

## Can the Pilot of an Aircraft Prevent a Collision with Birds?

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In connection with the growing danger presented to aircraft by birds, the question arises of whether a pilot is able to perceive birds during flight, and by taking timely action avoid the danger of collision. Theoretically, the greater the speed of the aircraft the greater the distance at which it is necessary to observe a bird in order to prevent a collision. During flight the pilot's attention is focussed mainly on the instrument panel and on the operation of the controls. His limited ability to observe birds at a relatively long distance is also dependent upon the intensity of light, the size and colouring of the bird, the manner of flight, etc.

In order to investigate whether a pilot is able to perceive birds and, by taking immediate evasive action, prevent a collision with it, an analysis was made of more than 2000 collisions between aircraft and birds in the Soviet Union and in Czechoslovakia. The investigation examined whether pilots perceive a bird prior to collision, whether they notice the impact, and on which parts of the aircraft. At the same time an analysis was made of the influence of the speed of the aircraft, the altitude, and the weight category of the birds. The data analysed obtained either directly from pilots or from ground staff on the basis of the

collection of bird remains from runways or as a result of post-flight checks.

The data based on the collection of bird remains found by us or by airport staff on runways could not for the most part be attributed to any particular collision, since the pilot did not notice either the birds or the collision with them, nor were any other signs of the collision subsequently observed, such as blood stains, the remains of feathers or damage to aircraft. These findings can be explained by the fact that the take-off speed of an aircraft is in most cases not more than 300 kph. For this reason the ingestion of birds into engines, which at such speeds have a much greater mass than the birds, is not usually noticeable. The same applies to the impact of a bird on other parts of an aircraft. The airstream, combined with rain, snow and condensed water vapour in clouds, cleans blood stains off the aircraft, so that they can no longer be identified during post-flight inspection.

The second large category of data indicating a collision between an aircraft and a bird without attracting the pilot's attention is that of data from maintenance crews, who, during post-flight checks, find either bird remains or various types of damage to the aircraft. The most common finding is the ingestion of birds into an engine. Out of 176 cases of ingestion, 118 were not noticed by the pilot (67.1%). The ingestion of large birds is observed by the pilot more often than that of smaller species, usually when accompanied by a change in the engine's operation or a smell of burning. The time which elapses between the moment the bird is ingested into an engine and the moment when the pilot becomes aware of the fact can

be very long.

The bird species was identified in 176 cases of ingestion into an engine. Of this total the crew of the aircraft noticed birds of weight category C (1130 - 3630 g) in 28 cases, medium-sized birds (category B: 410 - 1310 g) in 21 cases, and small birds (category A: up to 113 g) in 9 cases. In 118 cases the crew of the aircraft did not notice the ingestion of a bird into the engine. Of these 16 ingested birds were large (cat. C), 37 medium-sized (cat. B) and 45 small (cat. A). Although it was not statistically confirmed from the material we analysed, the ingestion of large birds is probably more often noticed by pilots than the ingestion of small birds. It is, however, possible that in many cases where ingestion of medium and small bird species was noticed, this was due to the fact that not one but several birds were ingested (it is not usually possible to establish exactly how many birds were involved according to the remains found in engines). The question of whether or not the engine is put out of action depends not only on the weight of the bird and the speed (force) of the collision, but also on which part of the engine the bird gets into. The dust from feathers can affect engine lubrication to such an extent that rapid overheating results, leading to serious engine trouble.

Out of 560 cases of bird impact on wing surfaces, established on the basis of visible damage (denting, splitting etc.), the pilot noticed the impact in 126 cases (22.5 %). This type of impact was more often noticed where it involved

a large bird at high altitudes, where the speed of the aircraft and thus also the force of the impact is greater. In those cases where the bird species striking wing surfaces was identified, large species (cat. C) escaped notice in 49 cases, medium-sized species (cat. B) in 67 cases, and small species (cat. A) in 37 cases. Large birds were seen before impact in 29 cases, medium-sized birds in 11 cases, and small ones in 17 cases. It is again clear that large bird species are more often noticed by the pilot than small and medium-sized ones.

