

Changes of avifauna in green areas of Almaty City in the beginning of 21st century

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Abstract. Currently, there are serious changes in the environment in Almaty due to the accentuated urbanization processes. The avifauna of the city is experiencing serious stress pressure in this regard, which forces the animals to adapt to new conditions or leave this territory. The last fundamental research on the species composition of the city's fauna was conducted about 3 decades ago. The analysis of information on the birds of Almaty, collected by specialists of the Institute of Zoology over the past 50 years, showed significant changes in the avifauna. 5 categories of bird species were identified: 1) species that have disappeared from the urban fauna, 2) species whose numbers have declined significantly, 3) species that have a tendency to decline in numbers, 4) species whose numbers are stable or have increased, 5) species that are settling.

1 Introduction

Alma-Ata is located at the northern ridge of the foot of the Trans-Ili Alatau at an altitude of 700 to 900 meters above sea level. The architectural appearance and tree plantings of various parts of the city are very heterogeneous. The nature of the natural land adjacent to the city is also different. From the south – these are foothills with wild tree and shrub vegetation and cultivated fruit orchards, from the north-mainly open spaces, formerly steppe, now occupied by field and garden crops with swampy floodplains of rivers [1]. The native bird fauna consisted of the inhabitants of the tugai, which grew on the banks of rivers and streams that ran down from the mountains; steppes and meadow-steppes located on the saz in the north-eastern part; and cliffs that densely dotted all the northern surroundings. Over the 140 years of the city's existence, its territory has undergone radical changes – semi-deserts, dry steppes and meadows have given way to buildings and powerful tree plantations with a system of irrigation ditches. The breeding fauna of birds began to consist of 42% of dendrophiles that had previously nested on these lands, 22% of synanthropes brought by humans, and only 36% of native species [2].

The most favorable areas for birds are the old part of Alma-Ata. It is dominated by one-story buildings with good gardens. Of the tree species, the most common are apple, pear, stone fruit, and of the shrubs – raspberries, currants, and gooseberries. On the borders of the plots there are hedges of elm, elm, and acacia. Street plantings consist of elm, elm, poplar,

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birch, oak. Less maple, ash, linden, acacia. These trees form single-row or double-row plantings on each side of the street along the ditches. This is what most of the city was like until the 1950s. [1]

The Almaty avifauna has not been studied as a special scientific topic in the last 20 years, and the main few works on the study of birds of this megalopolis were published in 1960-80 of the last century. At the present time, when there are such significant and rapid changes in the urban avifauna, it becomes obvious that there is an urgent need to organize annual monitoring of birds in the city of Almaty with the city accounting according to a single method in nesting and winter time along the same routes of considerable length.

Dynamic processes in the avifauna of Kazakhstan and Central Asia, caused by a complex of climatic and anthropogenic factors, were particularly pronounced in the last decade of the twentieth century and in the first years of the new century [3,4]. Along with the dispersal of a number of species, the disappearance or sharp decline in the number of some previously common and background birds is observed. In the period from 1990 to 2005, significant changes occurred in the bird fauna of Almaty, which currently includes 223 species [5,6].

2 Material and Methods

The field surveys were conducted in 2018-2019 on the territory of the Main Botanical Garden of Almaty, the Park of the First President, the Gandhi Park, Park of the 28 Panfilovs Guards. There were 116 counts in total (44 of them were conducted in the Main Botanical Garden of Almaty). The length of the routes was 5 km in the Main Botanical Garden of Almaty, 1.52 km in the park of 28 Panfilovs Guards, 0.88 km in Gandhi Park, 4 km in the Park of the First President. Periodicity of counting was 1-2 times a week for 40-180 minutes. All counts were made in the morning, mostly from 9.00 to 12.00. In the course of the study, the authors used route method of bird population accounting and observation of behavioral features of birds on model areas. The recorder moves along the route and marks all birds of the counting class that observer sees or hears. For each encounter, the species, the number of individuals met and the distance from the record-keeper to the animal at the moment of detection shall be indicated. In addition, the starting and ending times and distance travelled are noted. Weather conditions, characteristics of biocoenosis are also recorded [7]. Authors also used some information kept in data base of Institute of Zoology of the Republic of Kazakhstan.

3 Results

The analysis of information on the birds of Almaty, collected by specialists of the Institute of Zoology over the past 50 years, showed significant changes in the avifauna. 5 categories of bird species were identified: 1) species that have disappeared from the urban fauna, 2) species whose numbers have declined significantly, 3) species that have a tendency to decline in numbers, 4) species whose numbers are stable or have increased, 5) species that are settling.

