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CHANGES OF VERTEBRATE FAUNA IN GREEN AREAS OF ALMATY CITY DUE TO THE URBANIZATION

Abstract. Currently, there are serious changes in the environment in Almaty due to the accentuated urbanization processes. The fauna of wild-living vertebrates 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, and therefore there is a necessity for repeated research. The aim of the research is to identify patterns of the vertebrates species composition formation within some Park zones of the southern part of Almaty in the context of the last 30 years. The main methods used in the study are route records of vertebrate fauna and bioindication. An analysis of the data from the research centers, as well as the authors' own bio-indicative studies, revealed an unfavourable state of environmental quality. Based on data from the own records (from February to December), it can be concluded that the species diversity of Almaty fauna has decreased or has undergone a considerable territorial redistribution since the end of the twentieth century.

Key words: fauna, vertebrates, birds, Almaty, urbanization, green zones, pollution.

Introduction. The animal component is most susceptible to dynamic changes under the influence of external factors, and in urban conditions [1], where there is a high degree of mosaic of landscapes, a lower level of ecological sustainability of ecosystems, as well as many other specific environmental conditions, processes occurring inside animal populations differ significantly in intensity from natural, and animals are even more sensitive to environmental factors than they are under natural conditions. Until the middle of the 20th century, the city of Alma-Ata was mainly occupied by one-story buildings, abundantly alternating garden and parking spaces. Now the main part of the territory of Almaty, especially this concerns the central districts, is occupied by multi-story new buildings. The area of the green areas has declined sharply. To date, the area of green plantations is as high as 4.8 m^2 per person at a rate of 13 m^2 (not less than 10m^2) [2,3] and this indicator continues to decrease. Negatively affect the quantity and species diversity of vertebrates not only insufficient array of woody vegetation, but also the violation of the level of park plantations. Recently, the number of shrubby and herbaceous plant species that served as a shelter and food source for many wild animals has sharply decreased within the city.

In the case of Almaty, the mosaic and characteristic features of the habitats included are the most pronounced because of the nature of the urban development that has been historically established, as well as the natural conditions of the area. Also, every urban environment is more or less zoned from the central to the periphery. Different combinations of these conditions lead to the formation of specific zoocenoses in selected areas of the city. In this regard, in an urban landscape, it is most appropriate to use route methods for registering animals, which allows taking into account the difference in biotopes and the spatial distribution of organisms. Bioindication methods are also used in this work. Data from chemical and environmental analyses do not provide objective data on the impact of environmental quality on living organisms, in contrast to biotesting methods that take into account the direct reactions of organisms to environmental factors.

The main purpose of our research was to determine some faunistic changes in wild birds, amphibians, reptiles and mammals in certain green areas of the Almaty city in response to the growing urbanization of the environment. The objectives were:

- To study the development of the urban landscape and its socio-economic and environmental characteristics;
- To clarify the modern species composition of bird fauna, amphibians, reptiles and mammals in the green areas of Almaty;
- Identify possible causes of changes in the population of vertebrate fauna within the green zones of southern Almaty.

Material and Methods. The studies were conducted in 2019, from 24 January to 20 December on the territory of the Main Botanical Garden of Almaty (hereinafter – MBG), the Park of the First President, the Gandhi Park, Park of the 28 Panfilovs Guards. In the MBG area studies were conducted from February to June 2010. There were 116 counts in total (44 of them were conducted in MBG). The length of the routes was 5 km in the MBG, 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 the following methods:

1. Route method of bird population accounting;
2. Observation of behavioral features of birds on model areas;
3. Route method of accounting for amphibians and reptiles;
4. Route method of accounting for mammals;
5. The method of bioindication by measuring fluctuating asymmetry.

The method of route-count is as follows. The recorder moves along the route and marks all members of the counting class that he 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 biota are also recorded [4].

The bio-indication method by measuring the fluctuating asymmetry consists in measuring the asymmetry of the width of the sheet or the length of the hull on the right and left sides [5,6]. Then, using the formula (1) given in the text of the article, the asymmetry coefficient is calculated and the pollution level is determined by comparison with the table values.

