Transport Canada / Transports Canada
Safety and Security / Sécurité et sûreté

Aerodrome Safety Branch
330 Sparks St., Place de Ville, Tower C
Ottawa, Ontario
K1A 0N8

Your file / Votre référence
Our file / Notre référence

February 12, 1997 AKP5158-36-20-51

Members/Participants
Bird Strike Committee Canada

Dear Member/Participant:

Please find enclosed the minutes/proceedings from Bird Strike Committee Canada meeting #25 which was held in Ottawa on November 6 and 7, 1996. In addition, a draft agenda for BSCC #26 has been included for your information. If you have comments or questions on either document, please feel free to contact the undersigned.

Bird Strike Committee Canada #26 will be held in St. John's, Newfoundland on Wednesday, April 23, and Thursday, April 24, 1997. The meeting will be held at the Delta St. John's Hotel and Conference Center located at 120 New Gower Street. There is a block of rooms reserved under Transport Canada, Bird Strike Committee Canada, at $109.00 per night for a single, and $119.00 for a double. The price does not include taxes, and we recommend that you book your room soon, because the block will be released on March 25, 1997. The toll free reservation number in Canada is 1-800-268-1133. In the United States the number is 1-800-877-1133, or you can call the hotel direct at 709-739-6404. You may wish to bargain for a lower room rate, because the price that I have quoted was necessary in order to guarantee a block of rooms.

If you have agenda items, or wish to present a paper, please contact me before March 14, at 613-990-0515, or Fax at 613-957-4260. Also, if you plan to attend this meeting, I would appreciate hearing from you, because it will help us to plan the field trip.

We look forward to seeing you in St. John's.

Regards,

Bruce MacKinnon
Wildlife Control Specialist

Canada

21-0017 (95-02)

AGENDA TIMETABLE

BIRD STRIKE COMMITTEE CANADA
26TH MEETING

ST. JOHN'S, NEWFOUNDLAND
APRIL, 1997

Wednesday, April 23, 1997

TIME	SUBJECT	SPONSOR
0830 - 0900	COFFEE AND MUFFINS	ALL
0900 - 0905	WELCOME	BRUCE MACKINNON
0905 - 0910	OPENING	HAROLD HEFFERTON ST. JOHN'S AIRPORT MANAGER
0910 - 0920	INTRODUCTION OF ATTENDEES	MARIO LAROSE & BRUCE MACKINNON
0920 - 0930	REVIEW OF MINUTES - BSCC 25 ACTION ITEMS	MARIO LAROSE & BRUCE MACKINNON
0930 - 0945	BIRD STRIKE SUMMARY REPORTS	DND, TC, AC, CAI, FAA, USAF, ICAO
0945 - 1000	ROBIN HOOD BAY WASTE DISPOSAL FACILITY - AN OVERVIEW	DR. ROLPH DAVIS
1000 - 1200	FIELD TRIP - ROBIN HOOD BAY WASTE DISPOSAL FACILITY	DAVE BLACKMORE DR. ROLPH DAVIS
1200 - 1330	LUNCH - HARBOUR RESTAURANT BATTERY HOTEL	ALL
1330 - 1600	FIELD TRIP - ST. JOHN'S AIRPORT	JIM ROCHE - ST. JOHN'S AIRPORT

Thursday, April 24, 1997

TIME	SUBJECT	SPONSOR
0830 - 0900	COFFEE AND MUFFINS	ALL
0900 - 0940	GULLS ASSOCIATED WITH THE ST. JOHN'S AIRPORT AND THE ROBIN HOOD BAY WASTE DISPOSAL FACILITY	DR. ROLPH DAVIS
0940 - 1000	ROBIN HOOD BAY WASTE DISPOSAL FACILITY ST. JOHN'S MUNICIPALITY PERSPECTIVE	DAVE BLACKMORE
1000 - 1030	COFFEE BREAK	ALL
1030 - 1050	WILDLIFE CONTROL TRAINING COURSE PICKERING AVIFAUNA STUDY - UPDATE	DAVE FAIRBAIRN
1050 - 1100	BIRD HAZARDS TO AIRCRAFT BOOK UPDATE	DR. HANS BLOKPOEL BRUCE MACKINNON DR. RICHARD DOLBEER
1100 - 1110	AGRI-SX BIRD DETERRENT DEVICE	MARIO LAROSE
1110 - 1130	MILITARY AIRFIELD ZONING REGULATIONS	PIERRE IBROT
1130 - 1200	OPEN	
1200 - 1300	LUNCH	ALL
1300 - 1445	OPEN	
1445 - 1515	COFFEE BREAK	ALL
1515 - 1530	OPEN	
1530 - 1545	OTHER BUSINESS	ALL
1545 - 1600	CONCLUSION	ALL

BIRD STRIKE COMMITTEE CANADA
MEETING 25, NOVEMBER 6 & 7, 1996

CO-CHAIRS:
Mario Larose, Department of National Defence and Bruce MacKinnon, Transport Canada

MINUTES PREPARED BY: Carol Nishitoba
Transport Canada, Safety and Security, Aerodrome Safety

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Minutes of the 25th meeting of Bird Strike Committee Canada

November 6, and 7, 1996
Citadel Inn
Ottawa, Ontario, Canada

1.0 Introduction and Welcome

Iain Henderson, Director General, Transport Canada Airports, opened the meeting, stressing three points regarding bird strikes: 1) the probability of a major aircraft loss resulting from a bird strike is increasing; 2) birds are a serious international problem; and 3) the bird strike problem is a technical implementation problem where solutions are of no use unless put into effect.

Bruce MacKinnon provided the official welcome, and explained that there was a change in focus with this meeting. Normally there is a field trip on the second day, but the large number of papers dealing with landfill and zoning issues necessitated two days indoors.

2.0 Introduction of Attendees

3.0 Review of the Minutes/BSCC 24 Action Items

There were no comments or amendments proposed for the BSCC 24 minutes.

BSCC Action item 1 ("BSCC Logo") was discussed by Mario Larose. The issue will be discussed at BSCC 26. As for action item 2 ("Future Role & Activities of BSCC"), Bruce MacKinnon felt that it was premature to discuss this because of uncertainty related to the reorganization within Transport Canada.

4.0 Airport Operator Liability

Captain Richard Sowden explained that airport operators can be liable for bird strike accidents that occur within the airport environment and can face potential lawsuits. Airport operators must take all reasonable action(s) to reduce the chance of a bird strike. Airport operators should not limit their actions only to the airport, but should work to influence land use decisions off airport property that have the potential to affect safe aircraft operations. Airport operators must be aware of their legal responsibilities and involve others in the aviation industry (e.g. ATC, pilots, aircraft designers) to exchange information and share the responsibility of preventing bird strike hazards. (See appendix 4 for more information.)

5.0 TDC Bird Hazard Research Project

Trevor Smith from the Transportation Development Centre in Montréal gave a preview of the aforementioned project. This comprehensive project will research and evaluate the nature and cost of bird hazards and assess and reduce the risks of bird strikes by updating and expanding on a TDC study from 1979. The results may lead to additional R&D solutions to manage bird hazards. LGL is undertaking the first phase of the project before continuing with more specific research. Trevor said they hope to have the project completed by the end of 1997. (For an outline of his presentation please see appendix 5.)

6.0 Other Business

Bruce MacKinnon discussed a proposal to update the Bird Hazards to Aircraft book written by Dr. Hans Blokpoel. Since being issued in 1976, the book has been widely distributed within the aviation community, and an updated book could prove to be invaluable. Although Transport Canada's involvement in this issue is uncertain, the involvement of the aircraft and airline industry as well as other stakeholders would be important. There was agreement from the committee that the book should be updated, and a letter of resolution in support of the project from BSCC to Transport Canada senior management was proposed.

7.0 Managing the FAA Bird Strike Database and Initial Analysis

Sandra Wright explained the task of organizing and inputting past and present data into the FAA bird strike database. Tasks she described included arranging the backlog of entries, eliminating duplicates, and completing incomplete reports. The first annual report reflecting bird strike information was published in November 1995. Several changes were made to improve the FAA strike reporting form 5200-7. (Please see appendix 6.) Although there are many reports to sift through, it is estimated that about 80% of all American bird strikes go unreported.

Ed Cleary presented statistics based on the 1993, 1994, and 1995 bird strike reports (see appendix 7). Some of the bird strike statistics included time of day (most strikes occur during the day but there is a higher strike rate at dusk), type of aircraft (mainly short haul commercial aircraft), species most frequently struck (gulls), and reporting source (most by commercial aircraft operators). He pointed out that although there are hidden indirect costs, the overall cost of wildlife strikes to US airlines and military may exceed $200 million/year.

8.0 Assessment of Bird Strike Accident Risk using Event Sequence Analysis: An Update

Todd Curtis from Boeing provided an update on an event sequence analysis presentation that he originally gave at BSCC 24. He pointed out that by using event sequence analysis and determining what has occurred in past accidents you can determine possible future outcomes. He examined 8 large jet transport accidents for this case study, and discovered some common elements among the 8 events.

9.0 Using the World Wide Web for Bird Strike Hazard Awareness

Todd Curtis informed us of the bird hazards to aircraft web site he has set up to provide information to the general public on aviation safety. It is a prototype site on a private page using public information, with no affiliation to Boeing. Todd outlined his 12-step program for putting together a successful web site, and gave several reasons to be on the World Wide Web.

His site can be found at http://airsafe.com

10.0 Nairobi ESAF Workshop

Alistair Pinus from ICAO reviewed the proceedings of the Nairobi ESAF workshop held at the Nairobi ICAO regional office. This workshop was held during one week in September and was attended by regional and international representatives. Bird strike incidents are on the increase and are becoming a serious problem in Africa. After reviewing some of the presentations from the workshop he concluded that the meeting was beneficial to all participants. (See appendix 8 for a report on the ESAF workshop.)

11.0 Ottawa-North Bay Bird Studies

Carol Potter's presentation was divided into two parts. At first she discussed the results of her Ottawa and North Bay airport bird studies, which assessed the abundance and habitats of birds and reviewed bird control activities. Her findings showed that Ring-billed gulls were the most abundant species; few bird movements took place between woods and airfield; and that shorter grass attracts the more commonly struck species. She concluded with several recommendations to mitigate bird strike hazards through methods such as maintaining longer grass height and developing stronger zoning regulations.

Carol then presented her Carleton University thesis on Ring-billed gull populations near the Ottawa and North Bay airports. She outlined the 4 objectives of the project and reported her research methods and results. Her 3 conclusions were: the number of gulls is affected by landscape, Ring-billed gulls near airports exhibit different characteristics than those in forested areas, and the bird control program at MacDonald-Cartier International Airport is working (i.e. gull numbers are lower). (The abstract from her paper is found in appendix 9.)

12.0 BSCUSA-Phoenix

Jim Forbes summarized the proceedings from the August BSCUSA meeting in Phoenix. Due to an increased registration cost resulting from AAAE involvement, many of the regular members from the industry could not attend. However the Elmendorf AWACS accident led to a large turnout from the USAF. Jim discussed 3 issues being examined for the upcoming meeting in Boston: the original idea of producing meeting proceedings was rejected by the Steering Committee, who concluded that the cost of postage and printing was too high; three working groups were developed to address various issues; and in future letters of resolution will be prepared by the committee. Jim concluded his presentation by mentioning that the next BSCUSA meeting will be at Boston's Logan airport on August 12 to 14, 1997, and anyone who would like to present a paper should contact Richard Dolbeer.

13.0 Mexican Bird Hazard Assessment at Proposed Mexico City International Airport

Ed Cleary discussed a new Mexico City airport which is being planned because there is no expansion potential at the current Mexico City Airport. The FAA had been consulted to evaluate one of 3 sites. He emphasized that Mexico is concerned about safety issues related to birds, and recommended the formation of a BSC Mexico or BSC North America.

Richard Dolbeer gave a description of the proposed site, and explained that it is a major wintering ground for waterfowl, which are protected by international treaty, and the necessary wetland drainage that would occur in order to build an airport would require the provision of compensating habitat for waterfowl.

14.0 'Flying With the Birds' video

Bruce MacKinnon presented Dr. Yossi Lesham's video that was shown at BSCE in London. This excellent video describes the work that has been done in Israel to manage the bird strike problem.

15.0 Tribute to Red Mason

Bruce MacKinnon presented a gift to Red Mason on behalf of Transport Canada and BSCC. Red's many years of contribution to BSCC, the Transport Canada Wildlife Control training program, and his work at Lester B. Pearson International Airport were acknowledged.

16.0 Wildlife Control Officer's Association

On behalf of Peter Jarman, Bruce MacKinnon presented an outline of a proposal to create a Wildlife Control Officer's Association which would provide a forum for communication between airport wildlife control personnel and committees such as BSCC, BSCUSA, and IBSC. (Complete information can be found in Appendix 10.)

17.0 Multi-Agency Bird Strike Awareness Video

A new bird strike awareness video which is being developed by Transport Canada and Boeing was shown to the group. Comments were provided by the committee, and the video will be modified to address the committee's suggestions. The updated video will be shown at BSCC 26.

18.0 The Potential for Significant Financial Loss Resulting from Bird Strikes In and Around an Airport

Michael Robinson from Alexander Howden Aviation provided some insight into the insurance aspects of the aviation industry. Current liability claims for jet transport accidents are around $2-$3 million/passenger (US). Michael described several scenarios to illustrate how high awards could go (up to $1.4 billion). He concluded by stating that airport liability insurance is relatively inexpensive when compared to the potential costs incurred due to a bird strike accident (see appendix 11).

19.0 Findings of a 2 Year Wildlife Hazard Assessment at Washington Dulles Airport

Jessica Dewey presented the results of a comprehensive study undertaken from September 1994 to August 1996 at Washington Dulles Airport. Four ecological studies were carried out: a bird survey; a small mammal study; a pond survey; and a deer management study. (Please see appendix 12.)

At the end of this presentation, the meeting was adjourned for the day.

DAY 2

20.0 Introduction to TC Aerodrome Safety Branch

Harvey Layden, Transport Canada's Director of Aerodrome Safety explained that Transport Canada is undergoing a significant transition and will no longer by operating airports. The Aerodrome Safety branch was created in order to focus on policies, standards, and regulations.

21.0 Victoria Wildlife Control Management Plan

David Fairbairn from Jacques Whitford informed us that very few airports have a documented airport wildlife control management plan. As a result, Transport Canada has contracted Jacques Whitford Environment Ltd. to produce a management plan for Victoria International Airport so that this plan can be used as a model for other airports in Canada. (See appendix 13.)

22.0 Proposed Standards for New and Expanded Landfill Sites - Accepting Non-Hazardous Waste - Airport Planner's Perspective

Diane Waller began by explaining that local governments control much of the land surrounding airports. However, the federal government has produced 2 documents as guidelines in order to influence the types of land use activities that take place near airports: The Airport Protection Plan and Land Use in the Vicinity of Airports (TP 1247). The issues related to restrictions placed on lands near airports can become very complex and there is a need for ongoing dialogue between airport operators and municipal government officials.

Two case studies dealing with Ottawa International Airport were then presented. The first occurred in June 1993 when the city of Gloucester wanted to create stormwater management ponds near the airport to control and treat stormwater runoff before it entered the Rideau River. Transport Canada's involvement began late in the process, after the Master Plan was created and no other possible location was available. The ponds were constructed and the city has agreed to monitor the area for bird hazards and has modified the original plans to create an environment which is less attractive to birds.

The second event began in June 1996, with a proposal to create a recycling facility southeast of the airport, within the 8 km bird hazard zone. The proponent was convinced that his facility would not create bird problems, and was unwilling to undertake a bird study. The Ministry of the Environment and Energy (MOEE) is satisfied that the facility can operate bird-free, but will conduct regular monitoring, and has attached strict conditions to the proponent's certificate of approval.

From these 2 case studies, Diane found some problems with the site selection process. First, TP 1247 is only a guideline, rather than a regulation. Second, airport planners have no authority over off-airport land-use. Recent changes to the Ontario Government planning process have included a draft document containing standards for landfill sites, incorporating the 8 km radius in the siting process. (See appendix 14.)

Brad Eckert from the Province of Ontario MOEE gave an overview of provincial responsibilities. The provincial government has issued Ontario landfill standards, not regulations, which outline what the ministry expects when siting facilities such as landfills. If MOEE standards are met, the facility should not create a bird hazard problem for a local airport. Many of the details regarding a site's location and management must be worked out between the proponent and airport operator, although the MOEE will monitor activities.

23.0 An Industry Perspective on the Siting of Waste Disposal Facilities - With Reference to Aviation Safety Issues

Howard Golby from BFI presented BFI's perspective on the siting of landfills near airports. He stated that the proponent should be aware of issues that may arise when siting, and there is a need for timely and open communication between airport operators and the proponent. Birds can be prevented from using landfills by implementing and maintaining control programs from the start, in addition to properly managing the site environment.

Two case studies were presented to demonstrate that landfill sites and airports can co-exist. The first dealt with the opening of Denver's new international airport in 1995. Prior to the airport's development, a landfill had been in operation 10,000 ft from the southernmost E-W runway. BFI treated this issue as though the landfill were a new initiative. They determined that a bird control program was required and one was implemented in August 1993. When compared to the number of gulls in the area prior to the control program, there are 95-97% fewer gulls at the landfill since implementation of the bird control program. The second study dealt with Winnipeg International Airport. A landfill was proposed 2 years ago that would be situated 9 km north of Runway 18-36 at Winnipeg International Airport. The site was opened on October 11, 1996. Numerous parties have been involved in the planning process (TC, the airport, pilot unions, provincial government, municipal government), and actions were carried out with the same objective as in Denver: to keep the birds away from the site. This will be achieved through a bird control program, as well as by covering waste and draining standing water. As a result, birds have not become established on the site to date.

Howard stressed the importance of constantly maintaining a control program by telling us that when the program was stopped for one day, 500 gulls moved into the landfill area. He concluded his presentation by stating that irrespective of distance, landfills and airports can co-exist as long as there is communication among all parties combined with proper management of the site. (Please see appendix 15.)

24.0 St. John's Bird Hazard Study

Dr. Rolph Davis from LGL Ltd. described the landfill site at Robin Hood Bay in St. John's, Newfoundland as "unique". The site is located 4 km from the airport, and it is a 100 acre area that remains without benefit of any modern management techniques. Transport Canada has funded 2 studies to determine how bird behaviour affects the landfill and airport. The first study took place between late November 1995 and March 1996. It was determined that there are 25, 000 gulls in the area which feed at the landfill site, and they then fly to Quidi Vidi Lake to loaf. The gulls range in size from the 2 lb. Herring Gull to the 4.5 lb. Great Black backed gull. The second study took place from late June to early October and focused on nesting birds. It was a period with few gulls since young were leaving the nest. The study concluded that the nesting season resulted in fewer birds affecting the airport. Rolph explained that the city of St. John's has no money to improve the management of the landfill site, or to develop a bird control program. Furthermore, in spite of the fact that there is a significant air safety risk associated with the birds feeding at the Robin Hood Bay facility, studies have not been conducted during the period when the greatest number of birds are in the area, and the problem may be even greater than predicted.

25.0 Pickering Avifauna Study

Ron Huizer from Jacques Whitford Environment Ltd. described the ongoing study (which began mid March 1996 and continues until February 1997) of landfill and compost sites within a 50 km radius of the airport. With 2 key loafing and feeding areas near Lake Ontario, the total number of birds in the study area is currently 27,000 -- a 400% increase since 1972. The main feeding-loafing area is the Brock West landfill. Waste from the Greater Toronto Area is sent here, and several studies have pointed out the importance of this area for gulls. The second bird attractant are the many compost sites which have been developed in association with pig farms. Food waste from restaurants is fed to the pigs, and left-overs are composted. It is the compost material that is attractive to gulls.

Ron concluded his presentation by stating that compost sites pose a significant potential bird hazard, and recommended that restrictions similar to those of landfill sites be imposed. (See appendix 16.)

26.0 YVR Wildlife Control Management Plan

Dave Ball from YVR described the airport's new wildlife control management plan which was initiated in March 1996 after a BA B767 struck 30 ducks. Currently, the airport has a 24 hour a day, 7 day per week patrol program, with 2 Wildlife Control Officers on duty at all times. The team is made up of Dave as supervisor, 8 full-time Wildlife Officers, 1 chief Wildlife Officer, and 2 spares. From September 15 to October 15, 29,339 birds were observed. The costs for the program are as follows: $250,000 in salary dollars, $40,000 - $50,000 for vehicles, $60,000 for equipment, and an unknown amount for project costs, such as ongoing worm and grass studies. Dave described the current grass study, which is part of a 5 year plan to establish Reed Canary grass throughout the airport. The airport is also testing the use of Velcro to attach Nixalite to signs and other perches so that the Hot Foot which was previously used will not cause problems for maintenance operations.

Dave described 2 current bird problems at YVR; both involving the new terminal. Although every effort was made to eliminate all possible nesting and roosting sites, some still exist. Also, during the construction phase birds became trapped inside the building. In addition to the problem of birds flying inside the terminal (although many have been caught and released), many passengers have begun to feed them. (See appendix 17.)

27.0 BSCC Action Item

Vic Soiman presented a draft letter of resolution from BSCC to update and print Dr. Hans Blokpoel's 1976 book., Bird Hazards to Aircraft. He received unanimous support for this proposal from the committee, making this the first action item generated from BSCC 25.

28.0 The Bird Tracking and Aircraft Strike Forecast System

Dr. William Seegar presented information about using satellite telemetry to study and track free-ranging animals. For example, he has placed a small transmitter on a Peregrine Falcon and has been able to monitor the bird's movements through the Andes and examine its habitat without having to send someone into the field. Work is currently being conducted on a sophisticated GIS system used in combination with satellite telemetry to construct a model to forecast bird flight. The model uses meteorological information and will be used during the next 4 months at Naval Air Station Fallen. If successful, the model can be used to forecast and provide data on bird patterns in and around airports. Bill's group hopes to use this system at a civilian airport with an established wildlife control program to see how it can assist in monitoring potential bird threats.

29.0 One Dimension Soaring Forecast Model to Predict Bird Flight in Relation to Local Aircraft

Harlan Shannon described current research that is being conducted on the correlation between the soaring of birds and the boundary layer, that part of the lower atmosphere directly influenced by the earth's surface, in order to predict the threat of a bird strike since birds rely on thermal circulation for soaring. The model is one-dimensional in nature, and to initialize it 3 data sets were used: atmospheric sounding; large-scale model data (which can influence and impact small processes), and off-the-shelf meteorological and biographical material (constants in the model). Budgets of heat, moisture and momentum were calculated for each model layer, and the stability of each model layer determines the extent of the thermal circulation.

The study was based on Pelican flight altitude vs. time of day over a one month period. From this data, 2 conclusions were made based on preliminary model results. The first is that the model does show a correlation between soaring birds and the boundary layer process. Data revealed that the altitude of the Pelicans increased during the day (9 a.m. - 2 p.m.) with thermal activity. Harlan did mention that the birds sometimes found additional lift from other weather systems such as thunderstorms, which caused a slight deviation from the pattern. The second finding was that the model can predict the evolution of thermals. This information will assist in knowing where to look for birds in the vertical column, while satellite telemetry can give us the actual position of the birds, leading to the ability to forecast bird flight patterns to avoid bird strikes.

30.0 Canada Goose Movements in the Vicinity of Jamaica Bay - New York City

Dr. Steve Garber from JFK Int'l Airport spoke about the different flight paths and movements of Canada Geese that reside at Jamaica Bay in New York City. He described the birds' daily movements and how they affect aviation safety at JFK Int'l Airport.

31.0 Birds at JFK Airport - Abundance, Risk to Aviation, and Management

Dr. Steve Garber described the complexity of managing wildlife at a busy international airport, and provided some insight into the current lawsuit brought against JFK by Air France as a result of damage done to the Concorde after a bird strike involving Canada Geese in 1995. He went on to discuss problems with protected lands near the airports, and some of the work that has been done with groups such as those who race pigeons near the airport. (See appendix 18.)

32.0 JFK Airport Falconry Program

Steve Garber explained that JFK needed more tools for their wildlife management program, and although debate continues on the merits of falconry as a bird control technique for airports, they felt that a test program had merit. He went on to describe the success that they have had with falconry so far.

33.0 Calgary Avifauna Study

Terry Thompson from Calgary International Airport described the implementation of the wildlife control management plan prepared by Howard Troughton from the University of Calgary. Howard's plan provided 64 recommendations; such as dawn, dusk and weekend patrols, alterations in land-use practices, and the need to identify bird remains after strike incidents are identified.

Further to this, Calgary has conducted an evaluation of the Phoenix Wailer. Although they decided that the product is a short term deterrent at best, the scope of the study was a limiting factor and further study is necessary to completely evaluate the product.

34.0 Results of JFK Shooting Program

Jim Forbes presented data for the period 1991 to 1996 for the JFK gull shooting program, which begins in May and runs to the end of August annually. Laughing gulls are the main problem species, with 173 laughing gulls struck by aircraft between 1988 and 1990. In total, there have been 44, 359 laughing gulls removed, with 1991 being the year with the largest number shot, primarily because it was the first year of the program. However, the number in the colony has declined only 30%. He concluded by recommending the continuation of the shooting program and other techniques until the gulls can be permanently moved. (See appendix 22.)

36.0 Action Items generated from BSCC 25

1. BSCC Logo - Mario Larose will discuss the Logo at BSCC 26.

2. Bird Hazards to Aircraft Book - Bruce MacKinnon will work towards facilitating the update of Hans Blokpoel's 1976 book; Bird Hazards to Aircraft

35.0 Other Business

The next BSCC meeting will take place on April 23 and 24 in St. John's Newfoundland.

At this point, the meeting was adjourned.

BIRD STRIKE COMMITTEE CANADA
MEETING 25, NOVEMBER 6 & 7, 1996

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4. Airport Operator Liability
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7. Wildlife Strikes to Civilian Aircraft in the United States 1993-1995
8. Report on the Second ESAF Workshop on the Reduction of Bird Hazards to Aviation
9. Birds and Bird Control at two Ontario Airports (Ottawa and North Bay Airport)
10. Proposal for an Association of Airfield Bird Controllers
11. The Potential for Significant Financial Loss Resulting From Aircraft Bird Strikes in or Around an Airport
12. The Ecological Study Conducted at Washington Dulles International Airport
13. Victoria Airport Wildlife Management Plan
14. Bird Hazards A Planning Perspective: Ottawa - MacDonald-Cartier International Airport
15. An Industry Perspective on Landfill Sitting Near Airports as it Relates to Bird Management Issues
16. Transport Canada Avifauna Study: Pickering Airport Lands
17. Vancouver Airport Authority: Wildlife Management Plan
18. Management of Canada Geese at North American Airports
19. John F. Kennedy International Airport: Rodent-Eating Raptor Survey
20. John F. Kennedy International Airport: Piping Plover Survey
21. Rock Dove (*Columba livia*) Strike Rates at John F. Kennedy International Airport in New York City
22. Shooting Gulls to Reduce Strikes with Aircraft at John F. Kennedy International Airport, 1991-1996: Draft Summary
23. Do Populations of North American Canada Geese Pose an Increasing Hazard to Aviation?
24. International Civil Aviation Organization Bird Strike Statistics
25. Eindhoven C-130 Crash
26. Avian Ecology and Air-Traffic Safety at Vancouver International Airport

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APPENDIX 1

Organizational Letter

Transport Canada Transports Canada

Airports Aéroports

Transport Canada
Environment and Support Services
18C, Place de Ville
Ottawa, Ontario
K1A 0N8

Your file Votre référence

Our file Notre référence

June 25, 1996

AKP 5158-36-20-51

All Members/Participants
Bird Strike Committee Canada

Dear Member/Participant:

Please find enclosed the minutes from Bird Strike Committee Canada meeting #24 which was held in Richmond, British Columbia on April 10 and 11, 1996. In addition, a copy of the 1995 Bird Strikes to Canadian Aircraft Summary Report has been included. If you have questions or comments on either document, please feel free to contact the undersigned.

Bird Strike Committee Canada meeting #25 will be held in Ottawa, Ontario, on Wednesday, November 6 and Thursday, November 7, 1996. The meeting will commence at 0830 on Wednesday, at the Citadel Inn, 101 Lyon Street, in downtown Ottawa. There is a block of rooms reserved under Transport Canada, Bird Strike Committee Canada, at $81.00 per night single, and $91.00 for a double. We recommend that you book your room soon. The toll free reservation number is 1-800-567-3600.

If you have agenda items or wish to contribute a paper for presentation, please call Bruce MacKinnon at 613-990-0515 before September 30.

We look forward to seeing you in Ottawa, and if you have any questions or comments, please contact the undersigned.