1) Birds disappeared by the beginning of the 21st century from the urban fauna:

Streptopelia turtur arenicola stopped breeding in Alma-Ata in the early 1960s. [1] Later, this species reappeared in the city in the 1980s and in many areas of its old part became quite common [8], inhabiting city parks, orchards, plantings in squares and along streets. A sharp decline in the number again occurred in 1995-2000. The only pair of these turtle doves nested for three years (2002-2004) on Christmas trees near the building of the Academy of Sciences. In 2000-2005, the turtle dove was also extremely rare in the foothill zone of the Northern Tien Shan, Dzungarian Alatau and Tarbagatai, which indicates a large-scale depression of the number of this species within the range [9, 10]. The disappearance of *Streptopelia turtur*

arenicola occurs as a result of long-term cyclical fluctuations in the number, the reasons for which are not yet clear. Probably, this species, wintering in Africa, is subjected to increased persecution and destruction by humans on the flight paths in the Mediterranean countries and in places of mass concentrations on African wintering grounds.

Sturnus vulgaris porphyronotus was one of the most common birds in the city of Alma-Ata in the 1960s and 1990s [1,8,11]. Clusters of young birds of 100-200 individuals were constantly observed in the Main Botanical Garden. Later, in 1994-1997, there were fierce conflicts between this species and the *Acridotheres tristis* over nesting sites. In 1998-2000, in the southern part of the city, breeding pairs, broods and flying flocks of this species ceased to be found. The last starlings nesting in the city were noted in 1999 and 2000 on the Vesnovka River between Timiryazev and al-Farabi Streets. Having stopped nesting in the city, the starling in 2000-2005 surprisingly stopped meeting on its territory and during the migration period. The number in suburban settlements has also decreased. The main reason for the friendly disappearance of the starling in Almaty is considered to be the displacement of its myna. However, the main reason, apparently, lies in the extremely strong pollution of the air basin of the city, the reduction of territories with a rural landscape, absorbed by multi-storey buildings, the deterioration of food conditions, etc.

Lanius phoenicuroides phoenicuroides in the 1980s was one of the characteristic nesting birds of the shrubby thickets of gardens, squares and wastelands of the city, but already in May 1994, the last pair of this species was seen in the garden of Gorvodkanal. In 1995-2005, this species was not found. The disappearance of this bird in Almaty coincided with a large-scale depression in the population of this species in the Tien Shan.

Crex crex in the 1960s nested in the Main Botanical Garden, the Zoo, the central part of the Baum Grove and on the periphery of tree nurseries in the southern and southwestern parts of Alma-Ata [1]. In the 1970s, the voices of this species were often heard on the outskirts of the city in the foothills of the Trans-Ili Alatau. Periodically, this species nested in the Main Botanical Garden [8]. It was occasionally recorded here in May 1985-1986 [12]. The last mating calls of one male were heard on June 17, 1994 in the upper part of the park area of the Exhibition in high grass among rare pine plantings, and the other-in June 2003 on the territory of the Al-Farabi Kazakh National University on a vacant lot near the Vesnovka River.

Lanius minor in the 1960s nested on the outskirts of the city and in the Baum grove [1], in 1985-1986 it was recorded in the Main Botanical Garden [12], but later this species completely disappeared.

Sylvia nisoria merzbacheri in 1990-1998 was a common species in the city gardens and parks of Almaty, but in 2000-2005 it almost disappeared in the city.

Saxicola torquata maura stopped breeding in the southern part of Almaty in 1990-1995. However, during the migration period, this species continues to occur quite often within the city.

Dendrocopos major tianschanicus and *Rhodospiza obsoleta* in 1960-1980 nested in Almaty [8], but in 1990-2005 during the breeding season they were no longer found. Only occasionally, from August to April, solitary birds appear in the green areas of the city.

2) Birds significantly reduced their numbers in the early 21st century:

Streptopelia senegalensis ermanni - the first case of mass death was recorded in the winter of 1984/85, when the number of this species in Alma-Ata decreased by 2-3 times [13], although the number of *S. decaocto stoliczkae* and *Columba livia* var. *domestica* did not decrease. The next depression in the number of this species occurred in 1999-2000 [14] and to this day its number remains at an extremely low level. This species has become very rare in areas of the city with multi-storey buildings, although in the suburbs with rural-type estates, there are still separate pockets on the eastern and north-eastern outskirts of the city.

In March 2005, only 44 individuals of this species were registered on 50 km of city streets during the citywide census [15].