Results. The structure of the biotopes of the city is very heterogeneous, with different architectures, nature and density of the greenery, presence of water bodies, etc. The natural landscapes adjacent to the city's boundaries are also very different from each other. From the south side, which has been studied, the pre-mountain areas with tree and shrub vegetation predominate.

In the history of the formation of the city, researchers distinguish three main periods [7]. Having traced the history of Almaty urban architecture, construction trends and landscape changes, there is a visible movement from a military settlement to a large metropolis. And during the period of its development, the city has undergone a wave-shaped change in the living conditions for wildlife, sometimes for the worse or for the better from the middle of the XVIII century to the present day [8-11]. Accordingly, over three quarters of a century, the population of the city reached 952,000, and since then has increased by 2 times (to 1,854,656 people) [12]. Today, we can talk about the beginning of a new, fourth stage of urban transformation, which is characterized by a significant increase in the anthropogenic load on the landscape. First of all, we should note the significant advance of the city's borders to the South and the inclusion of the territories of mountain stalls in its composition [13]. In this regard, there is a further displacement of wild fauna from natural habitats. The height of residential, industrial and other buildings has increased significantly. Also, due to the increase in the density of the city's population, the appearance of a large number of private vehicles and housing plots, the increase in the capacity of thermal power plants and boiler houses that provide the city with heat and electricity, the level of physical (noise, electromagnetic, vibration and light) and chemical pollution of the environment continues to grow. In the bulletins of "Kazhydromet" on the state of the environment, Almaty always has the status of a city with a very high level of atmospheric pollution [14]. According to the National center of expertise dated November 22, 2019 [15], as a result of planned laboratory monitoring of the atmosphere in Almaty, the MPC was found to exceed many substances (in 431 samples out of 1,576), including NO_2 by 2.2 times,

SO_2 by 1.2 times, and CO by 1.4 times. According to the mayor's office of Almaty, in 2019, the volume of emissions of pollutants into the atmosphere amounted to 123 thousand tons, and API_5 ($ИЗА_5$) ranges between 7-9 units and higher [14-16]. Data from research centers confirm the authors' own research based on the study of fluctuating asymmetry of plant leaves – an indicator used for monitoring environmental quality not only by chemical indicators, but also in connection with its impact on biological systems [17]. Fluctuating asymmetry is random deviations from the ideal symmetry of plants, caused, among other things, by negative deviations from the norm in the quality of the environment.

For this study, 10 leaves were selected from 7 trees of the birch (*Betula spp.*) from different parts of the city. The following parameters were measured for the research: width of half of the leaf; length from the base of the second vein of the second order; the distance between the bases of the first and second veins of the second order (each side); distance between the ends of the first and second veins of the second order; the angle between the main vein and the second vein from the base of the second order.

The leaf asymmetry values were calculated. For this purpose, an integrative indicator showing the average relative difference per topic was found using formula (1):

$$X = \frac{\sum Z}{n} = \frac{Z_1+Z_2+\cdots Z_n}{n} \quad (1),$$

where, X – degree of asymmetry of the organism; Z – the average relative difference between the sides per feature of each leaf; n - is the number of leaves.

To determine the quality of atmospheric air, the values were compared with table data for deviations from the norm. To determine the quality of the atmosphere by fluctuating asymmetry, a five-point scale was developed, in which 1 point is a conditional norm, and 5 points is a critical state. Based on the results of the analysis, it can be concluded that the Central and densely populated areas of the city are subject to extremely serious anthropogenic pressure. The calculation results are shown in table 1.

