The dynamics of fauna and population of birds in agricultural landscapes on the border of Kazan International Airport

A F Bespalov and A N Belyaev

Institute of Fundamental Medicine and Biology, Kazan Federal University, Kremlevskaya str., 18, 420008, Russia

E-mail: kerwood@mail.ru

Abstract. The dynamics of fauna and population of birds from agricultural lands near Kazan International Airport has been studied for one year. A total of 60 bird species have been registered, of which 26 species must be considered as highly dangerous to flying aircraft. With regard to seasonal activity, the nesting period (April – June) is the most hazardous, since it is characterized by maximum species richness and total population density of birds, as well as their high species diversity. Furthermore, a serious danger is posed by the period of post-nesting nomadic movements and the onset of migrations (July – September) when the species diversity turns out to be the highest and the total population density begins to decrease. It has been recommended based on the obtained results that the current crops should be replaced by cultivars that will be less attractive to birds. In spring and autumn, certain bird hazing and frightening measures must be taken on a more regular basis.

1. Introduction

The need to ensure flight safety, which appeared due to advances in air transportation since the late 20th century, is closely associated with the problem of reducing bird-aircraft collisions. This problem can not be solved efficiently without detailed studying of annual behavioral patterns in birds living near airports and aircraft runways [2, 3, 4], because 70% of all birdstrikes take place in aerodrome areas, especially during takeoff and landing [5].

The aim of this study is to reveal the annual dynamics of fauna and bird populations from agricultural lands near Kazan International Airport, as well as to find out the extent to which their presence on the edge of the airport is dangerous for aircraft flying. The following tasks are set in accordance with the above aim: to assess species richness, total population density, and species diversity of birds inhabiting agricultural lands near the airport territory; to identify the dominant species in the overall bird population; and to describe seasonal aspects in the dynamics of bird fauna and population changes.

Kazan International Airport is a large airport which located 26 km south of Kazan, and has has been operating flights since 1979. Its territory is surrounded by agricultural lands, i.e., fields divided by forest belts and meadows. During the period of study, rye, wheat, medick, potato, and pea plants were recorded in the fields adjacent to the aerodrome.

2. Material and methods

Route counting of birds without limiting transect width was performed from June 2015 to May 2016 (every month) in agricultural lands along the perimeter of the airport borders. The route length was 13 km and remained unchanged throughout the study. All birds, regardless of the distance to them, were registered with subsequent conversion of the obtained data into area units based on average detection ranges [6]. For birds registered as they were flying, corrections were made for the average rate of their movement [7]. Using the materials of route counting, the population density of birds was determined and seasonal aspects in the bird population were assessed. When describing the bird population, only species accounting for more than 10% of the community were considered as either dominants or subdominants, depending on their abundance. In order to assess the population structure of birds, the following parameters were used: species richness (number of species), total population density (density (ind./km^2) of birds in all types of habitats under consideration), species diversity (Shannon-Weaver index). The population of birds was investigated using cluster analysis with the help of the PAST software (version 3.16) based on measuring the Euclidean distance (paired group option).

3. Result and discussions

Sixty bird species were registered during the period of study. Among them, 38 species were passerines. The species richness gradually decreased from June (28 species) (figure 1) to December (2 species), then increased, most sharply from April (21 species) to May (30 species). The largest number of species was found from April to September, thereby indicating the importance of this habitat for bird groups in the nesting period and their further nomadic movements. In winter, birds tend to stay away from agricultural lands.