Cuculus canorus subtelephonus in 1990-1995 was found in the southern part of the city on tall trees and antennas of high-rise buildings. Since the late 1990s, this species has completely disappeared in Almaty. The disappearance of this species coincided with the disappearance of *Lanius phoenicuroides*, in whose nests the cuckoo laid its eggs.

Phasianus colchicus mongolicus in the 1980s and 1990s nested on the territory of the Main Botanical Garden and was one of the attractions of Almaty. This species was often found in the foothill part of the city between the gorges of Bolshaya and Malaya Almatinka, occupied by gardens and dachas. In the 1990s, this species stopped nesting in urban settings as a result of intensive building construction in the southern part of the city. Further development of the southern parts of the city, especially the construction of buildings in green areas, may gradually lead to the complete displacement of the pheasant from the city.

Luscinia megarhynchos hafizi in the first 3-4 decades of the twentieth century, this species was the most common bird in Alma-Ata [16], but already in the 1960s their number sharply decreased due to rapid construction and reduction of tree and shrub areas, single pairs were preserved in the gardens of the southern and south-eastern suburbs, as well as in the Baum grove and in the central city park [1]. In 1985-1986, the nightingale was a common species in the Botanical Garden and in other green areas of Alma-Ata [12]. In the Main Botanical Garden in May 1992, singing nightingales were quite common, but already in May-June 1994, a sharp decrease in their number was noted. The decline in the number of this species was due to the destruction of its nests by the magpie *Pica pica*, which became numerous here.

Lanius schach erythronotus in 1986-1995 annually nested in groups of pyramidal poplars in the southern part of the city, but after the construction began here, this species was gradually replaced.

In 2000-2005, there was a decrease in the number and disappearance of three species of swallows in urban areas with a multi-storey type of development: *Hirundo rustica*, *H. daurica* and *Delichon urbica*, of which the first in 1985-1986 was a common bird in areas of both rural and urban development, as well as in the green areas of Alma-Ata [12, 17]. In the first decade of the 21st century, the migrating coastal swallows *Riparia riparia*, *R. diluta* also ceased to be recorded in the city.

At least 2-3 times in the central parts of the city, the number of two species of sparrows, *Passer domesticus* and *P. montanus*, decreased, which in 2000-2005 became small and rare in areas of multi-storey buildings, especially in places with a minimum of tree and shrub stands. The size of the autumn-winter flocks of house sparrows has also noticeably decreased. If in 1990-1995 in the microdistricts "Almagul" and "Kazakhfilm" there were still winter accumulations of up to 100-200 individuals of house sparrows, then in 2000-2005 in the former places they most often keep flocks of 20-40, less often up to 60 individuals. The phenomenon of noisy sparrow clusters in the dense crowns of trees or thickets of shrubs that enlivened city streets and squares during winter thaws has also disappeared.

There was a decrease in the number of *Carduelis caniceps* and *Sylvia communis*, as well as rare summer meetings with *Parus cyanus*, which in 1985-1986 widely nested in the Main Botanical Garden, the central city park and in the green area along Gagarin Street [12].

3) Species that have a tendency to decline in numbers.

Chloris chloris turkestanicus as a result of settlement in 1973-1974, this species appeared in Alma-Ata and in the next 10-12 years became a common breeding bird here [18,2]. In 1985-2000, it was found as a background bird in all parts of the city, including even the most noisy and crowded places: bus stations, bazaars and squares. A noticeable decline in the population in the southern part of the city began to be observed in the spring of 2003. One of the main reasons for the decline in the number of this species and the grey-headed goldfinch in Almaty is the destruction of their nests by a large magpie.

Motacilla personata in the southern part of Almaty began to disappear in Almaty from March - April 2004, in 2005 this species was not observed even during the flight, although in the 1990s this species often nested in the southern part of the city.

In 2000-2005, the number of *Streptopelia decaocto* significantly decreased. In 2003-2005, there was a marked decrease in the number of *Turdus merula intermedius* found in the southern part of the city in spring and summer, although this species is a common bird in other parts of the city.

4) Species whose numbers are stable or have increased.

Pica pica first settled in Alma-Ata in 1965 in the Main Botanical Garden [1]. Mass settlement of the city of this species occurred already in the 1970s, and in 1980-1985 it was already numerous on the territory of the botanical garden. Thus, in the botanical garden in 1985 and 1986, its population density was extremely high and reached 75 and 70 pairs/1 km² [19], which is an order of magnitude higher than that in natural landscapes. A large magpie remains in the city throughout the next 20 years. This was one of the main reasons for the decline in the number of dendrophilous bird species.

