*	Pseudo-synanthrope
1.3.3	***Sturnidae* Rafinesque, 1815**	

Table1. *Cont.*

№	Latin Name	Degree of Synanthropy
10.	*Sturnus vulgaris* Linnaeus, 1758	Bonded
11.	*Sturnus roseus* Linnaeus, 1758	Optional breeders
12.	*Acridotheres tristis* (Linnaeus, 1766)	Bonded
1.3.4	***Corvidae* Leach, 1820**	
13.	*Pica pica* Linnaeus, 1758	Pseudo-synanthrope
14.	*Corvus monedula* Linnaeus, 1758	Optional breeders
15.	*Corvus frugilegus* Linnaeus, 1758	Optional breeders
16.	*Corvus cornix* (Linnaeus, 1758)	Optional breeders
1.3.5	***Turdidae* Rafinesque, 1815**	
17.	*Turdus merula* Linnaeus, 1758	Bonded
1.3.6	***Paridae (Vigors, 1825)***	
18.	*Parus bokharensis (Lichtenstein, 1823)*	Pseudo-synanthrope
1.3.7	***Passeridae* Rafinesque, 1815**	
19.	*Passer domesticus* Linnaeus, 1758	Optional breeders
20.	*Passer indicus* (Linnaeus, 1858)	Optional breeders
21.	*Passer montanus* Linnaeus, 1758	Bonded
1.3.8	***Fringillidae (Leach, 1758)***	
22.	Fringilla coelebs (Linnaeus, 1858)	Optional breeders
1.3.9	***Emberizidae* Vigors, 1825**	
23.	*Emberiza calandra* Linnaeus, 1858	Pseudo-synanthrope
II	***Mammalia* Linnaeus, 1758**	
2.1.	***Rodentia* Bowdich, 1821**	
2.1.1	***Gliridae* Thomas, 1906**	
24.	*Dryomus nitedula (Pallas, 1776)*	Pseudo-synanthrope
2.1.2	***Cricetidae* Fisher, 1814**	
25.	*Ellobius tancrei* Blasius, 1884	Pseudo-synanthrope
2.1.3	***Gerbillidae* Gray, 1825**	
26.	*Meriones libycus* Lichtenstein, 1823	Pseudo-synanthrope
2.1.4	***Muridae* Illiger, 1811**	
27.	*Mus musculus* Linnaeus, 1758	Bonded
28.	*Rattus turkestanicus* (Satunin, 1903)	Bonded
29.	*Rattus norvegicus* Berkenhout, 1769	Bonded

3.3. Biodefense Characteristics

We also described the bio-damage characteristics of synanthropic birds and mammals living in Osh city, dividing them into three groups according to the degree of bio-damage: high, medium and low. Species with a high degree of bio-damage include 7 species of birds and 3 species of mammals. Species with a medium degree of bio-damage include 7 bird species and 1 mammal species. Species with a low degree of bio-damage include 9 bird species and 2 mammal species (**Table 2**).

Table 2. Degrees of bio-damage caused by synanthropic birds and mammals.

Degrees of Biodegradation	Bird and Mammal Species
High degree of biodamage	**Aves:** *Acridotheres tristis, Passer montanus, Columba livia, Streptopelia senegalensis, Sturnus roseus, Sturnus vulgaris, Turdus merula* **Mammalia:** *Mus musculus, Rattus turkestanicus, Rattus norvegicus*
Moderate degree of biodamage	**Aves:** *Streptopelia decaocto, Delichon urbica, Hirundo daurica, Hirundo rustica, Corvus monedula, Corvus frugilegus, Corvus cornix.* **Mammalia:** *Ellobius tancrei*
Low degree of biodamage	**Aves:** *Apus apus, Apus melba, Motacilla personata, Pica pica, Parus bokharensis, Passer domesticus, Passer indicus, Fringilla coelebs, Emberiza calandra* **Mammalia:** *Dryomus nitedula, Meriones libycus*

The bio-damaging properties of synanthropic species inhabiting cultural landscapes, which have a significant negative impact on human activity, have been determined. In recent years, there has been a noticeable increase in the bio-damaging activity of synanthropic birds and mammals, which leads to significant losses for gardeners, farmers, and harms municipal utilities in cities and other spheres. In recent years, there has been a tangible increase in the bio-damaging activity of synanthropic birds and mammals, which leads to significant losses for gardeners, farmers, and harms municipal utilities in cities and other areas.

All synanthropic birds and rodents can serve as intermediate hosts for parasites.

Many synanthropic birds cause significant damage to vineyards and cherry trees in cultivated landscapes. This group includes *Acridotheres tristis*, *Passer montanus*, *Sturnus roseus*, *Sturnus vulgaris*, *Passer domesticus*, and *Passer indicus*, which, in addition, play a key role in regulating insect populations.

Birds with a high degree of bio-damage pollute parks and monuments with their excrement, which accelerates corrosion processes and worsens the aesthetic appearance of the city. Among them *Acridotheres tristis*, *Passer montanus*, *Columba livia*, *Streptopelia senegalensis*, *Sturnus roseus*, *Sturnus vulgaris*, *Turdus merula*, *Streptopelia decaocto*, and *Corvus monedula*, *Corvus frugilegus*, *Corvus cornix* stand out. Especially *Corvus frugilegus*, forming mass aggregations on large trees of the park during overnight stays, contributes to significant pollution of the territory and an increased noise level.