Regards,

Bruce MacKinnon
Manager, Wildlife Control

APPENDIX 2

BSCC 25 Agenda

AGENDA-TIMETABLE

BIRD STRIKE COMMITTEE CANADA
25TH MEETING

OTTAWA, ONTARIO
NOVEMBER 6-7, 1996

Wednesday, November 6, 1996

TIME	SUBJECT	SPONSOR
0830 - 0900	Coffee and Muffins	Complements of Jacques Whitford Environment Ltd.
0900 - 0905	Welcome	Bruce MacKinnon
0905 - 0910	Opening	Iain Henderson Director General Transport Canada Airports
0910 - 0915	Introduction Of Attendees	All
0915 - 0920	Review Of Minutes - BSCC 24 Action Items	Mario Larose Bruce MacKinnon
0920 - 0935	Airport Operator Liability	Captain Richard Sowden
0935 - 0950	TDC Bird Hazard Research Project	Trevor Smith
0950 - 1020	Coffee	Compliments of Jacques Whitford Environment Ltd.
1020 - 1100	Managing the FAA Bird Strike Database and Initial Analysis	Ed Cleary Sandra Wright
1100 - 1125	1. Assessment of Bird Strike Accident Risk Using Event Sequence Analysis: An Update 2. Using the World Wide Web for Bird Strike Hazard Awareness	Todd Curtis
1125 - 1145	Ottawa-North Bay Bird Studies	Carol Potter
1145 - 1150	Nairobi ESAF Workshop	Alistair Pinos Bruce MacKinnon
1150 - 1200	BSCUSA-Phoenix	Jim Forbes Richard Dolbeer
1200 - 1300	Lunch	All
1300 - 1305	Mexican Bird Hazard Assessment at Proposed Mexico City International Airport	Ed Cleary Richard Dolbeer
1305 - 1325	'Flying With the Birds' video	Yossi Leshem
1325 - 1330	Wildlife Control Officer's Association	Bruce MacKinnon for Peter Jarman
1330 - 1400	Multi-Agency Bird Strike Awareness Video	Bruce MacKinnon
1400 - 1405	Tribute to Red Mason	All
1405 - 1430	The Potential for Significant Financial Loss Resulting from Bird Strikes In and Around an Airport	Michael Robinson (Alexander Howden Aviation)

1430 - 1500	Coffee	Compliments of Jacques Whitford Environment Ltd.
1500 - 1530	Findings of a 2 Year Wildlife Hazard Assessment at Washington Dulles Airport	Jessica Dewey
1530 - 1550	Victoria Wildlife Control Management Plan	David Fairbairn
1550 - 1600	IBSC-BSCE-London	Mario Larose Richard Dolbeer
1600 - 1730	Second International Water Volleyball Tournament	All
1730 - 1900	Social Hour-Rideau Room	Howard Golby (BFI)

Thursday, November 7, 1996

TIME	SUBJECT	SPONSOR
0830 - 0900	Coffee and Muffins	Compliments of Jacques Whitford Environment Ltd.
0900 - 0905	Introduction to TC Aerodrome Safety Branch	Harvey Laydon
0905 - 0930	Proposed Standards for New and Expanded Landfill Sites-Accepting Non-Hazardous Waste-Airport Planner's Perspective	Brad Eckert Dianne Waller
0930 - 1000	An Industry Perspective on the Siting of Waste Disposal Facilities - With Reference to Aviation Safety Issues	Howard Golby John Wonnacott
1000 - 1030	Coffee	Compliments of Jacques Whitford Environment Ltd.
1030 - 1045	St. John's Bird Hazard Study	Rolph Davis
1045 - 1105	Pickering Avifauna Study	Ron Huizer
1105 - 1200	Discussion	All
1200 - 1300	Lunch	All
1300 - 1310	YVR Wildlife Control Management Plan	Dave Ball
1310 - 1345	1: One Dimension Soaring Forecast Model to Predict Bird Flight in Relation to Local Aircraft 2: The Bird Tracking and Aircraft Strike Forecast System	Bill Seegar
1345 - 1425	1: Canada Goose Movements in the Vicinity of Jamaica Bay-New York City 2: Birds at JFK Airport-Abundance, Risk to Aviation, and Management 3: JFK Airport Falconry Program	Steve Garber
1425 - 1440	Coffee	Compliments of Jacques Whitford Environment Ltd.
1440 - 1450	Calgary Avifauna Study	Terry Thompson
1450 - 1510	YVR System Safety Review (1996)	David Anderson
1510 - 1515	Results of JFK Shooting Program	Jim Forbes
1515 - 1520	Other Business	All
1520 - 1530	Conclusion	All

APPENDIX 3

Transport Canada 1996 Birdstrike Highlights

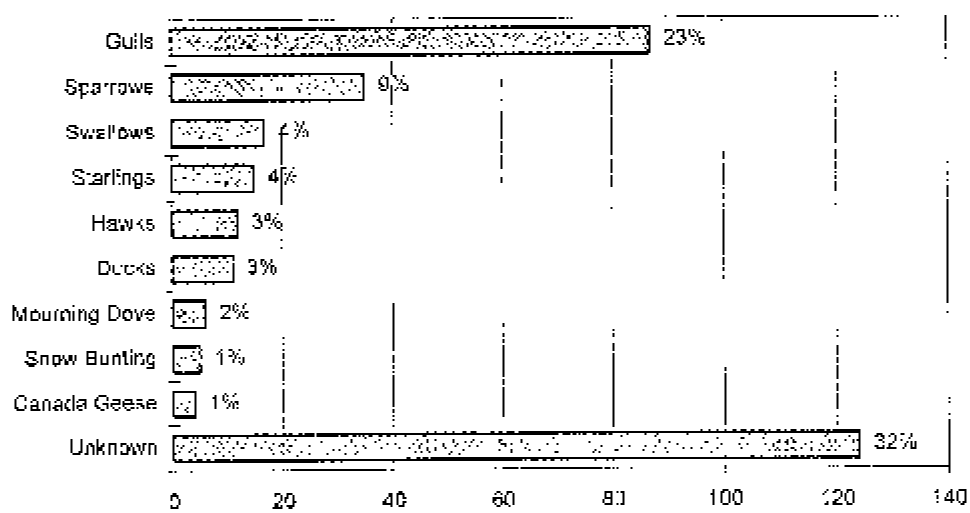
1996 Highlights

*N.B. The following is preliminary data only, and does not include strikes reported by airports, or through OIRS and CADORS.

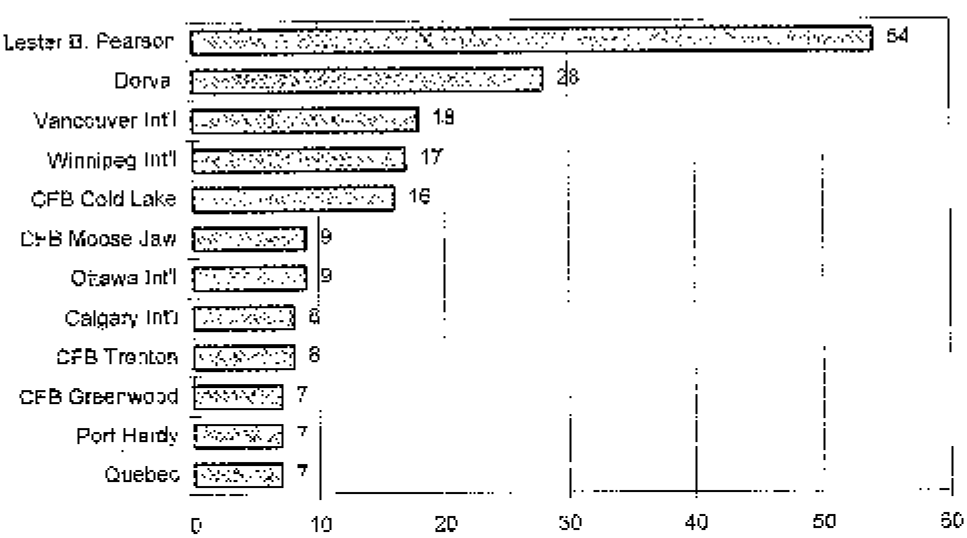
- So far, a total of 368 bird strikes were reported to Airports Group in 1996. Of these, 328 occurred at Canadian sites, 23 occurred outside Canada, and 17 were of unknown origin.

- There have been 12 Aborted Takeoffs and 34 Precautionary Landings.

- Predominant bird species have been gulls (23%), sparrows (9%), swallows (4%), and starlings (4%). Of the strikes reported, 32% could not identify the bird involved.



- Key airports include Lester B. Pearson International (54 strikes), Dorval (28 strikes), Vancouver International (18 strikes), and Winnipeg International (17 strikes).



APPENDIX 4

Airport Operator Liability

AIRPORT OPERATOR LIABILITY

by

Captain Richard Sowden
Chairman, Technical & Safety Division
Air Canada Pilots Association

Aviation safety operates on the principle that "what is wrong" is more important than "who is wrong". To expand on this: it is more important to identify what were the causal factors of an accident, and prevent similar accidents from occurring, than it is to identify the party or parties that may have committed the errors that directly or indirectly led to the accident.

This directly conflicts with the legal principles of negligence and liability. As individuals who are concerned with enhancing aviation safety we are all now placed in the difficult position of when we identify a safety problem, of not only having to determine "what is wrong" and correct it, but to make sure that from the legal perspective, that we are not the labeled "who is wrong", and become the subject of a major law suit.

Before we go any further let us quickly review the definitions of liability and negligence. I am not a legal expert so the definitions presented below, are expressed in layman's terms.

Negligence

A person or agency is considered negligent when they act without due care, or when they fail to act and a party whom they ought to have considered is affected by their actions or their failure to act.

Courts will impose certain "standards of care" which will be expected under given circumstances. A court will review all relevant documents to establish what the appropriate "standard of care" should be. This standard of care for bird hazards would be compared with ICAO ANNEX 14, Chapter 6 & 9, FAA Order 5200.5 and Transport Canada TP1247 and any other documents that would directly relate to the specific circumstances of the accident in question.

Liability

The principle of liability depends on the proof of negligence. Should a plaintiff be able to prove that a person or agency was negligent in their duties with respect to controlling wildlife either on, or in the vicinity of, an airport then that party or agency will be liable for any damages incurred.

Where does this lead us with respect to the liability of an airport operator with respect to responsibility for bird strike reduction programs. Three more legal definitions are necessary to complete the legal picture of responsibility. These are the legal terms "invitee", "occupiers liability" and "unusual danger". These terms are interrelated, and are explained below

Invitees

Aircraft using an airport are considered to be "invitees". Invitees are expected to use reasonable care on their part for their own safety.

Occupiers Liability

The operator of an airport is liable as an "occupier" of the airport property. The occupier must use reasonable care to prevent damage to an "invitee" from "unusual danger" of which he knows or ought to know.

Unusual Danger

Unusual danger is difficult to define and is determined on a case by case basis. The principle applied is that an occupier is required to exercise reasonable care to prepare the premises for the safe entry of the invitee.

From the above definitions we are able to draw the following conclusion:

In the event of an aircraft accident at their airport directly or indirectly caused by a bird strike, the operator of an airport, to minimize the possibility of being successfully proved negligent and therefore liable for damages incurred, must take all reasonable actions to minimize the risk of birdstrikes at that airport.

Failure to do a credible job in all aspects of birdstrike prevention at an airport will place the operator in a precarious position of liability in the event of a bird strike caused accident.

Airport operator birdstrike prevention is not limited to controlling birds on the airport itself. Aircraft approaching and departing an airport, while not actually on the airport property, are subject to danger from birdstrikes associated with bird movements in the vicinity of the airport that are attracted to landfill sites and other land uses that attract birds. The liability of an airport operator can extend to bird strike hazards caused by birds from off airport locations.

If the operator of an airport becomes aware of the potential development of a land use in the vicinity of the airport, such as a landfill site, that may produce an increase in the bird strike risks at the airport, then the airport operator must, to minimize possible litigation, carry out all reasonable actions to either prevent that land use from occurring, or to ensure that mitigation measures are carried out to prevent the land use from creating a bird strike risk to aircraft.

To minimize the chance of being successfully sued in the event of a bird strike at the airport caused by a bird from a nearby land use, it will be critical for the airport operator to establish that a logical process for evaluation of the proposed site was carried out, with respect to aircraft bird hazards. This site selection process must apply defined standards for land use within the vicinity of an airport, but more importantly it must be a case specific examination of the proposed landfill site and its interactions with the local bird population and the airport.

Critical to the success of reduction in the chance of litigation is that the airport operator must be able to prove a track record of active participation in the entire site selection process that establishes the airport operator's position of making all reasonable efforts to ensure safety at the airport is not compromised.

As an airport operator it must be remembered that one can describe the possibility of being made a party to legal action, in the event of a bird strike related accident, as being like the chances of getting a gastrointestinal disorder while traveling in the third world. It is not a question of if you get sick, but rather when, how badly and how long for. In the case of a law suit, it will be when you are sued after the accident, how much for, and how long it takes to settle the legal action.

You might ask:

"Why should I be concerned about being named in a post crash law suit?"

In recent times the typical post crash lawsuit monetary awards have been in the neighborhood of two to three million U.S. dollars per passenger, plus the cost of the aircraft hull. If we were to use the example of a one hundred million U.S. dollar aircraft, with two hundred passengers and crew on board that was totally destroyed and all aboard killed, the total award would be a minimum of five hundred million U.S. dollars.

Why have I taken the trouble to lead you through this discussion? The above information is not meant to be interpreted as scare tactics. The potential for expensive law suits is very real. Even if the legal action is not successful, the cost of defending against the action can be enormous.

My goal in making this presentation is very simple; I hope that by informing airport operators what their legal responsibilities are, and by pointing out what the potential costs can be if the job of wildlife management is not completed effectively, that I may have provided you with the ammunition to convince the powers that control airport budgets, that wildlife management is a cheap form of insurance against expensive law suits. This is a perfect example of the statement made by many aviation safety experts when battling bureaucrats who complain of the costs of implementing and maintaining aviation safety programs

"If you think that safety is expensive, try having an accident."

In conclusion:

Although I have focused my presentation on the responsibilities of airport operators, I must add that the rest of the aviation industry also shares responsibility in helping prevent bird strikes.

Regulators must enact effective legislation that allows for the control, or prevention of unsuitable land uses in the vicinity of airports.

Aircraft designers must investigate ways to build aircraft that have less chance of sustaining significant damage to critical components in the event of a bird strike.

Engine manufacturers must design engines that are able to withstand single bird or multiple bird strikes from larger species of birds still provide sufficient reliability to allow for a safe return of the damaged aircraft.

Air traffic controllers must provide information on bird movements to wildlife management personnel, to identify potential problem areas to be addressed, and pilots to aid them in making decisions on whether to adjust flight profiles or delay operations to reduce the chance of a bird strike.

Pilots must also help by reporting bird strikes when they occur, as well as informing air traffic control personnel of wildlife activity that they observe that may be of potential danger to other aircraft.

As you can see all of the members of the aviation industry must provide vital information on wildlife activities at an airport. These observations will enable the airport operator to develop and continually adapt a wildlife management program that will minimize the risk of aircraft operating in and out of that airport.

If we all work together to exchange information and support the common goal of reducing bird strikes, the end result will be safer travel for the public.

APPENDIX 5

New Project to Assess and Manage the Hazards of Birds to Aviation

NEW PROJECT TO ASSESS AND MANAGE THE HAZARD OF BIRDS TO AVIATION

- In October 1996 the Transportation Development Centre (TDC), began a project to research and evaluate the nature and costs of the hazard of birds, assess the risk to Canadian aviation as well as methods to reduce the hazard of bird strikes to aircraft.

- The Canadian firm LGL Limited, led by Dr. Rolph Davis, has been selected to undertake this project with TDC.

- TDC's client is Transport Canada's Aerodrome Safety Branch. The Project's steering committee includes members of BSCC - progress will be reported to members of BSCC.

- Intended to update and expand the previous (1979) national study, and assess the degree this hazard has changed over time.

- It will also involve completion of an initial assessment of the comparative effectiveness of technological and operational solutions (ground-based and aircraft-mounted) in reducing this aviation hazard.

- Expected to lead to additional R&D to develop and evaluate the solutions short-listed, and assist in the development of plans to cost-effectively manage bird hazards in Canada.

- A final report will be available the end of 1997.

TRANSPORT CANADA BEGINS NEW PROJECT TO ASSESS AND MANAGE THE HAZARD OF BIRDS TO AVIATION

In October 1996 the Transportation Development Centre (TDC), the R&D arm of Transport Canada, began a project to update a 1979 national study investigating the nature, costs, and methods to reduce the hazard of bird strikes to aircraft. The Canadian firm LGL Limited, led by Dr. Rolph Davis, has been contracted to undertake this project with TDC.

For more than two decades a Transport Canada wildlife control program has managed this hazard to Canadian aviation and collected information on bird strikes. The 1978 TDC study was pioneer work, and in 1992 TDC undertook a project to develop aircraft-mounted technology to deter birds from aircraft. This research, as well as the new project, is being undertaken at the request of Transport Canada's Aerodrome Safety Branch (Safety and Security Group), which manages the wildlife control program and collects bird strike statistics.

Two recent accidents highlight the need to do more to reduce this hazard: a U.S. Air Force AWACS was lost after it hit geese in Alaska - 24 people were killed, and the aircraft, worth more than $189 million, was destroyed; in Los Angeles a Canadian Airlines aircraft hit a one-pound barn owl - the total costs from this strike were estimated at $3 million. Other recent accidents that have been expensive for the airlines involved a Canadian Airlines aircraft taking off from Calgary and a Concorde landing at New York. It is estimated that the 2 200 bird strikes reported each year in the U.S. are only 15% of the actual number of bird strikes - and that the total annual cost of damage from bird strikes, aside from catastrophic accidents, is over half a billion dollars. 837 bird strikes were reported in Canada in 1995.

The new project is intended to update and expand the previous national study and to research and evaluate the nature and costs of the hazard of birds, and assess this risk to Canadian aviation. It will also involve completion of an initial assessment of the comparative effectiveness of ground-based and aircraft-mounted technological and operational solutions in reducing this aviation hazard. A final report will be available by the end of December 1997. This project is expected to lead to additional R&D to develop and evaluate the solutions short-listed, and assist in the development of plans to cost-effectively manage bird hazards in Canada.

Organizations and individuals who would like to become involved in this project or have information that may be relevant are invited to contact:

Trevor Smith
Transportation Development Centre
Transport Canada
800 René Lévesque Blvd. West, 6th Floor
Montreal, Quebec
Canada H3B 1X9
Tel.:514-283-0022, Fax:283-7158
e-mail: smithtn@tc.gc.ca

or

Dr. Rolph Davis
President
LGL Limited
22 Fisher Street
P.O. Box 280
King City, Ontario
L7B 1A6
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e-mail: lgl@idirect.com

APPENDIX 6

Things that Go Bump in the Flight: Managing the FAA Wildlife Strike Database

THINGS THAT GO BUMP IN THE FLIGHT: MANAGING THE FAA WILDLIFE STRIKE DATABASE

Sandra E. Wright
U.S. Department of Agriculture, Animal Damage Control
National Wildlife Research Center
6100 Columbus Avenue, Sandusky, Ohio 44870

ABSTRACT: The collision of birds and other wildlife with aircraft is a serious problem. To better define wildlife problems at and around airports in the United States, the FAA has collected bird and other wildlife strike reports since 1968. In 1995, the U.S. Department of Agriculture, Animal Damage Control (ADC) Program, through an Interagency Agreement with the FAA, took over management of the database. As of November 1996, over 10,000 records on wildlife strikes to civilian aircraft from 1992 to the present have been organized by date, checked for accuracy, edited and entered into a computerized database. Approximately 85% of the strikes were reported on the FAA 5200-7 form, with the remainder coming from various sources including individual airport reports, FAA Preliminary Aircraft Incident Reports and NASA's Aviation Safety Reporting System. Many strike reports contained incomplete or conflicting information. Additional data and clarification of these reports have been obtained by contacting those involved as well as by referencing aviation industry databases.

The first annual report summarizing wildlife strikes to civilian aircraft in the United States has been completed for 1994. The International Civil Aviation Organization has received copies of the 1994 and 1995 FAA database for entry into their world-wide bird strike database. The compilation and analysis of this information is critical in determining the scope of wildlife strikes so that corrective measures can be taken to ensure safe and economic air transport. Database reports have already been used to justify wildlife management actions at airports that otherwise might have been too controversial to undertake.

Recommendations to improve the FAA Form 5200-7 include: changing the "Date of incident" to read month, day, year; change "Take-off" to "Take-off roll"; broadening "Engine Damage Cost" to include all costs; deleting "in thousands" in the "Estimated cost" section and deleting "Optional" next to "Reported by". Presently, it is estimated that less than 20% of all strikes are reported. Suggestions for improving the form and promoting the reporting of strikes are welcome.

NUMBER OF RECORDS IN THE FAA WILDLIFE STRIKE DATABASE AS OF NOVEMBER 1996

Year	No. of Records	Comments
No Date	117	
1983-88	36	New entries
1989-91	5138	Not edited
1992	2245	In progress
1993	2214	Edit complete
1994	2307	Edit complete
1995	2412	Edit complete
1996	689	In progress
TOTAL	15, 158	

APPENDIX 7

Wildlife Strikes to Civilian Aircraft in the United States 1993-1995

Wildlife Strikes to Civilian Aircraft in the United States 1993-1995

Federal Aviation Administration Wildlife Aircraft Strike Database

Serial Report Number 2

Report Prepared by

Edward C. Cleary[1]

Sandra E. Wright[2]

Richard A. Dolbeer[3]

[1] Staff Wildlife Biologist, DOT-FAA-AAS-317, 800 Independence Ave. SW., Washington, DC, 20591

[2] Biological Science Technician, USDA/APHIS/ADC/DWRC, 6100 Columbus Ave., Sandusky, OH 44870

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ACKNOWLEDGMENTS

The dBase file and support programs used to enter and organize strike data were established by J. Rapol and E. LeBoeuf, FAA Office of Airport Safety and Standards, Washington, DC. Their assistance in the initiation of this project was essential and is greatly appreciated. T. H. Hupf and S. Agrawal, FAA Technical Center, Atlantic City, New Jersey, also provided critical support and advice as did USDA biologists H. A. Bolte, C. P. Dwyer and R. P. Sliwinski. Finally, we acknowledge the pilots, mechanics, tower control personnel and other members of the aviation community who took the initiative to report wildlife strikes. Sponsorship and funds for the ongoing maintenance of the FAA Wildlife Strike Database are provided by the Federal Aviation Administration Office of Airport Safety and Standards, Washington, DC and Airports Division, Airport Technology Branch, FAA Technical Center, Atlantic City International Airport, New Jersey.

Wildlife Strikes to Civilian Aircraft in the United Sates, 1993-1995.

ABSTRACT

This report represents the first intense examination of several years of United States civilian aircraft wildlife strike data. Reported wildlife strikes involving civilian aircraft in the U. S. for 1993-1995 were analyzed. About 2,200 wildlife strikes were reported to the Federal Aviation Administration (FAA) each year. This reporting rate is probably less than 20% of the actual number. Reports were received from all 50 States and most USA territories. About 97% of the reported strikes involved birds, 3% involved mammals, and <1% involved reptiles. Gulls (14%) and waterfowl (6%) were the most commonly struck birds; deer (2%) and coyotes (<1%) were the most commonly struck mammals.

The types of aircraft most frequently involved in wildlife strikes were Boeing 737 (18%), McDonald Douglas MD-80/DC-9 (18%), and Boeing 727 (7%). Aircraft components most frequently damaged by birds were engines (29%), wings (21%), radomes (15%), and windshields (9%). Aircraft components most commonly damaged by mammals were landing gear (23%), propellers (14%), wings (11%), and fuselages (9%).

Twenty-one percent of the bird strike reports, and 76% of the mammal strike reports, stated the strike had a negative effect on the flight: aborted take-off (3%), engine shut down (1%), precautionary landing (5%), other (14%). Most bird strikes occurred during the day (66%), in late summer and early fall (51%), when the aircraft was on approach (37%), or during take-off (33%). Ninety percent occurred under 2,300 feet above ground level (AGL). Most mammal strikes occurred at night (68%), during the fall and early winter (57%).

For the 3 year period, 15% (979) of the bird strikes and 40% (71) of the mammal strikes caused damage to the aircraft or resulted in other related cost. Of the 1,050 strike reports indicating aircraft damage, only 530 reports provided an estimate of the aircraft down time (265 reports totaling 67,000 hours, avg. = 253 hours/report) and/or monetary losses (265 reports totaling $27.6 million, avg. = $104,000/report). We suggest these figures severely underestimate the actual cost of wildlife strikes to the civilian aviation industry because only 25% of the reports indicating aircraft damage provided an estimate of the aircraft down time and/or monetary loss, and presumably <20% of all strikes are reported. The actual losses attributable to wildlife strikes are likely closer to 374,000 hours/year of aircraft down time and $153 million/year in direct aircraft damage and related monetary losses.

Traditionally, airport wildlife management programs have focused on gulls because they have long been the species most commonly involved in wildlife strikes. The data indicates that while it is important not to lose sight of the role gulls play in wildlife strikes, the emphasis needs to be expanded to include other birds (especially waterfowl, raptors, and wading birds), as well as deer.

INTRODUCTION

Wildlife strikes have been occurring almost since the beginning of powered flight. Calbraith Rodgers, the first man to fly across the United States, was also the first to die as a result of a bird-aircraft collision. On April 3, 1912, Rodgers' Wright Pusher struck a gull, causing the aircraft to crash into the surf at Long Beach, California. As a result of several major aircraft accidents resulting from bird-aircraft collisions (Civil Aeronautics Board 1962, National Transportation Safety Board 1973, National Transportation Safety Board 1975, and others), the FAA began systematically collecting wildlife-aircraft strike data in the late 1970's using FAA Form 5200-7 - *Bird Strike Incident/Ingestion Report*. The extent of the wildlife-aircraft strike problem has been largely unquantified in the United States due to a lack of data analyses. Although the Federal Aviation Administration (FAA) monitored the reports in an effort to determine general trends, no detailed analyses were undertaken.

In April 1995, through an interagency agreement between the FAA and the U. S. Department of Agriculture's Denver Wildlife Research Center (DWRC), a project was initiated to obtain more objective and continuous estimates of the magnitude and nature of the wildlife strike problem to civilian aircraft in the USA The interagency agreement calls for DWRC to: 1) edit all strike reports (Form 5200-7) received by FAA to ensure consistent, error-free data, 2) enter all edited strike reports into the FAA Wildlife Strike Database, 3) supplement FAA-reported strikes with additional, non-duplicating strike reports from other sources, 4) provide FAA with an updated computer file each quarter containing all edited strike records, and 5) produce annual reports summarizing the results of the analyses. Such analyses are critical to determine the economic costs of wildlife strikes, the magnitude of safety issues, and most importantly, the nature of the problems (e.g., bird species, aircraft and engine types, airports, seasonality) so that corrective actions can be taken. In November 1995, DWRC submitted the first annual report *Bird and other wildlife strikes to civilian aircraft in the United States, 1994*, to the FAA (Dolbeer et al., 1995). This second report presented here includes the 1994 data summarized by Dolbeer et al. (1995) in a more comprehensive analysis of the FAA Wildlife Strike Database, covering 1993-1995. Subsequent annual and multi year reports will fallow.

Important factors to consider in reading this report are that completion of FAA Form 5200-7 is voluntary and many aircraft strikes go unreported. Dolbeer et al. (1995) calculated that in 1994, only 12% of the wildlife strikes occurring at John F. Kennedy International Airport (JFK) were entered into the FAA Wildlife Strike Database. Assuming this to be typical for the aviation industry in general, the strike data presented here represents <20% of the actual total.

METHODS

When a wildlife-aircraft strike occurs, someone (most often the pilot) voluntarily completes FAA Form 5200-7 and mails it to the FAA. All reports received are examined by the FAA staff wildlife biologist. Copies of major incident reports (Title 14, Code of Federal Regulations, Part 139.337, a:1-2) are forwarded to the appropriate U. S. Department of Agriculture, Animal and Plant Health Inspection Service, Animal Damage Control (ADC), State Director, and FAA

Regional Lead Certification Inspector. A print-out from the FAA Wildlife Strike Database showing the strike history for the airport in question is also provided.

The ADC State Director can contact the airport and offer assistance, or the FAA Airport Certification Inspector can request that ADC contact the airport operator, or the airport operator can contact ADC and request assistance. A Memorandum of Understanding (MOU) exists between FAA and ADC for assistance with wildlife hazard problems on airports. Generally, there is no charge to an airport for basic wildlife hazard evaluations conducted by ADC. It is only when long-term ecological studies are undertaken that cost becomes an issue.

All FAA Form 5200-7s are forwarded to DWRC's Sandusky, Ohio Field Office for entry into the FAA Wildlife Strike Database. After computer entry, all forms are archived by the date of the strike. Quarterly, DWRC supplies FAA's Office of Airport Safety and Standards with updates of the strike database by computer disk. Information in the FAA Wildlife Strike Database is made available to interested parties upon request.

The methods used to sort, screen, edit, enter data, and archive the report forms are discussed in Dolbeer et al. (1995), and Wright (1996). Unless specifically stated, the numbers and percentages presented in the results represent the totals, and average values for the 1993-1995 period. All percentages are based on the total known number, 1993-1995. No attempt has been made to distinguish among years in the narrative, unless there was a major difference in the numbers. The numbers for the individual years, 3-year averages, and the percentages of the total known are presented in most of the tables.

RESULTS

In 1993-1995, 6,695 non-duplicate reports of wildlife strikes were received and entered in the database; 82% came from FAA Form 5200-7. Six percent of the reports received came from multiple sources (Table 1). The majority of the reports (75%) came from commercial carriers, 11% from the business sector, and 7% from the private sector. In 7% of the cases, the type of aircraft operator was not reported (Table 2).

Reports were received from all 50 states, Puerto Rico, and the USA Virgin Islands. California (10.3%), Texas (8.0%), Florida (7.5%), Illinois (6.6%), New York (5.6%), and Pennsylvania (5.1%) reported the most bird strikes. Pennsylvania (11.5%), Illinois (10.9%), Texas (7.5%), New York (6.3%), Michigan (5.7%), and New Jersey (5.7%) reported the most mammal strikes. Reported strikes to American-owned aircraft occurring outside of the USA, totaled 135 bird strikes and 3 mammal strikes (Table 3).

A little over half (3,287) of the reported bird strikes occurred during July (11%), August (13%), September (14%), and October (13%). Twenty-two percent of the reported bird strikes occurred during March-May. The majority (53%) of reported deer strikes occurred in September (13%), October (15%), and November (19%) (Table 4, Figures 1 & 2).

Only 183 (3%) of the reported bird strikes and 13 (8%) of the reported mammal strikes did not report the time of occurrence. Of those reports where the time of day of the strike was reported, 4,160 (66%) of the bird strikes occurred during the day, and 1,551 (24%) occurred at night. This contrasted with 38 (24%) of the reported mammal strikes occurring during the day and 109 (69%) at night (Table 5, Figures 3 & 4).

Most (6,137, 94%) of the bird strike reports indicated the phase of flight when the strike occurred: 36% during approach, 18% while landing, <1% when taxiing, 32% during take-off, and 6% during climb-out. For the same period, 158 (90%) of the mammal strikes reported the phase of flight when the strike occurred: 9% of the mammal strikes occurred when the plane was airborne - striking bats. The remainder occurred when the plane was landing (57%) or during take-off (34%) (Table 6).

The altitude above ground level (AGL) of the strike was indicated in 83% (5,404) of the reports. Thirty-eight percent of the known altitude strikes were reported as occurring when the aircraft was on the ground, 16% occurred between 1 and 100 ft AGL, 75% occurred under 600 feet AGL, 90% occurred under 2,300 ft AGL, 95% occurred under 4,100 ft AGL, and over 99% of the known altitude strikes occurred under 9,000 ft AGL. The highest altitude AGL for a reported strike was 25,000 feet (Table 7).

Short-haul commercial aircraft reported the greatest number of wildlife strikes : Boeing 737 (1,207, 18%), McDonald Douglas MD-80/DC-9 (1,183, 18%), Boeing 727 (473, 7%). The remaining aircraft types reported <4% each. The types of aircraft reporting the most strikes also reported high numbers of strikes having an effect on the flight or causing damaging to the aircraft (Table 8).

Aircraft components most commonly reported as being struck by birds were windshields (1,177), engines (840), noses (835), wings/rotors (816), radomes (667), and fuselages (660). Those components suffering the greatest percentage of damage when struck by birds were lights (89%), tails (43%), engines (40%), wings/rotors (37%), Radomes (13%), and landing gear (11%). Mammals were most often struck by the landing gear (60%) and were much more likely to be involved in a damaging strike than were birds (Table 9). Forty percent of the mammal strikes and 15% of the bird strikes damaged the aircraft.

About 22% of the reported bird strikes indicated the strike affected the flight: 5% prompted a precautionary landing, 3% resulted in an aborted take-off, 1% caused the engine to shut down, and 13% had some other effect. Six percent did not report the effect, if any, and 72% had no reported effect. About 64% of the mammal strikes affected the flight: 8% resulted in a precautionary landing, 12% caused an aborted take-off, and 44% had some other effect. Fourteen percent did not report the effect, if any, and 24% reported no effect (Table 10).

Birds were involved in 6,519 (97%) reported strikes, mammals in 176 (3%), and reptiles in 2 (<1%). The bird or bird group involved was identified in 48% of the reports. The mammal or mammal group, and reptile or reptile group involved was identified in all cases. Gulls (30%), waterfowl (12%), doves (10%), raptors (10%) and sparrows (8%) were the most commonly struck birds (Table 11 A). Deer (66%), coyotes (14%), and bats (5%) were the most commonly struck mammals (Table 11 B).

Sixteen percent (979 bird and 71 mammal) of the reports indicated that the strike damaged the aircraft. However, only 265 reports (25% of the 1,050 reports indicating damage) provided an estimate of the aircraft down time (totaling 67,000 hours, avg. = 253 hours) and only 256 (25%) provided an estimate of monetary losses (totaling $27.6 million, avg. = $104,000). The number of reported damaging strikes was similar for gulls (167, 16%) and waterfowl (171, 16%). Geese were involved in 109 of the 171 reported damaging waterfowl aircraft strikes. Deer were involved in 66 (6%) of the damaging strikes (Table 12).