Table 1 – Results of rapid assessment of the state of the environment by bioindication

Sampling location	Indicator of average relative asymmetry per sample	Point	Characteristics of pollution
Timiryazev street, KazNU	0.231	5	Critical condition
s / t Dzerzhinsky	0.022	1	A conditional norm
Kalkaman microdistict	0.035	1	A conditional norm
Koktem 2 microdistict (Park)	0.03	1	A conditional norm
Sairan lake	0.061	3	Dirty
Vesnovka, Bukhar Zhyrau street	0.041	2	Contaminated
Ozhet microdistict	0.12	5	Critical condition

By the end of the last century (1980-1990), about 185 species of birds (including nesting, wintering, migratory and flying species) were regularly recorded in Almaty. Of these, the most common in the spring was a Collared Dove, the Laughing Dove, Pheasant, Great Spotted Woodpecker, Masked Wagtail, Blackbird, Great Tit, Starling, Magpie, Tree and House sparrows, Greenfinch, Chiffchaff and others [8].

In the spring of 2005, the following species were recorded in the territory of the city: Peregrine Falcon, Laughing Dove, Tree Pipit, Masked Wagtail, Isabelline Red-tailed Shrike, Common Mynah, Lesser Whitethroat, Chiffchaff, Stonechat, Blue-headed Redstart, Bluethroat, Blackbird, Great tit, House Sparrow, Chaffinch, Greenfinch [18].

Currently, the study of such green areas of the city as the main Botanical garden of Almaty, the Park of 28 Panfilov guards, the Park of the first President did not reveal a significant number of previously ordinary representatives of the city's avifauna. So, when in the 80 - 90s the spring population of green zone birds numbered 38 species (March-27 species) [8], according to studies of 2019, 18 species were registered in March, 15 in April and 19 in May: mallard (*Anas platyrhynchos*) – March-April; marsh harrier (*Circus aeruginosus*) – March, single occurrence; common buzzard (*Buteo buteo*) – March; pheasant (*Phasianus colchinus*); Wood Sandpiper (*Tringa glareola*) – April, single occurrence; Common Mynah (*Acridotheres tristis*); Woodpigeon (*Columba palumbus*) – April-May; Rock Dove (*Columba livia*); Collared Dove (*Streptopelia decaocto*); Swift (*Apus apus*) – May; Magpie (*Pica pica*); rook

(*Corvus frugilegus*) – March; Carrion Crow (*Corvus corone*); Hooded Crow (*Corvus cornix*) – March; Syke's Warbler (*Hippolais rama*) – May; Chiffchaff (*Phylloscopus collybitus*) – April-May; Blackbird (*Turdus merula*); Coal Tit (*Parus ater*); Great tit (*Parus major*); Grey tit (*Parus bokharensis*); House Sparrow (*Passer domesticus*); chaffinch (*Fringilla coelebs*) – March-April; Brambling (*Fringilla montifringilla*) – March; Red-fronted Serin (*Serinus pusillus*) – March; Greenfinch (*Chloris chloris*) – May; Siskin (*Spinus spinus*) – May; Scarlet Rose Finch (*Carpodacus erythrinus*) – May.

The summer population of birds is represented by 31 species based on the results of surveys conducted in the model plots: Mallard (*Anas platyrhynchos*), Common Buzzard (*Buteo buteo*), Pheasant (*Phasianus colchinus*), Woodpigeon (*Columba palumbus*), Stock Dove (*Columba oenas*), Turtle Dove (*Columba livia*), Collard Dove (*Streptopelia - decaocto*), Long-eared owl (*Asio otus*), Swift (*Apus apus*), hoopoe (*Upupa epops*), House Martin (*Delichon urbica*), white wagtail (*Motacilla alba*), masked wagtail (*Motacilla personata*), Isabelline Red-tailed Shrike (*Lanius isabellius*), Mynah (*Acridotheres tristis*), magpie (*Pica pica*), rook (*Corvus frugilegus*), Carrion Crow (*Corvus corone*), Whitethroat (*Sylvia communis*), Lesser Whitethroat (*Sylvia curruca*), Chiffchaff (*Phylloscopus collybitus*), Spotted Flycatcher (*Muscicapa striata*), Black Redstart (*Phoenicurus ochruros*), blackbird (*Turdus merula*), Coal tit (*Parus ater*), Azure tit (*Parus caeruleus*), Great tits (*Parus major*); house sparrow (*Passer domesticus*), greenfinch (*Chloris chloris*), siskin (*Spinus spinus*), Scarlet Rose Finch (*Carpodacus erythrinus*).