Acridotheres tristis was first acclimatized in Alma-Ata in 1962, but already in 1964-1965 this species nested in many parts of the city, and in the 1970s and 1980s it gradually became a common species [1,8,11]. A sharp increase in the number of mynas in Almaty was observed in 1990-1999.

The density of *Parus major* and *Columba livia* var. *domestica* is relatively stable and high in Almaty.

5) Species in which settlement occurs

Columba palumbus casiotus has been regularly observed in the Main Botanical Garden since 1984, and since 1992 this one has started nesting there [20].

Streptopelia orientalis meena, which breeds on the northern slope of the Trans-Ili Alatau in the 1980s, was found in Alma-Ata only during the migration period. However, in 1985-1986, the first breeding pairs were already found in the Main Botanical Garden [12], in 1990-1993 - in tree plantations along al-Farabi Avenue. Currently, this species continues to nest in the zoo and the central city park.

Corvus monedula was considered a common flying and wintering species in Alma-Ata [16,1,8]. In the immediate vicinity of the city, its sporadic nesting is known in the Trans-Ili Alatau between the cities of Almaty and Talgar. In urban settings, cases of synanthropic nesting of this species were not known until the early 1990s [21]. Since 1989, this species has been regularly breeding in the southern part of Almaty. This species makes its nests in the ends of hollow concrete pillars of high-voltage power lines, under a metal bracket fixed above the hole [9].

Corvus corone orientalis relatively often nested in the gardens of the city of Almaty in the early twentieth century [21], but since the second half of the century it has ceased to nest here and was found mainly in the autumn-winter period [1]. Only occasionally and not every year in spring and summer in different parts of Almaty, individual pairs were observed [1,2,8], but documented facts of their nesting within the city have not yet been obtained. In the Main Botanical Garden of Almaty in April 1995, a nest of this species with a clutch of 4 fresh eggs was discovered in a group of *Pinus strobus* pines [9]. In 2000-2005, individual pairs of black crows nested on the territory of the zoo, the central city park, the park named after 28 Panfilov Guards and the Al-Farabi Kazakh National University.

Corvus frugilegus, colonies of this species were known in 1917-1921 in different parts of the city of Alma-Ata, but in the 1930s they were abandoned by birds and after that, rooks nesting in the city is no longer known. In 1995-1997, a colony of this species appeared in old stands of poplar and elm along the Pervomaika-Kapchagai highway. In 2000-2005, this colony grew to several thousand nests over 5 km, while small colonies of 25-50 nests merged into a single settlement in the last 2-3 years. Settlement on roadside forest plantations goes

in the direction of Almaty. As a result of the multiple increase in the number of rooks in the first decade of the 21st century, many thousands of settlements of these birds appeared in the suburbs of Almaty. Especially large colonies were formed in 2000-2005 between the railway stations Uzunagach and Chemolgan.

4 Discussion

Among the potential reasons for the changes in the species diversity and population decline it is possible to indicate climate change, namely the increase the number of dry and hot days 1–3 every decade over the last seventy years, a decline in precipitation during the summer period, the increase in average annual temperature since 1950, a decrease in ice mass by 15–20 % [22]. Also, a significant impact is caused by the anthropogenic factor, which is manifested in an increase in technogenic pressure on the fauna, a reduction in diversity and area of green spaces, as well as violations of their tiers. An important aspect of the avifauna formation is a sufficient abundance of food and conditions necessary for the reproduction of populations, as well as features of the placement of animals in the spatial and temporal aspect. According to our observations, the number of visitors to certain green areas also significantly affects the occurrence of birds.

Based on the data that was collected as a result of accounting (from February to December 2019), we can conclude that the species diversity of the avifauna of Almaty has decreased in comparison with the end of the XX century. According to research in 1988:

- 37 species of birds were observed in the green areas of the city in winter: *Accipiter nisus*, *Falco columbarius*, *Phasianus colchinus*, *Streptopelia decaocto*, *S. senegalensis*, *Bubo bubo*, *Asio otus*, *Dendrocopos major*, *Picoides tridactylus*, *Acridotheres tristis*, *Pica pica*, *Corvus monedula*, *C. frugilegus*, *C. corone*, *C. cornix*, *Troglodytes troglodytes*, *Prunella atrigularis*, *Regulus regulus*, *Leptopoeile sophiae*, *Turdus atrogularis*, *T. pilaris*, *T. merula*, *T. viscivorus*, *Parus ater*, *P. cyanus*, *P. major*, *Passer domesticus*, *P. montanus*, *Fringilla coelebs*, *F. montifringilla*, *Serinus pusillus*, *Spinus spinus*, *Carduelis carduelis*, *Carpodacus rhodochlamys*, *Uragus sibiricus*, *Mycerobas carnicaps*;