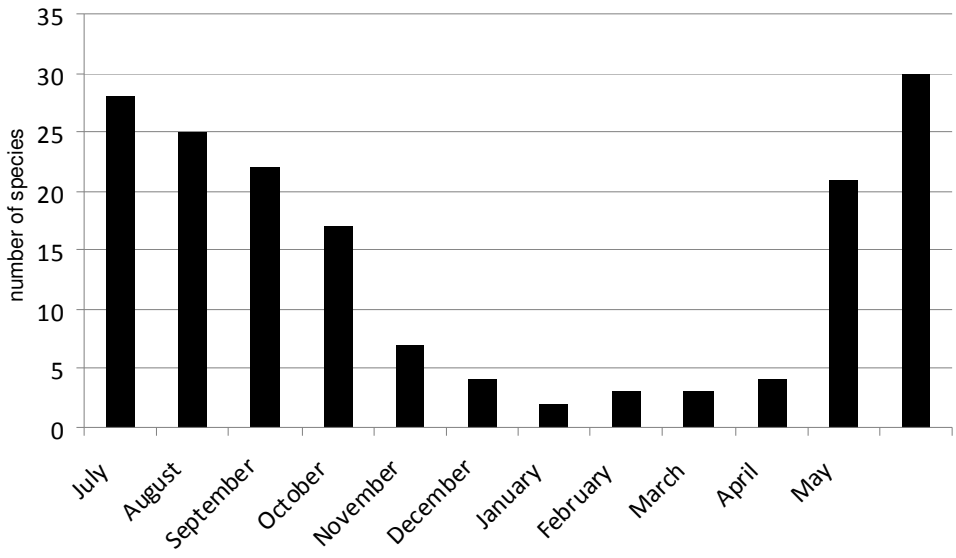

Figure 1. The dynamics of species richness (number of species) of birds in agricultural areas on the border with Kazan International Airport.

The following bird species (relatively large-sized or gregarious) posing a potential risk to aircraft were resident in the territory of study: grey heron (*Ardea cinerea*), bean goose (*Anser fabalis*), mallard (*Anas platyrhynchos*), black kite (*Milvus migrans*), hen harrier (*Circus cyaneus*), pale (*C. macrourus*), Montagu's harrier (*C. pygargus*), Western marsh harrier (*C. aeruginosus*), northern goshawk (*Accipiter gentilis*), common buzzard (*Buteo buteo*), eastern imperial eagle (*Aquila heliacal*), white-tailed eagle (*Haliaeetus albicilla*), common kestrel (*Falco tinnunculus*), grey partridge (*Perdix perdix*), northern lapwing (*Vanellus vanellus*), black-headed gull (*Larus ridibundus*), common wood

pigeon (*Columba palumbus*), rock dove (*C. livia*), short-eared owl (*Asio flammeus*), black woodpecker (*Dryocopus martius*), common starling (*Sturnus vulgaris*), rook (*Corvus frugilegus*), hooded crow (*C. cornix*), common raven (*C. corax*), fieldfare (*Turdus pilaris*), and redwing (*T. iliacus*). The occurrence of semiaquatic bird species is due to the relative proximity of the Mesha River. Migratory geese are attracted to large winter crop areas. In these areas predatory species find stable groups of other small-sized birds and mammals. Synanthropic species fly to the territory because of nearby villages and airport facilities, which are favorable for nest building.

The total density of bird population (figure 2) reached a maximum in June (1188.1 ind./km^2) and May (1139.1 ind./km^2) and a minimum during the period from October to March, falling to6.2 ind./km^2 in December. Interestingly, the values of this parameter obtained for the same period turned out to be several times higher in the adjacent small forest habitats [8]. The population density of birds staying in agricultural lands during and, especially, after the nesting period was mainly dependent on the field-grown crop species and the extent of their harvesting, as well as the presence of forest belts adding tree, shrub, and marginal species to the complex of plants [9, 10].

The highest population density was recorded for Eurasian skylark (*Alauda arvensis*) from April to June (up to 443.1 ind./km^2 in May). Moreover, the following bird species were characterized by high population density: common chaffinch (*Fringilla coelebs*) (up to 196.9 ind./km^2 in June) confined to the forest belts; Western yellow wagtail (*Motacilla flava*) (up to 190,8 ind./km^2 in May); and common linnet (*Acanthis cannabina*) (up to 190.8 ind./km^2 from July to September) migrating from one agricultural land to another after the nesting period. The dominance of the former three species in agricultural landscape of the studied territory was reported previously by other researchers [11]. These birds are small-sized and pose little danger to aircraft.