During the autumn surveys 22 species were recorded: Mallard (*Anas platyrhynchos*), Common Buzzard (*Buteo buteo*), Mash Harrier (*Circus aeruginosus*), Hobby (*Falco subbuteo*), Lesser Kestrel (*Falco naumanni*), pheasant *(Phasianus colchinus*), Woodpigeon (*Columba palumbus*), Turtle dove (*Columba livia*), Collard dove (*Streptopelia decaocto*), Mynah (*Acridotheres tristis*), Magpie (*Pica pica*), rook (*Corvus frugilegus*), Carrion crow (*Corvus corone*), Hooded crow (*Corvus cornix*), Lesser Whitethroat (*Sylvia curruca*), Chiffchaff (*Phylloscopus collybitus*), Goldcrest (*Regulus regulus*), Spotted flycatcher (*Muscicapa striata*), Blackbird (*Turdus merula*), Coal tit (*Parus ater*), Great tit (*Parus major*), house sparrow (*Passer domesticus*).

Table 2 – Results of counting the number of birds in the Botanical garden, 2019.

Birds species	Number (unit)				
	February	March	April	May	June
Magpie	36	71	56	62	66
Great tit	68	76	52	57	58
House Sparrow	–	23	20	24	27
Blackbird	21	18	27	27	25
Woodpigeon	–	–	13	10	11
Chiffchaff	~20	~20	~20	~20	~20
Mynah	–	–	–	8	12
Pheasant	–	–	–	5	8

Among other classes of vertebrates, there is much less species diversity in the study areas. A total only 5 species of wild–living mammals and 1 species of reptiles were recorded using route records: Central Asian (steppe) turtle (*Testudo horsfieldi Gray*); Weasel (*Mustela nivalis*), Shrew (*Sorex araneus*), House mouse (*Mus musculus*), grey rat (*Rattus norvegicus*), Squirrel (*Sciurus vulgaris*). Amphibians were not found in the parks. At the same time, in the period of 1980–1990, scientists of the Institute of Zoology registered 10 species of reptiles and 3 species of amphibians on the territory of Almaty: Green toad (*Bufo viridus Laur*.) lake frog (*Rana ridibunda Pall*.), Siberian frog (*Rana amurensis Boul*.), colorful lizard *(Eremias argute Pall*.), fast lizard (*Eremias velox Pall*.), *Asymblepharus alaicus Elpatjewsky*, dice snake (*Natrix tessellate Laur*.), grass snake (*Natrix natrix L*.), *Agkistrodon halys Pall*., steppe viper (*Vipera ursini Bonap.*), patterned skid (*Elaphe dione Pall*.), *Psammophis lineolatum Brandt.*

According to studies conducted in European cities in the early 1980s, amphibians in the urban environment are more susceptible to death as a result of anthropogenic factors. On roads at that time, about 50 % of all dead vertebrates were amphibians [19]. The result of anthropogenic impact in the case of batrachofauna is also a change in the quantitative ratio of species, location (where the main factor is the

xerification of the environment), the age composition of the population, as well as morphological characteristics of individuals [8].

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 % [20]. 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 [21]. 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), 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 (Park) areas of the city in winter: *Accipiter nisus, Falco columbarius, Phasianus colchinus, Streptopelia decaocto, Streptopelia senegalensis, Bubo bubo, Asio otus, Dendrocopos major, Picoides tridactylus, Acridotheres tristis, Pica pica, Corvus monedula, Corvus frugilegus, Corvus corone, Corvus cornix, Troglodytes troglodytes, Prunella atrigularis, Regulus regulus, Leptopoecile sophiae, Turdus atrogularis, Turdus pilaris, Turdus merula, Turdus viscivorus, Parus ater, Parus cyanus, Parus major, Passer domesticus, Passer montanus, Fringilla coelebs, Fringilla montifringilla, Serinus pusillus, Spinus spinus, Carduelis carduelis, Carpodacus rhodochlamys, Uragus sibiricus, Mycerobas carniceps*;