- up to 47 species of birds were observed in spring: *Phasianus colchinus*, *Streptopelia decaocto*, *S. senegalensis*, *Asio otus*, *Dendrocopos major*, *Sturnus vulgaris*, *Anthus trivialis*, *Motacilla alba*, *M. personata*, *Acridotheres tristis*, *Pica pica*, *Corvus monedula*, *C. frugilegus*, *C. corone*, *C. cornix*, *Prunella fulvescens*, *Regulus regulus*, *Phoenicurus phoenicurus*, *Phylloscopus collybitus*, *P. trochiloides*, *P. inornatus*, *P. griseolus*, *Phoenicurus erythrogaster*, *Luscinia svecica*, *Saxicola torquata*, *Phoenicurus caeruleocephalus*, *P. erythronotus*, *Turdus atrogularis*, *T. merula*, *T. viscivorus*, *Parus ater*, *P. cyanus*, *P. major*, *Passer domesticus*, *P. montanus*, *Fringilla coelebs*, *F. montifringilla*, *Chloris chloris*, *Serinus pusillus*, *Spinus spinus*, *Carduelis carduelis*, *Carpodacus rhodochlamys*, *Uragus sibiricus*, *Mycerobas carnicaps*, *Emberiza cia*;

- the summer population was represented by 45 species: *Milvus migrans*, *Accipiter nisus*, *Falco subbuteo*, *F. tinnunculus*, *Phasianus colchinus*, *Crex crex*, *Streptopelia decaocto*, *S. turtur*, *S. orientalis*, *S. senegalensis*, *Cuculus canorus*, *Otus scops*, *Coracias garrulus*, *Merops piaster*, *Upupa epops*, *Hirundo rustica*, *H. daurica*, *Delichon urbica*, *Motacilla cinerea*, *M. personata*, *Lanius collurio*, *L. minor*, *Oriolus oriolus*, *Acridotheres tristis*, *Pica pica*, *Acrocephalus dumetorum*, *Passer montanus*, *Sylvia nisoria*, *S. communis*, *S. curruca*, *Phylloscopus collybitus*, *P. trochiloides*, *Muscicapa striata*, *Luscinia luscinia*, *Turdus merula*, *Remiz pendulinus*, *Parus cyanus*, *P. major*, *Passer domesticus*, *Chloris chloris*, *Carduelis carduelis*, *C. caniceps*, *Carpodacus erythrinus*, *Emberiza bruniceps*;

- and the autumn population – 46 species: *Accipiter nisus*, *Falco tinnunculus*, *Phasianus colchinus*, *Columba palumbus*, *Streptopelia decaocto*, *S. orientalis*, *S. senegalensis*, *Merops piaster*, *Dendrocopos major*, *Hirundo rustica*, *Motacilla cinerea*, *M. personata*, *Sturnus*

vulgaris, *Acridotheres tristis*, *Pica pica*, *Corvus monedula*, *C. frugilegus*, *C. corone*, *C. cornix*, *Prunella atrigularis*, *Phylloscopus collybitus*, *Phylloscopus trochiloides*, *Phylloscopus inornatus*, *Regulus regulus*, *Muscicapa striata*, *Phoenicurus erythronotus*, *Luscinia svecica*, *Turdus atrogularis*, *T. viscivorus*, *Remiz pendulinus*, *Parus ater*, *P. cyanus*, *P. major*, *Passer domesticus*, *P. montanus*, *Coracias garrulous*, *Fringilla coelebs*, *F. montifringilla*, *Serinus pusillus*, *Chloris chloris*, *Carduelis carduelis*, *C. caniceps*, *Carpodacus erythrinus*, *Uragus sibiricus*, *Mycerobas carinceps*, *Emberiza cia*

According to the results of our surveys we can conclude that the habitat conditions of the above-mentioned representatives of the avifauna have changed, which has led to their disappearance, or a sharp reduction in the number within urban areas, or a redistribution of habitats within the city. It should be borne in mind, however, that the author's research does not cover all the green areas of the city, based on which it is impossible to draw an unambiguous conclusion about the green areas of the city as a whole. These studies need to be supplemented with materials from studies of ornithologists (as well as specialists in other classes of vertebrates) and birdwatchers.

5 Conclusion

Thus, we concluded that the active processes of urbanization, reflected in the increase in the number and density of population of the city, the deterioration of environmental quality, as well as changing quantitative and qualitative indicators existing parks have a significant negative impact on the modern condition of bird's fauna in Almaty.

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