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AIRCRAFT AND BIRDS

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At the third seminar I reported that our work on ecological changes at airports was a useful method of controlling bird hazards to aircraft. At the fifth seminar I talked about our studies of bird migration by radar and the use of that knowledge to keep flying aircraft away from bird concentrations.

Those techniques are still effective. Since then we have: sought ground cover less attractive to birds than grass; developed methods of controlling earthworms to reduce bird attraction; improved radar data handling; improved bird hazard forecasts; studied light effects on birds; quantified bird spacing in flocks; studied the relation between small mammal populations and the predatory birds they attract to airports; tried out a gasoline-powered model aircraft shaped and flown like a falcon, and published a book on our work.

Bird hazards to aircraft are still serious. The most dramatic example was the loss of a DC-10 at Kennedy Airport, New York last November caused by entry into one engine of one (possibly more) Greater Black-backed Gull. No lives were lost but a $24 million aircraft was destroyed. Bird control at Kennedy Airport was not enough to prevent that Incident and a number of less serious ones which preceeded it in a short period last autumn. Heathrow Airport, at London, England handles about the same traffic load as Kennedy. It uses a 21 man group, around the clock and all year, to control its bird problems from 4 specially-equipped 4-wheel-drive vehicles. The officials there have found that level of staffing and equipment is necessary to maintain flight safety and a low level of bird strikes.

In our search for a ground cover plant to replace grass we examined dozens of plant species. Disadvantages of grass are the need for frequent mowing to maintain proper height to reduce bird numbers and the use of grass as food by some birds. Grass meets several criteria for airport ground cover:

1. control of soil erosion.
2. solid support for wheeled vehicles without crushing or killing.
3. fire resistance.
4. relative unattractiveness to insects and birds when properly mowed.
5. freedom from damage by weather and most of the chemicals used in airport operations.

Few other plants meet those criteria. Some prospects failed on fire resistance. Others would not grow in the soil on some airports. One species with the desired characteristics would grow only on poor soil at some eastern airfields. It is a weed with no commercial sources of seed or cuttings. Introducing the plant into a new area would require development of new technology for seed collection and planting. After a pilot scale introduction we concluded that with the soil quality limitations and difficulty of ensuring germination we would be better to stay with grass but manage it better to control small mammals, insects, small birds, and related problems.

Airport vegetation has other problems. Ice control on runways is done with urea rather than salt to avoid corrosion to aircraft. Urea is a fertilizer, so the grass at the edge of the runway grows better. On some prairie airfields ground squirrels thrive in the greener grass at the edge of the active surfaces. Ground squirrels attract raptors which can damage aircraft. Urea use must be followed by ground squirrel control.

We have automated radar equipment so a traffic controller can have a readout of numbers of bird echoes per radar quadrant per minute without looking at a radar console. At a pre-determined number he can issue suitably-phrased warnings to crews of aircraft approaching those sectors. For slight additional cost a vertical-looking pencil-beam radar can give vertical heights of echo groups. With present technology we can quantify the migratory bird hazard by altitude and by quadrant on a minute to minute basis at any airport. Operational use has not begun. The equipment has been tested for a couple of seasons under operating conditions at two airports in different parts of Canada. The controllers find it easy to use and reliable.

Bird migration forecasts based on weather forecasts are in regular use at a major national defense base. It enables the operations people to plan flight exercises in relation to bird migration hazard forecasts available as much as 24 hours in advance. Those forecasts and their wise use have enabled us to eliminate the loss of one to two aircraft (CF-104) per year. There have been no losses through bird strikes in the past five years in which the forecasts have been used. The training program is the same as it was but now not all exercises are carried out during the heaviest part of the migratory period for large birds.

Trying to move birds out of the way of aircraft involved us with strobe flashers of different colours. If you want to catch the attention of gulls and pigeons, a flasher in the red end of the spectrum at a flash rate between 8 and 12 per second works well. We do not yet know how to repel birds. Catching their attention may improve their ability to judge aircraft approach rates and take evasive action. The flash rates involved are in a range which may cause hypnotic or other mental disturbance to humans. Before we recommend installation of flashers at that rate on aircraft to let the birds know something is coming, we must ensure there are no problems for the aircraft crew.

I mentioned greener grass and ground squirrels. One major airport has a small mammal problem because parts of the field cannot be mowed properly. Small mammal populations build up in those areas. They attract hawks and owls during the summer and Snowy Owls in the winter. All those raptors get hit by aircraft. Better management of the vegetative cover to reduce small mammals numbers will reduce the bird hazard.

When our associate committee on bird hazards to aircraft began operation 14 years ago we soon learned what birds caused problems and why they were attracted to airports. After removing food, water, and shelter from airport areas we still needed dependable ways of scaring birds away on short notice. We tried a variety of shell crackers, and some worked well. We have tried more kinds over the years. Every time we get a reliable shell cracker that works well either the company goes out of business or for some other reason the supply is interrupted. After 14 years we are still looking for good shell crackers and a dependable supply.

