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Some Statistic Data on Birds' Strike to Aircraft and Helicopters over the Territory of the Soviet Union

Introduction

The problem of birds' strike to aircraft is a part of the general problem of aircraft protection against adverse environmental effects.

At present besides such dangerous atmospheric phenomena for aviation as electric discharges, icing, wind shear, turbulence etc. the "ornithologic factor" is gaining the greatest importance and as far as its effect on flight safety is concerned it also plays one of the important roles.

Due to the construction of gas-turbine engined aircraft, their speed and acceleration increase, danger created by birds is steadily increasing. ICAO was forced to pay attention to that problem which has become some serious danger for flight safety.

If we may regard birds as belonging to the category of the so-called adverse environmental effects, we should approach this problem the same way as we did in respect of other phenomena of this category. Such common approach consists of three main interrelated aspects:

A. The determination of normalized adverse environmemtal effects (parameters of the given type).

B. The evaluation of the influence of the chosen adverse en-

environmental effects' parameters on a certain type of aircraft.

C. The development of operation methods and (or) technical means providing aircraft protection from the given adverse environmental effects.

Each aspect contains a whole set of problems. For example, while considering the first aspect it is necessary to determine which birds, in what amount, under what conditions and with what probability can cause catastrophic consequences at their strike to aircraft. If the probability of such catastrophic consequences exceeds the established level of flight safety, Airworthiness Standards for Aircraft (Helicopters) must provide requirements on aircraft protection from such effects. As it is known, glasses in the cockpit as well as engines must be designed to stand one bird's strike or several birds' strike, possessing certain kinetic energy.

Even if there are no catastrophic consequences birds' strike to aircraft is the cause of disastrous danger to aviation and may lead to aircraft accidents in the presence of some additional adverse factors.

Peculiarities of the Ornithologic Situation in the USSR

The Soviet Union is situated in many geographic zones and has immense territory. Because of this fact, the ornitologic situation within its territory is characterized by a great dissimilarity and inconstancy.

The attached chart-scheme shows the biggest places of concentration of birds as well as the main migration routes during spring

and autumn. One can see that most birds congestions are situated on Black Sea and Baltic coasts, on some northern and far eastern sea coasts as well as on some internal water bodies (Caspian Sea, Azov Sea, Aralsk Sea, Baikal Lake etc.). The most important migration routes pass as a rule along littorals, riverbeds (Volga, Ural, Yenisey) and foothills.

The most numerous birds constituting hazards to aircraft operations are gulls and ducks in Baltic Region; starlings and rooks in Central Region of Russia; gulls in Caucasus; starlings, hawks and eagles in Central Asia, ducks, crows and rooks in Siberia, gull in Far East.

The most intensive migrations take place in spring (March - April) and in autumn (September - October). During these seasons birds fly at considerable heights in day-time as well as at night. In Baltic Region intensive birds migrations have been registered at altitudes up to 2-3 km, in Ukraine - up to 1-2 km, in Central Regio up to 1 km.

Cases of Collision of Civil Aircraft with Birds during 1975-76

The USSR Civil Aviation registered in 1975 212 cases of bird strikes, in 1976 - 181 case.

The most frequent birds strikes took place at the following airports:

1975 - Domodedovo (5), Kazan, Koltsovo, Krasnoyarsk, Tashkent (4), Beguishevo, Borispol, Min.Vody, Rovno (3).

1976 - Domodedovo (6), Krasnodar (5), Borispol, Vnukovo (4), Buhara, Yerevan, Koltsovo, Minsk, Rostov (3).

The table 1 specifies the said collisions according to the types of aircraft. We can see that such aircraft as AN-24, IL-18. Yak-40 encountered birds more frequently than other types.

In general, more than half of all cases pertains to turbine-engined aircraft (57% in 1975 and 51% in 1976), the share of turbine-jet aircraft exceeds a quarter (28% in 1975, 29% in 1976), piston-engined aircraft hold 1/10 of the total number of collisions (12% in 1975, 14% in 1976), and helicopters - 3% in 1975, 6% in 1976.