The total reported bird strike damage amounted to 30,000 hours of aircraft down time and over $26 million of aircraft damage and related cost. Waterfowl, primarily geese, caused the majority ($12 million, 47%) of the monetary losses followed by raptors ($2.7 million, 8%), wading birds and doves ($1.5 million, 5%, each), gulls ($1.2 million, 4%), and deer ($0.5 million, 2%). Reported mammal strike damage totaled 37,000 hours of aircraft down time and over $700,000 of aircraft damage and related losses (Table 13). Deer caused the majority (29,000 hours, 44%), of aircraft down time followed by gulls (10,000 hours, 15%), waterfowl (8,000 hours, 10%), and coyotes (6,000 hours, 9%). We believe these figures significantly under represent the actual losses because of low reporting rates and other factors. The actual figures are probably closer to 374,000 hours/year of aircraft down time and $153 million/year monetary losses (see discussion).

DISCUSSION

This report is the first multiple year examination of wildlife strike data for U. S. civilian aircraft. The report lays a foundation for further analyses as additional data become available. No airport or aircraft type are immune from the hazards of a wildlife-aircraft strike. With over 90% of strikes occurring occur below 2,300 feet AGL, short-haul commercial aircraft are especially vulnerable. Boeing 727, 737, 757, McDonald Douglas MD-80/DC-9, and Fokker FK-100 aircraft were involved in over 50% of the reported strikes during 1993-1995. Compared to long-hall aircraft, they spent more time operating at lower altitudes. Airport wildlife management programs aimed at reducing wildlife strikes must focus not only on eliminating wildlife attractants on and in the vicinity of airports, but they also need to address hazardous wildlife movements in the vicinity of the airport's approach/departure airspace and aircraft movement areas.

Most bird strikes (66%) occurred during the day. Seasonally, two peak periods of bird strikes were noted. A little over half (3,287) of the reported bird-aircraft strikes occurred in July - October, and 22% of the strikes occurred during March - May. The summer-fall period corresponds with the fledging season, when large numbers of young inexperienced birds are present, as well as with the annual fall migration. The spring peak corresponds with the spring migration (Bellrose 1980, Johnsgard 1968).

Most mammal (primarily deer) strikes occur at night (66%). Seasonally, the majority (53%) of the reported deer-aircraft strikes occurred in September (13%), October (15%), and November (19%), the time period of most deer-auto accidents (Bells and Graves 1971). This time period corresponds to the dispersal of the previous years' fawns and the rutting season (Severinghaus and Cheatum, 1969). Airport personnel responsible for wildlife-aircraft safety and pilots should be especially vigilant during these peak periods of wildlife activity.

Gulls were involved in more civilian aircraft strikes (30% of total) than waterfowl (13% of total). However, both were involved in essentially the same number of damaging strikes: gulls (167, 16% of the total), waterfowl (171, 16% of the total). Further, reported waterfowl strike damage ($12.1 million) was over nine times the reported damage caused by gulls ($1.3 million). Of the $12.1 million in damage to civilian aviation caused by waterfowl, geese caused almost $12 million. Seven million dollars of the $12 million aircraft damage caused by geese came from one strike (Ralph Carrozza, FAA Certification Inspector, AEA-620, personal communication). On June 3, 1995 an Air France Concord caught fire after two of its four engines ingested Canada geese during touch down at John F. Kennedy International Airport. Both engines were destroyed and the plane suffered other damage. No passengers were injured.

Two other note-worthy aircraft strikes involving Canada geese occurred in 1995. On September 22, an Air Force Airborne Warning and Control System (AWACS) aircraft crashed, killing all 24 people on board, after ingesting geese into its number 1 and 2 engines during takeoff from Elmendorf Air Force Base, Alaska. This was the first crash of an AWACS plane since the Air Force began using them in 1977 (Bird, 1996). Because this strike involved a military aircraft, it is not included in the FAA Wildlife Strike Database. On September 25, a Cessna Citation, carrying House Speaker Newt Gringrich and his party, struck Canada Geese on takeoff from Mackinac Island, MI. One goose was ingested into the right engine and 1 other struck the leading edge of the left wing. The pilot aborted the takeoff, stopping the plane 30 feet off the end of the runway. There were on injuries. (Washington Post, 9/23/95, p A4) It is not surprising that geese cause more damage than gulls when colliding with aircraft because geese are heavier (8 - 12 pounds versus 1 - 3 pounds respectively) and denser than gulls (Seamans et al. 1995).

Traditionally, airport wildlife management programs have focused on the most frequently struck species of gulls (e.g., McLaren et al. 1984, Dolbeer and Bucknell 1994). Our data indicate that while it is important not to loose sight of the role gulls play in wildlife strikes, the emphasis needs to be expanded to include waterfowl (especially geese), raptors, wading birds, as well as deer. Many species of gulls, urban Canada geese and deer are undergoing marked population increases throughout many areas of the U. S. and Canada (Rusch et al. 1995, Hestbeck 1995, Stont, et al. 1993, Dolbeer and Bernhardt 1986, Blokpoel and Tessier 1986, Conover and Chasko 1985). As populations of these species continue to increase, the strike potential will also increase correspondingly.

The full magnitude of the wildlife-aircraft strike problem is difficult to assess for a number of reasons. First, many of the reports are completed and submitted by personnel who, for various reasons, simply do not know the extent of the damage, the amount of aircraft down time, or monetary loss. FAA has no mechanism for back tracking and retrieving these lost data. Second, we know that most wildlife-aircraft collisions are not reported to the FAA. The reporting rate is affected by such factors as: the safety awareness programs and policies of the airlines involved, the flight or ground personnel's awareness of the strike and their willingness to complete the necessary paperwork, the safety awareness programs and attitude of the airport management and operations personnel and their willingness to complete the necessary paper work, and whether or not there is an active airport wildlife management program that constantly encourages the reporting of wildlife strikes .

Washington Dulles International and Chicago O'Hare have very active wildlife management programs with at least one ADC Wildlife Biologist working full time on these airports. Martin Lowney (State Director ADC, Virginia, personal communication) reported 28 wildlife strikes at Washington Dulles International Airport between 1 September 1994 and 31 August 1995, 17 of which were in the FAA Database, a 60% reporting rate. Robert Sliwinski (Wildlife Biologist, ADC/DWRC, personal communication) calculated that 58% of the strikes occurring at Chicago's O'Hare Airport were entered into the FAA Database. These airports are the exception, rather than the rule. John F. Kennedy International Airport (JFK) has an excellent bird aircraft strike awareness and control program, and yet only 12% of the known wildlife strikes occurring in 1994 at JFK were in the FAA database (Dolbeer et al. 1995). JFK's reporting rate is probably closer to the national average than are the reporting rates of Washington Dulles International or Chicago O'Hare.

Even though the full magnitude of the wildlife-aircraft strike problem is difficult to assess, it is possible to estimate the probable minimum and maximum cost to U. S. civilian aviation, given the reports received by the FAA are a representative sample of the whole and a 20% reporting rate.

For 1993-1995, there were 1,507 (23%) reports indicating that the strike damaged one or more parts of the aircraft and/or had a negative effect on the flight, i.e. precautionary landing, aborted take-off, fuel dump, etc. However, only 265 (18%) reports provided an estimate of the monetary loss (totaling $27.6 million, avg. = $104,000/report). In addition, only 265 (18%) reports provided an estimate of the amount of time the aircraft was out of service for inspection or repairs as a result of the strike (totaling 67,000 hours, avg. = 253 hours down time/report). The annual reported losses were $9.2 million and 22,300 hours of aircraft down time.

Given the reported monetary losses and aircraft down time are all of the losses sustained by the 1,507 effected aircraft, and a 20% reporting rate, then the annual cost of wildlife-aircraft collisions to U.S. civilian aviation would be no less than $46 million/year in monetary losses and 112,000 hours/year of aircraft down time.

Or, if we assume the 1,242 strikes that reported aircraft damage but did not report monetary losses or down time also averaged $104,000 in damage and 253 hours down time per strike, then the total losses for the 3-year period for reported strikes would be $157 million and 381,000 hours of aircraft down time, or $52 million and 127,000 hours down time per year for reported strikes. If only 20% of the strikes are reported, then the annual cost of strikes to U.S. civilian aviation would be $260 million/year in monetary losses and 635,000 hours/year of aircraft down time.

The actual losses to U.S. civilian aviation should fall between these two extremes. Averaging these extremes places the annual cost of wildlife strikes to U. S. civilian aviation at $153 million/year in monetary losses and 374,000 hours/year of aircraft down time. Wong (Larose and McKinnon 1996) estimated that 33% of all foreign object damage (FOD) suffered by United Airlines was causes by wildlife. He also estimated the cost of all FOD to U.S. civilian aviation at $350 million annually. Therefore, his estimate of the cost of bird damage is $117 million/year. Both ours and Wong's estimate of the cost of wildlife strikes are well over $100 million/year. Conover et al. (1995) estimated wildlife strikes cost the U.S. military $112 million/year. Thus, the cost of wildlife strikes to U.S. civilian and military aviation well exceeds $200 million annually.

An indication of the magnitude of the wildlife civilian aircraft strike problem in the USA is starting to emerge from the analyses of these data. Several more years of data need to be analyzed before an accurate picture of the problem and its cost to the civilian aviation industry is assembled. However, we now have enough data to begin making reliable predictions regarding the occurrence of strikes, such as the most likely time of day, time of year, altitude, and wildlife species involved in strikes. Persons charged with airport wildlife management can use this data to begin to formulate, justify, and take corrective actions. The accuracy of our analyses and resulting recommendations is limited by data availability. Those within the aviation industry are encouraged to report all wildlife strikes so that we can continue building an accurate picture of the problem. This will enable wildlife managers and the aviation industry to work together to reduce the strike rate and improve the safety and economics of U. S. civilian aviation.

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Table 1. Sources of information for reported wildlife strikes to civilian aircraft, USA, 1993-1995.

	Number reported (% of total)			
	Years			
Source	1993	1994	1995	3 Yr. Avg.
FAA form 5200-7	1,795 (81)	1,852 (84)	1,881 (83)	1,843 (82)
FAA Air Carrier Incident Report	106 (5)	79 (4)	80 (4)	88 (4)
Individual Airports	89 (4)	33 (1)	37 (2)	53 (2)
FAA Preliminary Aircraft Incident Report	13 (1)	21 (1)	66 (3)	33 (2)
NASA Aviation Safety Reporting System	7 (<1)	18 (1)	1 (<1)	9 (<1)
FAA Aircraft Accident/Incident Prelim. Notice	18 (1)	8 (<1)	9 (<1)	12 (1)
Other	39 (2)	35 (2)	70 (3)	48 (2)
Multiple sources	134 (6)	167 (7)	136 (6)	146 (6)
TOTAL	2,204 (100)	2,213 (100)	2,280 (100)	2,232 (100)

Table 2. Number of reported wildlife strikes to civilian aircraft, by type of operator, USA, 1993 1995.

Operator	Number reported (% of total)			
	Years			3 Yr.
	1993	1994	1995	Avg.
Commercial carrier	1,635 (74)	1,667 (75)	1,729 (76)	1,677 (75)
Business	224 (10)	204 (9)	312 (14)	47 (11)
Private	154 (7)	190 (9)	108 (5)	151 (7)
Government/Police	6 (<1)	9 (<1)	12 (1)	9 (<1)
Unknown	185 (8)	143 (6)	119 (5)	149 (7)
TOTALS	2,204 (100)	2,213 (100)	2,280 (100)	2,232 (100)

Table 3. Number and percent of reported bird and mammal strikes to civilian aircraft 1993-1995, by U. S. States, including Puerto Rico (PR) and USA Virgin Islands (VI).

	Birds					Mammals				
	Years					Years				
STATE	1993	1994	1995	3 Year Avg	% of Total	1993	1994	1995	3 Year Avg.	% of Total
AK	10	17	22	16	0.8%	0	0	1	<1	0.6%
AL	21	60	30	37	1.7%	1	0	0	0	0.6%
AR	9	14	16	13	0.6%	0	2	2	1	2.3%
AZ	12	12	15	13	0.6%	2	2	1	2	2.9%
CA	210	221	239	223	10.3%	0	1	2	1	1.7%
CO	19	21	14	18	0.8%	0	1	2	1	1.7%
CT	23	33	29	28	1.3%	2	0	2	1	2.3%
DC	44	63	54	54	2.5%	0	0	1	<1	0.6%
DE	1	6	1	3	0.1%	0	1	0	<1	0.6%
FL	140	167	181	163	7.5%	0	1	2	1	1.7%
GA	28	66	49	48	2.2%	1	1	1	1	1.7%
HI	24	17	35	25	1.2%	0	0	0	0	0.0%
IA	23	20	24	22	1.0%	2	0	0	1	1.1%
ID	2	5	10	6	0.3%	0	0	0	0	0.0%
IL	173	124	132	143	6.6%	8	3	8	6	10.9%
IN	23	18	31	24	1.1%	0	2	1	1	1.7%
KS	10	8	11	10	0.4%	0	0	0	0	0.0%
KY	74	66	54	65	3.0%	0	0	1	<1	0.6%
LA	70	48	71	63	2.9%	0	0	0	0	0.0%
MA	39	28	29	32	1.5%	0	0	0	0	0.0%
MD	26	29	31	29	1.3%	0	2	4	2	3.4%
ME	10	7	17	11	0.5%	0	0	1	<1	0.6%
MI	53	40	31	41	1.9%	1	8	1	3	5.7%
MN	25	27	13	22	1.0%	0	0	0	0	0.0%
MO	43	36	51	43	2.0%	1	3	0	1	2.3%
MS	14	11	6	10	0.5%	0	1	0	<1	0.6%
MT	6	2	4	4	0.2%	0	0	0	0	0.0%
NC	46	74	72	64	2.9%	0	4	0	1	2.3%
ND	3	8	8	6	0.3%	0	0	0	0	0.0%
NE	27	33	25	28	1.3%	1	0	0	<1	0.6%
NH	9	14	6	10	0.4%	0	2	1	1	1.7%
NJ	75	80	83	79	3.6%	3	7	0	3	5.7%
NM	3	4	9	5	0.2%	0	0	0	0	0.0%
NV	2	9	10	7	0.3%	0	0	1	<1	0.6%
NY	138	108	117	121	5.6%	3	4	4	4	6.3%
OH	83	78	83	81	3.7%	2	0	1	1	1.7%
OK	14	11	9	11	0.5%	1	1	0	1	1.1%
OR	26	21	24	24	1.1%	0	0	1	<1	0.6%
PA	101	108	122	110	5.1%	6	8	6	7	11.5%
PR	4	0	2	2	0.1%	0	0	0	0	0.0%
RI	7	9	6	7	0.3%	1	0	0	<1	0.6%

Table 3. (Continued)

	Birds					Mammals				
	Years					Years				
STATE	1993	1994	1995	3 Year Avg.	% of Total	1993	1994	1995	3 Year Avg.	% of Total
SC	12	12	15	13	0.6%	2	0	0	1	1.1%
SD	2	4	5	4	0.2%	0	0	0	0	0.0%
TN	62	45	51	53	2.4%	0	0	1	<1	0.6%
TX	194	180	150	175	8.0%	6	2	5	4	7.5%
UT	32	24	18	25	1.1%	1	0	0	<1	0.6%
VA	42	56	54	51	2.3%	1	0	4	2	2.9%
VI	4	5	8	6	0.3%	0	0	0	0	0.0%
VT	1	2	2	2	0.1%	0	0	0	0	0.0%
WA	57	42	44	48	2.2%	0	0	1	<1	0.6%
WI	21	13	26	20	0.9%	1	4	0	2	2.9%
WV	11	10	10	10	0.5%	2	5	2	3	5.2%
WY	1	2	0	1	0.0%	1	1	0	1	1.1%
TOTALS										
US States and Territories	2,109	2,118	2,159	2,129	97.9%	49	66	57	57	98.9%
FGN [1]	47	26	62	45	2.1%	1	2	0	1	1.7%
All reported Strikes	2,156	2,144	2,222	2,174	100%	50	68	57	58	100%

[1] FGN. Foreign strikes. Strikes involving American owned aircraft occurring outside the United States and its territories.

Table 4. Number of reported bird and mammal strikes involving civilian aircraft by month, USA, 1993-1995. See also figures 1 & 2.

Month	Years 1993	1994	1995	Total Repted	3 Yr. Avg.	% of Total
		Birds				
Jan.	97	89	95	281	94	4%
Feb.	93	75	73	241	80	4%
Mar.	131	120	153	404	135	6%
Apr.	180	145	147	472	157	7%
May	195	170	204	569	190	9%
Jun.	157	137	141	435	145	7%
Jul.	227	227	235	689	230	11%
Aug.	287	297	284	868	289	13%
Sep.	323	310	275	908	303	14%
Oct.	249	265	308	822	274	13%
Nov.	123	198	193	514	171	8%
Dec.	92	111	113	316	105	5%
Totals	2,154	2,144	2,221	6,519	2,173	100%
		Mammals				
Jan.	3	2	2	7	2	4%
Feb.	1	2	1	4	1	2%
Mar.	1	6	10	17	6	10%
Apr.	3	1	3	7	2	4%
May	4	3	0	7	2	4%
Jun.	8	3	4	15	5	9%
Jul.	5	4	3	12	4	7%
Aug.	0	3	4	7	2	4%
Sep.	7	7	8	22	7	13%
Oct.	7	12	7	26	9	15%
Nov.	7	17	9	33	11	19%
Dec.	4	8	6	18	6	10%
Totals	50	68	57	175	58	100%

Table 5. Reported time of occurrence for wildlife strikes to civilian aircraft, USA, 1993-1995. See also Figures 3 & 4.

	Number of Reported Strikes							
	Year							
	1993		1994		1995		3 Yr. Avg.	
Time of strike	Birds	Mammals	Birds	Mammals	Birds	Mammals	Birds	Mammals
Dawn	81	1	71	-	105	1	86	1
Day	1,373	20	1,392	7	1,395	11	1,387	13
Dusk	122	2	136	5	110	6	123	4
Night	512	25	487	53	552	31	517	37
TOTALS								
Time reported	2,088	48	2,086	64	2,162	49	2,112	54
Time not reported	65	3	58	4	60	8	61	5
Strikes	2,153	51	2,144	68	2,222	57	2,173	59

Table 6. Reported phase of flight of wildlife strikes to civilian aircraft, USA, 1993-1995.

	Number of Reported Strikes							
	Year							
	1993		1994		1995		3 Yr. Avg.	
Phase of flight	Bird	Mammals	Birds	Mammals	Birds	Mammals	Birds	Mammals
Decent	68	-	68	-	85	-	74	-
Approach	760	9	705	1	752	4	737	5
Landing	344	22	402	39	339	28	365	30
Taxi	9	-	8	-	14		10	
Take-off	606	12	689	26	679	17	659	18
Climb	137	-	114	-	139	-	130	-
En Route					73			
Total reported	1,999	43	2,057	66	2,081	49	2,048	53
Not reported	154	8	87	2	141	8	127	6
Total	2,153	51	2,144	68	2,222	57	2,175	59

Table 7. Number of reported bird strikes to civilian aircraft by elevation (feet) above ground level (AGL), USA, 1993-1995.

Altitude (feet AGL)	Number of Reported Strikes: Years 1993	1994	1995	3 Year Average	% of total known alt. strikes.	Cumulative % of total known alt.
0 to 0	622	754	664	680	38%	37.8%
1 to 100	301	281	302	295	16%	54.1%
101 to 200	126	141	131	133	7%	61.5%
201 to 300	94	89	101	95	5%	66.7%
301 to 400	53	66	64	61	3%	70.1%
401 to 500	49	28	36	38	2%	72.2%
501 to 600	59	60	56	58	3%	75.5%
601 to 700	21	17	17	18	1%	76.5%
701 to 800	14	15	12	14	1%	77.2%
801 to 900	19	35	24	26	1%	78.7%
901 to 1,000	11	4	13	9	1%	79.2%
1,001 to 1,100	60	61	56	59	3%	82.5%
1,101 to 1,200	8	6	5	6	<1%	82.8%
1,201 to 1,300	11	20	18	16	1%	83.7%
1,301 to 1,400	10	5	5	7	<1%	84.1%
1,401 to 1,500	8	10	6	8	<1%	84.5%
1,501 to 1,600	38	32	35	35	2%	86.5%
1,601 to 1,700	6	7	7	7	<1%	86.9%
1,701 to 1,800	8	2	7	6	<1%	87.2%
1,801 to 1,900	9	7	10	9	<1%	87.7%
1,901 to 2,000	6	4	3	4	<1%	87.9%
2,001 to 2,100	30	26	38	31	2%	89.6%
2,101 to 2,200	2	1	3	2	<1%	89.7%
2,201 to 2,300	4	6	6	5	<1%	90.0%
2,301 to 2,400	4	1	2	2	<1%	90.2%
2,401 to 2,500	4	1	1	2	<1%	90.3%
2,501 to 2,600	16	18	9	14	1%	91.1%
2,601 to 2,700	2	1	1	1	<1%	91.2%
2,701 to 2,800	3	1	4	3	<1%	91.3%
2,801 to 2,900	3	2	5	3	<1%	91.5%
2,901 to 3,000	1	2	1	1	<1%	91.6%
3,001 to 3,100	31	24	36	30	2%	93.2%
3,101 to 3,200	0	0	2	1	<1%	93.3%
3,201 to 3,300	1	5	0	2	<1%	93.4%
3,301 to 3,400	2	1	2	2	<1%	93.5%
3,401 to 3,500	7	1	2	3	<1%	93.7%
3,501 to 3,600	2	4	12	6	<1%	94.0%
3,601 to 3,700	0	2	0	1	<1%	94.0%
3,701 to 3,800	3	2	1	2	<1%	94.2%
3,801 to 3,900	0	0	1	<1	<1%	94.2%
3,901 to 4,000	1	0	2	1	<1%	94.2%
4,001 to 4,100	0	15	30	15	1%	95.1%
4,101 to 4,200	0	1	0	<1	<1%	95.1%

Table 7. Continued.

Reported altitude of strike in feet AGL.	Number of Reported Strikes — Years 1993	1994	1995	3 Year Average	% of total known alt. strikes.	Cumulative % of total known alt.
4,201 to 4,300	18	1	2	7	<1%	95.5%
4,301 to 4,400	0	0	2	1	<1%	95.5%
4,401 to 4,500	2	0	0	1	<1%	95.5%
4,501 to 4,600	0	5	12	6	<1%	95.9%
4,601 to 4,700	3	0	0	1	<1%	95.9%
4,701 to 4,800	2	1	0	1	<1%	96.0%
4,801 to 4,900	0	0	0	0	<1%	96.0%
4,901 to 5,000	18	2	0	7	<1%	96.3%
5,001 to 6,000	29	28	18	25	1%	97.7%
6,001 to 7,000	9	16	13	13	1%	98.4%
7,001 to 8,000	7	7	14	9	1%	98.9%
8,001 to 9,000	6	3	9	6	<1%	99.3%
9,001 to 10,000	0	6	2	3	<1%	99.4%
10,000 to 15,000	9	10	10	10	1%	100.0%
15,001 to 25,000	1	0	2	1	<1%	100.0%
TOTALS						
Altitude Reported	1,753	1,837	1,814	1,801	100%	100%
Altitude not Reported	401	307	408	372		
Total Reported Strikes	2,154	2,144	2,222	2,173		

Table 8. Total number of reported wildlife strikes to civilian aircraft and the number and percentage of strikes reporting an effect on aircraft flight or damaging the aircraft, by aircraft type, 1993-1995.

Aircraft Manufacture	Aircraft Model	No. of Reported Strikes	No. of strikes effecting flight	% of strikes effecting flight	No. of strikes damaging aircraft	% of damaging strikes
Boeing	B-737	1,207	275	23%	187	15%
McDonald Douglas	MD-80/DC-9	1,183	148	26%	112	19%
Boeing	B-727	473	51	11%	37	8%
Fokker	FK-100	254	24	9%	18	7%
Boeing	B-757	250	54	22%	42	17%
British Aerospace	BA-31	186	66	35%	45	24%
Saab	340	161	41	25%	21	13%
Beach	1900	141	45	32%	42	30%
deHavilland	DHC8 Dash 8	125	21	17%	10	8%
Embraer	120	123	22	18%	11	9%
Cessna	172	116	50	43%	49	42%
Avions Transp. Regional	42	114	21	18%	20	18%
Cessna	152	104	43	41%	28	27%
Airbus Industries	A-300	101	17	17%	11	11%
Boeing	B-747	100	30	30%	32	32%
Learjet	25	90	28	31%	22	24%
Boeing	B-767	84	13	15%	13	15%
McDonald Douglas	DC-8	73	6	8%	6	8%
Shorts	360	63	13	21%	10	16%
McDonald Douglas	DC-10	58	9	16%	7	12%
Sweringen	3 Merlin	57	18	32%	9	16%
Fokker	FK-28	51	11	22%	9	18%
Total		5,114	1,006		741	
All other Aircraft		1,583	489		309	
All aircraft		6.695	1,495	22%	1,050	16%

Table 9. Civilian aircraft components reported as being struck and damaged (% damaged) by wildlife, USA, 1993-1995.

	Number of Reported Strikes							
	Year							
	1993		1994		1995		3 Yr. Avg.	
Parts of Aircraft	Birds	Mammals	Birds	Mammals	Birds	Mammals	Birds	Mammals
Radome								
Struck	200	-	229	2	247	1	225	1
Damaged	25	-	44	2	43	-	37 (16%)	1
Windshield								
Struck	364	-	411	1	402	2	392	1
Damaged	25	-	39	1	42	1	35 (9%)	1
Nose								
Struck	254	2	277	4	304	3	278	3
Damaged	25	1	19	3	17	2	20 (7%)	2
Propeller								
Struck	73	2	88	13	96	10	86	8
Damaged	11	2	7	11	5	6	8 (9%)	
6								
Wing/rotor								
Struck	243	2	274	11	299	4	272	6
Damaged	85	1	91	11	100	3	92 (37%)	5
Fuselage								
Struck	213	2	231	8	216	6	220	5
Damaged	10	1	9	7	7	4	9 (4%)	4
Landing gear								
Struck	89	13	124	29	125	18	113	20
Damaged	9	10	15	16	12	12	12 (11%)	13
Tail								
Struck	25	-	28	3	37	21	30	8
Damaged	12	-	13	3	15	1	13 (43%)	1
Lights								
Struck	23	1	17	2	17	-	19	1
Damaged	20	1	15	2	15	-	17 (89%)	1
Engine(s)								
Struck	250	2	299	6	291	5	280	4
Damaged	112	1	126	4	99	2	113 (40%)	2

Table 10. Reported effect-on-flight of wildlife strikes to civilian aircraft, USA, 1993-1995.

	Number of Reported Strikes							
	Year							
	1993		1994		1995		3 Yr. Avg.	
Effect on flight	Bird	Mammals	Birds	Mammals	Birds	Mammals	Birds	Mammals
None	1,541	12	1,584	15	1,596	15	1,574	14
Aborted take-off	52	3	66	11	58	7	59	7
Engine shut down	8	-	11	-	16	-	12	-
Precautionary landing	116	-	112	5	110	6	113	4
Other	258	25	267	32	311	21	279	26
Not reported	178	9	104	6	131	8	138	8
Total	2,153	51	2,144	68	2,222	57	2,175	59

Table 11 A. Identified bird groups most commonly involved in reported wildlife strikes to civilian aircraft, USA, 1993-1995.

Wildlife Groups	Number of Reported Strikes: Years 1993	1994	1995	3 Yr. Avg.	% of Total Known
Gulls	350	321	295	322	30%
Waterfowl	140	146	125	137	13%
Ducks	(66)	(66)	(35)	(57)	(5%)
Geese/swans	(74)	(80)	(81)	(80)	(7%)
Blackbirds	136	132	113	127	12%
Blackbirds	(81)	(71)	(69)	(74)	(7%)
Starlings	(55)	(61)	(44)	(53)	(5%)
Doves	110	135	90	112	10%
Rock doves	(40)	(46)	(47)	(44)	(4%)
Mourning doves	(70)	(89)	(53)	(71)	(7%)
Raptors	103	108	121	111	10%
Hawks	(76)	(85)	(99)	(87)	(8%)
Owls	(25)	(15)	(18)	(19)	(2%)
Eagles	(2)	(8)	(4)	(5)	(<1%)
Sparrows	89	90	79	86	8%
Corvids	24	35	30	30	3%
Crows	(21)	(33)	(29)	(28)	(3%)
Ravens	(1)	(2)	(1)	(1)	(<1%)
Shorebirds	18	33	25	25	2%
Pelicans	(1)	(4)	(3)	(3)	(<1%)
Plovers	(1)	(4)	(3)	(3)	(<1%)
Killdeer	(12)	(17)	(13)	(14)	(1%)
Sandpipers	(4)	(8)	(6)	(6)	(1%)
Vultures	13	23	16	17	2%
Waders	28	23	28	26	2%
Egrets	(18)	(14)	(15)	(16)	(1%)
Herons	(7)	(7)	(6)	(7)	(1%)
Cranes	(3)	(1)	(6)	(3)	(<1%)
Grebes	(-)	(1)	(1)	(1)	(<1%)
Swallows	31	25	18	25	2%
Total Known Birds	1,094	1,086	1,017	1,066	100%
Total Unknown Birds	1,059	1,058	1,205	1,108	
Total Reported Bird Strikes	2,153	2,144	2,222	2,173	

Table 11 B. Identified mammal and reptile groups most commonly involved in reported wildlife strikes to civilian aircraft, USA, 1993-1995.

Wildlife Groups	Number of Reported Strikes — Years 1993	1994	1995	3 Yr. Avg.	% of Total Known
Ungulates	33	56	32	41	69%
Deer	(30)	(55)	(30)	(39)	(66%)
Elk	(-)	(1)	(-)	(<1)	(1%)
Cattle	(2)		(1)	(1)	(2%)
Pronghorn Antelope	(1)		(1)	(1)	(2%)
Canids	6	12	16	11	19%
Coyotes	(4)	(9)	(11)	(8)	(14%)
Dog	(-)	(1)	(2)	(1)	(2%)
Fox	(-)	(1)	(2)	(1)	(2%)
Raccoon	(2)	(1)	(1)	(1)	(2%)
Bats	6	-	3	3	5%
Opossum	2	-	1	1	2%
Woodchucks	4	-	3	2	4%
Total Reported Mammal Strikes	51	68	57	58	100%
Reptiles		1	1	1	100%
Alligator	(-)	(1)	(-)	(<1)	
Turtle	(-)	(-)	(1)	(<1)	

Table 12. Number of reported wildlife strikes causing damage to civilian aircraft, USA, 1993-1995.