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

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

– and the autumn population – 46 species: *Accipiter nisus, Falco tinnunculus, Phasianus colchinus, Columba palumbus, Streptopelia decaocto, Streptopelia orientalis, Streptopelia senegalensis, Merops apiaster, Dendrocopos major, Hirundo rustica, Motacilla cinerea, Motacilla personata, Sturnus vulgaris, Acridotheres tristis, Pica pica, Corvus monedula, Corvus frugilegus, Corvus corone, Corvus cornix, Prunella atrigularis, Phylloscopus collybitus, Phylloscopus trochiloides, Phylloscopus inornatus, Regulus regulus, Muscicapa striata, Phoenicurus erythronotus, Luscinia svecica, Turdus atrogularis, Turdus viscivorus, Remiz pendulinus, Parus ater, Parus cyanus, Parus major, Passer domesticus, Coracias garrulous, Passer montanus, Fringilla coelebs, Fringilla montifringilla, Serinus pusillus, Chloris chloris, Carduelis carduelis, Carduelis caniceps, Carpodacus erythrinus, Uragus sibiricus, Mycerobas carniceps, 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 Park 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. It is important to note that only 2–5 km South of the upper observation site (the first President's Park) there are already species that were not marked by the author of the work in the model areas (Grey Goldfinch(*Carduelis caniceps)*, Waxwing(*Bombycilla garrulus*), Scops Owl (*Otus scops)*, Roller (*Coracias garullus*), Black Kite (*Milvus migrans*), Rufous Turtle Dove (*Streptopelia orientalis*), Golden Jackal(*Canis aureus*), European Badger (*Meles meles*), Alaian Lidless Skink (*Asymblepharus alaicus*), frogs (*Ranidae*), etc.), which suggests the presence of significant anthropogenic pressure on the species composition of the fauna.

Thus, at this stage of research, 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 fauna in Almaty.

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УРБАНИЗАЦИЯҒА БАЙЛАНЫСТЫ АЛМАТЫ ҚАЛАСЫНЫҢ ЖАСЫЛ АЙМАҚТАРЫНДАҒЫ ОМЫРТҚАЛЫ ЖАНУАРЛАР ФАУНАСЫНЫҢ ӨЗГЕРУІ

Аннотация. Бұл мақалада урбанизация процестерінің Алматы қаласының кейбір жасыл аймақтарында фауна сипаттамаларының өзгеру динамикасына әсері қарастырылады, атап айтқанда, Алматы қаласының Бас ботаникалық бағы, 28 гвардиялық–панфиловшылар паркі, Тұңғыш Президент саябағы. Мақалада қоршаған ортаның ластануы, дәлірек атмосфералық ауаның ластануы және оның құстар мен басқа да жануарлардың қауымдастығына әсері де қозғалады.

Мұндай экожүйелердің қалыптасу және жұмыс істеу процестерін зерттеу қазіргі экологияның ең өзекті мәселелеріне жатады. Зоологиялық элемент сыртқы факторлардың әсерінен динамикалық өзгерістерге ұшырайды, ал қала жағдайында ландшафтардың мозайкалық деңгейінің жоғары болуы, экожүйелердің экологиялық тұрақтылығының төмен деңгейі, сондай–ақ ортаның басқа да ерекше жағдайлары, популяцияның Жануарлар ішінде өтетін процестер табиғи жағдайлардан қарқындылығы жағынан үлкен жағына қарай ерекшеленеді және жануарлар табиғи жағдайларға қарағанда ортаның сыртқы факторларының әсеріне аса сезімталдық танытады.

