SPHERE OF ACTION AND EFFICIENCY OF THE MEANS AT AERODROMES FOR THE PREVENTION OF COLLISIONS BETWEEN BIRDS AND AIRCRAFT

V.E.YACOBY, USSR

At the present time it is impossible to prevent collisions of birds with planes on some stages of flight of aircraft with the means at our disposal. This situation may be explained by the characteristics of the action of various means for detection of birds, for control and prognosis of their behaviour on the paths of flight of aircraft.

From this aspect we examine here the advantages and disadvantages of various means of frightening birds from aerodromes and detection of them in flights and on the ground, now being used.

The utilization of the active means fro prevention of collisions with birds is common in the aerodromes of the USSR and other countries at the present time (Table I).

A number of passive means of prevention of collisions with birds by decreasing attractiveness of aerodromes to them are now very effective (Table 2).

Reviewing the advantages and disadvantages of methods of prevention of collisions of birds with aircraft one may note that they frighten flocks from the ground and prevent collision with aircraft by birds that take off from the ground (for example pyrotechnic and bioacoustic means, birds of prey, laser). Other methods prevent, within the zone of their actioh, the landing of some species of birds on the ground or water for feeding, nesting or rest, and thereby prevent collisions (for example, elimination of food and other attractions at the aerodrome, high grass, wire over water, mechanical repellents, carbide cannon).

Neither these nor other means prevent transit flight through the air space over airfields by single birds and flocks as well as feeding flights of pigeons, rooks, gulls and some other species that live nearby and fly from the distance up to I5-20 km. Thus all these means prevent collisions, in the best case, with flocks of only some species and only up to 5 to 6 m above a runway during landing and take-off (Table 3).

According to my data 25 per cent of all collisions occur in this zone. Twenty two per cent of all collisions with birds are with flocks. Therefore even under I00 per cent effectiveness of prevention

by the means mentioned above, only 5.5 per cent of all possible collisions above the runway are being prevented. The lack of universal action and delay in detection of flocks decreases this figure still more.

Furthermore, 50 per cent of all collisions with birds occur in take-off or landing within the range of detection of the landing radar system. And although landing radar can detect single flying birds and flocks within I0-I2 km altitude more than 50 m, the probability of collision prevention is insignificantly small, not more than I-2 per cent in cases of mass bird movements.

Away from the airspace of the airfield about 25 per cent of all collisions with birds occur within the zone of surveillence. In this way I00 per cent detection by the radar controller makes it possible to prevent 5.5 per cent of all possible collisions within the range of radar detection of birds.

In total the utilization of the means available to the airfield makes it possible to prevent a maximum of I2 to I3 per cent of the possible collisions with birds. In reality this amounts to 6-7 per cent because of imperfection of means and possibilities of detection of birds in the flight path of the aircraft.

In my opinion the following ways and measures to strengthen means of detection of birds and prevention of collisioms between them and aircraft are now applicable.

I. Intensification of the capability of aircraft to frighten birds and enhancement of distance of detection of aircraft by birds by use of landing head-lights and on-board laser in day time.

2. Prevention of disorientation of birds at night as a result of blinding by landing lights.

3. Detection of massive migrating flocks and assessments of their direction, speed and altitude of flight with routs of aircraft, the relation of such flights of birds to meteorological, biological and anthropogenic factors.

4. Intensification of the capabilities of automatic detection by radar of birds on runways, both day and night, but especially the latter; of individual soaring buzzards, eagles, swifts and other species at great altitudes away from airfields; and of all birds at low altitudes away from airfields.

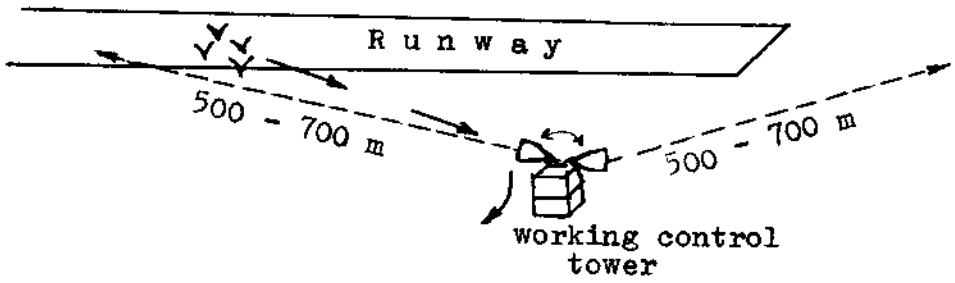

Fig.1. Scheme of action of high-power rotating loudspeaker at control tower to broadcast distress calls.