	Years			Total damaging strikes	3 yr. avg.	% of total
	1993	1994	1995			
BIRDS						
Gulls	53	56	58	167	56	16%
Waterfowl	48	63	60	171[4]	57	16%
Blackbirds	11	9	8	28	9	3%
Doves	15	13	12	40	14	4%
Raptors	22	27	17	66[5]	28	8%
Crows	9	5	-	14	7	2%
Vultures	7	13	10	30	10	3%
Waders	7	5	5	17[6]	7	2%
Misc. birds	3	7	7	17	6	2%
Unknown birds	134	133	162	429	143	41%
Total Birds	300	335	344	979	326	93%
MAMMALS						
Ungulates	12	36	20	68[7]	23	7%
Carnivores	-	2	1	3	1	<1%
Total Mammals	12	38	21	71	24	7%
Grand Total	312	373	365	1,050	350	100%

[4] Geese caused 109 of the 171 damaging waterfowl strikes.
[5] Hawks caused 50 of the 66 damaging raptor strikes.
[6] Herons caused 11 of the 17 damaging wading bird strikes.
[7] Deer caused 66 if the 68 damaging ungulate strikes.

Table 13. Reported losses (aircraft down time in hours and repair cost, lost revenue, and other monetary losses) resulting from wildlife strikes to civilian aircraft, USA, 1993-1995.

	Losses -- time and money							
	1993		1994		1995		3 year totals	
	hours	dollars	hours	dollars	hours	dollars	hours	dollars
BIRDS								
Gulls	7,864	$134,762	574	$727,440	1,347	$418,604	9,785	$1,280,806
Waterfowl	2,504	$63,400	2,479	$1,408,924	2,990	$10,591,471	7,973	$12,063,795[1]
Blackbirds	83	$7,900	769	$463,000	6	$11,000	858	$481,900
Doves	12	$75,100	24	$400	39	$1,507,290	75	$1,582,790[2]
Raptors	181	$382,500	3,868	$2,164,500	235	$214,763	4,284	$2,761,763[3]
Shorebirds	6	$6,000	97	$55,500	-	-	103	$61,500
Vultures	524	$50,000	153	$11,148	35	$55,000	712	$116,148
Waders	1,387	$65,000	125	$507,000	97	$1,003,000	1,609	$1,575,000[4]
Unknown birds	2,397	$4,872,254	788	$956,456	1,408	$1,080,005	4,593	$6,908,715
Total losses due to birds strikes	14,960	$5,656,916	8,952	$6,301,828	6,165	$12,882,183	30,077	$26,840,927
MAMMALS								
Ungulates	3,600	$132,000	25,668	$463,342	80	$35,500	29,348	$630,842[4]
Carnivores	-	-	5,760	$105,000	2,160	$35,500	7,920	$140,500[5]
Total losses due to mammals strikes	3,600	$132,000	31,428	$568,342	2,240	$71,00	37,268	$771,342
Total losses due to all wildlife strikes	18,560	$5,788,916	40,380	$6,870,170	8,405	$12,953,183	67,345	$27,612,269

[1] Geese caused $11.98 million of the $12.06 million in waterfowl caused damage.
[2] One rock dove strike caused $1.50 million of the $1.58 million in dove caused damage.
[3] Hawks caused $2.3 million of the 2.76 million in raptor caused damage.
[4] Herons caused $1.5 of the $1.57 million in wading bird caused damage.
[4] Deer caused $500 thousand of the $600 thousand in ungulate caused damage
[5] Coyotes caused $105 thousand of the $140 thousand carnivore caused damage.

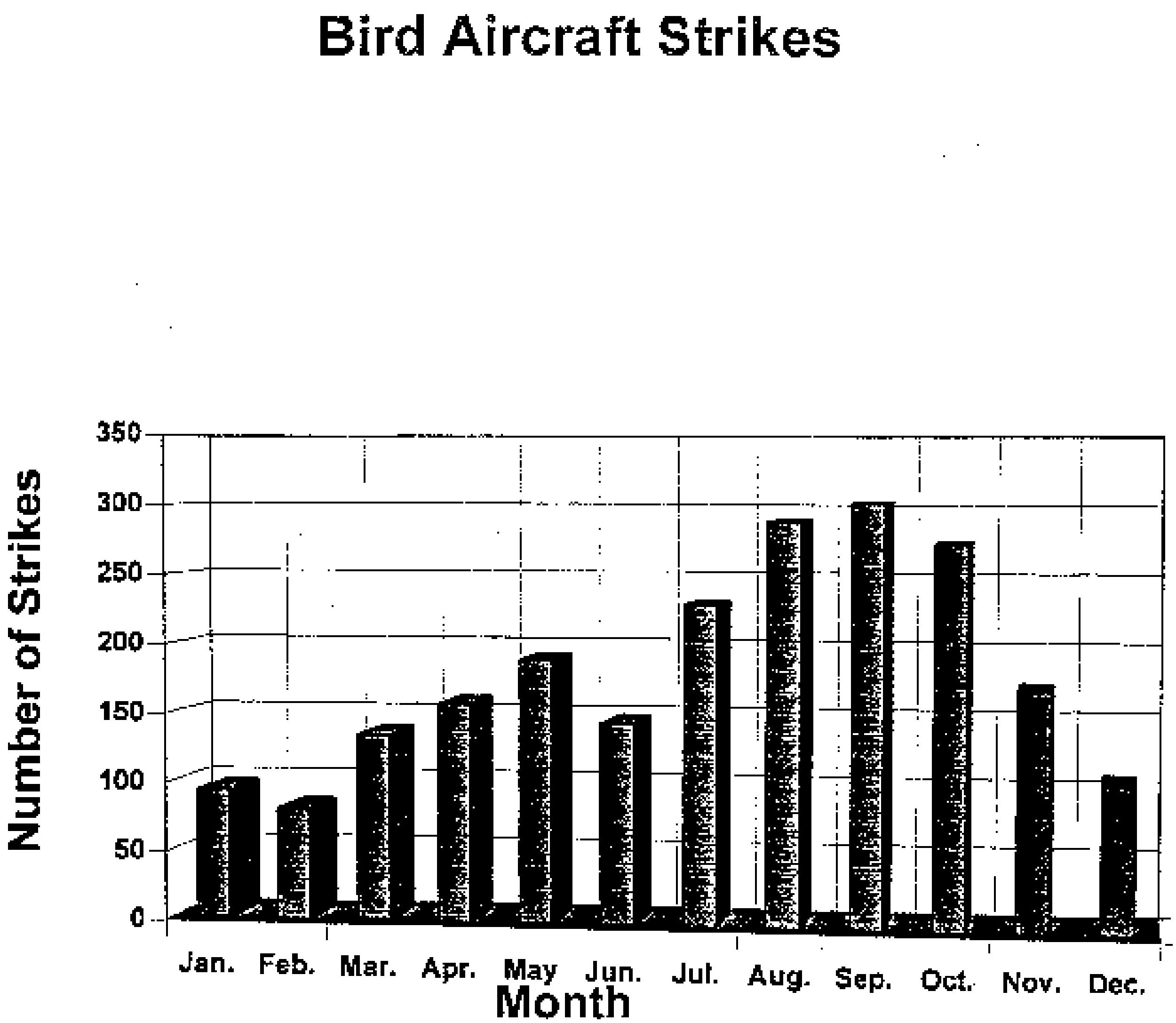

Figure 1. Mean number of reported bird strikes to civilian aircraft, USA, 1993-1995.

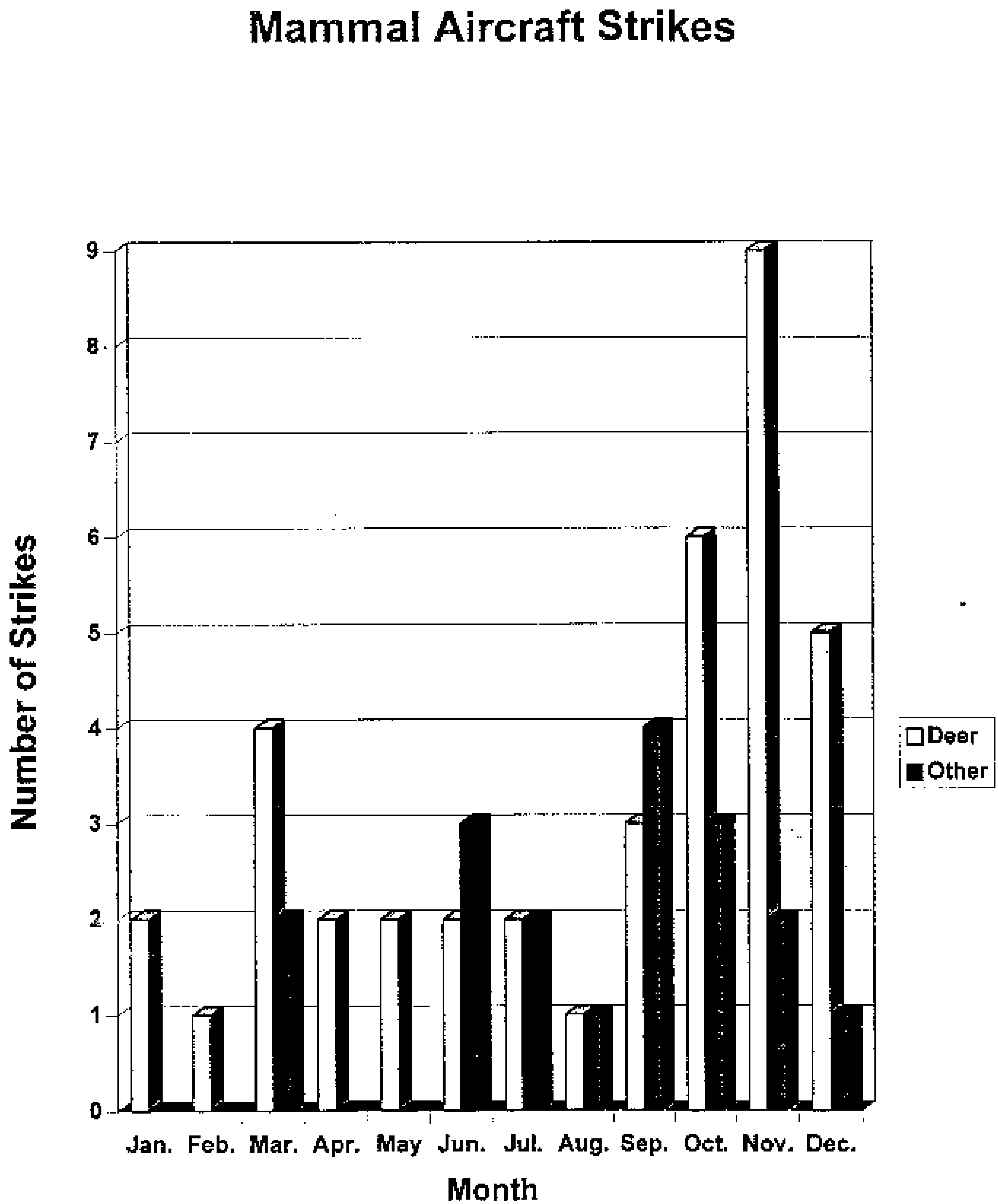

Figure 2. Mean number of reported mammal strikes to civilian aircraft, USA, 1993 - 1995.

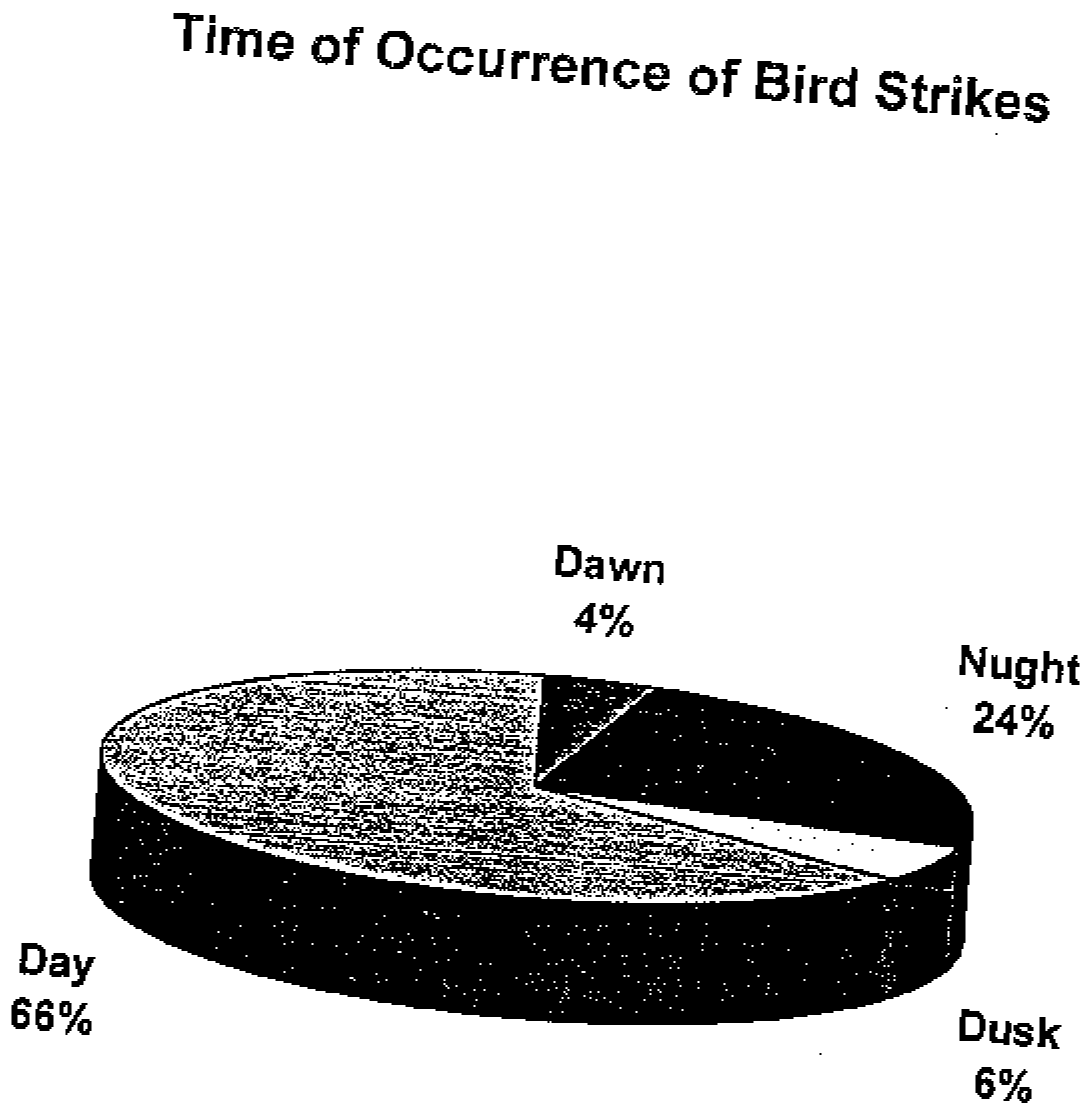

Figure 3. Time of occurrence of reported bird strikes involving civilian

Time of Occurrence of Mammal Strikes

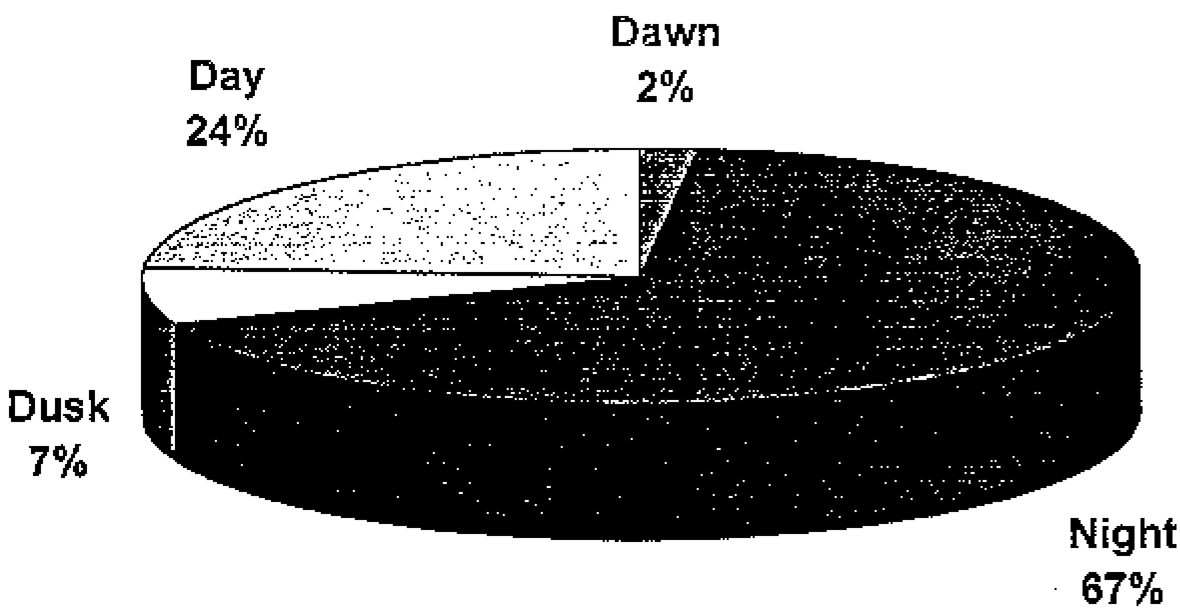

Figure 4. Time of occurrence of reported mammal strikes involving civilian aircraft, USA, 1993-1995.

APPENDIX 8

Report on the Second ESAF Workshop on the Reduction of Bird Hazards to Aviation

Report on the
Second ESAF Workshop on the Reduction of Bird Hazards to Aviation
Nairobi 16 -20 September 1996
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ICAO

1. General

1.1 The workshop was attended by participants from 11 States within the ESAF region. From outside the region, experts were provided by Canada, Germany and the United States as well. Interested international organizations were represented by ASECNA and IFALPA. In total, there were 40 participants at the workshop.

1.2 Mr. Z. M. Baliddawa, the ICAO regional representative who opened the meeting, on behalf of the Secretary General of ICAO, stated that the continuing problem of bird strikes within the ESAF region required that States place greater emphasis on bird hazard control and reduction. He further emphasized the importance of workshops and seminars for the exchange of information and ideas which could be applied to this end.

2. Discussion

2.1 Bird Strike Statistics

2.1.1 Thirty working papers dealing with a wide variety of subjects relating to bird hazards at airports were presented to the meeting. Several papers presented statistics showing the number of bird strikes within the region, which showed that the number of bird strikes reported in ESAF States were representative of a serious problem. In addition, there appeared to a discrepancy between the number of bird strikes known to the States within the ESAF region and the number of bird strikes which were reported to ICAO. The importance of compiling statistics on bird strikes when developing airport wildlife control programmes was emphasized.

2.2 The Local Situation

2.2.1 Progress made by States in reducing bird hazards at airports was the subject of three excellent presentations which dealt with the problems facing two airports. The first paper, which was presented by Ethiopia, detailed efforts to reduce the bird strike risk at Addis Ababa/Bole International Airport. An ornitholigical study identified the various problem species as well as their feeding patterns. Recommendations were made to reduce the attractiveness of the airport to birds in the hope that this would reduce the number of birds attracted to the airport. This has met with some success.

2.2.2 Two presentations dealt with problems facing Kisumu airport in Kenya. This airport is frequented by large numbers of Maribou Storks which may weigh as much as six kilograms. The airport is also host to several other large bird species including, the Pied crow, Hadada Ibis, Sacred Ibis, Black Kite and Abdims Stork. The paper described past efforts to control these species and the results, which have not been entirely successful. When the number of problem species and their size is considered, it becomes clear that

Kisumu airport has a uniquely hazardous situation to deal with. The problem is compounded a local industry which produces an edible food source attractive to the birds. After several instances of substantial damage, a local air carrier has ceased operation of its B737 aircraft into the airport.

2.2.3 These papers characterised a problem which faces all of the States within the region: With the very limited financial resources available, how much can be done to reduce bird strikes? The Ethiopian paper showed what can be done when the the aviation authorities fully support the effort. The control programme at Bole International involves no high technology, just a consistant effort by motivated, trained personnel which is at the root of its success. The problem at Kisumu airport, however, requires more involvement from the national aviation authorities to relocate and maintain through enforcement, the surrounding area free of a cottage industry which attracts birds to the airport.

2.3 Various Agenda Items

2.3.1 Other agenda items discussed bird observation, migration forcasting, environmental management and aircraft bird strike resistance. Four presentations dealt with the subject of bird dispersal methods and techniques. Two of these, presented detailed information on various bird dispersal methods and discussed their advantages and limitations. Papers dealing with bird strike awareness and training included the development of an awareness programme for bird strikes, the organization of a bird strike committee and the training of airport staff. These papers emphasized the need for bird strike committees to be able to cope with a broad spectrum of tasks which include everything from the initial assessment of the bird hazard to recommending a course of action to resolve the problem.

2.3.2 In response to the questionnaire which followed the first ESAF workshop on bird hazards, an item on the legal implications of bird hazards was added to the agenda for this meeting. The legal implications of bird strikes were discussed at some length. It became clear that the airport authority would most likely be held accountable for an accident resulting from a bird strike which occurred within its boundaries, unless it could prove that it had not been negligent by the fact that it had in place a well developed, co-ordinated wildlife control programme.

3. Conclusions:

3.1.1 The meeting was well attended. The concensus among the attendees was that useful information was provided regarding the bird hazard situation within the AFI Region. The meeting arrived at the following conclusions.

3.1.2 Due to the urgency of the problem of bird strikes within the region and what was percieved as a lack of importance allocated to reducing the number of strikes by local aviation administrations, participants were of the opinion that one of the Recommended Practices in Section 9.5 of Annex 14,Volume I, should be raised to a Standard.

3.1.3 It was decided that all bird strikes occurring within the ESAF Region should be forwarded to the ICAO ESAF regional office for onward transmission to ICAO HQ and inclusion in the IBIS databases. The need for accurate reporting, especially with respect to the bird type, was emphasized.

3.1.4 Those representing States with established bird strike committees, felt that all related institutions should be represented on those committees. In addition, it was felt that those participating in bird strike committees should have the authority to make decisions or take appropriate action as required.

3.1.5 The problem of inadequate funding for airport wildlife control programmes was addressed by the meeting. It was generally agreed that, adequate resources would be allocated provided sufficient bird strike data was collected and an appropriate bird hazard management programme was developed.

- END -

APPENDIX 9

Birds and Bird Control at two Ontario Airports (Ottawa and North Bay Airport)

From "Birds and Bird Control at two Ontario Airports (Ottawa Airport and North Bay Airport)"--report prepared for Transport Canada, by Carol Potter, February, 1996.

Executive Summary

The study was undertaken on behalf of Transport Canada and the Canadian Wild life Service to assess the abundance and habits of birds on and near airports in Ontario and to asses the hazards these birds pose to flight safety in the region. In order to conduct as comprehensive an evaluation as possible, the study was limited to two airports: North Bay and Ottawa. For each airport, birds were surveyed on the airfield itself, within a 2 km radius of the airfield, within an 8 km radius of the airfield and in the sky over the airfield. The study also examined the contribution of various natural and human habitats to bird abundance by assessing movement of birds between the airport and these habitats. Bird behavior was also recorded in an attempt to identify attractants of different species to airports and the landscape around them. Based on the data collected, a hazard index was designed to quantify the risks associated with each species. Several elements connected with the airports themselves and their surroundings were analyzed to evaluate not only the success of bird control on the airport but the effectiveness of zoning regulations in keeping various birds away.

OTTAWA AIRPORT

Strike History

Strikes have been increasing at Ottawa Airport (1977-1994). Strikes involving Species struck most often include Ring-billed Gulls, Snow Buntings, sparrows, Swallows and Rock Doves. Ring-billed Gull strikes have fluctuated over the 17 year period, with no significant increasing or decreasing trend. However, considering that the local Gull population has increased exponentially over this period, the relative number of gulls struck is decreasing. The increase in strikes at the Ottawa Airport can be attributed to Snow Buntings and Swallows. Rock Dove and Sparrow strikes have remained nearly constant.

Airport Survey

Twenty four species of birds were recorded at the Ottawa Airport. More species occurred in the both long (22) and short (21) grass than on the paved surfaces (14). Although, diversity of species was similar in both grass habitats, shorter grass contained more individual birds. A major reason for this was the extremely large flocks (~1,000 individuals) of Snow Buntings which frequented the short grass areas from October to April.

Most species recorded in short grass: Eastern Meadowlark, Horned Lark, Ring-billed Gull, Snow Bunting, Starling and Upland Sandpiper foraging. Species recorded in pavement habitat, including the Barn Swallow, Starling, Snow Bunting and Rock Dove were usually flying over it. Only the Horned Lark and the Ring-billed Gull were more likely to be sitting on a runway than flying over it. Resting on or flying over runways puts a species at higher risk. Those found to do this, Barn Swallow, Horned Lark, Ring-billed Gull, Rock Dove, Snow Bunting and Starling, also appear habitually on the strike list

Short grass attracted more species involved in strikes than long grass. Since 1977, five species have accounted for 85% of strikes at Ottawa Airport (Ring-billed Gull, Snow Bunting, Sparrow spp., Swallow spp. and Rock Dove. Except for the Sparrows, all these species avoided the longer grass, preferring either short grass alone or short grass in conjunction with pavement. Three of them, the: Ring-billed Gull, Snow Bunting & Rock Dove were found on pavement just as often as in the adjacent short grass, putting them in a precarious position. The Barn Swallow occurred ubiquitously.

Based on an equal weighting of bird size, period of residency in the area of the airport, frequency of occurrence on the airfield, flock size and habitat preference (propensity to be on runways), the highest risk species included the Ring-billed Gull, American Crow, Rock Dove, Snow Bunting, Starling and Horned Lark. The incorporation of a behavior/intelligence factor in the weighing calculations would likely have lowered the hazard ranking of the Crow. Crows are known to be intelligent and agile. However, as this characteristic was not as well known for most species, it was thus left out of the hazard ranking calculation.

Transit Flights

Overall, bird traffic over the airport was insignificant. There was no indication that large numbers of any species daily fly over the airport on their way to resources such as a roost or large feeding area. Single or small flocks of Ring-billed Gulls passed over the airfield, in all directions, regularly throughout the day. Because of this flight pattern, there is always the potential for gulls to be attracted to temporal feeding opportunities which arise when sod is disturbed or grass is mowed. The only time large flocks pass over the airfield is in the spring and fall when flocks of up to 360 Canada Geese make their way north and south. Despite the fact that these Geese have neither been identified as being struck nor occurred on the airfield, they are still a high risk because of their great body size and the large flocks in which they travel.

Vicinity Survey

Most species recorded on the airfield actually occurred more frequently in the vicinity of the airport. The most conspicuous bird in this group was the Ring-billed Gull which was much more common in lawns near the airport, such as a school yard, than on the airfield lawns. The exceptions to this trend included the Snow Bunting Upland Sandpiper and Horned Lark which were more abundant and frequent on the airport than anywhere within 2 km of the airport. The Upland Sandpipers was only recorded on the airfield lawns.

Bird densities were highest in fields. Fifty percent more birds were recorded per hectare of field than per hectare of equivalent space on lawns, surrounding buildings or on sites which provided human food waste (eating sites). Most species which occurred more than sporadically, occurred in association with one or two particular land use/habitats. Robins, Barn Swallows, Gulls and Crows were attracted to lawns. Gulls and Grackles gathered at eating sites. Buildings attracted a group of birds, including the Barn Swallow, Starling, Rock Dove, House Sparrow and House Finch, all of which nest in cavities or on platforms. Fields may have contained the highest numbers of individual birds, but they were species not historically involved in strikes such as the Bobolink, Red-winged Blackbird, Savannah Sparrow and the Song Sparrow. Within the building habitat group, all species avoiced the control tower site. Rock Doves were especially plentiful at the wind tunnel and swallows were attracted to small hangars. Crows were found most often around buildings that had open dumpsters and were to the north of the airfield.

The same group of birds commonly found near buildings, Rock Doves, Crows, House Sparrows, House Finches, Starlings and Swallows were most often observed feeding when they were observed near those buildings. In addition to feeding at buildings, Starlings, Barn Swallows and Rock Doves fed on lawns and House Sparrows at sites which provided human food waste. Ring-billed gulls generally flew over the buildings and fed and rested on lawns and at eating sites, which included two chip stands and a drive-in theater.

Commuting to Airport from Adjacent Habitats

The same Starlings, Barn Swallows Rock Doves and House Sparrows, associated with buildings adjacent to the airport, feed in the short grass habitats on the airfield. These species were observed frequently and consistently traveling across the boundary between building sites and the airfield. This 'commuting' behavior is supported by the findings that significantly more Rock Doves and Barn Swallows frequented those areas of the airfield which were near the adjacent buildings where they were most commonly observed. Hence, buildings attract this group of birds and thus directly contribute to their presence and on the airport.

Barn Swallows were by far the most frequent and numerous commuters. Between April and August, an average of eight Barn Swallows crossed the border between building sites and the airfield every ten minutes. One building contributed an average of 21 swallows per 10 minutes. However not a single

Swallow commuted from the control tower. Observations of individual birds leaving buildings, circling over the grass and runways and returning to the hangar indicated that Swallows were flying to the airfield to obtain food for their nests. The Gulls attracted to the large chip stand at the north-west corner of the airfield regularly moved back and forth from the stand to the north field of the airport. No other land use contributed as many Gulls. As many as 18 individuals were recorded flying to and from the chip stand per 10 minutes. Often the Gulls would fly to the airfield and loaf in the short grass or on the small quiet runways until summoned back, by a Gull at the chip stand, when food had become available.

Commuting frequency was lowest where the boundary consisted of woods. Species which came out of woods most often, such as the Crow, Blue Jay and Red-Winged Blackbird, were the lowest hazard species which have not been habitually involved in strikes. Crows commuted from woods most often and were most likely to come from a pine plantation to the north of the airfield. The pine plantation likely contains a crow roost. The highest risk species came from human altered and supplemented habitats of buildings (Rock Dove, Barn Swallow, Starling, House Sparrow) and outdoor eating sites (Gulls).

Surrounding Landscape

There are no major attractions such as landfills or large breeding/roosting sites within an 8 km radius of the Ottawa Airport. Resources which are most often utilized by hazardous species are temporally variable ones such as agricultural (crop and pasture) fields which attract large flocks and more constantly available ones such as school yards and fast food restaurants which can only accommodate small groups of birds.

Agricultural land 3-5 kilometers south of the airport attracts large (up to 1,000 birds) flocks of Canada Geese during spring and fall migration. During this period the Geese also frequent Central Experimental Farm property to the west and northwest of the airfield. The Experimental Farm properties also attract large (~300 bird) flocks of Gulls during plowing and hay-cutting from April to November. Both of these large birds are attracted by feeding and resting opportunities. Rock Doves were also observed in agricultural land, occurring in small groups in barnyards and infrequently in fields.

Urbanized habitats including buildings, pavement and lawns support large numbers of Rock Doves and Ring-billed Gulls. Within this habitat, Rock Doves are closely associated with office and apartment buildings. Gulls frequent lawns most often, especially school yards. Gulls are also prevalent on pavement and near fast food restaurants.

With the exception of the pastures and corn fields south of the airport, all the above mentioned attractants lie to west of the airport as do both large landfills and the portion of the Ottawa River in which Ring-billed Gulls nest and roost. Because of this spatial arrangement, Gulls are likely drawn away from the airfield. Further, similar resources do not exist to the east of the airport, giving the birds little reason to move across the airport.

Bird Control

There were more gulls per hectare of grass in the vicinity of the airport than on the airfield itself. This tends to support the effectiveness of present control efforts, assuming equal desirability of lawns. Gulls preferred the school yard lawn over other lawns in the vicinity because of food availability and the absence of trees. Food waste is often left behind by the children at lunch and recess time. Gulls circle over the children while they are out and forage throughout the yard when they go into the school. The golf course was least desirable because trees frequently disturbed its openness. A large lawn around an office building which was devoid of trees but lacked human food supplements was intermediate in attractiveness. However, Gulls still preferred this lawn over all the airfield lawns, and although not a strong test, this may suggest control efforts on the airfield are deterring gulls.