Жұмыстың мақсаты соңғы 30 жылда Алматы қаласының оңтүстік бөлігінің кейбір саябақ аймақтары шегінде омыртқалы жануарлардың түрлік құрамын қалыптастыру заңдылықтарын анықтау болып табылады. Зерттеу барысында келесі міндеттер шешілді: 1) қалалық ландшафттың даму процестерін және оның әлеуметтік–экономикалық және экологиялық сипаттамаларын зерттеу; 2) Алматы қаласының жасыл аймақтарының аумағында мекендейтін құстар, амфибиялар, рептилиялар және сүтқоректілер фаунасының қазіргі заманғы түр құрамын нақтылау; 3) Алматы қаласының оңтүстік бөлігінің жасыл аймақтары шегінде омыртқалы жануарлар фаунасының өзгеруінің мүмкін себептерін анықтау.

Зерттеу жүргізу барысында авторлар келесі әдістерді пайдаланды:

1. Құстарды есепке алудың маршруттық әдісі.
2. Амфибияларды есепке алудың маршруттық әдісі.
3. Сүтқоректілерді есепке алудың маршруттық әдісі.
4. Флуктуирлеуші асимметрияны өлшеу жолымен биоиндикация әдісі.

Омыртқалы жануарларды есепке алу 2019 жылдың қаңтар айынан желтоқсан айына дейін Алматы қаласының Бас ботаникалық бағында, Тұңғыш Президент саябағында, 28 гвардияшы–панфиловшылар атындағы саябағында, Ганди саябағында жүргізілген. Ауа сапасына биологиялық тестілеу жүргізу үшін материалдарды іріктеу қаланың орталық аудандарына қатысты автомагистральдарға және географиялық

бөлуге жақындық белгісі бойынша сараланған қала аумағындағы 7 нүктеде жүргізілді. Атмосфера сапасын анықтауына ресми зерттеу деректері пайдаланылды.

Жүргізілген есептер түрлік әртүрліліктің төмендеуін (модельдік учаскелер шегінде) анықтауға мүмкіндік берді, ол антропогендік престің үздіксіз күшеюіне байланысты Алматы қаласының омыртқалы жабайы фаунасының тұрақты мекендейтін жерлерінің қайта бөлінуіне байланысты болуы мүмкін, ол ортаның химиялық және физикалық ластануының шамасына, сондай–ақ қала халқының тығыздығы мен санының өсуіне байланысты. Сондай–ақ фауна сипаттамаларының өзгеру себептерінің бірі климаттық көрсеткіштердің өзгеруі болып табылады: соңғы жетпіс жыл ішінде әр онжылдықта құрғақ және ыстық күндер санының 1–3–ге артуы, жазғы кезеңде жауын–шашын мөлшерінің азаюы, орташа жылдық температураның артуы, 1950 жылмен салыстырғанда мұз массасының 15–20 %–ға төмендеуі. Сондай–ақ, жасыл желектердің алуан түрлілігі мен алаңын төмендету, сонымен қатар олардың қабаттылығын бұзу факторы елеулі әсер етеді, өйткені фаунаның қалыптасуының маңызды аспектісі тағамның жеткілікті молдығы және популяцияларды жаңғыртуға қажетті жағдайлар болып табылады. Авторлардың бақылаулары бойынша, сол немесе басқа да көгалдандырылған аймаққа келушілер саны да омыртқалылардың түрлі түрлерінің кездесулеріне айтарлықтай әсер етеді.

Осылайша, биоәртүрліліктің төмендеуінің қаланың урбанизация үдерістерінің қарқындауынан белгілі бір тәуелділігі анықталды. Бұл мәселе осы көрсеткіштерді корреляциялау факторларын одан әрі әзірлеуді және нақтылауды талап етеді.

Түйін сөздер: фауна, омыртқалылар, құстар, Алматы, урбанизация, жасыл аймақтар, ластану.

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ИЗМЕНЕНИЕ ФАУНЫ ПОЗВОНОЧНЫХ В ЗЕЛЕНЫХ ЗОНАХ ГОРОДА АЛМАТЫ В СВЯЗИ С УРБАНИЗАЦИЕЙ

Аннотация. В статье рассматривается влияние процессов урбанизации на динамику изменения характеристик фауны в некоторых зеленых зонах города Алматы таких, как главный ботанический сад г.Алматы, парк 28 гвардейцев–панфиловцев, парк Первого Президента. В статье также затрагивается тема загрязнения окружающей среды, а именно атмосферного воздуха и его влияние на сообщества птиц и других животных.