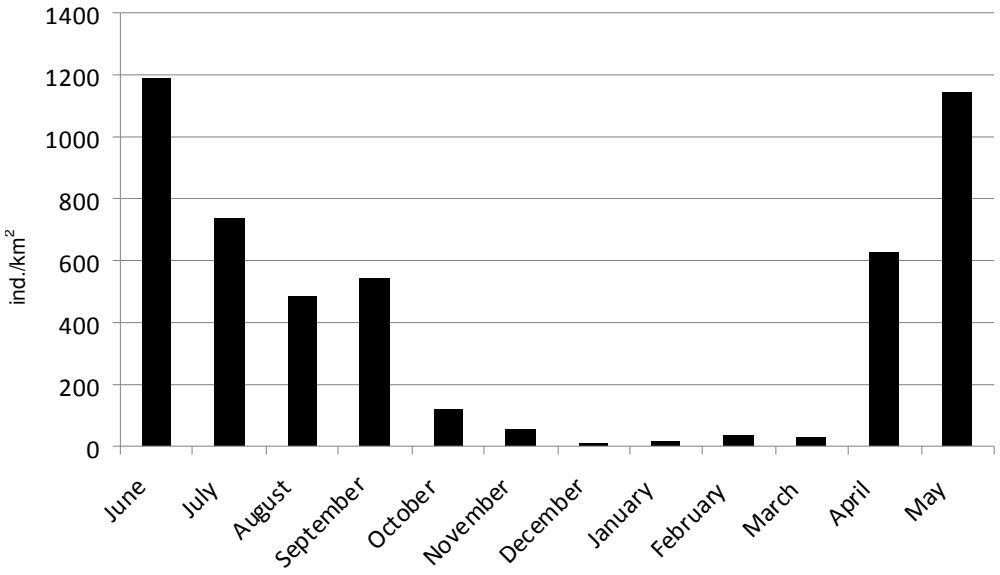

Figure 2. The dynamics of total population density (ind./km^2) of birds in agricultural areas on the border with Kazan International Airport.

Prevailing bird species were *A. arvensis* from April to June (up to 50%), *M. flava* in July (18.9%), *A. cannabina* in August-September (up to 35.4%), great tit (*Parus major*) from October to December (42.1-99.7%), and *P. perdix* from January to March (99.8-37.5%). In different months, the subdominants were tree pipit (*Anthus trivialis*) (up to 13.4%), Eurasian magpie (*Pica pica*) (up to 25%), Eurasian tree sparrow (*Passer montanus*) (up to 31.6%), *F. coelebs* (up to 16.6%), Eurasian siskin (*Spinus spinus*) (up to 13.7%), and European goldfinch (*Carduelis carduelis*) (up to 37.5%).

Therefore, small-sized bird species were generally dominant in the population. They are not very hazardous to aircraft. The flocks of *P. perdix* stayed in the fields and meadows around the aerodrome during the winter period only. These birds may collide with aircraft at low elevations, during takeoff and landing.

The biodiversity index (figure 3) hardly reached 0.02 in winter months, increased from March to July (1.1-2.5), and then decreased from August to November (2.4-1.0). On the whole, these values are not high, and the maximum diversity of birds in July and August indicates the important role of the biotope for post-nesting nomadic movements and autumn migrations.

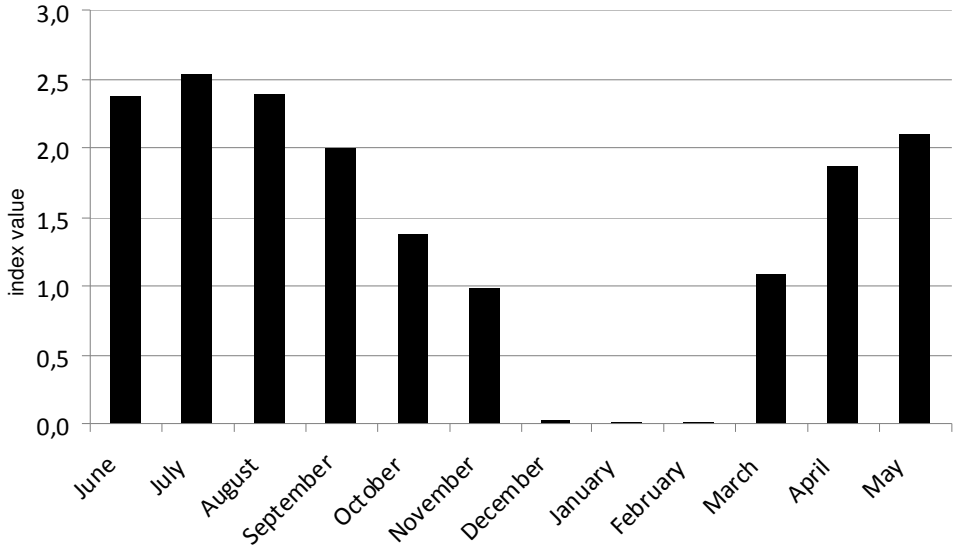

Figure 3. The dynamics of species diversity (Shannon-Weaver index) of birds in agricultural areas on the border of Kazan International Airport.