Numerical populations of synanthropic birds and mammals cause significant damage to grain crops in fields and warehouses. This group includes *Columba livia*, *Corvus monedula*, *Corvus frugilegus*, *Corvus cornix*, *Acridotheres tristis*, *Passer montanus*, *Streptopelia senegalensis*, *Sturnus vulgaris*, *Mus musculus*, *Rattus turkestanicus*, and *Rattus norvegicus*.

Some birds nesting on water pipes and electrical installations damage them with their feces. Rodents gnaw through the insulation of power lines and transformers, causing significant material costs. The following species can be distinguished among them: *Acridotheres tristis*, *Passer montanus*, *Columba livia*, *Streptopelia senegalensis*, *Sturnus roseus*, *Sturnus vulgaris*, *Streptopelia decaocto*, *Mus musculus*, *Rattus turkestanicus*, and *Rattus norvegicus*.

Ellobius tancrei damages melons, vegetable and cereal crops, also complicates irrigation works in agriculture.

Acridotheres tristis, by feeding on chicks and eggs of house sparrows (*Passer domesticus*) and town swallows (*Delichon urbica*), has contributed to a sharp decrease in their numbers. The population size of *Delichon urbica* in 1996 was 82±6.69 individuals/km², in 2001 - 126±12.7 individuals/km², and in 2021 - 22 (0.7%) individuals per 1 km2. The number of *Passer domesticus* in 1996 was 30±9.83 individuals/km², and in 2001 33±15.31 individuals/km², and in 2021 this species was found only in spring and summer seasons as a migratory species [3,5]. Currently, both species are extremely rare in Osh city.

There is also an increase in the number of *Rattus norvegicus*, which has led to a decrease in the number of *Rattus turkestanicus* and was one of the reasons for the decline in the amphibian population.

The problem of birds colliding with aircraft is a pressing issue in modern aviation [27]. Osh International Airport uses various methods of bird deterrence, including passive means of protection, bioacoustics installations and regular environmental control measures to reduce the risk of birds

in the airfield area.

In addition, we determined the densities of five synanthropic rodents (*Mus musculus*, *Rattus turkestanicus*, *Rattus norvegicus*, Dryomus nitedula and *Meriones libycus*) in order to assess their bio-damaging effects. The linear trap-night method was applied for the study. Among the species recorded, *Rattus norvegicus* had the highest frequency of trap hits with 38.5±6.03%, indicating its dominance over other species. It should be noted that this species is relatively new to the south of Kyrgyzstan, and its distribution area and quantitative indicators were first studied by U.A. Atabekov [11]. The second place in terms of occurrence was occupied by *Mus musculus*, with a proportion of 29.58±5.42% (**Table 3**).

Table 3. Quantitative indicators of bio-damaging rodents.

№	Species Name	Absolute Number	%
1.	*Mus musculus*	21	29,58 ± 5,42
2.	*Rattus turkestanicus*	11	15,49 ± 4,29
3.	*Rattus norvegicus*	25	35,21 ± 5,67
4.	*Dryomus nitedula*	5	7,04 ± 3,04
5.	*Meriones libycus*	9	12,68 ± 9,95
	Total:	**71**	**100**

Among the bio-damaging rodents found in all biotopes of Osh city, *Mus musculus*, *Rattus turkestanicus*, *Rattus norvegicus* and Dryomus nitedula were noted. The species *Ellobius tancrei* predominantly inhabits single-storey residential buildings and agricultural lands. The abundance of *Ellobius tancrei* was found to increase in crop fields, whereas the population of *Meriones libycus* increased in new settlements on the outskirts of the city (**Table 4**). For the first time, *Meriones libycus*, *Ellobius tancrei* and Dryomus nitedula are considered as synanthropic species.

Table 4. Biotopic distribution of bio-damaging rodents of Osh city.

№	Species name	Rural Type of Construction (One and Two-storey Houses)	Urban Type of Development (Multi-storey Buildings)	River Flood-plain	Canal Banks	Green Areas (Parks)	Croplands
1.	Mus musculus	+++	++	+	++	+	+
2.	Rattus turkestanicus	++	++	+	++	+	+
3.	*Rattus norvegicus*	++	++	+	+	+	+
4.	*Meriones libycus*	+	-	-	+	-	++
5.	*Ellobius tancrei*	+	-	+	+	+	+++
6.	*Dryomus nitedula*	+	+	+	+	+	+

4. Discussion

In general, it can be concluded that changes in climatic conditions, along with anthropogenic transformation of the urban environment, have a twofold impact on fauna. On the one hand, the destruction of natural habitats (deforestation, drainage of wetlands, etc.) contributes to the reduction of biodiversity. On the other hand, urbanized areas often form favorable conditions for the existence of certain animal species due to the presence of shelters, nesting sites, food waste, and a variety of tree and shrub vegetation. This attracts synanthropic species, promotes their establishment in the urban ecosystem, and strengthens the processes of monodominance, which can lead to the displacement of less adapted species.