Generally speaking it can be said that out of 589 collisions where the weight category of birds was recorded, the pilot noticed the impact in 256 cases and failed to notice in 333 cases. Out of the collisions noticed by pilots, small birds (cat. A) were involved in 21.9 %, medium-sized birds (cat. B) in 33.2 %, and large birds (cat. C) in 44.9 %. Out of the 333 collisions not noticed by the pilot, it was found that the collision was caused by category A birds in 99 cases (29.7 %), by category B birds in 153 cases (46.0 %), and by category C birds in 81 cases (24.3 %). The frequency of collisions with category B birds (40.4 % of collisions) was found to be statistically significantly higher than that of collisions with category A birds (26.3 %,  $\chi^2 = 17.53$ ) and category C birds (33.3 %,  $\chi^2 = 4.06$ ).

Of the 256 cases where the pilot noticed the impact of a bird the location of the impact was in 77 cases (30.1 %)

the windscreen, in 57 cases (22.3 %) the wings, and in 58 cases (22.6 %) there was an impact on or ingestion into an engine. The remaining 25 % of impacts was on various other parts of the aircraft.

Out of 1194 collisions 956 (80.1 %) were at altitudes of up to 500 m. Of these the pilot saw the birds prior to collision in only 143 cases (15 %). At altitudes from 500 to 7200 m there were 438 collisions, in only 23 of which (9.7 %) were the birds observed by the pilots.

At aircraft speeds up to 400 kph there were 847 collisions (55.3 %), in 156 of which (18.3 %) birds were observed by the pilot prior to the collision. At speeds from 400 to 900 kph there were 144 collisions, in 14 of which (9.7 %) birds were observed before collision.

It is apparent from the above analyses that the pilot has a chance, though a limited one, of seeing a flock of or even individual birds. But in practice we have no reports of pilots having actually taken evasive action to avoid collisions with birds of which they had become aware. But situations are known, on the basis of actual data, in which action can be taken to avoid collisions between aircraft and birds:

- 1) If airtraffic controllers observe on their radar screens mass flights of birds, they may inform a pilot, who may then take immediate evasive action to avoid a collision.
- 2) If on take-off a pilot sees on or near the runway a flight of birds whose approach might have far-reaching consequences for the aircraft which is taking off, he may re-

quest a delay in take-off and the taking of measures to scare the birds off.

3) If during flight a pilot observes a mass flight of birds, he may inform the airport authorities, who may in turn inform the pilots of other aircraft flying on the same course.

Ethological research has revealed certain specific reactions of birds, e.g. of birds of prey, to approaching aircraft. Birds which have experience of the danger presented to them by the aircraft themselves try to avoid a collision. From actual collisions of aircraft with birds it is clear that the majority involve young and inexperienced birds.

It can be concluded from the results of analysis of more than 2000 collisions between aircraft and birds that: Pilots most often notice the impact of a bird on the wind-screen (30.1 %), followed by impact on or ingestion into an engine (22.6 %) and impact on wing surfaces (22.3 %). The ingestion of a bird into an engine is usually noticed when it results in engine trouble.

Most collisions (80.1 %) occurred at altitudes up to 500 m. In only 15 % of these cases did pilots observe a bird prior to collision. At lower aircraft speeds (up to 400 kph) 85.5 % of collisions occurred; birds were observed by pilots prior to collision in only 18.3 % of cases. The greatest number of collisions (40.4 %) involved birds of weight category B, followed by category C (33.3 %) and category A (26.3 %).

Individual flying birds, and therefore especially flocks of birds, are better able to observe at great distances the

approaching danger of collision with any aircraft than is the pilot, with attention centered on flying the aircraft, able to observe the birds. It follows that a bird is better able to avoid a collision with an aircraft than the pilot.

As is shown in the preceding paragraph, the question of whether a pilot can avoid a collision with an aircraft and thus avoid a collision by means of a bird's evasive action is extremely complex, and it is urged to pay greater attention to it.

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