RESULTS OF THE ANALYSIS OF BIRDSTRIKES TO AEROFLOT REGISTERED AIRCRAFT FOR THE PERIOD FROM 1970 TO 1979

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The research work to prevent collisions of aircraft with birds is carried out in the USSR on a complex basis in various areas, including:

- analysis of birdstrike incidents to aircraft;
- identification of seasonal and regional features of ornithological situation;
- development and realization of measures to reduce the attractiveness of aerodrome territories to birds;
- development of methods for ecological and ornithological survey of aerodrome areas;
- employment of radar stations for detection of flying birds;
- development of methods and means for scaring away birds from aerodromes (bioacoustic units, pyrotechnic devices, birds of prey, etc.);
- studies of the effectiveness of switched-on aircraft landing lights in the daytime for driving off birds;
- investigations into the response of birds to an approaching aircraft,and some other areas.

The results of birdstrike incidents to USSR civil aircraft, as recorded during 1970 to 1979, show the following.

By the types of aircraft the birdstrike incidents were distributed as follows:

turbojet aeroplanes	- 32%
turboprop aeroplanes	- 49%
piston aeroplanes	- 16%
helicopters	- 3%.

This data indicates that turboprop aeroplanes account for a major part of collisions. However, it should be noted that the number of birdstrikes to turbojets was increasing from year to year and it was in 1978-1979 that it first exceeded the number of birdstrikes to turboprop aeroplanes.

Depending on the place of impact of a bird on an aircraft the collisions were distributed as follows:

engine	-	[illegible]
wing	-	31%
widshield	-	6%
radar antenna	-	6%
stabilizer	-	3
fuselage	-	5%
landing light	-	8%
landing gear	-	2%.

By the months the birdstrike incidents were distributed as follows:

January and February	-	2% (each)
March	-	6%
April and May	-	about 9% (each)
June and July	-	about 12% (each)
August and September	-	14% (each)
October	-	12%
November and December	-	4% (each).

For a period of 10 years 67% of birdstrikes were recorded in the daytime and 33% at night. In spite of the fact that the strikes recorded at night are twice as few as in the daytime, the probability of birdstrikes to an aircraft in the daylight and in the dark is of no big difference because the flight density is materially lower lower at night than in the daytime.

The crest of the absolute number of night birdstrikes fell on May ([illegible]) and October (19%). Howevere, the amount of night birdstrikes reached its maximum in spring, April (29%) and in autumn, November (40%).

On the whole, the amount of birdstrikes at night was 25% and 33% in spring and autumn (periods of intensive night migrations), respectively, 14% in summer, 22% in winter (many birds birds fly away for feeding and fly back for a night rest in the dark).

The birdstrike incidents were distributed by altitudes as follows:

0 to 100 m	-	46%
101 to 400 m	-	28%
401 to 1000 m	-	13%
1001 to 2000 m	-	7%
2001 to 5000 m	-	5%
over 5000 m	-	1%.

In spring and autumn the number of collisions at high altitudes increases considerably since it is at these times that birds undertake migratory flights which often happen at high altitudes. Also, in spring and autumn the amount of night collisions grows considerably at altitudes over 400 m. This can be explained by the fact that intensive night migrations at high altitudes take place in these periods of the year.

By aircraft speeds the birdstrike incidents were distributed as follows:

up to 100 km/hr	- 3%
101 to 300 km/hr	- 71%
301 to 500 km/hr	- 25%
over 500 km/hr	- 1%.

By the phases of flight the birdstrike incidents were distributed as follows:

taxiing	- 1%
take-off and landing run	- 5%
take-off	- 13%
climbing	- 25%
cruising	- 5%
descent	- 39%
landing	- 12%.

The overwhelming majority of collisions at the 'descent' and 'climbing' phases occurred at altitudes up to 400 m, i.e. in close proximity to an aerodrome.

By ecologo-systematic groups of birds the birdstrike incidents are distributed as follows:

pigeons	- 26%
gulls	- 19%
waterfowl (ducks, geese)	- 14%
small house-sparrows	- 14%
birds of prey (falcons, goshawks, eagles)	- 13%
corvidae (crows, rooks, jackdaws)	- 6%
swifts	- 3%
owls	- 3%
storks and cranes	- 2%.

Pigeons, [illegible] sparrows and birds of prey most [illegible] with aircraft.

The amount [illegible] collisions with pigeons was relatively high in [illegible] with gulls - high in summer and [illegible] of prey - high in spring and [illegible] in spring and autumn [illegible] autumn and winter [illegible] birds - high in winter [illegible] explained by seasonal [illegible].

[illegible] collided with aircraft more frequently [illegible] 300 km/hr and rarer at [illegible] km/hr, whereas waterfowl and swifts, [illegible] with pigeons were recorded relatively [illegible] phase, with gulls - at 'take-off and landing [illegible]' at 'take-offs' and 'landings', with small sparrow-type birds - at the 'landing' phase, with birds of prey - at the '[illegible]' and 'descent' phases, with swifts - at the '[illegible]' and '[illegible]' phases. Gulls, corvidae and waterfowl, [illegible] of the birds, collided with aircraft [illegible]. Birds of prey, corvidae and waterfowl [illegible] at high altitudes. This is explained by [illegible] of these birds.