Thus, along with the protection of useful bird species in the urbanized ecosystem, studies aimed at regulating the number of bio-damaging synanthropic species occurring in

large quantities, as well as the development and implementation of measures based on the obtained data, are becoming increasingly relevant

The same birds and mammals that cause biological damage play a key role in ecosystems, performing important ecological functions such as regulating insect pests and other roles. In this regard, we face the challenge of developing effective measures to regulate the abundance of bio-damaging species that have a negative impact on human activities in cultural landscapes, while not damaging their populations and preserving ecosystem balance. As shown in the example of the Oromia cities in Ethiopia, greening of urbanized areas plays an important role not only in improving atmospheric air quality [28], but also in creating favorable conditions for the habitat and conservation of some rare and vulnerable bird species in urban landscapes.

Methods to Reduce Biodamaging Activity of Synanthropic Birds and Mammals

Various methods are used to protect gardens, parks and monuments from bio-damaging bird species. Among mechanical methods, rotating glass objects, reflective CDs, metal cans that make wind noise, and pyrotechnic deterrents are used. Covering small areas with netting and broadcasting the sounds of birds of prey are also effective measures. Chemical repellents include alpha-chloralose, 4-aminopyridine, polybutylene, fenthion, endrin, and other substances designed to repel birds. Additionally, birds of prey from the falcon family (Falconidae) are used to disperse synanthropic bird species. However, their widespread use is limited due to the status of many species as rare and protected, as well as the difficulty of taming and keeping them. In this regard, it is more appropriate to use remotely controlled devices imitating the image of birds of prey with simultaneous broadcasting of their sounds.

It is recommended for horticulturists to consider planting different varieties of mulberries (Morus) near sweet cherry (Prúnus avium), considering that starlings (Sturnus) prefer mulberries of two varieties. This practice may be useful to create sustainable ecosystems in agrocenoses, which favor the attraction of these birds, and can play a role in regulating insect populations and improving biodiversity in orchard plantations.

To prevent ornithotic and zoonotic infectious diseases, it is recommended to apply comprehensive protection measures. One important step is to cover the roofs of buildings to prevent nesting of synanthropic birds and rats. Cracks and gaps in the walls of multi-storey buildings should also be sealed to prevent the entry of these animals. An important aspect is to maintain a proper sanitary condition of the urban environment, as well as to conduct activities aimed at improving environmental education and awareness among the population. This will help to improve the understanding of the importance of sanitation and ecology, as well as raise awareness of the prevention of animal and bird-borne diseases.

5. Conclusions

As a result of the study, the species *Meriones libycus*, *Ellobius tancrei* and Dryomus nitedula were identified and considered as synanthropic for the first time. These species were not previously considered in the context of synanthropic populations, which represents an important addition to ecosystem studies in urban landscapes of Kyrgyzstan.

The study identified 23 species of birds and 6 species of mammals living in the city of Osh, whose existence is closely related to human activities. These species can be both obligate synanthropes, fully dependent on urban conditions, and facultative, partially using cities as habitats.

Synanthropic birds and mammals cause significant damage to various sectors of the economy, including agriculture, utilities and infrastructure. Losses are associated with damage to crops, contamination of monuments, destruction of communications and increased costs for protection and restoration of damaged facilities. Synanthropic species can be carriers of parasites, acting as sources of infectious diseases, which emphasizes the need for comprehensive measures to prevent ornithotic and zoonotic diseases.

To protect against bio-damaging species, a variety of population control methods have been proposed, such as mechanical and chemical methods of protection, the use of birds of prey and remotely controlled devices. These measures should be aimed at minimizing damage to ecosystems and preserving the balance of nature.

One of the key aspects of preventing bio-damage is to maintain the sanitary condition of the urban environment,

as well as to implement measures to increase the level of environmental education and awareness among the population. This will help to raise awareness of risks and protection measures against bio-damaging species.

Recommendations to plant different varieties of mulberries (*Morus*) next to sweet cherry (*Prúnus avium*) can contribute to the establishment of sustainable ecosystems in agrocenoses, improving biodiversity and insect regulation, as well as attracting birds useful for agriculture.

To better manage the abundance of synanthropic species, it is necessary to continue monitoring their populations, study their bio-damaging characteristics, and develop new methods of protection against their impact on various types of urban and rural infrastructure.

Author Contributions

All authors made some contribution to this study: A.A. led and organized the research work. Also A.A., K.S., and G.T. took part in the collection of material and participated in all route studies. A.A. and K.S. carried out static processing of the obtained materials. G.T. typed the text on the computer and participated in the collection of literary sources. B.S. developed the research concept. A.A., K.S., and G.T. prepared the initial version of the manuscript. B.S. helped to edit the manuscript and was responsible for the work related to translation. All authors read and approved the final version of the manuscript.

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Data Availability Statement

All data presented in this study are available upon request. Additional data may be made available upon reasonable request.

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Conflict of Interest

All the authors declare that there is no conflict of interest in relation to the research, authorship, and publication of this study.

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