The same table 1 also shows that most damaged engines belonged to AN-24, IL-18 and Yak-40. There were cases where a bird collision caused damage of 2 engines at once (IL-18 - 4 cases, AN-24 - 3 cases Yak-40 and TU-134 - one case for each type). The most frequent collissions of birds with the windshield which resulted in its breakdown were registered with aircraft AN-2, because this type of aircraft is mostly used for air-chemical works and it flies at the same altitudes as birds during their intense migration.

In 1975-76 the average figures showing numbers of bird collisions at different altitudes are: 0-100 m - 38% of the total number of collisions; 101-400 m - 33%; 401-1000 m - 14%, 1001-2000 m - 10% over 2000 m - 5%.

The table II shows that at altitudes up to 100 m aircraft encountered mainly small and medium birds, at altitudes from 101 m up to 400 m - medium and large birds, at altitudes 401-1000 m - medium birds, and at altitudes more than 1000 m - small and large birds.

It is of certain interest that at altitudes from 401 to 1000 m aircraft encountered mainly pigeons, predatory birds, crows and waterfowl, and at altitudes over 1000 m - only hawks, eagles and swifts.

The distribution of the above mentioned cases according to speed of aircraft is as follows:

up to 100 km/h - 2%

from 101 to 300 km/h - 58%

from 301 to 500 km/h - 36%

more than 500 km/h - 4%.

The distribution of bird collisions by flight phases is as follows:

run/roll out - 3%

take-off (to 15 m) - 11%

climb-out - 21%

cruising flight - 11%

descent (to 15 m) - 39%

landing - 15%.

More frequent bird strikes during aircraft descent, as compared with climb-out, can be explained, to our mind, by the fact that during descent (approach to land) aircraft for a longer time fly at low altitudes where the possibility of bird collision is higher.

It should be pointed out that most bird strikes at cruising levels occur to piston-engined aircraft and helicopters which fly at comparatively low altitude at cruise speeds.

The size of birds encountered by aircraft was determined in 168 cases in 1975-76 and their species was determined in 135 cases.

Small birds (up to 110 g) hold 23% of the total number of collisions, medium birds (110-1810 g) - 63%, large birds (over 1810 g) - 14%. In reality, aircraft encounter small birds more frequently, but because of their small size and weight such cases are very difficult to be established.

The following birds struck aircraft most frequently: pigeons (Columba) - 28%; gulls (Larus) - 16%; ducks and geese (Anatidae) - 12%; predatory birds (Falcones) - 16%; starlings (Sturnidae), sparrows (Passer), swallows (Hirundinidae) - 13%; crows (Corvus) and swifts (Apodidae) - 5%.

Pigeons struck aircraft rather frequently all year round, gulls - mainly in summer and early autumn, ducks - in spring and autumn.

The figure 2 shows that the biggest part of collisions of aircraft with birds was registered in the second half of summer (during after-nesting movements) and in early autumn (during mass birds migration to wintering places). During spring, bird collisions with aircraft were registered more rarely. The fewest number of bird strikes was registered in winter.

The distribution of the total number of collisions by different day hours is as follows: morning - 7%, daylight hours - 62%, evening 5%, night - 26%. By "morning" we mean the period of 2 hours beginning from the moment of dawn coming, "evening" is the period of 2 hours before darkness.

If we take into consideration that the intensity (frequency) of civil aircraft flight in daylight time is much higher than at night, we can conclude that the probability of bird strike in daylight time and at night is approximately the same.

The table III helps us to conclude that the most frequent birds collisions were registered in April, August, September and October, in other words during mass night migratory flights.

From the table IV we see that birds collisions with aicraft in the night and evening time were registered mainly at heights of

100-400 m, and those in daylight time and the morning - at heights up to 100 m. It is of importance that most of collisions that occurred in the darkness relate to waterfowl and to swifts.

According to the reports of pilots in 1975-76 the percentage of cases of collisions of aircraft with a single bird comes to 37% of the total number, and collisions with birds flock constitutes 63%. But we should not take these figures for granted because many cases of collisions with bird flocks are registered as collisions with a single bird.

All data stated in our paper relate only to the period of 2 years. Nevertheless all these data are sufficient for us to make a conclusion of great importance of the problem and the necessity of its being solved as soon as possible.