Исследование процессов формирования и функционирования таких экосистем относится к наиболее актуальным вопросам современной экологии. Зоологический элемент более всего подвержен динамическим переменам под влиянием внешних факторов, а в условиях города, где наблюдается высокая степень мозаичности ландшафтов, меньший уровень экологической устойчивости экосистем, а также многие другие специфические условия среды, процессы, протекающие внутри животных популяций значительно отличаются в большую сторону по интенсивности от естественных, и животные проявляют еще большую чувствительность к воздействию внешних факторов среды, чем в естественных условиях.

Целью работы является выявление закономерностей формирования видового состава позвоночных животных в пределах некоторых парковых зон южной части города Алматы в разрезе последних 30 лет. В ходе исследования решались следующие задачи: 1) изучить процессы развития городского ландшафта и его социально–экономических и экологических характеристик; 2) уточнить современный видовой состав фауны птиц, амфибий, рептилий и млекопитающих, обитающих на территории зеленых зон г.Алматы; 3) установить возможные причины изменений населения фауны позвоночных в пределах зеленых зон южной части г.Алматы.

В процессе проведения исследования авторами использовались следующие методы:

1. Маршрутный метод учета населения птиц;
2. Маршрутный метод учета амфибий и рептилий;
3. Маршрутный метод учета млекопитающих;

4. Метод биоиндикации путем измерения флуктуирующей асимметрии.

Учеты позвоночных животных проводились с января по декабрь 2019 года на территории Главного ботанического сада г. Алматы, парка Первого Президента, парка им. 28 гвардейцев–панфиловцев, парка Ганди. Отбор материала для проведения биологического тестирования качества воздуха производилось в 7 точках на территории города, дифференцированных по признаку приближенности к автомагистралям и географическому распределению относительно центральных районов города. Использованы данные официальных исследований качества атмосферы.

Проведенные учеты позволили выявить снижение видового разнообразия (в пределах модельных участков), которое, вероятно, вызвано перераспределением мест постоянного обитания дикоживущей фауны позвоночных г.Алматы в связи непрерывным усилением антропогенного пресса, который выражается в увеличении ровня химического и физического загрязнения среды, а также ростом плотности и численности населения города. Также одной из причин изменения характеристик фауны может служить изменения климатических показателей: именно увеличение количества сухих и жарких дней на 1–3 каждое десятилетие в течение последних семидесяти лет, сокращение количества осадков в летний период, увеличение среднегодовой температуры, снижение ледниковой массы на 15–20% по сравнению с 1950 г. По результатам анализа загрязнения атмосферного воздуха посредством биоиндикации и изучения данных различных ведомств, можно сделать вывод, что центральные и густонаселенные районы города подвергаются крайне серьезному антропогенному давлению. Также значительное воздействие оказывает фактор снижения разнообразия и площади зеленых насаждений, а также нарушений их ярусности, так как важным аспектом формирования фауны является достаточное обилие пищи и условий, необходимых для воспроизведения популяций. По наблюдениям авторов, количество посетителей тех или иных озелененных зон также значительно влияет на встречаемость различных видов позвоночных.

Таким образом, выявлена определенная зависимость снижения биоразнообразия от интенсификации процессов урбанизации города. Данный вопрос требует дальнейшей разработки и уточнения факторов корреляции данных показателей.

Ключевые слова: фауна, позвоночные, птицы, Алматы, урбанизация, зеленые зоны, загрязнение.

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REFERENCES

[1] Kubantsev B.S., Kolyakin N.N. Spatial differentiation of the animal component of industrial city ecosystems // Ecology, 1995. N 2. P. 140–145.

[2] Izbitskaya V., Evening Almaty: Green Card [Electronic resource].2019. Date of update: 14.11.19. URL: http://vecher.kz/incity/zeljonaya–karta (date of the application: 15.12.19)

[3] BS RK 3.01–02–2012 Plannig and construction of individual housing areas [SN RK. Planirovka i zastroyka raiyonov individualnogo zhilishnogo stroitelstva]. Nur–sultan, Kazakhstan, 2012 (in Russ.).