Cluster analysis revealed seasonal specifics in bird population. The nesting period (April – June) (figure 4) characterized by the maximum values of species richness and total population density of birds, as well as their high species diversity, stands out.

The period of post-nesting nomadic movements and the onset of migrations (July – September) with the maximum species diversity can be distinguished. The species richness and total population density of birds begins to decrease. During this period, the risk of birdstrikes in the airport area is particularly high.

In other months, the fauna and population of birds are generally characterized by the low values of species richness, total population density, and species diversity. Hence, birdstrikes become less likely.

Attention should be paid to the fact that the structure of bird population during the vegetation period differed in some areas of agricultural lands near the airport. The southeastern border with the airport is most dangerous, because the territories adjacent to it are actively used for growing winter crops and the Mesha River is not away from this area. Winter crops attract birds, including predators, as the places for feeding and nesting. The areas around the Mesha River are parts of migratory routes in spring and autumn for many bird species, especially semiaquatic ones, such as geese. In other periods, these areas favor penetration of semiaquatic birds and large-sized predators into the southern border with the airport.

For example, a flock of bean geese was flying northwards along the Mesha River on May 11 (12.24 a.m.), but then changed its course and began to slowly circle at the height of 40 m above the southern border of the airport, heading to its territory for daytime rest and in search for food, because it was attracted by the large green areas of winter crops.

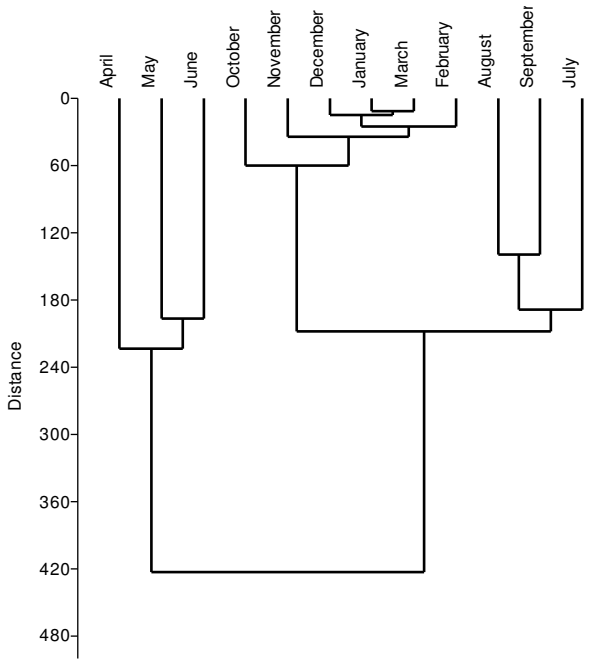

Figure 4. The dendrogram of similarities in bird population in different months.

Furthermore, ten white-tailed eagles from the areas of the Mesha River circled for a long time over this territory. The birds hovered and swooped down on each other with specific squawks, flying below 30 m or above 300 – 400 m. They moved to the airport territory and back to its border, circling above the field with winter crops. In the daytime, black-headed gull flocks (up to 86 ind.) fly above this habitat, including the aerodrome area, from the south. Thus, particular attention should be focused on the southern border of the airport. Winter crops are very attractive for migratory geese and other birds. So, it is appropriate to replace them with cultivars that will be less preferred by birds [12]. In spring and autumn, certain hazing measures should be taken to scare birds flying from the Mesha River.

Therefore, agricultural lands with both open (fields) and forest (forest belts) areas are used by various bird species from open and forest biotopes. Intermittent water bodies which dry out later in spring add even typical semiaquatic birds (mallard) to the bird fauna. After the harvesting period, many seeds are left in fields. They are potential food objects and attract birds during the period of post-nesting nomadic movements (August-September). There are also many sparrow nestlings in the period from June to September, which attract predatory birds, thereby creating the risk of birdstrikes. The studied territory was unattractive to birds from October to March. During this period, only migratory (tits) or passing (*C. cornix*) birds could be seen here in the daytime, and only small flocks of *P. perdix* appear to be more stable, being confined to winter crops.