The highest numbers of Gulls were attracted to airfield when sod was being disrupted or lawns mowed. After the onset of such disturbances, Gull numbers increased continually throughout the day, due to a combination of new arrivals and the reluctance of satiated birds to move on. In fact, birds lingered long after the activity ceased. If a particular section of lawn was mowed early in the day, Gulls would still be present on that lawn late in the afternoon. Gull presence could be minimized by starting mowing as late in the day as possible when more birds have obtained their daily food requirements and would soon be returning to their roost. Mowing after dark would ensure optimal results, but may not be possible. However, mowing early in the morning is the worst course of action, as it assures that birds seeking out foraging sites first thing in their day will be immediately attracted and that numbers will increase throughout the day. Satiated gulls need not waste energy searching for more food or even flying somewhere else and, in addition, to confound the problem, there will always be more birds attracted by conspecifics.

The design and construction of the Control Tower/Data Processing Complex to deter cavity nesting birds has been a resounding success. Very few birds are present and commuting from this building is almost non-existent.

Relocating the large chip stand away from its location adjoining the northwest corner of the Ottawa Airport has reduced not only the number of birds at this site, but dramatically diminished the volume of birds commuting to the airport and thus lowered the number of Gulls on the airfield.

NORTH BAY AIRPORT

Strike History

Annual strikes have remained at a constant low level at the North Bay Airport. Snow Buntings are the most commonly struck species. The only group of birds for which strikes are increasing is the migrant birds, but the number of strikes/year for these species is low (~1/yr.). Snow Bunting and Gull strikes fluctuated annually with no overall trend.

Airport Survey

Overall there were far fewer birds at the North Bay Airport. Just as many species were recorded (24), but they occurred infrequently and in small numbers. Long grass supported the most diversity but contained fewer individual birds in total than the other habitats. The most used habitat was the short grass. Surprisingly, more birds were attracted to the pavement than to the long grass.

Horned Larks, the most commonly recorded bird at North Bay, avoided pavement and occurred equally in short and long grass. Snow Buntings, common in winter, were found equally in all three habitats. Gulls were conspicuously absent from the airport transects. This is an unexpected result, given the history of conflict with this species. The North Bay Airport has had a meticulous bird control program for many years, aimed at both birds in general and mammals, but Gulls were most often the target. For most other birds struck in the past, low observations prevented statistical analysis. The highest risk species, based on the same quantification of the data that was used in Ottawa, are Ravens, Snow Buntings, Gulls, Canada Geese and Rock Doves. Unlike Ottawa, no habitat clearly attracted the most hazardous species.

Transit Flights

Very few birds flew over the airport. The only species which flew over regularly, albeit in small groups, was the Gull. Despite the fact that there were no Gulls recorded on the airfield, they were not absent from the area. Throughout the year, on average, one gull flew over the airport every fifteen minutes. This pattern is identical to the pattern exhibited by Ottawa Gulls. Canada Geese albeit rare and in small flocks, were significantly more likely to pass over in spring and fall. Most birds which flew over the airport, particularly Gulls and Crows, were heading either towards or away from the old landfill site, which had stopped receiving waste one month before the study began.

Vicinity Survey

There were also far fewer birds in the vicinity of the North Bay Airport than in the vicinity of the Ottawa Airport. The attractiveness of buildings to birds was negligible. Robins were present most often (77% of visits). Gulls were more common than most birds; present 57% of the time. This is surprising, considering that they were never observed on the airfield. For some reason birds are avoiding the airport more than any other site in the area. This is likely a result of effective bird control. With the exception of the Robin, Gull and American Crow, no species occurred more than 50% of the time. As in Ottawa Horned Larks and Snow Buntings were more common on the airport than anywhere else, and Gulls preferred to be where foods waste may be available and on lawns.

Commuting to Airport from Adjacent Habitats

There was far less commuting between adjacent land uses and the North Bay Airport, most notably from buildings. As buildings had very few birds associated with them, it is not surprising that few birds would commute from them. Only starlings commuted, albeit rarely, between the buildings and the airfield. Commuting occurred frequently between the airfield and the old landfill. Birds were twice as likely to enter from this area. Most birds traveling between the airfield and old landfill were Gulls or Crows.

Surrounding Landscape

The non-agricultural, predominantly wooded landscape around the North Bay Airport results in very few attractants for hazardous species. As in Ottawa urbanized features attracted Ring-billed Gulls and Rock Doves. Rock Doves were associated with structures such as buildings and bridges, while Ring-billed Gulls preferred lawns and fast food restaurant/mall developments.

There are no major attractants within 8 km of the airport. The above mentioned urban habitat attracts only small numbers of birds (mean ~16 per flock), and are all located far to the west of the airport, which is isolated by woods.

Bird Control

The landfill, located under the approach to the main runway, was relocated at the end of June, 1994. The level of control necessary at the airport has dropped significantly in all months since the move. Gull numbers dropped immediately upon closure and have remained low, ever since. Although gulls are still being shot and scared away, the amount of control aimed at them has decreased dramatically. The fact that no gulls appeared in any of the approximately 880 transects sampled over the study period is likely a favorable reflection on the continued diligence of the bird control staff. It should also be noted that historically about 50% of the control efforts took place at the landfill and the other half on the airport property.

SUMMARY

Although there are birds present at both airports, they occur in small numbers and infrequently. Control efforts at both airports have been successful at reducing the number of Ring-billed Gulls present. Removing gull attractants, namely the Ottawa chip stand and the North Bay landfill, from adjoining property have successfully deterred gulls from both airports. The potential of building modifications to dramatically reduce the number of small birds at airports has been clearly demonstrated. Despite the absence of major risks to flight safety, several steps could be taken to reduce present bird strike levels.

Recommendations

1. Ring-billed Gulls should be the major target species for control at both airports.

2. Since longer grass is less attractive to Gulls, grass could be maintained at a longer height.

3. At the very least, grass cutting should begin late in the day to reduce the number of birds attracted and the length of time the birds remain on the property.

4. Stronger zoning regulations are required to keep Gull attractants which provide human food supplements (chip stands, fast food restaurants, drive-ins, landfills, schools) outside of the 2 km radius. Landfills must be strategically placed so that not only do gulls not spill over onto airfields, but they do not fly over the airfield to get to them.

5. The bird control personnel at the Ottawa Airport should be aware of the potential risk involved in the proximity of Canada Geese feeding areas and flight paths. Staff should be on the lookout for the birds in the spring and fall and be prepared to disperse the Geese from the airport and from the fields to the south if a problem arises

6. The increase in Barn Swallow strikes could be effectively dealt with by modifying existing buildings adjacent to the airfield and providing strict regulations modeled after the design of the control tower for new construction. Existing buildings should reduce their attractiveness to cavity nesting birds by blocking crevices. Pigeons should be discouraged from rooftops, through habitat manipulation such as nets which would tangle their feet.

7. More effort should be given to accurate bird identification. Recognition of birds would be made easier with a simple area specific identification guide. Small guides, which contain only birds commonly or occasionally occurring there should be provided to the staff of each airport. The guide should contain a picture and description of the bird, including size. The likelihood of occurrence and season of expected occurrence are very important in narrowing down the possibilities.

M.Sc. Thesis, Ecology, Carleton University
Carol Potter
Title: **PRIMARY RESOURCE CONFIGURATION EFFECTS ON SECONDARY RESOURCE USE BY RING-BILLED GULL POPULATIONS IN TWO LANDSCAPES**

How such a study fits into Landscape Ecology

It has been suggested that a patch of (primary) habitat is enhanced if there are smaller (secondary) resources nearby which can substitute for the primary resources from time to time. I proposed that the opposite may occur. That is, the proximity of secondary resource patches to a primary resource may enhance the resource use/quality of that secondary patch. More precisely, if the roost-to-landfill corridor is analogous to a primary foraging resource because it often contains thousands of individuals, smaller resource patches (lawns or agricultural fields) near the flight corridor should be used more frequently and by more individuals than similar patches further away from the flight corridor. That is, more gulls would be expected in patches nearest to the flight corridor.

There are many examples of larger populations being supported by a landscape because individuals can supplement their primary resources from time to time but few examples of resources being used more often because they are near larger resources, or even rarer resources being used more often because they are en route between primary resources. The best example concerns Herring Gulls in England. The researchers found that gull flight paths shifted completely when landfills were relocated and gull abundances in agricultural fields, parks and golf courses shifted in unison.

Objectives

1. **To learn what variables are important determinants of secondary resource quality for Ring-billed Gulls** Is distance to flight corridor the most important variable or is gull distribution among such resources better explained by some other factor such as distance from river?

2. **To develop a model to predict gull abundance based on those variables** And test the reliability of the model.

3. **To assess airport gull control efforts at MacDonald Cartier Airport In Ottawa.**

4. **To find out whether gulls in vastly different landscapes determine resource quality in a similar manner** That is, does the predictive model apply to other landscapes.

Variables affecting Ring-billed gull abundance on lawns

Methods

Study area- 152 lawns were chosen within the known foraging range of the Ottawa Ring-billed Gull population. Lawns (herbaceous vegetation < 10 cm) were chosen (rather than agricultural fields) because it is the same habitat as at airports and I wanted to apply the results to an assessment of the bird control program. The foraging range was delineated based on the flight direction of gulls returning to their roosts at night. For example, at what point south of Ottawa do gulls return to the St. Lawrence River at dusk. This point would then be outside the foraging range of the Ottawa population.

The area contains a roost used by over 20,000 individual gulls (number counted leaving RMOC landfill on one evening) and two landfills one small landfill (Laidlaw) at which gulls are actively controlled and one larger landfill (RMOC) without gull control.

Delineate flight corridor - based on observations of large flocks of gulls returning to the roost at dusk;

Measurement of landscape and internal patch attributes For each lawn site, I characterized its type (ballfield, school yard, gold course, etc.), measured its area (from air photographs), counted the number of sides which were at least half bordered by trees (gulls like open sites), and measured the distance to the river, the nesting colony, the roost, both landfills and both corridors. I also recorded whether the site was between both corridors. Grass length was recorded at each visit (gulls prefer short vegetation).

Gull census - The lawns were visited 30 times between time of fledging and first permanent snow cover (mid July to mid Nov.) and all gulls present counted. This period is when gulls are most prevalent at landfills and thus are traveling daily between the roost and the landfill.

Results

Landscape variables

Distance to corridor explained the most variability, based on a series of simple linear regressions. Average gull abundance was considerably lower at distances of over 10 kilometers from the corridor. The potential of a lawn to attract gulls was much higher near the RMOC flight corridor. Distance to river, colony and the RMOC landfill were also significant influences on gull abundance.

Internal patch variables

Only openness significantly affected patch quality. The presence of trees around a lawn significantly reduced the likelihood of the lawn being used by Ring-billed Gulls. Although average number of gulls varied, gulls consistently avoided those patches with 3 or 4 treed sides.

Type of landuse, area of lawn or length of grass did not affect gull abundance on their own.

Interpretation

It would be misleading to suggest that grass length had no effect because grass length varied so little. Of the 101 sample lawns, 73 were almost constantly under 10 cm. The maximum average for any site was about 14 cm. Thus long grass occurred too infrequently for its effect to be assessed. Nevertheless, gulls were never present when grass was over 15 cm tall and controlling grass length with all else held constant would likely support the previous findings.

The large number of gulls using the flight corridor results in a large regional pool of gulls able to utilize nearby patches. The potential to attract gulls to a particular patch becomes much higher near the corridor. For example, fairgrounds in Navan, Metcalfe and Carp rarely contained gulls. However, during and after the fairs, when there was much garbage larger flocks of gulls (30-150) were present. However, the Richmond fairgrounds (near the main corridor) attracted over 400 gulls during fair clean up. Although the presence and abundance of gull flocks can be erratic, the potential to have large groups from time to time is considerably higher near flight corridors.

These results have practical implications for zoning of airports and landfills. Present guidelines suggest that landfills should not be located within an 8 kilometer radius of airports. There is no consideration of distance to gull flight corridors. However, as distance to corridor was the best single predictor of gull abundance, it should be considered as important as distance to landfill in regional planning.

Predictive Model

Methods

Including all the variables simultaneously in a multiple regression analysis lets us look at their combined effect, which is more a reflection of reality. At the landscape scale many factors act in concert to produce the patterns we see.

A stratified (by distance to corridor) random sample of two-thirds of the data (101 lawns) was entered into a step wise multiple regression analysis to determine the best model. Gull abundance at each site was defined as the average number of gulls observed over the 30 observation periods. Grass length was also averaged for each site over the 30 observations.

The reliability of the model was tested based on its success in predicting the observed gull abundances on the remaining one-third of the data (51 lawns). Two tests were used to assess the reliability of the regression model developed in (5) above. First, the average gull numbers observed at the 51 validation sites were examined to see if they fit within the confidence intervals of the predicted values generated by the regression model. I decided to consider the model reliable if 90% of the validation sites could be predicted within the confidence boundaries. Second, correlations between observed and predicted values were compared using Pearson correlation coefficients.

Results

Best gull abundance prediction model

Ring-billed Gulls chose lawns based on a complex function of both internal patch and landscape characteristics. The best model contained five variables which together explained 37% of the variation in the data: distance to corridor RMOC corridor, distance to river, distance to roost, size of lawn and degree of openness.

Thus gull abundance increased as lawns become closer to the river and the main flight corridor and as size of lawn increased. Gull abundance decreased as lawns become closer to the roost and as lawns become more closed in by trees.

Gull distribution model for Ottawa landscape: Results of step-wise multiple regression analysis (Response Variable= GULLOG) (R-square = 0.37)

	Mean Square	F Value	Pr > F
Model	14.00	10.98	0.0001
Number of treed sides (TREE)	23.15	18.30	0.0001
Size of lawn (AREA)	16.56	13.90	0.0005
Distance to river (DISTRIV)	15.17	12.00	0.0008
Distance to roost (DISTRST)	12.76	10.09	0.0020
Distance to corridor A (DISTCORA)	36.57	28.92	0.0001
GULLOG =2.2566-0.4227(**TREE**) + 0.00001(**AREA**) - 0.0710(**DISTRIV**) + 0.0712(**DISTRST**) - 0.1002(**DISTCORA**)			

Reliability of predictive model

The gull distribution model derived from the Ottawa sample lawns was a successful predictor of the Ottawa validation sites judged by both tests; confidence intervals around the predicted values and Pearson correlation coefficients.

Fifty of the 51 validation sites (96%) fell within the confidence interval of the model's predictions. The predicted values were significantly correlated with the observed values (PCC=0.45; P=0.0009). Forty-three percent correlation is good considering that sites in the model were 63% correlated. Therefore, the model was considered a reliable predictor of gull abundance in the landscape in which it was generated.

Assessment of Airport Bird Control

Methods

Effectiveness of gull control

Since the model's reliability was established, I could use it to assess the effectiveness of the bird contro program. This was evaluated based on whether observed gull abundances on airport lawns were lower than those predicted by the model.

The airport was considered as a set of 18 separate lawns divided by runways and taxiways. Gull on the airport sample lawns were counted during the same time period and using the same sampling method as for the off airport lawns in the area. Gull control at the Ottawa Airport was evaluated using by comparing observed abunaance (GULLOG) with predicted abundance using Pearson correlation coefficients and by testing whether observed gull numbers (GULLOG) were lower than the confidence interval predicted by the model. Because the airport lawns are close together, the lawns were described by the same distance variables and as all lawns were completely open; only area and grass varied among individual lawns.

Internal patch attractants

An additional multiple regression was conducted on the airport data including a set of potential gull attractants; short grass; cutting of grass; and rainy days to assess what could be attracting gulls to particular patches at similar distances from the river, colony, roost, landfills and flight corridors.

Results

Effectiveness of gull control

There were less birds on most airport lawns than on similar lawns in the area. Over the entire airport, Ring-billed Gull abundances as predicted by the model were not correlated with the observed gull abundances (PCC=-0.00649; P=0.97796). Sixty percent of the airport lawns had actual abundances below the 95% confidence limit of the model.

Internal patch attractants

Length of grass, lawn cutting, and rainy conditions were all significant factors while size of lawn was not. Gulls generally avoided patches with grass over 15 cm high, preferring those where grass was below 10 cm. Gulls were more abundant when it was raining.

However, the most significant attractant of gulls was the cutting of grass. Long grass (>15 cm in height) deterred gulls. This has been commonly recognized at a several airports. Gulls were strongly attracted to grass cutting operations. Gulls were always present during lawn cutting, often in the hundreds.

Interpretation

Effectiveness of gull control

The lower than expected gull abundance over 60% of the airport lawns and low abundance on the remaining lawns suggest that some factor, presumably the gull control program, is repelling gulls. Gull abundance was lower than expected on most lawns near the main runways. That is, gulls are less abundant on these portions of the airfield than would be expected given their abundance in the landscape in general. Observed gull abundances did fit within the range of the model for lawns A, I, K, L, M, O and P. Hence control was by definition not effective in these areas. However, all these lawns were near the lower confidence limit, suggesting some effectiveness of the control program on these lawns as well. With the exception of A and I and K these lawns were all located in the "north field" which is used by smaller planes and where air traffic is lower than the two main runways (note: I and K adjacent to north field).

Internal patch attractants

Gulls can be deterred by keeping grass over 15 cm in height and by cutting grass late in the day when gulls have or are about to return to the night roost.

Applicability of Predictive Model to Another Landscape

Would the model developed in an urban/agricultural landscape also apply to a mainly forested landscape that also contained a population of Ring-billed Gulls and a landfill? North Bay was chosen because it was such a landscape and because there was a reliable research assistant available.

Methods

Sampling

The observed values were recorded on 22 sample lawns over the same period as the Ottawa data was collected. Because corridor mapping data was not available in North Bay, the corridor was designated as a direct line south from the landfill to the lake. I based this on the assumption that gulls leaving landfills take the shortest route back to water, as they do in Ottawa. The landscape and internal patch variables were measured in the same manner.

Analysis

A second step wise multiple regression analysis was conducted on the Ottawa data. This time, using only the variables which were applicable to the North Bay landscape. That is I left out distance to roost (because there was no information on roost location) and I left out the variables pertaining to having two landfills (because there was only one landfill).

Applicability of the model was tested in the same two ways. First, by assessing whether the average observed values **(GULLOG)** from the North Bay lawns fit within the confidence intervals of the corresponding predicted values generated from the customized model built in the Ottawa landscape. I decided to consider the model to be generalizable if 80% of the North Bay sites could be predicted within the confidence boundaries. I chose a lower value than in step 5 because in this case the model is being used to predict a landscape other than the one in which it was developed. It is to expected that the model would be more reliable predicting observations from the landscape in which it was generated. In addition, wider confidence limits would be expected because not all variables may be applicable to the customized model. Second, correlations between observed and predicted values were compared using Pearson correlation coefficients.

Results

Best gull abundance prediction model

The best customized gull prediction model which could be applied to the North Bay landscape contained 3 terms: number of treed sides, area and distance to flight corridor. As in the original model, number of treed sides and distance to corridor were the strongest terms in the model. Gull abundance dropped with increasing distance from colony and corridor and with decreasing lawn openness.

Applicability of predictive model

The customized model was accurately generalized to the North Bay landscape. 21 of the 22 observations fell within the 95% confidence intervals of the 3-term model's predictions. However, the second test did not support the first test. The customized model did not accurately predict the observed gull numbers (GULLOG) (PCC=0.28; P=0.3176).

Interpretation

Success of the model

The model was not the best possible representation of the North Bay situation. Multiple regression analysis of the North Bay data including only the 3 terms from the general model indicated that, although the 3-term customized model was significant overall (F=3.14; P=0.0401) and accounted for 41% of the variability in the data, only one term, number of treed sides, was significant. Analyzing each term separately shows that in North Bay, distance to corridor is not an important predictor of gull abundance. Distance to corridor accounted for <1% of the variability in the North Bay data and was not significant (F=0.09; P=0.7723). Distance variables were much less correlated in North Bay.

Patch choice at North Bay

Unlike in Ottawa, patch quality for Ring-billed Gulls in North Bay was determined solely by the internal patch attributes of openness and area.

These two variables alone explained 52 percent of the total variation. External variables relating to the position of primary resources was unimportant to this population. The results do not support any connection between the landfill and lake roost as primary resources. Distance from lake also had no effect on gull abundance. Note that, the lack of effect of flight corridor location is not unequivocal as the position of the corridor was totally arbitrary and assumed.

Because both landscapes contain a gull roost and a landfill, one might expect the same mechanisms to be operating. This was not the case. The North Bay Ring-billed Gull population is not as reliant on the landfill as the Ottawa Ring-bills. According to local naturalists, very few gulls (~500 average at one time) use the North Bay landfill, compared to the Ottawa landfills (~3 to 12 thousand).

The problem in generalizing the model may be that equivalent habitats in vastly different landscapes are assumed by the model to be of the same value. The North Bay gulls nest and roost in fish-rich Lake Nipissing, where it is not necessary to go off in search for food. Thus landfills may offer the same resources but the North Bay gulls do not require them, so they do not have the same value as they do in a situation such as the Ottawa River.

Models such as this would likely perform better in landscapes with similar types of resource configurations. That is, the gull abundance model developed in the Ottawa landscape may work better in a landscape that is more heterogeneous (not predominantly forest), containing lawns and agricultural resources and or when good foraging is not available near the colony.

Conclusions

1. The number of gulls found on lawns is affected by both landscape (external to the patch) processes as well as characteristics of the patch itself. The biggest influences are distance from gull flight corridors and openness of the lawn.

2. Ring-billed gull populations in urban/agricultural landscapes without nearby feeding and roost resources exhibit different distribution patterns than gulls in primarily forested landscapes with adjacent feeding and roost resources.

3. The gull control program at MacDonald Cartier Airport has resulted in lower than ambient gull abundance. Gulls can be further discouraged by keeping grass over 15cm and restricting grass cutting to evenings.

APPENDIX 10

Proposal for an Association of Airfield Bird Controllers

BIRD STRIKE COMMITTEE EUROPE

BSCE23/WP39
London, 13 - 17 May 1996

PROPOSAL FOR AN ASSOCIATION OF AIRFIELD BIRD CONTROLLERS

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Summary

The paper details a proposal for an association of airfield bird controllers, as distinct from the members of BSCE. This could provide a number of advantages for BSCE and other organisations involved in reduction of bird strikes, including two-way dissemination of information between BSCE (and similar organisations) and the personnel actively involved in bird control, a large number of dispersed information gatherers for the scientists and early warning of trends which may not be apparent from bird strike statistics alone. The paper is divided into three sections - possible advantages, possible disadvantages, and suggested organisation and costs.

(Key words: - Bird Controllers, Association)

1. INTRODUCTION

1.1 Personal Introduction

I have been involved in airfield bird control since 1974, initially working on USAF airfields in the east of England, and subsequently at the Defence Research Agency airfield at Bedford and other research and general aviation airfields. A couple of years ago I was speaking to somebody from the CAA, who, in turn, put me on to the BSCE Chairman, and I subsequently attended the 1994 meeting in Vienna.

1.2 Problems encountered in contacting BSCE

This was my first contact with BSCE in twenty years of active bird control - until that point, BSCE had been something which I had heard of but had never really known anything about. Neither had I been able to find anything out about BSCE, despite occasional attempts, and avid reading of all literature which I could find on the subject. From conversations with other bird controllers from the Ministry of Defence (Procurement Executive), the Royal Air Force and Civilian airports, I know that this is a widespread problem.

The above is in no way intended as a criticism of BSCE - the problems of trying to notify every bird controller in the country (let alone in Europe) about BSCE meetings directly would be immense, and for notices in magazines to be effective, one would need to be sure that the people it is aimed at read every issue of that particular magazine from cover to cover.

1.3 Proposal for an Association of Airfield Bird Controllers

To avoid this situation, I would like to propose an association for airfield bird controllers, with links to organisations such as BSCE. It would comprise those individuals working in airfield bird control (but who may not necessarily be present at BSCE conferences for reasons other than money or geographic awkwardness), those delegates to BSCE who have a professional interest in airfield bird strike reduction and others who are directly involved in airfield bird control, whether as suppliers or users of labour, equipment or other services.
`E and other similar organisations play a fundamental role in reduction of birdstrikes. However, the emphasis is, quite rightly, on scientific methods and presentations. The vast majority of airfield bird controllers would be completely lost if they were to read about Spearmann's Rank Correlation Coefficient, the chi squared test for association etc. when applied to statistics. Accordingly, I believe that a separate, but linked, organisation for these people would serve many purposes.

Given that most airfields or airports of any size have at least one person working to reduce the bird strike risk (whether or not it is a full - time occupation), the potential membership of such an association is vast, particularly if it covers all geographic regions. There can be few occupations with such a potential membership who do not already have a professional body acting for them and, where necessary, working to maintain standards.

2. ADVANTAGES

2.1 Dissemination of information from BSCE and similar organisations.

The cutting edge of bird strike reduction is at this sort of meeting. How does the man or woman on an airfield get to know of latest advances or current policy? This would be a primary function of an association - the dissemination of findings made by scientists and others and presented at these meetings. The information need not include the methodology or statistics which the information is based upon, simply the bare facts and guidance as to whether or not a particular method of bird clearance works.

2.2 Dissemination of information between members

This aspect is probably not of direct concern to BSCE, but could include such things as information about suppliers of equipment, recently published literature of interest, competitive insurance brokers etc.

2.3 Dissemination of information from members to BSCE

It is not beyond the realms of possibility that somebody working on an airfield will come up with an idea for bird dispersal or deterrence which may be worth trying on a wider basis. The existence of a contact between the people working on airfields and organisations such as BSCE and the Bird Strike Research Club at Worplesden would facilitate the passing on of information of this sort. The final destination for the information could then be decided by BSCE - i.e. should the information be used as a basis for CAA, Ministry of Defence or industry funded research or analysis, would the information be better acted on by a small concern, would the information be better put in the bin! etc.

2.4 An association could provide a vast army of collectors of data

A fundamental requirement of research is that there are sufficient data available to make the findings significant. By engaging airfield workers on a national or international basis, there is a possibility of a more complete approach to information gathering. Where the abilities of the workers does not extend to detailed gathering of information, a general approach may still provide useful information.

2.5 Opportunities for exchange / interest visits to learn of different problems

On a number of occasions, I have visited other countries and been intrigued by the sort of bird problems encountered. The problem of finding who to contact to see these at first hand are greater than might be expected - on larger airfields, the telephone exchange operators rarely seem to know what an airfield bird controller is, let alone whether or not the airfield has one. An association of airfield bird controllers could provide names and contact numbers for those members who are willing to discuss their work with others from different countries.

2.6 Dissemination of the requirements of BSCE, CAA etc.

As the BSCE (and other similar organisations) are the primary decision makers on policy, a contact point for dissemination of these policies would assist in achieving a uniform policy and standards throughout the relevant geographical region.

2.7 More scientific and professional methods can be introduced

Following on from the original idea that airfield workers often do not have the ability to introduce scientific methods to their work, an attempt could at least be made to give them information which will allow them to do so. This could be in the form of papers written by, for example, members of BSCE, articles in a journal or even simply a suggestion of relevant literature available elsewhere.

Coupled to the above, I believe that an association with recommended standards for members can only lead to more professional and competent bird control units. Standards are currently extremely variable, which is inevitable given different levels of funding and commitment. The recommended standards could range from the very basic (can the problem birds be identified properly etc.?) to the more advanced, such as the standard of analysis of records, the background research and innovation for bird control at the particular airport or the advice given to airport management, air traffic controllers or aircrew.

A system of continuing professional development (as is common for other professional institutions) will ensure that the professionalism and competence will not only improve, but will continue to improve over time. Any improvement in standards can only be of benefit.

2.8 Airports authorities could check the credentials of those applying to work in bird control

With a structured membership to assist new entries to the profession, it is possible that membership could provide not only a good grounding in the work but also a means, which currently seems lacking, for airport authorities to ensure that personnel employed in airfield bird control are capable of carrying out the work competently and safely.

2.9 Training

The association could assist with training or advise where satisfactory training is available.

3. Disadvantages

3.1 Funding

Probably the greatest drawback is that of funding. This could be achieved either through sponsorship or by subscription or by a mixture of the two.

Prior to its inception, potential members would need to be notified of the association's existence (or the possibility of it). This could be achieved either by advertising, by direct mail shot or by notices in relevant journals. Delegates to this meeting could probably assist greatly by providing known addresses. A link with an organisation such as the Airport Operators' Association could also be helpful in this respect. In any event, the initial notification to potential members is likely to cost money.

Once in existence, costs are likely to involve administration (printing, postage, telephone etc.). This could be covered, at no great cost, by a small subscription, payable by each member.

3.2 Information

In order to function as envisaged, there will need to be input not only from members but also from the scientific and aviation community. There needs to be a willingness to contribute articles and expertise both from members and from others. The success or otherwise of such an association will depend entirely upon the willingness of interested persons to contribute to its success.

3.3 Administration

A central administration will need to be formed, perhaps consisting initially of just one person. If and when required, further 'officers' can be elected or chosen.

I would be happy to attempt to set up such an association should it be deemed beneficial.

4. Conclusion

The concept of a professional body for airfield bird controllers is not in any way envisaged as a rival to BSCE or other similar organisations, but as complimentary to their work and, hopefully, of assistance.

Finally, the fact that airfield bird controllers would have the opportunity of belonging to an organisation with set (high) standards, consisting of like-minded individuals with a common aim would produce a more cohesive and professional approach to what is occasionally regarded as a totally unskilled job.

At this point, I believe that there simply needs to be a discussion on the advisability of setting up such an organisation. Should the consensus indicate that this would be a worthwhile project, finer details can be worked out henceforth, although suggestions for any aspect would be useful.

Acknowledgement
I would like to thank John Thorpe, Chairman BSCE, for his constructive comments on this paper.

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To all delegates of BSCE (International Bird Strike Committee) 23

Airfield Bird Control Association

You may recall a paper which I presented at the Bird Strike Committee Europe meeting in London this year. In the paper, I proposed an association for airfield bird controllers.

Generally, the responses I received were positive, and I now propose to try and get the idea moving. Accordingly, if you would like to be kept informed about progress, please could you complete the following form and return it to me. In order to keep initial costs to a minimum, only those people who express an interest through this form will be kept informed about progress.

I am conscious that those people who would wish to be involved in such an association are likely to have widely differing ideas about how such an association should be run, its aims and its structure. If you have any thoughts about these, or about any other aspect, please could you fill in the second section of the form.

At present, I envisage that the association would have the following structure, although I remain open to any suggestions or criticism.

- **Membership**
  Any person who deals with any aspect of bird strikes as part of their work could belong to the association.

- **Subscription Fees**
  At present, costs are only those of mailing. When the association is more established, this subject will need to be addressed. You may wish to comment on this. There has been a kind offer of sponsorship from the manufacturers of Scarecrow (The Custom House Group) and from another commercial organisation.

- **Aims**
  The free exchange of information between members, the encouraging of high standards of professionalism, safety and quality, and the creation of better links

between all parties involved in airfield bird control. These are described more fully in BSCE 23 / Working Paper 39

- **Continuing Professional Development**
  If possible, a system of continuing professional development should operate. Of course, if membership is open to all interested people, this would inevitably have to be very wide ranging. In particular, those people actually involved in bird control should be encouraged to develop skills to ensure that bird control on airfields is as good as it can be and can only improve.