During the [illegible] approximately 70% of recorded [illegible].

One of the [illegible] hazard to aircraft can be [illegible] which occurred in October 1980 [illegible] in the area of the Mineralnye Vody airport.

The collision [illegible] of the day in climbing [illegible] the collision resulted in damage [illegible] left-hand wing, dents were also [illegible] and a hole in the navigator's cabin [illegible].

In [illegible] biological survey of aerodrome areas [illegible] the expedient way of accounting [illegible];

every fifth day the accounting of birds is made during two hours in the morning and two hours in the evening from observation points located at the end edge of the runway. In addition, pass-around is made along the runway boundary during which birds are counted up along the runway and the remnants of killed birds are picked up. Next day, a route survey is made at characteristic biotopographic sites in the radius 10 to 30 km away from the aerodrome. In doing this, bird concentration sites are identified, as well as the numbers, species and the behaviour of birds at concentration sites, time of the day when the birds make up concentrations, the features of the inhabited medium that contribute to bird concentrations, the routes, altitudes and round-the-clock activity of bird flights.

The studies on bioacoustic methods of driving off birds from aerodromes were aimed at studying the effects of 'regional specificity' and 'interspecificity' af scaring cries from corvidae, gulls and ordinary starlings.

The results obtained allow us to make a conclusion that the above-mentioned species of birds have no 'regional specificity' of repellent cries, at least on the European territory of the Soviet Union. The efficieny of cries was varying from 80 to 100% in different regions of the country.

The 'interspecificity' effects of scaring cries from birds were stable and sufficiently high (up to 85%) for closely related birds only. With systematically far related birds, the 'interspecificity' is observed, but not at all times and its efficiency is low (30%). Mixed flocks of birds are successfully scared away by repellent cries from birds of one of the species present in the flock.

To increase the efficiency of recordings used for driving off pigeons and to make them evade the zone of action of a scaring device, the latter should be also supported by pyrotechnic devices.

Investigations into scaring away birds from aerodromes with the use of birds of prey have shown rather a high efficiency of this method. The experiments were carried out with a goshawk and a small eagle. Response to the bird of prey was manifested only in cases when the bird of prey was above the birds being dispersed.

Gulls and rooks usually flew away when the bird of prey appeared. Driving off pigeons, starlings and jackdaws was most effective.

Crows, when they saw [illegible] flock and pursued the predator. In view of this, scaring is not effective in autumn and winter when the [illegible] form mixed flocks.

It is admitted that the use of birds of prey is impracticable at aerodromes all over the USSR because the upkeep, training and employment of birds of prey [illegible] expenses and the need for specialized [illegible].

Studies on the effect of [illegible] landing lights used in the daytime for protecting the aircraft against birds were extensively made under operational conditions. The analysis of statistical data has shown that the use of switched-on lights in take-off and landing in the autumn period which is bird hazardous to aircraft reduces the relative number of collisions by 1.5 - 2 times.

Visual observations of bird [illegible] on aerodromes in situations when an aircraft is approaching them have shown that many birds take notice of the aircraft with the landing lights on much earlier and cross the runway in front of this aircraft much rarer. For example, starlings were crossing the runway in 18% of cases when an aircraft was approaching with the lights on and in 38% of cases with the lights off.

The results of recent studies on bird response to an approaching aircraft indicate that a sitting crow starts responding to an approaching aircraft at about 150 m, [illegible] and starling - at 110 m, a black-headed gull and pigeon - at [illegible].

With an approaching aircraft [illegible] practically never crosses the runway, rooks and gulls cross the runway in 28% of cases, pigeons - in 23% and starlings - in [illegible] of cases. Birds that are sitting over 150 m away from the runway [illegible] response to an aircraft.

Investigations into the use of chemicals for reducing the bird number on an aerodrome were conducted in two areas:

- destruction of insects [illegible] invertebrates which are an attractive food for birds;
- repellent scaring of birds.

Used as toxic chemicals were sevin, naphthalene, phosphamide and metation.

The use of sevine gave no positive results. Naphthalene and metation produced, [illegible] on invertebrates.

Toxic chemicals were most effective during the first two weeks of treatment when the total number of insects was reduced by 1.5 to 3 times.

Application of phosphomide reduced the number of ground invertebrates by 10 to 20 times only with a considerable increase in the chemical concentration (up to 0.4%) and consumption (3 lit. $/m^2$).

The results of the studies on driving off birds indicate that the visit frequency and the time of staying the birds (rooks and starlings) were noticeably lower on areas treated with naphthalene.

The studies on cutting the grass cover on an airfield have shown that the greatest numbers of insects can befound on areas with uncut high grass. On areas with the grass cut to the height of 20 - 25 cm the numbers of insects were 1.7 times as low, with 50% of insects being inedible to birds, whereas on uncut areas their numbers amounted to less than 5%. Besides, the bird visit frequency was the lowest on areas with grass cut (to the height 20 - 25 cm). In view of the above-said it is recommended presently that the grass cover be cut to the height of 20 - 25 cm in case bird congregations are available on aerodromes.