Table I

Bird strike distribution by aircraft types

(1975-76)

Aircraft type	Number of bird strikes	Number of engines removed and damaged	Number of windscreen damage cases
Turbo-jet			
Yak-40	46	24	
TU-134	19	8	
TU-124	14	7	
TU-154	12	2	1
TU-104	9	9	
IL-62	11	5	
Total	111	55	1
Turbo-prop			
AN-24	130	46	1
AN-12	12	5	
IL-18	67	44	
TU-114	3	3	
Total	212	98	1
Piston-engined			
AN-2	41	8	11
AN-26	2		1
IL-14	10	3	2
Total	53	11	14
Helicopters	17	9	6
TOTAL	393	173	22

Table II

Bird strike distribution by flight altitudes and bird sizes (1975-76).

Flight alt.,m / Bird size	up to 101	101-400	401-1000	1001-2000	over 2000
Small birds	10	7	1	2	1
Medium birds	47	25	13	-	-
Large birds	3	9	2	2	2

Table III

Bird strike distribution by day periods and seasons

Day period / Month	Morning	Daylight time	Evening	Night
I	-	3	-	2
II	2	4	-	1
III	2	12	1	2
IV	-	13	-	10
V	2	23	5	9
VI	2	24	-	4
VII	-	18	2	2
VIII	3	29	1	15
IX	5	29	2	13
X	3	21	1	15
XI	1	11	2	6
XII	2	7	2	4

Table IV

Bird strike distribution by flight altitudes and day periods

Flight alt., m	up to 101	101-400	401-1000	1001-2000	over 2000
Day period					
Morning	12	2	1	1	1
Daylight time	59	46	19	12	5
Evening	3	6	1	3	1
Night	6	19	9	3	3

Bird strike distribution by months
(1975 + 1976)