- **Liaison / interest visits**
  It may be possible to arrange visits to other sectors of the industry which would allow a better understanding of other sector's work. Of course, this would have to be done on a regional basis.

- **Geographical Scope**
  I am trying to avoid things becoming too unwieldy. Accordingly, I intended initially to concentrate on membership from the United Kingdom and Europe. However, in order to get the association started, I intend to involve all interested people at this point, and all delegates to BSCE 23 will receive this mailout. I would be grateful if recipients of this paper could copy the form to other people in their area who might be interested.

If you have any ideas for a suitable name for the association, which would describe its functions and its membership succinctly, please indicate this on the form.

When (and if) I have a reasonable number of forms returned, I will put together a letter of invitation to be more widely distributed.

Finally, I should reiterate what was said in the paper, that this association is not intended to replace BSCE (or International Bird Strike Committee as it is now to be known), but to complement it.

Thank you

Yours sincerely

Peter Jarman

Section A

Complete this section to be informed about the association.

Name ______________________________

Address ______________________________

____

____

____

____

Telephone number(s) ______________________________

Fax number ______________________________

Occupation/Profession ______________________________

Section B

If you have any comments about any aspect, please write them below. I would welcome all comments. In particular, comments on the following would be useful. Continue on a separate sheet if necessary.

Membership (these could include airfield bird controllers, equipment suppliers, insurance companies, scientists, aviation authorities, other interested persons - any suggestions for other occupations would be welcome)

Continuing Professional Development (any suggestions for subjects which would either improve the standards of airfield bird control or would allow different involved professions to work together with more understanding of each others particular problems or assets would be welcome)

Membership fees,

Administration,

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When completed, please send to:

Peter Jarman
Birdcheck
26 Park Lane
Blunham
Bedford
MK44 3NJ
United Kingdom Telephone / Fax +44 1767 640448

Section A

Complete this section to be informed about the association.

Name ______________________________

Address ______________________________

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Telephone number(s) ______________________________

Fax number ______________________________

Occupation/Profession ______________________________

Section B

If you have any comments about any aspect, please write them below. I would welcome all comments. In particular, comments on the following would be useful. Continue on a separate sheet if necessary.

Membership (these could include airfield bird controllers, equipment suppliers, insurance companies, scientists, aviation authorities, other interested persons - any suggestions for other occupations would be welcome)

Continuing Professional Development (any suggestions for subjects which would either improve the standards of airfield bird control or would allow different involved professions to work together with more understanding of each others particular problems or assets would be welcome)

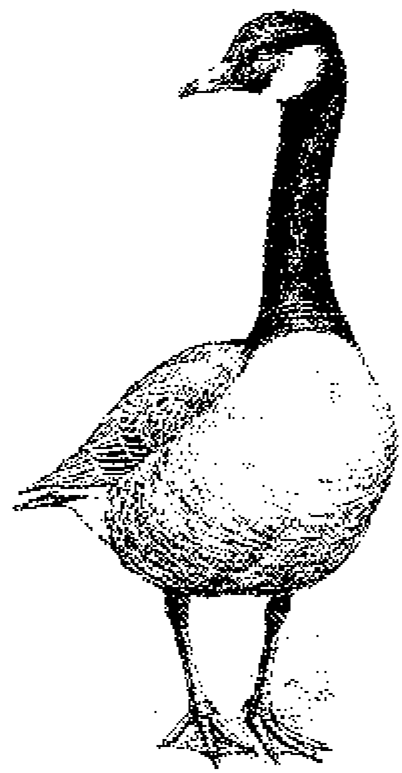
Membership fees,

Administration,

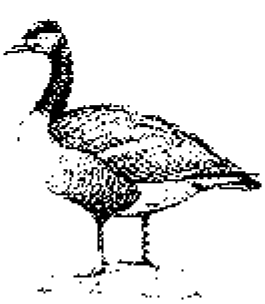
APPENDIX 11

The Potential for Significant Financial Loss resulting From Aircraft Bird Strikes in or Around an Airport

THE POTENTIAL FOR SIGNIFICANT FINANCIAL LOSS RESULTING FROM AIRCRAFT BIRD STRIKES IN OR AROUND AN AIRPORT



by M. Robinson
Alexander Howden Aviation
8 Devonshire Square,
London EC2M 4PL



Summary

Following a brief introduction, this paper contains a brief study outlining some arguments concerning the perceived need for maintaining an adequate bird dispersal programme complemented by an adequate "airport and/or air traffic control legal liability" insurance programme. It includes reference to known losses caused by bird strikes and an analysis suggesting that in an increasingly litigious world, bird dispersal measures must be vigilantly maintained.

October, 1996

Introduction:

This brief study offers a simple review outlining our strong belief as to why there is a need, indeed an increasing need, for airport and air traffic control authorities to arrange the appropriate legal liability insurance covers.

We commence our study by considering the potential for loss i.e. may an airport and/or air traffic control authority be found legally liable in the event of:

[i] loss of, or damage to an aircraft

[ii] injury or death of passengers and damage to their property, or

[iii] third party injury, death or property damage

resulting from a bird strike.

We offer a brief review of:

some known losses

of potential exposures i.e. fleet composition, traffic development etc.- both current and forecast, and general aviation;

some specific matters of concern, including some potential loss scenarios etc.

We hope our study will offer "food for thought"; adequate bird control measures and airport and/or air traffic control legal liability insurance are vital. In general terms, airport legal liability insurance is not expensive and considerable insurance capacity is available; limits of circa US$1,000 million and above are fairly simply arranged (subject always to satisfactory individual risk profiles).

Earlier this year, Mr. J. Goglia of the United States NTSB hosted a review on the subject of bird strikes; we take this opportunity of quoting his comment that *"...escalating bird populations are an increasingly serious hazard to airline operations and merit aggressive efforts to combat their presence near airports..."*

An accident involving a Boeing 747 aircraft could result in over 500 passenger fatalities - is this so impossible? We must always remember that the only difference between the possible and the impossible is that the impossible is merely likely to happen less often! Financial demands, for the aircraft hull, passenger fatalities and any third party injuries and/or damage following an aircraft bird strike could be significant.

We suggest the arguments for buying adequate airport and/or air traffic control legal liability insurance will be found compelling; will any further persuasion be required?

If I might paraphrase Sun Tzu, from, The Art of War; *"... If you know your adversary and know yourself, you need not fear the outcome of a multitude of problems. If you know yourself but not your adversary, no success can be complete. If you know neither your adversary nor yourself, you will succumb to every problem ..."*.

October, 1996 [birdcanf-presentn and birdcanf in freelance]

The potential for an airport and/or air traffic control legal liability loss resulting from an aircraft bird strike:

We open our study by asking three simple questions, namely;

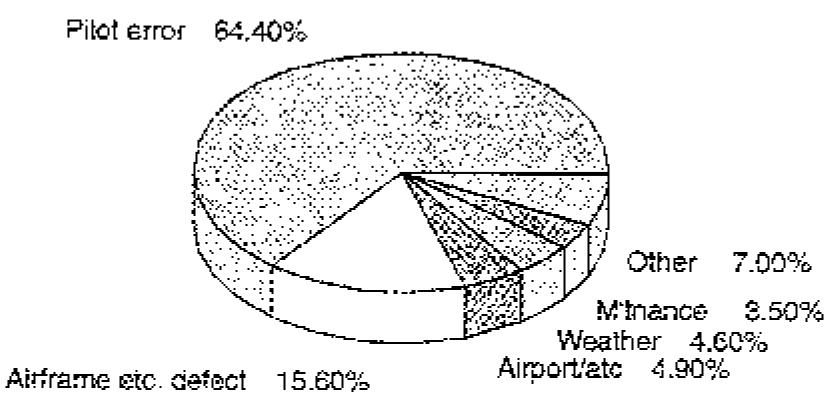
- is the potential for loss real?
- do losses occur?
- can an airport and/or air traffic control authority be found legally liable following an accident?

We answer in the simplest of terms, yes! The potential for loss is real, (many) accidents have occurred and an airport or air traffic control authority can be found legally liable following an accident. It is not just the daily regimen of slips and falls, collisions with glass doors etc. within an airport terminal that require an authority to purchase adequate airport legal liability insurance cover. The ever present possibility of debris on the runway, birds etc. with consequent threat to air traffic will always be a constant cause for concern and require vigilance in maintaining avoidance measures.

The trend for ever increasing legal liability damages awards must always be borne in mind. International protocols regarding passenger legal liability award levels are currently under review; could any such review impact adversely on an authority? I understand that according to Japanese philosophy, recourse to litigation represents a fundamental failure in human relations; we in the United Kingdom are currently witnessing an explosion in the desire to seek legal remedies - everything now seems to have a monetary price as we seek the new Holy Grail, **compensation.** It has been observed that once the law starts talking, there is no stopping them. Oddly enough, even in these troubled times, some airports, including some of the larger ones, do not appear to purchase any cover; surely a false economy?

By way of opening our study in very general terms, it is interesting to note that a recent Boeing study considers primary cause factors for recorded worldwide jet aircraft accidents, covering the period 1959 to 1994, inclusive. Of 884 accidents recorded, 4.9% are attributed to airport and/or air traffic control activity. The primary cause of loss is identified as per Figure 1.

Figure 1. - Jet airliner accidents - 1984 to 1994 inclusive - by cause:



It must be stressed that the foregoing applies in respect of airline losses only; it must also be borne in mind that airline traffic forms only a part of overall traffic levels: general aviation" activities are significant. Whilst the active commercial aircraft fleet currently stands at circa 24,000 aircraft, the active "general aviation" fleet (excluding the former Soviet Union) stands at circa 270,000 aircraft! We consider some fleet distributions later in this study.

Minor damage to aircraft caused by bird strikes may perhaps be caused, but the total destruction of an aircraft with resultant passenger fatalities is surely something of a long shot? Nevertheless, it is a possibility, perhaps an increasing possibility. If I might take an individual example, United Airlines reported that during 1995, they experienced a bird strike every 18,000 engine cycles; we understand that whilst in the majority of instances these involved small birds with little, if any, resultant aircraft damage, the airline's senior engineer at their San Francisco base, estimates that annually, circa 33% of all "fod" damage to United Airlines aircraft is caused by bird strikes! Recent discussions with a United Kingdom airline suggested that this figure should be reduced to perhaps 20% for a United Kingdom carrier.

I am sure that a myriad of examples will be cited during the course of this conference ; may I perhaps mention a number of instances, occurring during 1996, which had the fates been less than kind, could have resulted in significant financial loss with the airport and/or air traffic control authority perhaps being included in any subsequent legal actions.

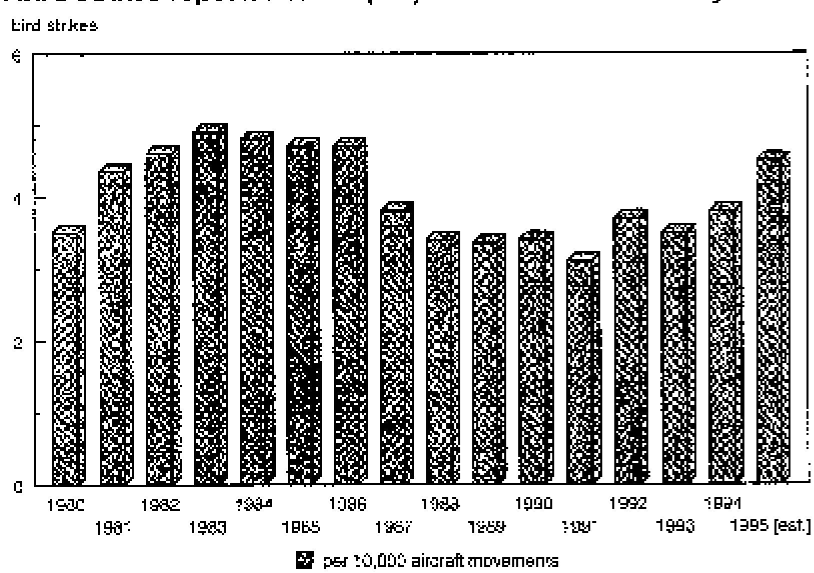
[i] a United Airlines Boeing 747 aircraft returned to Sydney Airport (Australia) following a bird strike (involving a number of magpie geese);

[ii] a Japan Airlines Boeing 747 aircraft returned to Cairns Airport (Australia) following a bird strike (involving 2 immature pelicans);

[iii] A Southwest Airlines, Boeing 737 aircraft aborted take off from Nashville Airport (USA) following a bird strike (an American kestrel) - it has been suggested that had the aircraft been on the other (shorter) runway it might have gone down a quarry with the possible loss of circa 125 passengers/crew.

Figure 2. illustrates aircraft bird strikes per every 10,000 aircraft movements (ie. one take off and landing) as reported to the United Kingdom Civil Aviation Authority by United Kingdom airlines, viewed in the historical context:

Figure 2. - Aircraft bird strikes reported to the (UK) Civil Aviation Authority:



In response to the question can an airport and or air traffic control authority be found legally liable following a bird strike accident, the answer is yes. We are able to cite two such incidents.

Firstly, the successful action taken against Norwich Airport following the December, 1973 loss, caused by an aircraft bird strike (gulls), of a Falcon 20 aircraft. The Judge, in his summing up, noted that "...the Defendants owed the Plaintiffs (the aircraft operator) the common duty of care, that is, a duty to take such care when carrying on their activities at the airport as was reasonable in the circumstances...". After weighing up all the considerable amount of evidence, the Judge decided that the Defendants failed in their duty and that "...there must be judgement for the Plaintiffs for damages...".

Secondly, the successful action by Safeco Insurance Company against the City of Watertown, following the June, 1975 loss, caused by an aircraft bird strike (again, gulls), of a Saberliner aircraft. I understand that the court held "...that the proximate cause of the crash was the failure to warn the pilot of the presence of birds...". Judgement for the full value of the destroyed aircraft was entered against the airport operator.

Are bird strikes a rare occurrence? We have already commented on United Airlines' experience. Figure 3., based on ICAO supplied information and covering the period 1989 to 1993 inclusive, identifies the consequences of bird strikes by individual effect, quite clearly demonstrating that an airport and/or air traffic control authority must constantly monitor bird populations and take the appropriate measures to disperse flocks:

Figure 3. - The consequences of bird strikes by individual effect:

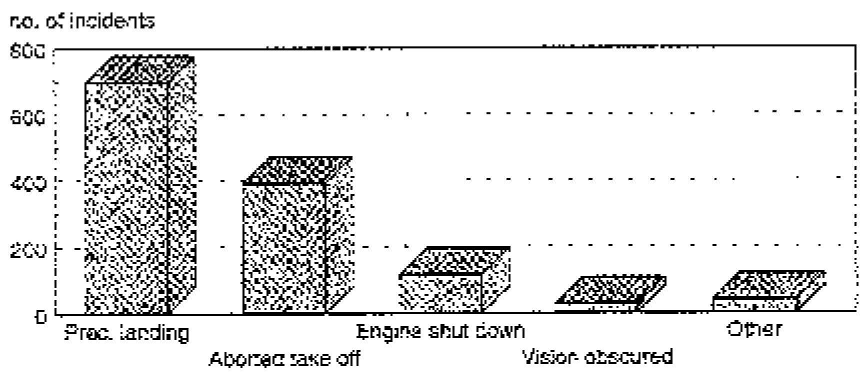


Table 1. identifies some individual instances of aircraft total loss, including, where applicable, the aircraft hull insured loss amount, resulting from bird strike(s):

Table 1. - Some individual aircraft accidents resulting from bird strikes:

Date of loss:	Location:	Aircraft type:	Insured hull loss:
November, 1975	JFK, New York	DC-10	circa US$ 25 million
April, 1978	Gossellies, Belgium	Boeing 737	circa US$ 7.9 million
July, 1978	Kalamazoo, USA	Convair 580	circa US$ 600,000
September, 1988	Bahar Dar, Ethiopia	Boeing 737	circa US$ 20 million *
January, 1995	Le Bourget, France	Falcon 20	circa US$ 2.3 million **
September, 1995	Elmendorf AFB, Alaska	"AWACS" (of U.S. Airforce)	not insured ***
July, 1996	Eindhoven	Hercules (of Belgian Airforce)	not insured ****
July, 1996	Aktion, Greece	"AWACS" (of Greek Airforce)	not insured

** there were 35 resultant fatalities and 21 serious injuries reported*

*** there were 10 resultant fatalities*

**** there were 24 resultant fatalities*

***** there were 34 resultant fatalities*

What of the culprits? Is the threat increasing or diminishing? In very broad terms, I understand the threat must be perceived as increasing. Airline fleet development forecasts suggest some significant increases in aircraft numbers as we move into the next century; please refer to the comments included later in this study. Whilst it is difficult to provide an accurate measure of bird populations, it would appear that in general terms, numbers of gulls, geese, (mute) swans and other wildfowl are either stable or showing increases (I understand that the United States, Canada goose population has grown 3 fold over the past decade with I must assume, similar increases elsewhere). An important and contributing factor to both increasing and newly resident populations, particularly here in the United Kingdom (and doubtless, elsewhere), is the growth in mineral extraction sites, an increase in the number of rubbish tips and established nature reserves. It is interesting to note that such sites may be situated in close proximity to an airport (the New York, JFK airport, adjacent to the Jamaica Bay Wildlife Refuge being such an example - a 1995 aircraft bird strike incident involved an Air France, Concord aircraft which ingested several Canada geese on landing) and must therefore be a source of constant concern. Bird dispersal methods must be ever monitored and reviewed. I do however feel I must refer to a most charming (and apparently successful) solution to the problem of bird strikes which has been developed at the Lake Hood seaplane base near Anchorage, Alaska. Pigs (namely Curly, Larry and Moe) take up residence during the gull breeding season and feast on the gulls' eggs. This response to the bird strike problem appears, so far at least, to have been successful; one of the base users is reported as saying *"...those pigs are the first thing that's ever worked..."*.

Should consideration of global warming play a part in our calculations? There appears to be a general consensus that temperatures world-wide are rising. Could rising temperatures affect some long established migratory patterns? It is, as yet, too early to comment; however, in the long term this must be a distinct possibility, perhaps some normally migratory birds might not feel the need to take their annual holidays? One change that has already been noted, here in the United Kingdom and doubtless elsewhere, is that birds are now nesting earlier.

In summary, bird dispersal methods must be ever monitored. Even the most carefully considered risk management programmes cannot be guaranteed to be 100% effective all the time!

A brief review of exposure levels - both current and forecast:

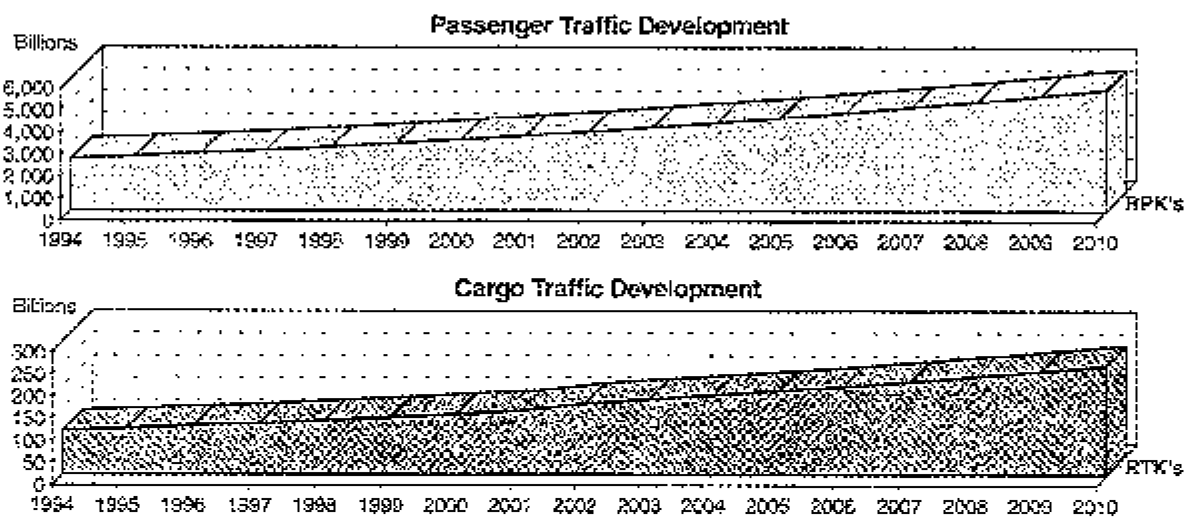
It is of course commercial air traffic and the carriage of passengers that presents the greatest potential for major legal liability loss; passenger traffic levels are ever increasing. Based on preliminary 1995 estimates, ICAO confirm a continued annual rise in both scheduled passengers and freight tonnes carried (and the international content), as is shown in Table 2. (the breakdown between domestic and international traffic showing constant annual increases in international traffic levels):

Table 2. - Traffic level development:

Year:	Passengers (millions)	Split domestic and international as %:	Freight tonnes (millions)	Split domestic and international as %:
1989	1,109	76% dom. and 24% int'l.	18.2	53% dom. and 47% int'l.
1990	1,165	76% dom. and 24% int'l.	18.4	53% dom. and 47% int'l.
1991	1,135	76% dom. and 24% int'l.	17.4	51% dom. and 49% int'l.
1992	1,145	74% dom. and 26% int'l.	17.6	47% dom. and 53% int'l.
1993	1,139	72% dom. and 28% int'l.	17.9	42% dom. and 58% int'l.
1994	1,227	72% dom. and 28% int'l.	20.0	41% dom. and 59% int'l.
1995 est.	1,286	72% dom. and 28% int'l.	21.6	41% dom. and 59% int'l.

These growth levels are compatible with general industry estimates which forecast continued levels of growth well into the next millennium; our interpretation of published forecasts is demonstrated in Figure 4.

Figure 4. - Passenger and cargo traffic development:



Interestingly, a White Paper, entitled "Air traffic management - freeing Europe's airspace" was recently presented by the European Commission against the backdrop of ever increasing air space congestion in Europe, the volume of air traffic being noted as constantly on the rise.

Additional evidence that traffic movements are moving ever upwards is demonstrated by traffic figures provided by the Airports Council International (ACI). As a brief aside, our affiliations to bodies such as the ACI and the International Federation of Air traffic Control Associations (IFACTA) demonstrate our interest in airport and air traffic control matters and ensure we enjoy continual access to, a wide range of statistical data. Figures 5. and 6. identify historic and forecast traffic levels (aircraft and passenger movements) at the major 30 Canada airports (as defined by Transport Canada) and based on Transport Canada promulgated figures:

Figure 5. - Aircraft movements (air transport and general aviation):

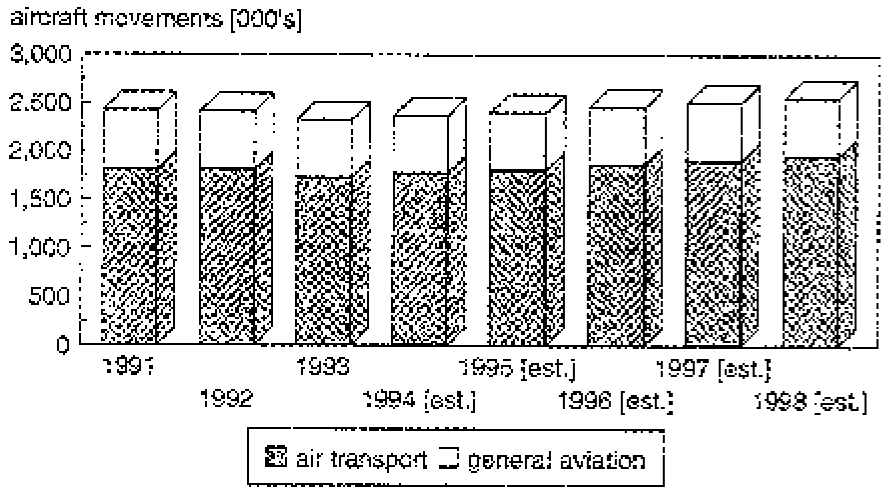
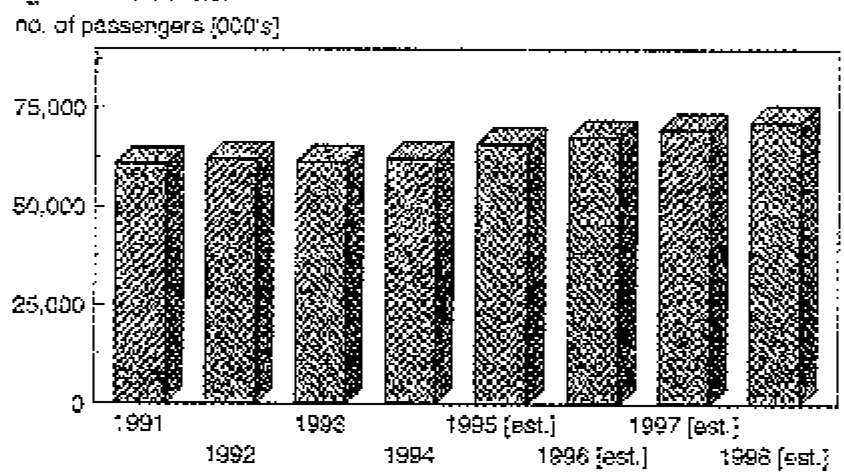
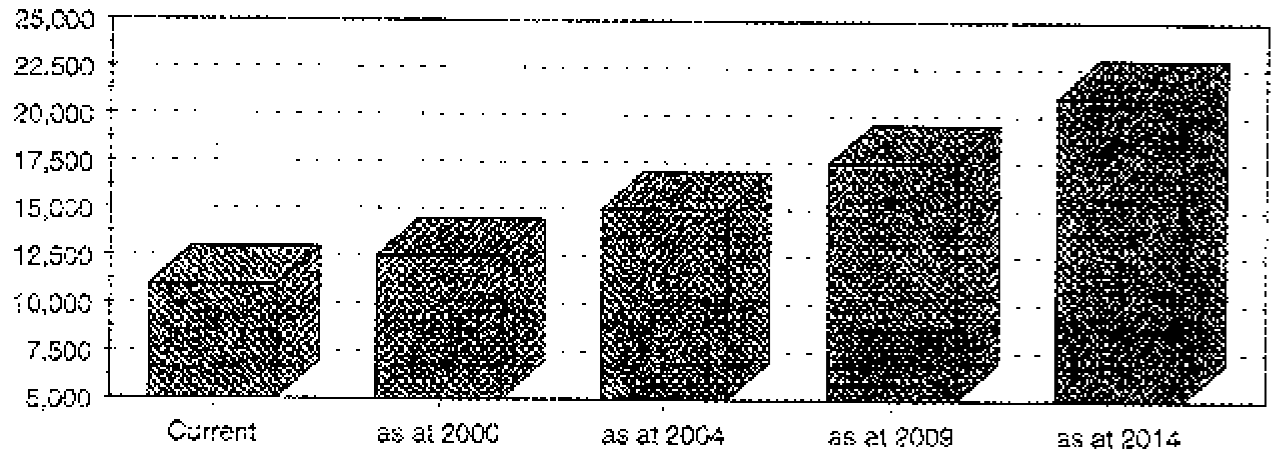


Figure 6. - Passenger movements:



To accommodate the forecast increases in traffic levels, some significant fleet development programmes are anticipated; current industry based indications suggest that the world jet aircraft fleet (excluding eastern built aircraft) will probably more than double within the next twenty years. Figure 7, based on published estimates, outlines our interpretation. To bring these forecasts to fruition will however require some considerable financial investment: according to published estimates, this could amount to excess of circa US$ 50 billion annually, by the year 2004 and beyond.

Figure 7. - The active world jet aircraft fleet - current and projected:



Similarly, some significant turbo prop fleet development is anticipated. Table 3. identifies our understanding of the make up of the world airline fleet as at mid September, 1996 (based on Airclaim's CASE database):

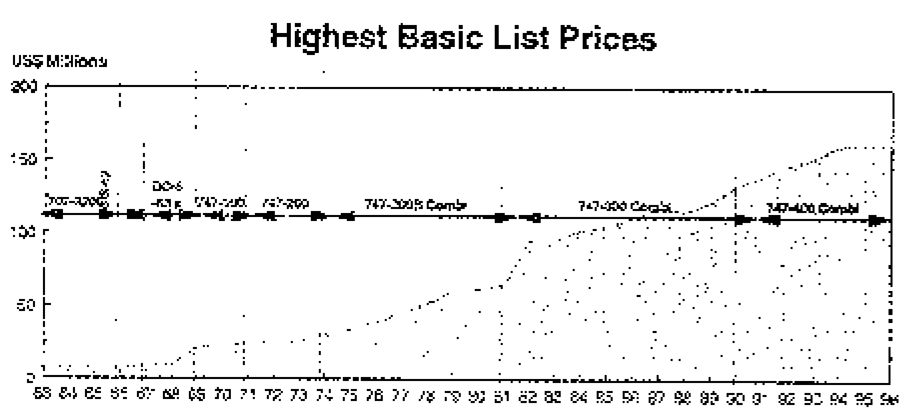
Table 3. - The current world airline fleet:

	Aircraft in service	Aircraft stored
Jet aircraft (excluding former USSR built aircraft)	11,360	390
Former USSR built jet aircraft	2,817	23
Turbo prop aircraft (excluding former USSR built aircraft)	4,908	306
Former USSR built turbo prop aircraft	3,507	98
Executive jet aircraft (non USSR built)	922	13
Totals	23,514	860

It is of course, the airline fleet composition that is of particular importance when considering airport and/or air traffic control legal liability insurance and the possibility of a major accident involving aircraft. We specifically identify two significant factors, namely (i) aircraft values and (ii) individual aircraft seating capacities.

Firstly, let us consider individual aircraft values. Figure 8, showing highest basic list prices, reflects the inexorable rise in aircraft values since 1963 (actual insured values are often considerably in excess of list prices once lease considerations etc. are taken into account - aircraft valued at US$ 250 million plus are currently being operated by the world's airlines!):

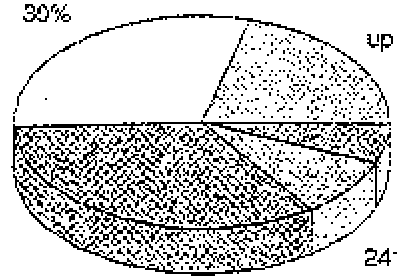
Figure 8. - Highest aircraft basic list prices:



These increasing values are reflected within the overall airline fleet insured value. Since 1986 the overall fleet value has increased by an extraordinary 200% (plus)! Our researches indicate that there are there are currently excess of 1,000 aircraft valued at US$ 100 million and over, either in operational service or on order to airlines.

However, whilst aircraft insured values are an important subject for consideration, it is of course, the potential for resultant legal liability loss in the event of airline passenger injury and/or fatality which provides the major cause for concern. What of individual aircraft passenger seating capacities? Figure 9. identifies our understanding of the individual aircraft seating capacity breakdown for the current world airline jet/turbo prop fleet (excluding business jet and former Soviet Union built aircraft and). It will be noted that approximately 6% of the world fleet of circa 17,000 aircraft are fitted with 350 (plus) seats, representing 9% of the airline jet fleet. Industry forecasts expect this figure will be considerably increased by the years 2014/15; perhaps to 20% or upwards i.e. circa 4,000 plus aircraft.