Years ago on the east and west coasts we tried two different techniques of using falcons to drive gulls away from airports. Two years of trials convinced us that falconry can be used to good advantage within limitations. The limitations are availability of falcons and falconers, the temperament and abilities of falcons and their inability to do the job at night, in high winds, heavy rains, or poor visibility. Sometimes the bird problems on airfields are at their worst under those weather conditions. We have not relied much on falconry, though it is used effectively in a number of European countries.

Recently, to deal with a small bird problem at one airport, we looked again at the falcon business. Peregrine falcons are rare now, so we decided to try a mechanical substitute. One of our DC-8pilot friends built, at our cost, a couple of prototype gas powered model falcons which are twice life size, fully aerobatic, faster than real falcons, and can be controlled to look like soaring falcons well enough to fool most of the birds and some bird watchers over which we have flown them. They are tricky to fly, and at a weight of 8 pounds we do not want them involved in a collision with an aircraft. We only let airline pilots fly them who are well aware of the complexities of air traffic control. The models work under the conditions under which we have tried them. They are one more method of controlling birds on airports.

The history of bird strikes goes back nearly to the start of aviation. The Wright Brothers first flew in the fall of 1903. The first person was killed by bird involvement with an aircraft in the spring of 1912. In Washington D.C. in the aviation and space division of the Smithsonian Institution you can see a model of the Wright-XE, the first aircraft to fly across the United States in the fall of 1911. The pilot of that aircraft was a hero for 6 months until he was killed in a crash caused by a gull at Long Beach, California, on April 3, 1912.

Bird problems have increased in importance since the introduction of turbine engines. When the wide-bodied aircraft were planned, we were told that their parts would be so big and strong that birds would not be a problem. We did not believe it then, and we do not believe it now. The introduction of wide-bodied, big-engine aircraft began in the late 60's. We held a world conference on bird hazards to aircraft in 1963. One of the experts there forecast that if those aircraft came into use at the planned rate within 5 years one would be lost in a serious bird strike. Economics prevented the wide-boded jets from coming into use as fast as the manufacturers hoped. The forecast was out by a couple of years. The first write-off was in November 1975 at Kennedy Airport.

We have been told that the big engines can be modified to prevent that sort of thing happening again. I got an explanation of how that can be done at a meeting in Washington three weeks ago. I believe the method may prevent that particular kind of engine destruction. I am not convinced that there are not other ways that birds can destroy engines of that size.

The Washington meeting I attended considered that before use engines should pass tests to render less likely engine destruction or serious aircraft damage in bird strikes. A question at the meeting was about spacing of birds in flocks, the size of flocks, and their behavior. Those things are important to answer the question, "How many birds of what size can go into an engine in a given incident?" There are published estimates of flock sizes and dimensions but no data on inter-bird spacing in flocks in different configurations.

We tried for several years to get information of that kind. In the last few weeks we have had some success. Three-dimensional photography of a flock of 6,000 Dunlins on an airport is a problem of logistics. We have a very persistent chap working under contract who has perfected a portable camera system and is now taking the right kind of photographs at Vancouver International Airport.

We sometimes have as many as 5 flocks of Dunlins on the airfield at one time. Single flocks can contain up to 10.000 birds. On three occasions in past years we have had three of the four engines on an aircraft damaged by passage through flocks of these small birds. We do not know how the damage is done nor how many birds go through an engine in how many micro-seconds. If we assume inter-bird spacing of 2 feet, a 6,000 bird flock can be a ball of birds 55 feet across. If you run a jet engine through the ball you cut a cylinder the diameter of the engine and 55 feet long. That put 70 birds in a DC-8 engine in less than 1/4 second. That assumes that the flock is spherical.

The flock is usually elongated in the direction of the flight, which is away from the aircraft down the runway. The birds bunch up as they do when pursued by a predator. The trajectory of an engine through the bird group is then longer and the bird spacing closer. Estimates give us figures between 150 and 450 birds per engine. DC-8s and 707s have had costly engine damage on a number of occasions. We hope our present work will give data the engine people need as they design more bird resistant engines.

Another problem is what happens when you hit a flock of geese. With the wide-bodied jets engine intakes are almost 8 feet in diameter. You could put a fair number of Canada Geese through a hole that big. With birds that size it is not a question of reducing engine damage but of ensuring that when the engine is destroyed it does not endanger the safety of the plane. We need more data to develop better tests that engines must pass before they go into use.