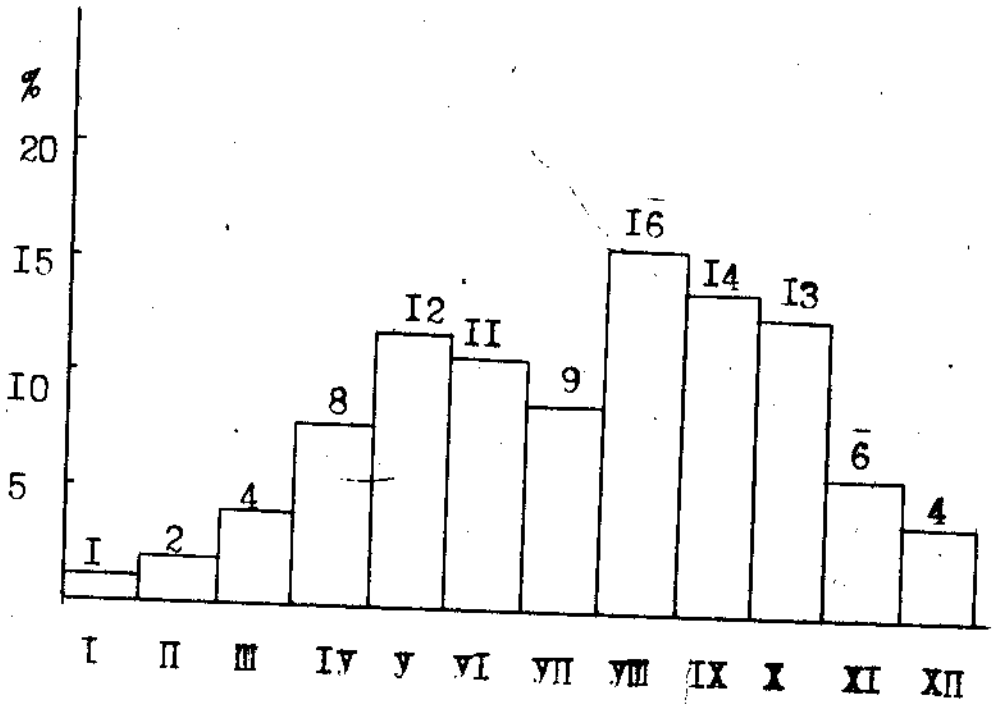
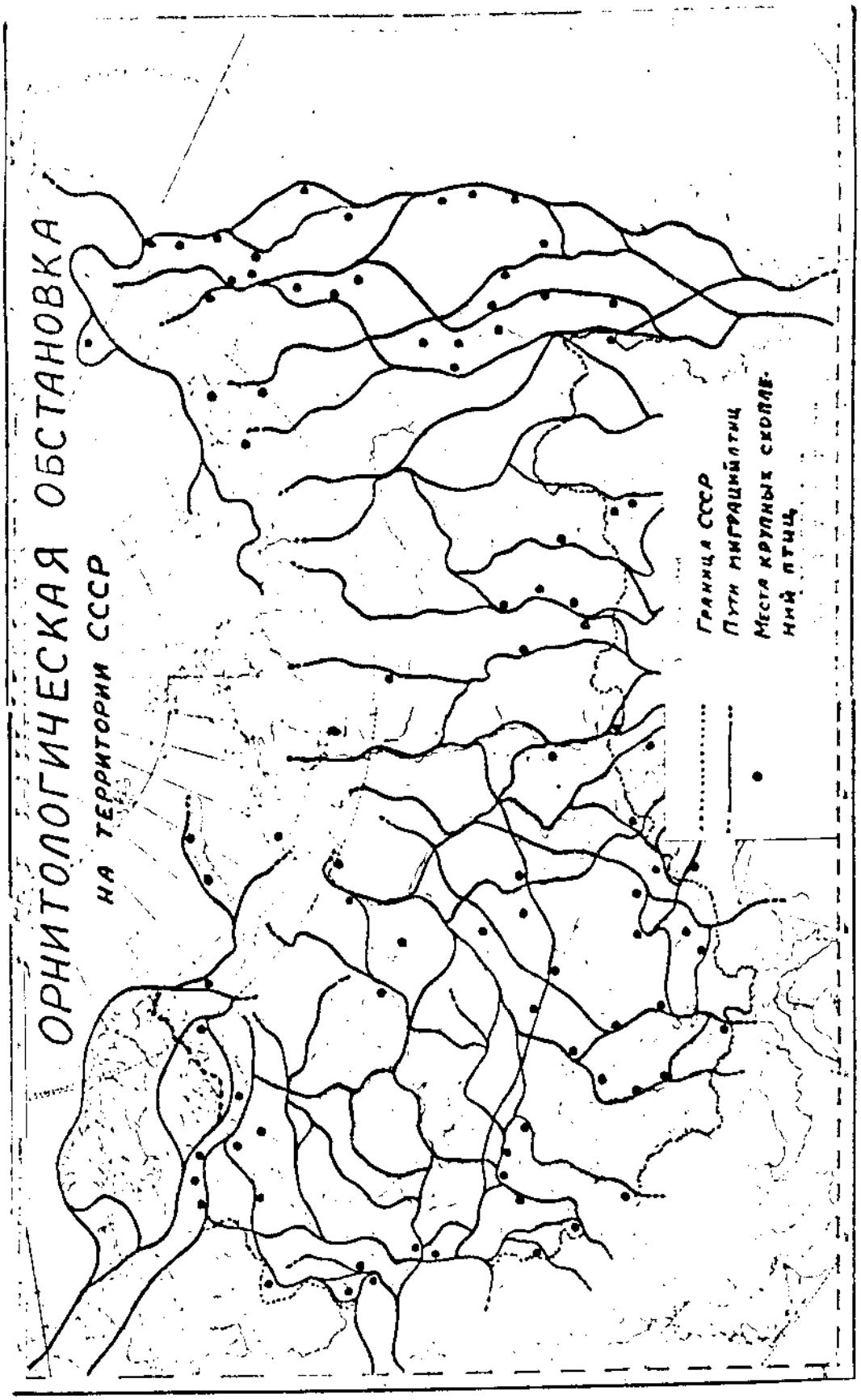


Fig.2


ОРНИТОЛОГИЧЕСКАЯ ОБСТАНОВКА
НА ТЕРРИТОРИИ СССР
Граница СССР
Пути миграций птиц
Места крупных скоплений птиц

Фиг. I.