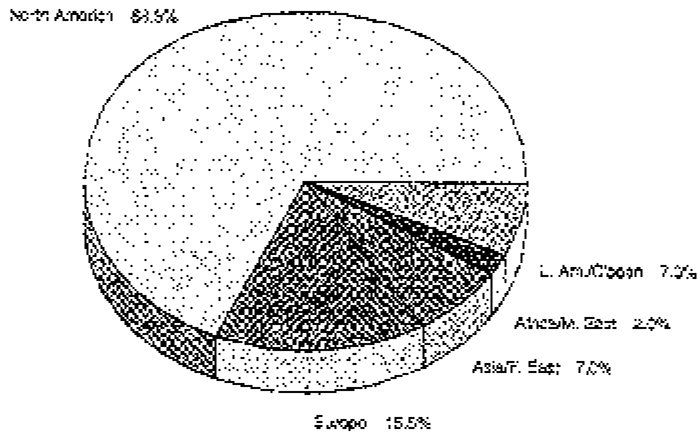
Figure 9. - The world jet and turbo prop airliner aircraft fleet - seat distribution:



Another factor by which we may determine potential for loss is to consider individual aircraft cycles. It is particularly interesting to note that the world airline fleet (excluding former Soviet Union built aircraft) is now flying excess of 31 million hours per annum, compared to around 22 million five years ago (an increase of 40% plus). Average annual cycles per aircraft are currently running at approximately 1,500 cycles per passenger aircraft and almost 1,100 cycles per freighter aircraft with average daily utilisation standing at approximately 6.5 hours per passenger aircraft and 3 hours per freighter aircraft.

Having considered commercial aircraft activity/distributions etc. we should perhaps touch on "general aviation" (there are many definitions of "general aviation" - our very simple interpretation is ... *aerial observation, agricultural, air taxi [this seems to cheerfully hover between both the commercial and "general aviation" camps dependant on whose definition is under review], corporate/executive, private/recreation and instructional activity* ... Whilst the potential for major legal liability loss is of course much less than for commercial activity, it is sensible to offer our understanding of "general aviation" activity . "General aviation" is dominated by the United States; we suggest that circa 63% of the active world fleet of circa 270,000 aircraft (excluding the former Soviet Union for which we understand aircraft numbers are fairly low) are based in the United States; our geographical viewpoint, Figure 10., identifies our understanding of the world-wide distribution (the 68.5% figure for North America is split 91.5% for the United States and 8.5% for Canada):

Figure 10. - The current active world general aviation fleet:



Of the foregoing, we suggest that slightly excess of 80% are piston engine aircraft, circa 4% turbo prop aircraft, circa 3% jet aircraft, circa 5% rotor wing aircraft with the balance relating to various other types. Our data base further suggests that the world-wide "general aviation" fleet (excluding China and the former Soviet Union for which activity is, we understand, minimal) currently operates for circa 40.5 million hours annually, perhaps slightly more, involving circa 120 million annual movements.

Increases in aircraft values, **increases** in aircraft numbers and particularly the number of operational wide body aircraft, **increases** in traffic levels are met head on by **increases** in certain bird population levels - could this combination of circumstances result in an **increase** in accidents?

What is the potential for financial loss - is the sky the limit?

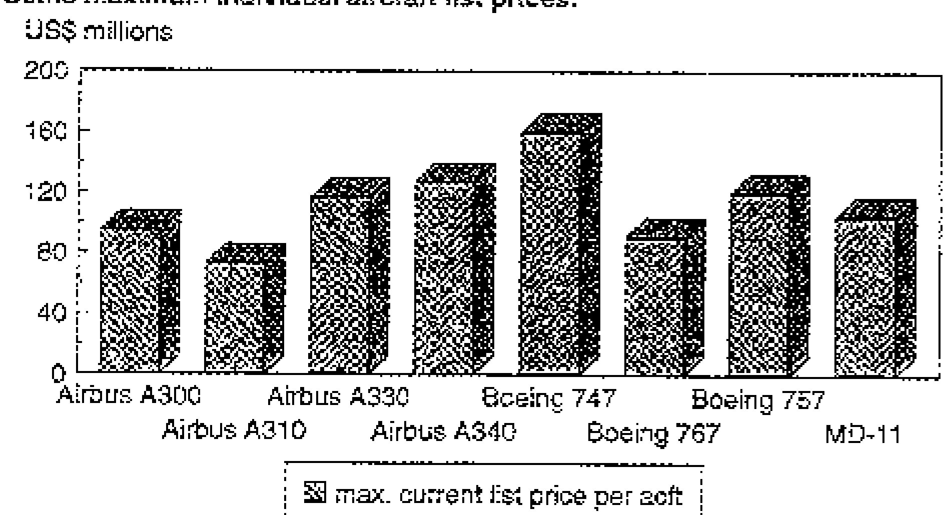
1994 calendar year airline loss levels were the highest on record and the single major contributing factor relates to passenger liability settlements and/or reserves, with potential liability losses arising from just the China Airlines and USAir accidents (26th April, 1994 and 8th September, 1994 respectively) approaching US$ 600 million. Liability exposures are of considerable concern to airline insurers; United States passenger legal liability awards are edging ever upwards with US$ 2.5 million (perhaps higher?) per person now considered by some the average (initial) reserve (with similar levels for Japan?). With regard to the (above mentioned) China Airlines loss we understand that relatives of some 121 passengers who died have filed a suit against both the airline and aircraft manufacturer claiming slightly more than US$ 2 million a passenger (the airline earlier offered up to US$ 154,000 a person). Whilst none of these actions appear to involve an airport and/or air traffic control authority (and certainly not birds) they demonstrate award trends.

Sadly, it seems there is now a tendency for us to feel that we are all victims - nothing is our fault; someone else is always to blame and we must be paid compensation (and lots of it) if something goes wrong; that someone is going to be the insurer (at least, while they have some money!). I can cite a number of weird and wonderful cases; perhaps I might refer to a well publicised case here (in the United Kingdom) of unhappy parents suing the management of a theatre for "trauma" suffered by a three year old child taken to see a production of Peter Pan, despite a warning issued by the theatre that the play was unsuitable for children below the age of 7 (a fact of which the parents were apparently aware) highlights an increasing insanity and inability to accept personal responsibility.

It is perhaps appropriate that we consider the important proposed changes to the international protocols affecting passenger legal liability awards i.e. the "IATA Intercarrier Agreement" etc. It is not necessary to reproduce the proposed agreement in full; merely to note that in essence, the purpose of the Agreement is to waive existing passenger liability limitations [Warsaw etc. Conventions] so that *...recoverable compensatory damages may be determined and awarded by reference to the law of the domicile of the passenger...* By this simple device, the world finally becomes the oyster of the United States legal system. As with seemingly all things, will the legal profession be the ultimate beneficiaries? It could be argued perhaps that the waiver of liability limits could dissuade plaintiffs from attacking other parties including airport etc. authority's in a move to circumvent Warsaw etc. limitations; conversely however, might such a development result in increased pressure on airline insurers to subrogate against an airport? An airline itself, following loss, might wish its insurers to take the appropriate legal measures to ensure that their (the airline) claims record reflects their own fortunes and is not blackened by the perceived failures of others.

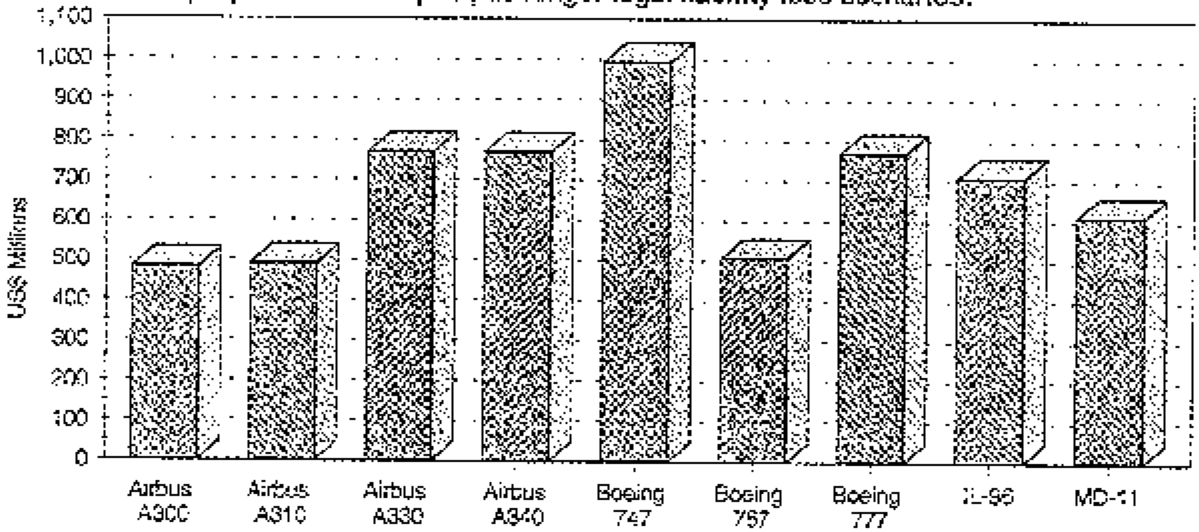
It does not require passenger fatalities to result in a significant claim. We have already considered the inexorable rise in aircraft values; Figure 11. identifies the maximum list price for the various current major (western built) high valued production jet aircraft:

Figure 11. - Some maximum individual aircraft list prices:



It is however passenger legal liability awards that present the greatest cause for concern. If we make the assumption that the average passenger liability award in the United States now stands at circa US$ 2.5 million a person, even a limit of US$ 1,000 million any one loss appears potentially inadequate. Figure 12, presented perhaps as a scare tactic as much as anything else, identifies the major current production aircraft, showing potential cumulative losses following a total loss based on a 70% passenger load factor (with 100% passenger fatalities) and a settlement of US$ 2.5 million a passenger:

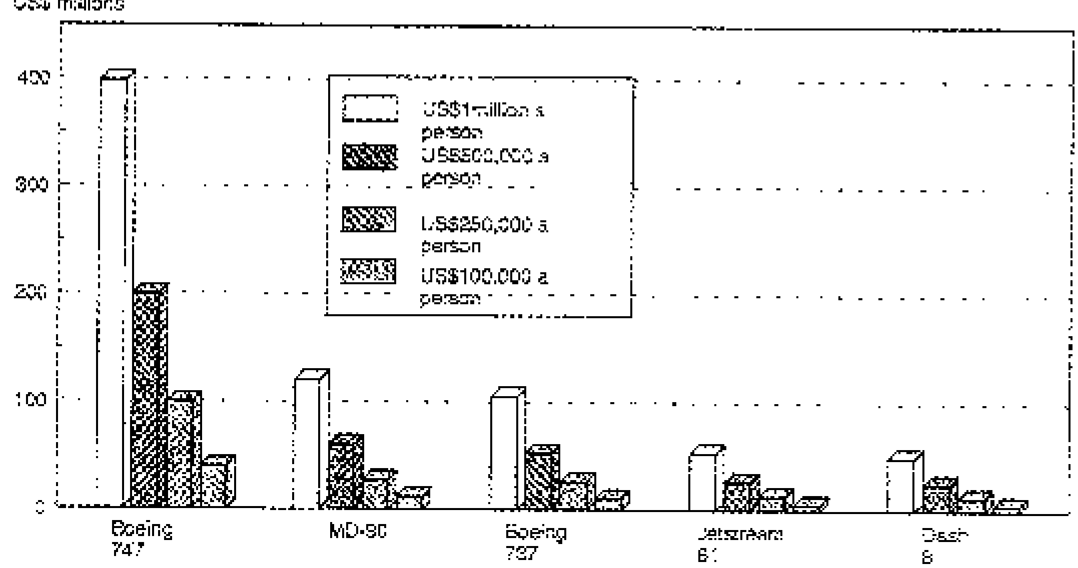
Figure 12. - Some projected catastrophe passenger legal liability loss scenarios:



It must always be remembered that the above is based on a 70% passenger load factor; what would happen in the event of a 100% load factor? Also, our projections make no provision for the aircraft hull (insured hull values can touch US$ 250 million) and any third party liability losses; in this regard we note the recent An-32 accident in Kinshasa, resulting in considerable loss of life on the ground. Similarly, there were 43 ground fatalities and a further 11 persons injured following the 1992 El Al Israel Airlines, Amsterdam accident. Additionally, we must always bear in mind that the foregoing illustration reflects claims assuming United States related exposures; awards elsewhere are not necessarily so high (yet!).

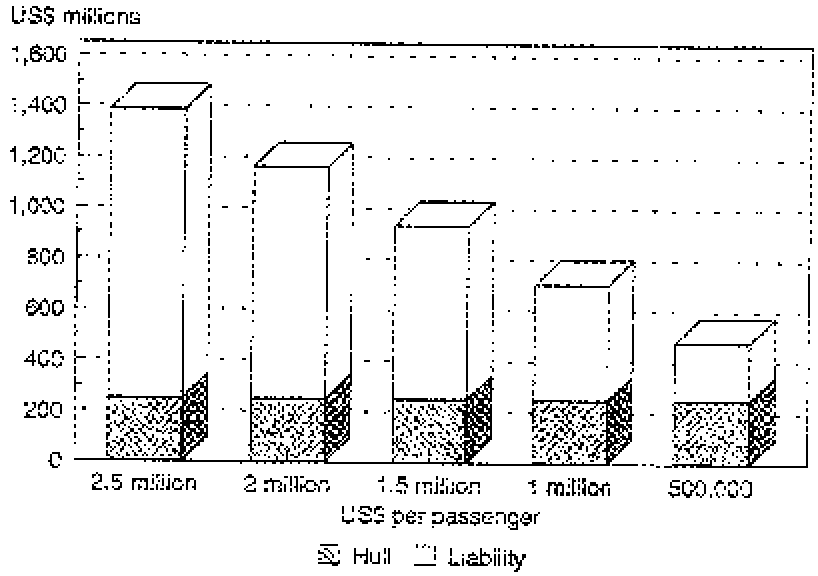
To enable us to view an overall picture, Figure 13. shows potential cumulative losses for some of the popular aircraft currently in service based on a number of average award levels, once again assuming a 70% passenger load factor (it must be borne in mind that it is essentially the loss of a high passenger capacity jet aircraft that provides the greatest exposure for the airport and/or air traffic control authority):

Figure 13. - Some selected passenger legal liability loss projections:



As a general comment, it is appropriate to consider the anticipated introduction into service of the New Large Aircraft (NLA's)? Whilst introduction into service is not scheduled until the years 1999/2001 for the Airbus A3XX aircraft (estimated hull insured value between US$ 250 and 300 million with up to 650 or more passenger seats) and the Boeing 747-600X aircraft (estimated hull insured value between US$ 200 and 250 million with up to 650 or more passenger seats), their impact will be considerable. It will surely be the potential liability exposures which will test the market. Figure 14. considers aircraft losses based on a hull value of US$ 250 million and a 70% load factor calculated on a suggested maximum seating capacity of 650 seats and graduated award levels (but excluding any provision for third party liability such as the An-32 accident in Kinshasa last year, resulting in considerable loss of life on the ground and damage to property):

Figure 14. Some (more) selected loss scenarios:



It is important to note that whilst we make reference to aircraft passenger load factors of 70% this must be viewed as a general average; in many cases, current passenger load factors are significantly in excess of this figure.

Whilst the selected limit may be based, in some measure at least, on local legal systems and the level of domestic awards, international initiatives such as the "IATA Intercarrier Agreement" will surely bring about a narrowing of national distinctions and must be fully considered when selecting the appropriate liability limits. We in Europe seem to daily witness the many tentacles of the European Commission merrily tickling away - there seems to be no end to the Commission's ability to lay down rules and regulations (the seeming lunacy of the Commission often defies belief - it appears they lay down standards for bananas, governing length and bend!).

Perhaps I might close this section with a few observations on the so-called, "hidden costs" of aircraft bird strikes. Firstly, we must ask the question; how much do aircraft bird strikes cost the airlines annually? I have heard a figure of circa US$ 2 billion mentioned! How are these costs calculated? Firstly, physical damage to the aircraft. Secondly, by the "hidden costs". In the event of an aircraft accident/incident, the aircraft operator will be saddled with a number of unexpected costs; many are not recoverable under the standard insurance policy and are referred to herein as "hidden costs". These may perhaps occur following a precautionary landing (such as a return to airport), an aborted take off or an engine (single or multiple) shutdown. The extent of such "hidden costs" is determined by a number of factors; these include:

the level of aircraft damage

the operator involved (ie. fleet size)

type of operation (passenger or cargo)

proximity of aircraft involved to the repair facility.

What factors contribute to these so-called, "hidden costs"? They might include:

the cost of re-routing passengers - this might include the cost of complementary tickets issued to disadvantaged passengers to make up for any inconvenience

the cost of passenger and/or crew accommodation, refreshments etc. ie. in the event of a delay in excess of circa 12 hours, all on-board food has to be replaced (is it fed to the birds?)

costs incurred to replace dumped fuel

costs incurred in bringing in replacement aircraft and/or engines (these are dependant on aircraft availability)

contractual penalties ie. for late delivery of cargo

any inspection costs

additional maintenance costs

additional airport and/or air traffic control charges (including storage charges); relocation of crews, cost of replacement crews

for seasonal operators the timing of the incident is important

loss of confidence and perceived damage to the "good name" of the airline ie. resulting in cancellations, loss of revenue and extra expenses incurred to restore the airline's "good name" etc.

the "ripple" effect of any of the foregoing which may include loss of revenues:

Conclusion, or perhaps more simply ... Goose - Please Vamoose!":

To summarise my earlier observations, I note that:

- airport legal liability insurance is relatively inexpensive and current insurers capacity levels are generally adequate to meet required levels of liability;
- individual insured aircraft values now touch US$ 250 million!
- the wide body aircraft content of the world airline fleet is ever increasing;
- in general terms, bird populations, geese (particularly Canada geese), gulls, (mute) swans and legal eagles are increasing;
- might changing weather patterns result in changes to migratory patterns - bird dispersal strategies must be constantly reviewed;
- there is an increasing trend to seek legal remedies to compensate any and all misfortunes - international passenger legal liability protocols are under review - passenger legal liability awards are generally increasing - will courts be increasingly sympathetic to the plaintiff?

The best laid plans of mice and men do sometimes go astray; our vision, particularly these days, is sometimes obscured by detail and we miss the obvious! New developments in engine manufacture (i.e. the GE 90 and Rolls Royce Trent engines) should help alleviate the problem, at least in part; even so, the bird strike problem will surely remain with us for as long as aircraft are flying.

On the evidence presented, I am sure that you will agree that the case for the maintenance of adequate airport bird dispersal techniques and airport and/or air traffic control legal liability insurance is compelling; I very much hope that my arguments have been persuasive. Whilst the possibility of a major loss may be slight, it is nevertheless real and must be kept in mind. Henry Kissinger suggested that "*...the real distinction is between those who adapt their purposes to reality and those who seek to mould reality to their purposes...*". There is always a need to both accept and adapt to, the current reality!

Thank you

Footnote: not quite aircraft bird strikes but two rather charming tales, and well worth the telling, which appeared in the press here recently.

A house martin, unable to fly after being attacked by a cat, was offered a seat on an Air Algerie aircraft, it being feared that the bird would have missed the migration to Africa. Said an Air Algerie spokesman, "*... the poor little thing would have died if he stayed in England, so it was the only sensible thing to do. The bird will have its own seat and will be looked after by an air steward for the entire flight ...*".

The co-pilot of a British Airways Boeing 747-400 aircraft was distracted on a flight from Gatwick to Sofia when a sparrow flew up his trousers. Somewhat discomfited up the trouser leg, the sparrow beat a retreat to the captain's headrest with the captain resorting, unsuccessfully, to attempted violence against the "poor little thing". Eventually, the bird was trapped and, as we understand it, made good its escape at Sofia, if albeit, something the worse for wear.

APPENDIX 12

The Ecological Study Conducted at Washington Dulles International Airport

THE ECOLOGICAL STUDY CONDUCTED AT WASHINGTON DULLES INTERNATIONAL AIRPORT

JESSICA DEWEY, USDA-APHIS-Animal Damage Control, 329 Nansemond St. SE, Leesburg, Virginia 20175
MARTIN LOWNEY, USDA-APHIS-Animal Damage Control, P.O. Box 130, Moseley, Virginia 23120

Abstract: Wildlife has been recognized as a potential hazard to human safety and aircraft operations at Washington Dulles International Airport. USDA-APHIS-Animal Damage Control (ADC) was requested to conduct an ecological study to generate site-specific management recommendations to reduce the potential for wildlife-human conflicts. ADC conducted 4 wildlife studies from September 1994 - August 1996: a bird survey, a pond survey, a small mammal survey, and a deer management study. Collected data and historic data were analyzed. Five bird species of concern have been recognized: European starlings, Canada geese, mallards, ring-billed gulls, and American kestrels. White-tailed deer, red fox, and coyotes were the mammal species which generated immediate concern. Wildlife management actions recommended to Dulles Airport officials involved habitat management, including the implementation of tall grass management within the AOA and the use of fencing to exclude hazardous species from attractive habitats, and population management, including harassment and population reduction of certain hazardous species.

APPENDIX 13

Victoria Airport Wildlife Management Plan

VICTORIA AIRPORT
WILDLIFE MANAGEMENT PLAN

Presentation to

Bird Strike Committee Canada
November 6, 1996

by

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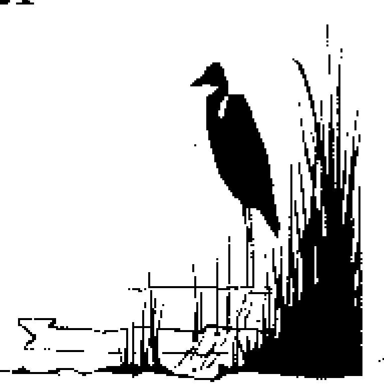


Jacques Whitford Environment Limited

PURPOSE OF A WILDLIFE MANAGEMENT PLAN

"To identify all activities required to reduce the potential risk to aviation, as a result of bird and mammal activity on and in the vicinity of the airport."

TRANSPORT CANADA'S POLICY

"It is the policy of Transport Canada to regard all wildlife on airports as potential hazards to airport and aircraft safety, and to site, construct, maintain and operate the airport and its facilities in a manner that will minimize these hazards"

PLAN DEVELOPMENT

- Document Review
- Workshop
- Field Surveys
- Staff Interviews
- Documentation

CONTENT

- Introduction
- Airport Operations
- Bird Strike Data
- Wildlife Survey
- Principal Participants
- Management Plan
- Reporting and Monitoring
- References

VICTORIA INTERNATIONAL AIRPORT
PASSENGER AND AIRCRAFT MOVEMENT STATISTICS FOR 1995

	PASSENGERS			MOVEMENTS	
	1995	% of Total Year 1995		1995	% of Total Year 1995
JAN	52,759	6.83%	JAN	12,690	7.76%
FEB	48,315	6.26%	FEB	10,844	6.63%
MAR	58,775	7.61%	MAR	14,806	9.06%
APR	58,539	7.58%	APR	13,703	8.38%
MAY	67,803	8.78%	MAY	16,131	9.87%
JUN	70,133	9.08%	JUN	14,428	8.83%
JUL	70,931	9.18%	JUL	16,150	9.88%
AUG	79,616	10.31%	AUG	16,032	9.81%
SEP	75,157	9.73%	SEP	14,907	9.12%
OCT	71,381	9.24%	OCT	12,161	7.44%
NOV	55,319	7.16%	NOV	10,404	6.36%
DEC	63,656	8.24%	DEC	11,217	6.86%
	772,384			163,473	

Summary of Bird Strike Data at Victoria International Airport by Month of Occurrence

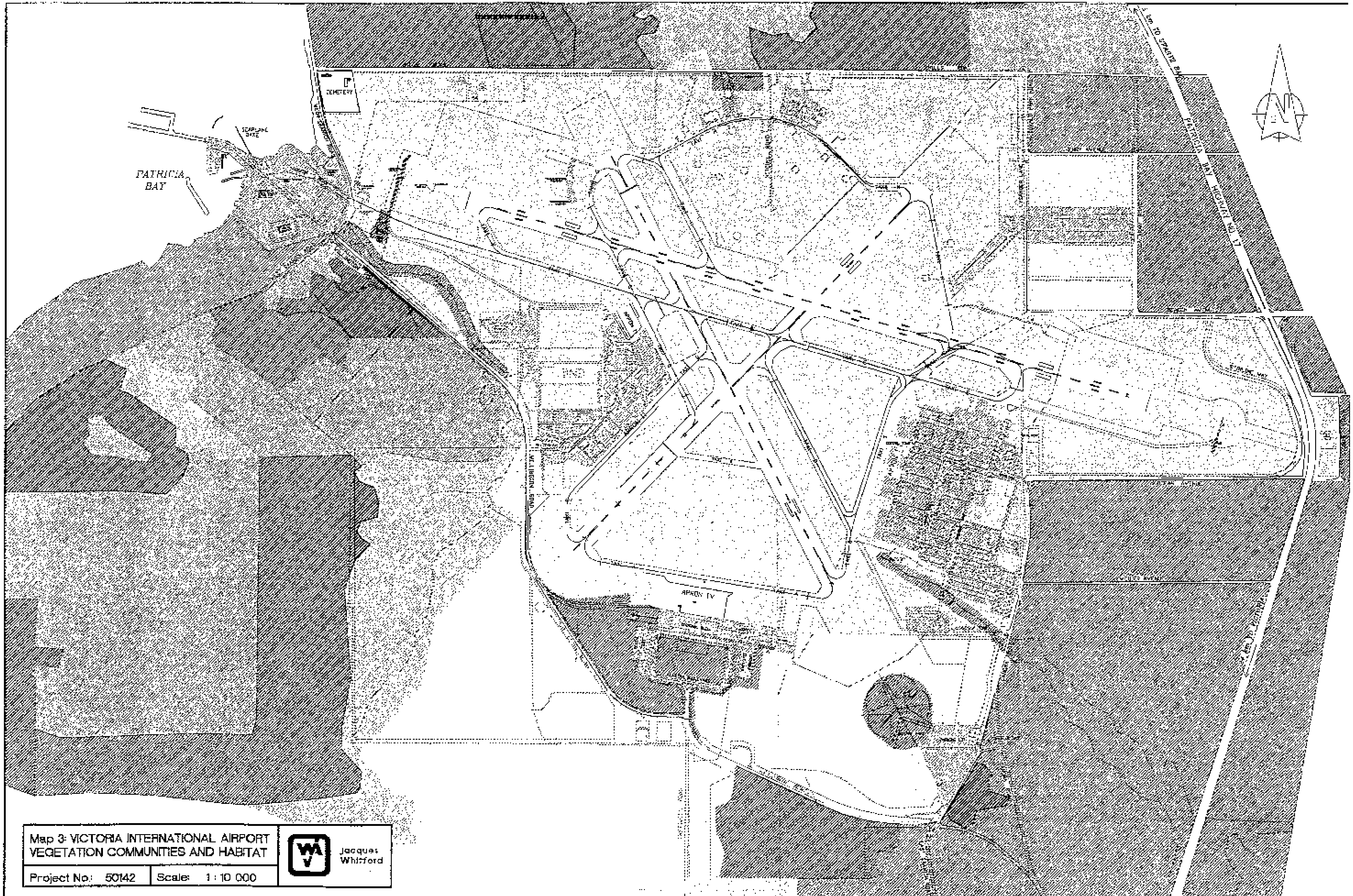
Month	1992	1993	1994	1995	Total	Total Percentage
January	2	2	1	1	6	9.1
February	2	0	3	0	5	7.5
March	0	1	1	1	3	4.5
April	0	3	1	0	4	6.1
May	0	1		0	1	1.5
June	0	2	1	1	4	6.1
July	3	0	1	2	6	9.1
August	1	1	1	1	4	6.1
September	2	8	1	0	11	16.6
October	1	1		2	4	6.1
November	3	0		10	13	19.7
December	0	1		3	4	6.1
Not Reported	0	0	0	1	1	1.5
Total	**14**	**20**	**10**	**22**	**66**	**100**

WILDLIFE SURVEY

- Bird Inventory
- Species Characteristics
- Attractants

Summary of Bird Strike Data at Victoria International Airport by Type of Bird Involved

Bird Type	1992	1993	1994	1995	Total	Percent of Total
Gull	5	9	4	11	**29**	43.9%
Sparrow	2	1		3	**6**	9.1%
Swallow	2	5	1		**8**	12.1%
Starling	1		1		**2**	3.0%
Sandpiper		1		2	**3**	4.5%
Duck		1	1	4	**6**	9.1%
Killdeer		1			**1**	1.5%
Wren		1			**1**	1.5%
Goose	1				1	1.5%
Unidentified	3	1	3	2	9	13.6%
Total	**14**	**20**	**10**	**22**	**66**	**100**


PATRICIA BAY
CEMETERY
APRON IV
Map 3: VICTORIA INTERNATIONAL AIRPORT
VEGETATION COMMUNITIES AND HABITAT
Project No: 50142
Scale: 1:10 000
Jacques Whitford

MANAGEMENT PLAN

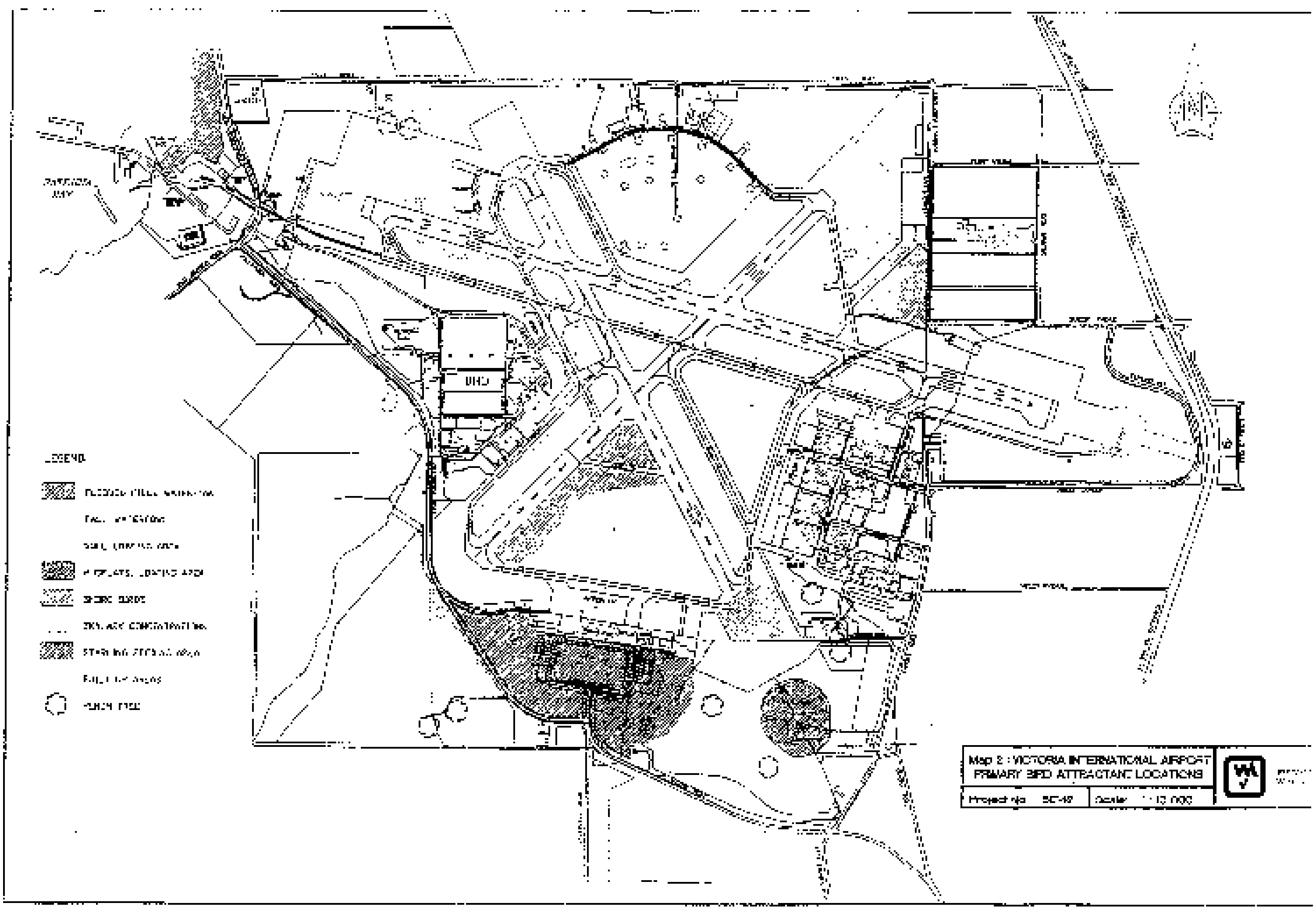
- Long Term
- Active Control
- Adjacent Lands
- Awareness