[4] Ravkin E.S., Chelintsev N.G. Methodological recommendations for integrated route accounting of birds. M.: Ed. Nature research Institute, 1990. 33 p.

[5] Freeman, D.C., Graham, J.H., Emlen, J.M. (1993) Developmental stability in plants: Symmetries, stress and epigenesis. Genetics 89, 97–119. URL: file:///C:/Users/IRBIS/Downloads/Developmental_stability_in_plants_Symmet.pdf (date of the application: 4.10.18)

[6] Freeman D.C., Graham J.H., Elena J.M., Tracy M., Hough R.A., Alados C., Escós J. Plant developmental instability: New measures, applications, and regulation. In Developmental instability: Causes and consequences; Polak, M., Ed.; Oxford University Press: New York, NY, USA, 2003. P. 367–386

[7] Borodikhin I.F., Birds of Alma – Ata, Alma–Ata, «Science», 1968. 121 p., P. 110–111.

[8] Vertebrates of Alma–Ata. Science, KazSSR 1988. ISBN 5–628–00325–5

[9] General plan for strengthening Vernyi, the Big And Small Almaty villages and the Tashkent Slobodka, with the surrounding area for a cannon shot. 1858;

[10] Foundation of the city of Alma–ATA (on the organization of strengthening Vernyi). Architecture and construction of Uzbekistan. 1990. N 6. 32 p.

[11] The first topographical survey of Alma–ATA. In the book.: Abstracts of the 2nd Congress of the geographical society of the Kazakh SSR (section of physical geography, teaching methods and history of geography). Alma–Ata, Science publishing house, 1985. P. 95–96.

[12] Auzhanov N. Alma–ATA – special legal status//Kazakhstan: economy and life, N 2, 1992. P. 52–54. URL: http://www.ecopolis.kz/category/planirovka–i–zastrojka–g–almaty–i–prigorodnoj–zony/ (date of the application: 29.11.19)

[13] On the change in the population of the Republic of Kazakhstan from the beginning of 2018 to January 2019. Statistics Committee of the Ministry of national economy of the Republic of Kazakhstan.URL: http://stat.gov.kz (date of the application 4.02.2019)

[14] monthly newsletters of RSE "Kazhydromet": 2010 N 1–12, 2011 N 1–12, 2012 N 1–12, 2013 N 1–12, 2014 N 1–12, 2015 N 1–12, 2016 N 1–12, 2017 N 1–12, 2018 N 1–12. URL: https://kazhydromet.kz/ru(date of the application 7.12.2019)

[15] National Center for Expertise. 2019. [Electronic rsource] URL: https://nce.kz/media/news/14819/ (date of the application 30.10.2019)

[16] Almaty air quality maps. 2019. URL: https://airkaz.org (date of the application 30.10.2019)

[17] Joseph L Tomkins, Janne S Kotiaho Fluctuating Asymmetry/ / ENCYCLOPEDIA OF LIFE SCIENCES / & 2001 Macmillan Publishers Ltd, Nature Publishing Group / www.els.net ; URL: http://users.jyu.fi/~jkotiaho/Publications/ELS01. pdf; (date of the application 22.01.2020)

[18] Birdwatching diaries. Birds of Kazakhstan: Askar Isabekov.2005. URL: https://birds.kz/m/v2blogs.php?l=ru&s=215

[19] Klausnitzer B. Ecology of urban fauna. Mir, USSR–1990.ISBN 5–03–001383–0

[20] Minasyan G., climate Change in Kazakhstan, URL: https://www.inform.kz/ru/ (date of the application 17.10.2019)

[21] Burt W.H. 1943 William Henry Burt, Territoriality and Home Range Concepts as Applied to Mammals, Journal of Mammalogy, 17 August 1943. Vol. 24, Issue 3. P. 346–352, URL: https://doi.org/10.2307/1374834 (date of the application 23.09.2019).

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