After 14 years of work we are phasing out our associate committee on bird hazards to aircraft. The flight safety organizations in the Departments of National Defense and Transport are well able to continue the work that we pioneered. It must continue to keep bird hazards to aircraft at a low level. The last of nearly a hundred publications of the committee is our book *Bird Hazards to Aircraft.* In it we have described our 14 years of experience as well as those of our colleagues. In its bibliography of 445 titles there is a wealth of detailed Information. We hope the book will be used widely to make flying safer by reducing bird hazards to aircraft.

DISCUSSION

Question: Navy operations people told me that slow-moving P-3s, which are glorified Electras, were involved in more strikes on take off than jets. They attributed this to the quieter jet engines. With jets becoming wider and quieter, do you find a correlation?

Solman: Just recently I was talking to the acoustics section of General Electric, and they've come to essentially the same conclusion. We knew for several years, particularly because of European experience, particularly with Air France and Lufthansa, that the 747s were having $7^1/_2$ times as many engine strikes as the 707s. When you think that the frontal area has a ratio difference of $4^1/_2$ to 1, you begin to wonder why the strike rate is $7^1/_2$ to 1. For a little while we worried about that. But then we figured that the bigger engines were quieter. One thing that triggers the birds to get out of the way is hearing the airplane coming. If they don't happen to be looking that way they don't necessarily see it. You get a shorter sound-warning period with the bigger, quieter engines. Also with the big engines, if the bird is on the center line of the engine, by the time he realizes he has a problem, he has to go twice as far to get out of the way. I think it's a combination of those two things.

Now there may be a few other tilts in there that we don't know about, but there are at least those two. General Electric went to the trouble of recording big engine noise of approaching aircraft. They took the recording out to the local garbage dump where there were lots of birds and played it to see at what point in the increasing noise level the birds got excited and jumped. They found, as you might expect, that a DC-10 has to be a lot closer with its quieter engines than, for instance, a DC-8 before you get the triggering effect. The other thing about the Electra and the big jets is the take-off angle of the two is different. The big jets are out of the zone below 500 ft a lot quicker than an Electra. So there are a couple of tilts that you've got to watch.

Recent British figures indicate speed alone is part of it. You get almost no strikes below 80 knots. This is essentially what protects you when you fly a propeller-driven aircraft.

Harrison: There have been a lot of problems with shell crackers. One of the big things is there is no such thing as a military spec.

Solman: We have a military spec. but we can't get anybody to build them to it.

Harrison: You've got the specifications and we've got the manufacturing capacity. I wonder if the National Pest Control Association would give me some data on the volume of shell crackers used by their people. If Interior would do the same thing, I think we could show enough volume on a yearly basis to interest manufacturers. Right now we pay $8.50 for a package of 25; and 8 to 10 of those are duds, so they cost 35-40¢ apiece.

Solman: All I can say is "Amen" to your suggestion.

Dyer: It seems to me that problems with birds are self-limiting. We've had some 15 years now of such problems, and while there have been some changes, it seems to me that 15-20 years from now there will be very little air traffic. In other words, we'll be diverting fuel into Air Force activities and probably have little fuel available for civilian travel. What are your projections in terms of civil programs? Will the current level of effort satisfy continuing needs, especially if needs diminish because of drastic drops in air travel.

Solman: I can't really answer that. Our military programs are very similar to our civil programs, and we find it easier to get things done on military bases. When the general gives the order, things tend to happen. It doesn't always work that way on the civil side. You're right that energy supplies are finite. One thing is sure, we're going back to turbo-props, instead of straight jets, on a pure economy basis, fairly soon. That will help the problem a little. Birds found ways of getting past the propeller and into turboprop engines, but that will not stop completely. The reason we are closing down our program is that other agencies are well-equipped to carry it on that just didn't exist when we started.

There was mention of the problem of landscape architects, designers, and planners not taking account of bird problems in an airport environment. I'd like to add a few thoughts, and I agree with everything that was said. I'd like to emphasize that airport buildings designed in the past have not been designed to exclude birds or to make it difficult for birds to perch on them. We have had the experience of having to have the designer reengineer whole buildings on some of our airports. We have come to the point where we catch the architect in the planning stages and change the blueprint instead of the building; it's a lot cheaper to do it that way.

As an example, in our newest airport, Mirabel, they designed the terminal building, which is $^{1}/_{4}$ mile long, with all the suspension members of the roof on the outside. That means you had a forest of beams sticking out and crossing. There were a thousand ideal pigeon nesting sites in the roof structure of the original design. We got to them before they built the building. When you visit Mirabel now, you'll see it has a flat roof on the outside.

Architects, if you can get to them, are quite capable of designing buildings that don't provide perches for birds. In our experience they sometimes forget to do that unless you remind them. I'm for reminding architects to help you design the bird problems out of airports. At Mirable we had already designed the birds out of the grounds and landscaping as far as possible. Even the site was less attractive to birds than some alternatives that were offered. We've been doing this in Sweden and other countries as well. I hope it's going to catch on.

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