4. Conclusions

1. A total of 60 bird species were registered, of which 26 species must be considered as highly dangerous for aircraft flying.

2. The species richness of birds decreased from June (28 species) to December (2 species) and then increased, most dramatically from April (21 species) to May (30 species). The number of species was higher in April-September, thereby confirming that the studied habitat plays an important role for bird groups during the nesting period and subsequent post-nesting nomadic movements.

3. The total density of bird population was maximum in May-June and low during the period from October to March, being determined mainly by the field-grown crop species and the extent of their harvesting, as well as the presence of forest belts.

4. The bird population was dominated by small-sized species (*A. arvensis*, *M. flava*, *A. cannabina*, *P. major*) posing little danger to aircraft flying. The flocks of *P. perdix* stayed in the fields and meadows around the aerodrome during the winter period. These birds may collide with aircraft at low elevations, during takeoff and landing.

5. The species diversity index was low during winter months (up to 0.02), then increased from March to July (up to 2.5), and then decreased from August to November (up to 1.0). On the whole, these values are not high, and the maximum diversity of birds in July and August indicates the important role of the biotope for post-nesting nomadic movements and autumn migrations.

6. With regard to seasonal specifics, the most dangerous periods for aircraft flying can be distinguished according to bird population dynamics: the nesting period (April – June), which is characterized by the maximum values of species richness and total population density of birds, as well as the high values of species diversity of birds; the onset of migrations (July – September) with the maximum values of species diversity and the beginning of a decrease in species richness and total population density. In other months, the fauna and population of birds is generally characterized by low values of species richness, total population density, and species diversity.

7. It was recommended based on the obtained results that the current crops must be replaced by cultivars that will not attract birds. In spring and autumn, bird hazing must be carried out on a more regular basis.

References

[1] Dolbeer R A 2013 *Wildlife in Airport Environments: Preventing Animal-Aircraft Collisions through Science-Based Management* (The Johns Hopkins University Press, Baltimore, Maryland, in association with The Wildlife Society) p 1–6
[2] Molodovskii A V and Zaloznykh D V 1999 *Vest. Nizhegorod. Gos. Univ. im. N.I. Lobachevskogo. Ser. Biol*. **1** 39–47
[3] Sodhi N S 2002 *The Auk* **119** 587–595
[4] Blackwell B F, Schmidt P M and Martin J A 2013 *Wildlife in Airport Environments: Preventing Animal-Aircraft Collisions through Science-Based Management* (The Johns Hopkins University Press, Baltimore, Maryland, in association with The Wildlife Society) p 153–165
[5] Borisov V V, Uryadova L P and Shcheblykina L S 2014 *Vestn. Pskov. Gos. Univ. Ser. Estestv. Fiz.-Mat. Nauki* **5** 3–11
[6] Ravkin Yu S 1967 *Nature of Tick-Borne Encephalitis Loci in Altai* (Novosibirsk: Nauka) p 66–75
[7] Ravkin Yu S and Dobrokotov B P 1963 *Organization and Methods for Counting Birds and Hazardous Rodents* (Moscow: Izd. Akad. Nauk SSSR) p 130–137
[8] Bespalov A F and Belyaev A N 2017 *Proc. Lyubishchev Lectures: Current Problems of Ecology and Evolution* (Ulyanovsk: UlGPU im. I. N. Ul'yanova) p 268–272
[9] DeVault T L, Begier M J, Belant J L, Blackwell B F, Dolbeer R A, Martin J A, Seamans T W, and Washburn B E 2013 *Human-Wildlife Interactions* **7(1)** 10–15
[10] Iglay R B, Buckingham B N, Seamans T W, Martin J A, Blackwell B F, Belant J L and DeVault T L. 2017 *Agriculture, Ecosystems and Environment* **242** 34–42
[11] Ivliev V G 2010 *Spatial and Temporal Heterogeneity of Bird Populations in Agro-Landscapes of the Republic of Tatarstan* (Kazan: Novoe Znanie) p 204
[12] DeVault T L, and Washburn B E 2013 *Wildlife in Airport Environments: Preventing Animal-Aircraft Collisions through Science-Based Management* (The Johns Hopkins University Press, Baltimore, Maryland, in association with The Wildlife Society) p 79–90