Table 1.Active means of avoidance of collisions with birds

Means	Advantages	Disadvantages	Collisions prevented
1. Pyrotechnic devices	Double effect: acoustical and visual. Good results on the flocks frightend from the ground level, and in combination with distress calls.	Necessity to detect and to approach birds. Not usually used against single flying birds.	Mostly with bird flocks taking off from ground
2.Mobile acoustic fright system broadcasting distress calls.	Good frightening of Laridae, Corvidae and some other birds at a distance of 200-300 m.	Preliminary reaction is flight toward source but away from source after repetition of signal or pyrotechnical support. Limited number of species affected.	— " —
3.Stationary acoustic installation. Series of loudspeakers along runway. Fig.1	— " — But acts along all runway.	— " — But it is impossible to support it by pyrotechniques.It is unnecessary to approach the birds.	— " —
4.High-power rotating loudspeaker at control tower to broadcast distress calls.	Some as 2 but effective within 500-700 m. First signal attracts birds away from runway toward control tower because of preliminary reaction. Controller can repeat signal, release fireworks, fire gun as support. Approach toward birds unnecessary.	Effective on a limited number of species. Effective only in area of control tower.	— " —
5.Birds of prey	Effective on flocks of majority of species on ground.	Predator must detect flock and fly toward it. Danger of collision with aircraft. Ineffective in bad weather and at night.	— " —

Table 1.(contin.).Active means of avoidance of collisions with birds.

Means	Advantages	Disadvantages	Collisions prevented
6.Aircraft model	Frightens away some birds on ground	— " —	— " —
7.Mechanic means- coloured flags, propellers, wings oscillated or rotated by wind.	Effective at short distance at first. Shortterm prevention of landing of birds in vicinity.	Impossible close to a runway. Rapid adaptation by birds.	— " —
8. Carbid cannon	Temporary frightening of ducks and pigeons,mainly	Rapid adaptation.	— " —
9.Lazer	Probably a good repellent,if lazer beam irradates eyes	Necessity of detection of bird.Danger to pilot. Optical action only.	— " —

Table 2. Passive means of avoidance of collisions with birds.

Means	Advantages	Disadvantages	Collisions prevented
I. Elimination of garbage dumps and other sources of food (waste, invertebrates, rodents, some plants).	Reduces carnivorous and granivorous bird flocks feeding at processed area.	Fails to prevent bird passage over a processed area. Not a universal remedy.	With birds taking off from the ground.
2. High dense grass.	Prevents searching for food, feeding and resting.	- " -	- " -
3. Wire over water.	- " -	- " -	With birds taking off from the water.
4. Obstacles against nesting on airfield and surrounding sites.	Reduction of number of birds on airfield.	- " -	Some decsease in collisions with young birds.
5. Stuffed birds, corpses in unnatural poses.	Shortterm prevention of landing.	Rapid adaptation. Sometimes attraction.	With birds taking off from runway.
6. Landing radar.	Detects single flying middle-sized birds and flocks in path of plane taking off and landing both at night and daytime.	A number of limitations in sector survey and and in detection of single flying birds by controller makes it impossible to prevent all collisions.	With mass bird movements detected in radar range.
7. Surveillance radar.	Good detection of mass bird migration through day and night. Provides examination and warning of mass migration in radar range of 20-I00 km.	Fails to detect birds in clutter zone of I5-20 km and at low altitudes. Impossible to identify species, number and altitude. Almost impossible to distinguish a single soaring bird. Comparatively long time of detection.	

Table 3. Efficiency of Methods for Prevention of collisions of aircraft with birds.

Height in metres	Collisions number(in %)	Means used	Collisions avoided.	Percentage of collision avoided.
0 - 6	25	Ground	With bird flocks over a runway.	5.5
6 - 50	50	Landing radar.	---	---
50 - 150		Landing radar	With mass bird movement	1 - 2
Higher 150	25	Surveillance radar.	With flock migration.	5.5