Active Wildlife Control

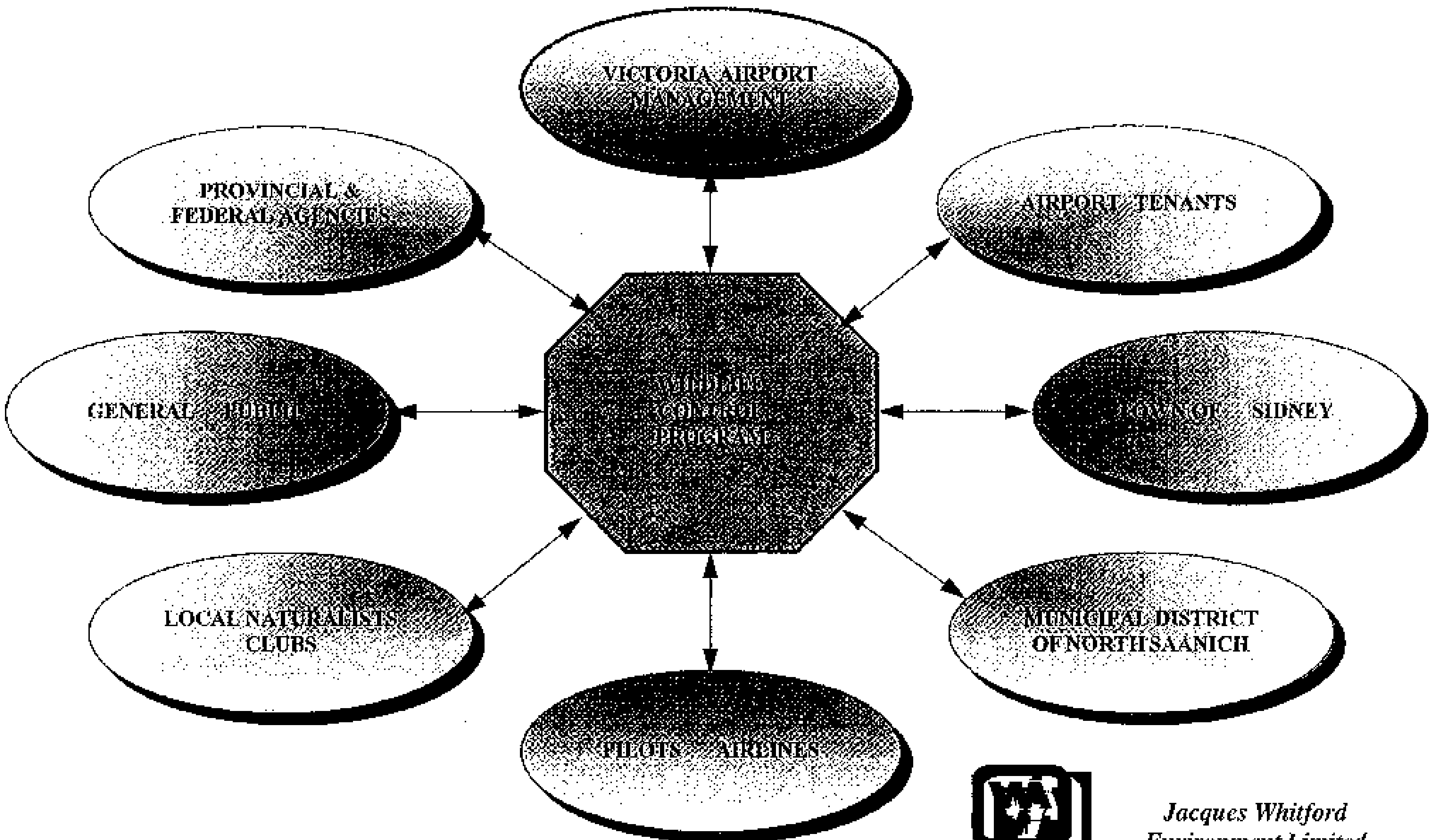
	Pyrotechnics	Removal/ Reinforcement	Distress Tapes	Nest Removal from Buildings	Lethal Chemicals
Starling	✓	✓		✓	✓
Gulls	✓	✓	✓		
Shorebirds	✓	✓			
Swallows				✓	
Waterfowl	✓	✓			
Sparrow				✓	✓
Raptors		✓			
Rock Doves (pigeons)	✓	✓		✓	✓
Crow	✓	✓		✓	
Blackbirds	✓	✓			

Long-Term Wildlife Management - Habitat Modifications

	Grass Height Management	Worm Control	Building Modifications	Flood Control in Fields	Perch Tree Removal	Insect Control	Seed Control	Vole Control
European Starlings	✓	✓	✓		✓	✓	✓	
Gulls	✓	✓		✓				
Shorebirds	✓			✓		✓		
Swallows			✓			✓		
Waterfowl				✓				
Sparrow	✓		✓			✓	✓	
Raptors	✓				✓			✓
Rock Doves (pigeons)			✓					
Blackbirds	✓				✓	✓	✓	
Crows	✓	✓			✓	✓		✓


LEGEND
Map 2 : VICTORIA INTERNATIONAL AIRPORT
PRIMARY BIRD ATTRACTANT LOCATIONS
Project no. 5042
Scale 1:10 000

WILDLIFE AWARENESS



Jacques Whitford Environment Limited

WILDLIFE MANAGEMENT PLAN

PRINCIPAL PARTICIPANTS

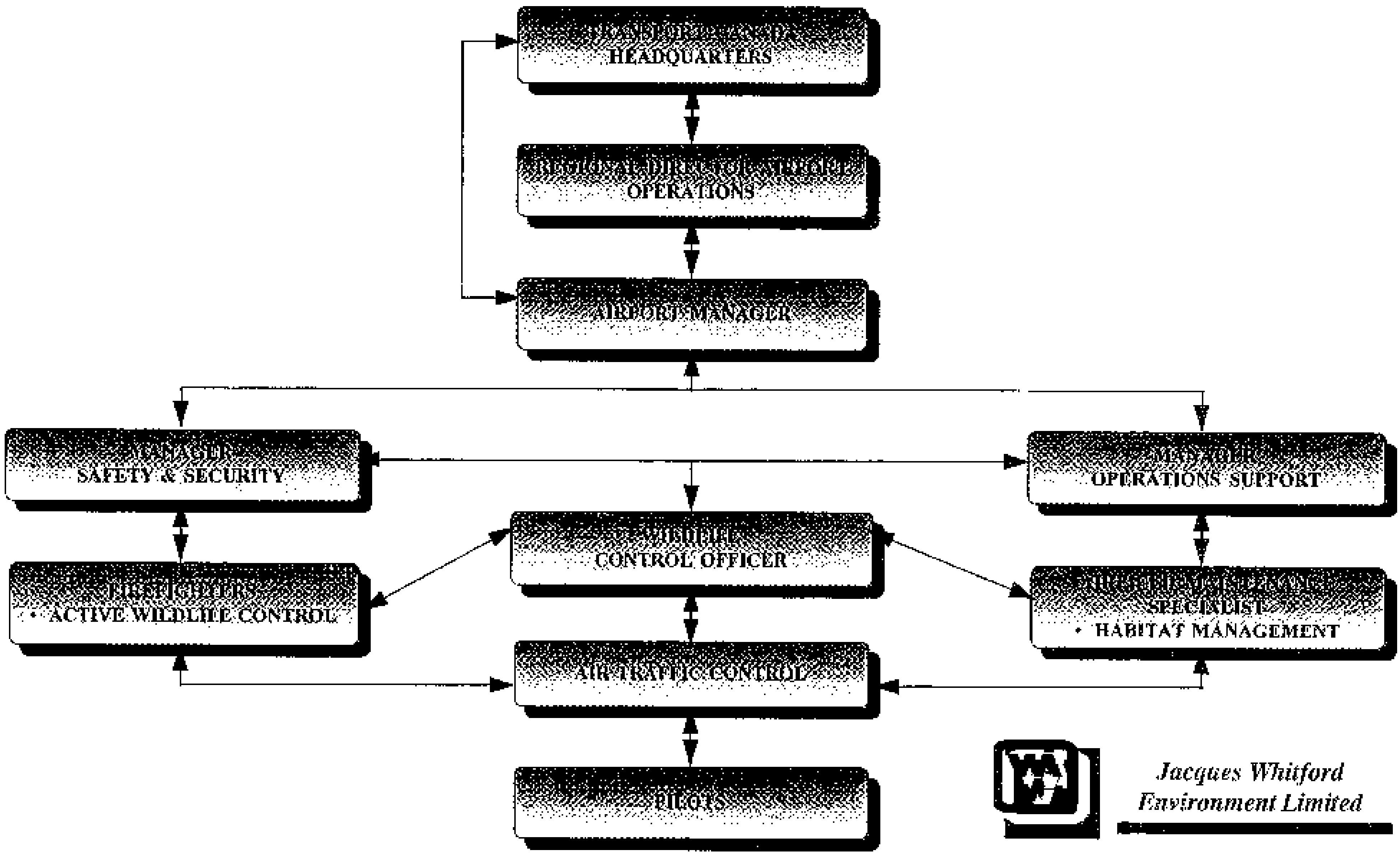


Table 5. Recommended Action Plan for Victoria International Airport

Issue	Long Term Plan	Short Term Plan	Target Species	Recommended Responsibility
Grass Height	• Review the contracts for grass cutting in light of long grass management for wildlife management. Specify that cutting and haying is to take place in the last two weeks of May or first week of June for all contract out areas. • Maintain grass length at a minimum length of 15 cm or longer throughout the year. The longer grass will reduce the attractiveness of the grass fields to loafing and feeding.	• Maintain short grass aprons along runways at the minimum width required by other aircraft safety concerns. • Maintained lawns in and around the terminal buildings, tenant buildings and parking lots should also be cut to 15 cm.	gulls, shorebirds, European Starlings, blackbirds, Skylarks, Savanna Sparrows	Airport Maintenance Specialists
Flooded Fields	• Use: open drainage ditching, placement of buried drain pipes, placement of fill or a combination of these. Care must be taken to ensure that ditches are constructed so that water will run off rapidly and that banks are sloped to allow for easy mowing.	• Place a grid of fine wires or monofilament strands over flooded areas which attract birds in the fall and winter. • Consult pages J7 and J8 in the Wildlife Control Procedures Manual-TP11500E.	gulls, waterfowl	Airport Maintenance Specialists Wildlife Control Officer
Building Modification and/or Nest Removal	• Remove old buildings on airside which are no longer in use. • Eliminate holes, crevices, roosting ledges and general access to buildings. • Consult pages G12 and G13, and J2 through J6 in the Wildlife Control Procedures Manual-TP11500E. Pages K2 through K18 of the Wildlife Control Procedures Manual-TP11500E, provides detailed discussions on the use of lethal chemicals. • Complete a routine inspection and nest patrol of all airside buildings and structures from late April through May. • Obtain approval from the Ministry of Environment, Lands and Parks.	• Complete a detailed survey of all buildings to determine problem areas which require immediate attention. • Prioritize buildings, with first priority given to airside buildings. • Place poison bait stations for short term solutions.	European Starlings, sparrows, swallows, Rock Doves	Airport Maintenance Specialists Professional Pest Control Firm Wildlife Control Officer Tenants
Raptor Perching Areas	• Monitor trees around the fenced perimeter. Remove if required. • Modify runway approach lights so they are less attractive to perching by birds. This may be best achieved with the placement of Bird-B-Gone. • Refer to pages J4 and J5 of the Wildlife Control Procedures Manual-TP11500E for details.	• Remove all large single trees on airside lands. • Remove small clumps of trees (ie 3-4 trees).	raptors	Airport Maintenance Specialists Wildlife Control Officer

CONCLUSIONS

QUESTIONS/COMMENTS?

APPENDIX 14

Bird Hazards A Planning Perspective: Ottawa - MacDonald-Cartier International Airport

BIRD HAZARDS
A PLANNING PERSPECTIVE
OTTAWA - MACDONALD-CARTIER INTERNATIONAL AIRPORT

November 7, 1996

BIRD HAZARDS - A PLANNING PERSPECTIVE
OTTAWA - MACDONALD-CARTIER INTERNATIONAL AIRPORT

BACKGROUND

Land use planning near airports is a complex matter which involves multiple jurisdictions in the Ottawa area: the federal government, the Regional Municipality of Ottawa-Carleton (RMOC), and several municipalities and townships. The federal government does not have control over off-airport land uses. This has been historically, and remains, a provincial responsibility and much of the power to make land use decisions has been delegated to the regional and municipal governments. Therefore, in many cases the Airport relies on the RMOC and the municipalities to protect its interests. This paper will highlight some of the efforts made by the Ottawa - Macdonald-Cartier International Airport to influence land use decisions that could lead to conflict with airport operations and some of the problems which have arisen. Given the interests of this audience, this paper will concentrate on land use planning as it effects bird issues.

Transport Canada issued in the early 1970s a document called TP1247, Land Use in the Vicinity of Airports, for the guidance of those tasked with determining appropriate land uses near airports. This document, which has been amended several times since then, outlines the operational characteristics of airports which may influence land uses outside an airport's boundaries and guidelines to achieve compatible land use planning. Part 111, Bird Hazards describes the types of land uses that should be avoided near an airport due to their potential for attracting birds. Much of the focus in the Ottawa area has been on Part 1V, Aircraft Noise as residential development is moving closer to the Airport compromising its operational integrity However, increased urbanization around the Airport is creating other problems which have become of considerable concern.

For several years, the Airport has been dealing with the RMOC and the surrounding municipalities in an effort to educate planners in the area of the protection needs for the Airport. The Airport reviews official plans, official plan amendments, concept plans, subdivision applications and site plans for developments in the vicinity of the Airport. The Airport has, at each stage of the planning process, flagged the issues that must be considered before land uses are approved around the Airport. During the review of official plans, the guiding document used by the municipalities for the distribution of lands in each of their jurisdictions, the Airport requested that clauses be included to address the need to respect height limitations, the need to avoid land uses that would impact navigational or radar equipment; the need to discourage lands uses or practices that would increase bird or wildlife populations near the Airport; and the need to address aircraft noise issues and other types of land uses that could negatively impact the Airport. The Airport's objective was to alert the development industry as early as possible in the planning process of the unique issues relating to lands near an airport and prevent irrevocable decisions before substantial investment was made. With respect to the bird hazard issue, the City of Nepean has incorporated the following clause into its Official Plan:

> "Landfill sites can represent a hazard to air navigation due to their potential to attract birds. The Ottawa International Airport will be consulted on any lands to develop new waste disposal sites that may have implications for the Airport."

The City of Gloucester's Official Plan states that:

> "Isolated industrial developments requiring extensive land areas may be permitted provided the development is to be used for municipal purposes. Examples of such uses would include waste disposal sites and snow dumps. Development of such uses will be subject to hydrogeological and geotechnical studies. Uses which are attractive to birds shall not be permitted in the vicinity of airports."

Neither the City of Ottawa's Official Plan, nor the Official Plan of the Regional Municipality of Ottawa-Carleton contain similar clauses.

In its dealings with planners, it became obvious that many planners were unfamiliar with airport constraints on off-airport lands. This could be due to the fact that development near the Airport is relatively new. Therefore, in the interests of further reinforcing an understanding of the issues requiring attention, in 1994 the Airport issued a document called the Airport Protection Plan. This document summarizes much of what is contained in TP1247 specifically applied to the Ottawa Airport, identifies land uses that require consultation with the Airport before any approvals are issued and contains drawings depicting the areas of concern.

CASE STUDY #1, CLASS ENVIRONMENTAL ASSESSMENT, STORMWATER MANAGEMENT AND TREATMENT, SOUTH URBAN COMMUNITY, STORMWATER MANAGEMENT POND #1

Despite the Airport's best efforts, in June of 1993. the Airport learned as part of the City of Gloucester's Master Drainage Plan for a large community proposed south of Ottawa Airport, that the City was proceeding with the preliminary engineering design and the environmental assessment for the construction of the first of four stormwater ponds. A previous Master Drainage Plan prepared to develop a "strategy for control of urban drainage from the new community", recommended at-source measures to maintain water-table recharge and control run-off rate, along with a system of ponds to provide final treatment and control of stormwater run-off before it reached Mosquito creek and the Rideau River. Four retention ponds were proposed with each pond designed to incorporate wetland areas and to hold a substantial permanent pool of water to provide the primary means of controlling urban run-off. A drawing of the area depicting the ponds is attached. The following quote from the Master Drainage Plan appropriately characterizes the City's intentions.

"The retention ponds that are being proposed are sizeable. In terms of urban design, it would seem that they should be looked upon as small urban lakes and integrated into the urban landscape accordingly. This will require the development of detailed landscape design plans as an integral part of the final design of each pond. The suggested geometry of the ponds indicates the need for landscaping and has provided for reasonable gentle sideslopes and flatter terraced areas to facilitate a final design that can be blended with neighbouring urban areas and in so doing provide recreational amenity and visual interest."[1]

The Airport, with the assistance of Headquarters, immediately intervened. Transport Canada's concerns, tabled at a meeting with the City and the consultants tasked with the design of the facility, included the potential for increased bird and wildlife activity near the Airport, the location of one of the largest ponds in relation to the proposed parallel runway, the overall number of ponds and their impact on existing operations and the cumulative impact of the ponds, the proposed parklands and industrial areas because of their potential for attracting birds. The birds of particular concern were identified as gulls and waterfowl.

However, at this point in time it was clear that the location of the ponds, which were cited after careful consideration of environmental issues and the natural drainage features of the area, could not be relocated. Other methods of stormwater detention, such as underground storage, were not considered practical because of the prohibitive costs. The City agreed to aggressively pursue methods for mitigation to discourage birds and wildlife from using the ponds. As a first step, a baseline study was undertaken to determine the number of problem birds in the Ottawa area, the likelihood of changing bird feeding or nesting habits that might result in increased populations around the airport and mitigative measures required to control bird numbers. The study concluded the following:

a) The interior Canada goose, because of its shyness and scarcity, would not likely be a problem in the vicinity of the Airport.

b) The giant Canada goose, on the other hand, is apparently tolerant of human activity and frequently nests in urban areas, including urban ponds. Although the populations are currently small in the Ottawa area, there is a high probability that their populations will increase as has occurred elsewhere in southwestern Ontario. Specialized design of the ponds would make them unattractive to the giant Canada goose.

c) The habitat of the stormwater retention ponds would be unsuitable for diving ducks.

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1 *Gloucester South Urban Community, Master Drainage Plan Report, June 1992, Gore and Storrie*

d) In the "dabbler" category of ducks, only the Mallard could be a problem and only under very ideal conditions which are unlikely. Any risk, which is considered small, could be further reduced through pond design and landscaping less attractive to ducks.

e) The ring-billed gull, which is abundant in the Ottawa area, because of its feeding and flight characteristics, would be the most serious problem near the Airport. Special attention would be required to discourage the ring-billed gull from visiting the area of the stormwater management ponds.

Several design and landscaping measures to mitigate against increasing bird activity near the ponds are recommended in the study including:

a) the design of the ponds with steep slopes minimizing areas of shallow water;

b) stabilization of the slopes with semipermanent mesh with dense planting of shrubs and trees;

c) the use of natural, tall grasses in the backshore areas of the ponds;

d) design that would minimize water level fluctuations to reduce the exposure of wet, bare soil;

e) restriction of open picnic areas or installation of overhead wiring where feasible;

f) overhead wiring for fast food restaurants;

f) strict garbage management, fines for feeding birds;

g) during construction activities, the requirement to minimize areas stripped of vegetation;

h) minimize use of large tarred and gravelled roofs.

i) strict by-law enforcement, monitoring of bird populations and readjustment of mitigation measures as required.[2]

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[2] *The Corporation of the City of Gloucester, Discussion Paper on Bird Management for the Leitrim and South Urban Community Growth Areas, November 1993, Gore and Storrie*

CASE STUDY #2, WASTE RECYCLING FACILITY

In January of 1996, the Airport was approached by a firm which had applied to the Ontario Ministry of Environment and Energy (MOEE) for a licence to operate a recycling facility southeast of the Airport. MOEE was aware of problems that had arisen in the vicinity of Carp Airport and advised the proponent to consult with Ottawa Airport before the operating licence would be issued. The location of the proposed facility was to the east of an extended centreline of Runway 14-32. The Airport and Transport Canada Headquarters met with the proponent and MOEE at which time the following concerns were tabled.

a) The proposed facility was inside the 8 kilometer radius of one of the Airport's reference points. Transport Canada does not recommend the use of lands in this area for garbage dumps or waste landfill sites given their potential to attract the types of birds that "pose the greatest danger to aircraft".

b) While the facility proposed was a recycling facility, not a waste disposal site, the intention was to recycle all types of waste including yard waste and food wastes gathered from hospitals, hotels, restaurants, etc.

c) The site proposed had the potential of attracting birds from the existing Trail Road landfill site in the City of Nepean. The result would be that birds would cross the flight path of an active runway.

The proponent advised that there would be no stockpiling of waste on the site and that the composting would be done inside closed containers which would control odours and collect leachates. He was confident that the facility would not represent an attraction for birds. Nevertheless, Transport Canada had an ongoing concern and requested that the proponent undertake a comprehensive bird study. Given the urgency in proceeding with the approval of the licence and the costs involved, the proponent was not prepared to conduct a study. After further assessing the issue, MOEE was satisfied that the facility could be operated bird free and committed to attaching conditions to the licence to alleviate Transport Canada's concerns. MOEE will be conducting regular on-site visits of the facility. In addition, the Airport will have access to the site to conduct monitoring of its own. Any contravention of the conditions of the licence could result in its cancellation.

Both of these cases demonstrate the weakness of the land use planning process. In the first instance, the Airport had advised the City during the concept stage for the proposed community that any stormwater management solutions must address potential bird attraction issues and again during the Official Plan amendment required to facilitate the development. Nevertheless, by the time the Airport was consulted, the City had completed its Master Drainage Plan for the area. The wheels were already set in motion. The Airport was fortunate that it was able to influence the ultimate design of the stormwater management ponds. However, the City was forced to readjust the design of the ponds with the resultant delay in the approvals process and at an additional cost not anticipated. In the second situation, the proponent was alerted to the need to consult with the Airport very late in the process. The proponent was committed to proceeding, and Transport Canada was under enormous pressure to accept the proposal without what it considered the necessary evidence of "due diligence". The Airport will have to rely on careful monitoring of the situation and MOEE's willingness to withdraw the licence should problems arise.

In large part, the problem stems from the fact that the recommendations of TP 1247, Land Use in the Vicinity of Airports are considered guidelines and do not have the force of law. The Minister has the authority under the Aeronautics Act to pass regulations required for the protection of airports and has done so for Ottawa Airport. However, the existing Airport Zoning Regulations for Ottawa Airport address height limitations only necessary for the safe landing and take-off of aircraft operating at the Airport. They do not address protection requirements for aeronautical facilities or restrictions on land uses that could result in bird attractions. The Airport Zoning Regulations are currently being revised and will include a "disposal of waste" clause. The wording of the clause, which is being finalized, will be similar to the following:

> No owner or lessee shall permit any part of the land to be used for the disposal of any waste edible by or attractive to birds.

There are potentially two problems with this. First of all, the disposal of waste clause will apply only to the lands affected by the zoning regulations which may give the false impression that any lands outside of the regulations are unrestricted. This would not prevent the situation from arising whereby more than one facility could be established on either side of an airport and the subsequent problem with birds crossing a flight path while visiting the sites. Secondly, the clause applies to "edible waste" only. The Airport will have to continue to rely on the guidelines contained in TP1247 and on provincial controls for issues relating to stormwater management.

That being said, the Province of Ontario and the Regional Municipality of Ottawa-Carleton have recently taken action that will be of great benefit to the Airport. In June of 1996, the Minister of Environment and Energy issued "Proposed Regulatory Standards for New Landfilling Sites Accepting Non-Hazardous Wastes". These standards will require "that a bird hazard study be carried out for any new site to be located within 8 kilometres of a public airport" and specify that the site within the 8 kilometre zone will not be approved unless the report demonstrates that there will not be a threat to aircraft operating in the area.

Meanwhile, on the local front, the RMOC is undergoing a review of its Official Plan. The RMOC has expressed a willingness to incorporate the requirements of the Airport Protection Plan into its Official Plan. The surrounding municipalities will be obliged to amend their Official Plans accordingly.

CONCLUSION

The foregoing is not intended as a criticism of those tasked with determining appropriate land uses around an airport. Planners are faced with a barrage of issues and are in the very difficult position of balancing the different interests of all agencies. In addition, the Province is delegating further responsibilities to the local levels of government which do not have the required level of expertise. This paper illustrates the complexity of land use planning around airports and the need for vigilance on the part of all of the parties involved in development that could impact an airport. It is only through a joint-effort that future problems can be avoided.

APPENDIX 15

An Industry Perspective on Landfill Siting Near Airports as it Relates to Bird Management Issues

AN INDUSTRY PERSPECTIVE ON LANDFILL SITING NEAR AIRPORTS AS IT RELATES TO BIRD MANAGEMENT ISSUES

Howard Goldby, P. Eng., Browning Ferris Industries

INTRODUCTION

BFI Waste Systems (BFI) has been invited to participate in the November 1996 Transport Canada Bird Strike Committee meeting to present an industry view of the siting protocols for establishing landfills near airports, with particular perspective on the issue of the interaction of aircraft with birds that could be attracted to the new landfill.

This brief discusses the experience gained by BFI in its history of siting and operation of landfills close to airports. In recent years, BFI has successfully managed the siting of new landfill facilities close to airports and the siting of a new airport close to an existing facility by using an approach that involves thorough pre-siting research using specialist bird habit and control experts, detailed discussion and negotiation with regulatory authorities and by developing and continuously employing a bird management program that discourages, and even prevents, birds from using these sites.

The brief includes case histories of two such successful programs that were developed using these approaches; one at the Tower Road Landfill which opened in 1981 and is located adjacent to the new Denver International Airport, in Denver, Colorado which opened in February of 1996, and one at the Prairie Green Landfill located about 9 kilometres from Winnipeg International Airport.

BFI INVOLVEMENT WITH BIRD STRIKE COMMITTEE CANADA AND TRANSPORT CANADA

BFI has a commitment to ensuring maximum public and employee safety at all of its operations. To this end, BFI is committed to establishing programs at its facilities near airports that will minimize the risk of interaction of aircraft with birds whose habits might be impacted by its operations.

In order to establish a true understanding of the potential risks to aircraft from bird interaction, BFI has been diligent in holding discussions with those interested parties which include airport managers, airline pilots, Provincial and State regulatory agencies in Canada and the United States and Federal agencies.

BFI is committed to a continuation of this position to ensure that its programs are understood and are well received, to be able to receive feedback for future improvements and to continue to provide an industry voice in such matters of public safety.

WHY ARE BIRDS A PROBLEM FOR AIRCRAFT?

Bird collisions with aircraft do occur and the potential impact to public and property safety can be severe. Needless to say, the cost of damage to aircraft caused by a bird impact can be significant. The risk of an interaction increases when birds "tower"; the process of rising to relatively high altitudes using thermal air currents. Where the altitude of the towering birds coincides with aircraft, the risk of an impact is greatest. Presumably, the risk of such an event is higher where concentrations of birds are located, and conversely, the risk reduces as the number of birds flying in air space common with aircraft also reduces. It is also reasonable to presume that it is probably impractical to expect that this risk can be removed entirely.

THE ATTRACTION OF A LANDFILL TO BIRDS

Birds are attracted to landfills because of their relatively constant food source. Examples can be sited where several generations of birds have been reared on "landfill cuisine" and now no longer regard the wild as the major source of sustenance. At a facility in Ontario, a small gull population attempted to establish a nesting site on the closed portions of the facility. Removal of this colony under an approved program has significantly reduced the population at this site. In Quebec, the numbers of gulls using a major site near Montreal increases substantially after hatching, with the subsequent overall population increase as a result of young following adults to this facility.

Therefore, an uncontrolled landfill will attract larger numbers of birds than those with effective control programs.

CAN THE RISK OF LANDFILL BASED BIRD INTERACTIONS WITH AIRCRAFT BE PREVENTED?.

While it would be too simple to state that removal of the risk of interaction entirely is possible, there are two (2) methods that have been employed to date that, when properly managed, have provided significant risk reduction. These are:

1) Bird/ Habitat Management; the prevention of bird use of a landfill.

2) Exclusionary Siting; enacting regulatory limits on the establishment of landfills in areas of high air traffic usage and, conversely, imposing zoning restrictions around existing landfills to limit the opportunity to establish an airport within prescribed distances from that site.

CAN BIRDS BE PREVENTED FROM USING LANDFILLS?

Can an interaction with a bird that uses a landfill for feeding or loafing be prevented? The answer to this question is that, while a guarantee of total prevention would be naive, the prevention of bird use is possible and can best be accomplished by proper management at the commencement of the landfill operation. It is, in our opinion, essential to the success of a control management program, that the studies and actions to be conducted be carried out by experts in the field of bird behaviour and bird control at landfills.

The procedures for implementing a bird discouragement program typically employ some or all of the following steps:

1) Determine the base bird situation in the area of concern. In this regard, the proponent of the new facility should study and document:

   - existing bird attractions such as other landfill sites, other feeding areas, and the like;
   - the current state of bird and aircraft interaction at local airports including gathering as much information as possible from knowledgeable sources; airport personnel, airline pilots local experts and the like
   - the species of birds using these sites; different species may have different behavioral patterns
   - flight paths between these sites and night roosting areas;
   - seasonality of appearance and behaviour; do the birds leave in the winter, for example;

2) Predict the change in bird locations and behaviour with the new landfill in place to determine:

   - if the new site (under an uncontrolled bird operation) would cause a change in the flight paths of the existing birds in the area; this point is of importance as the establishment of a new site could alter the traditional night flight paths of the bird flocks. In some cases, such an alteration could encourage birds to stray into aircraft flight paths or to fly over airports whereas previously this might not have been the case.
   - if the new site will attract birds that previously did not use landfills as a food source;
   - the likelihood of an increase in the risk of an interaction of an aircraft with a bird from the site, if the birds were uncontrolled and allowed to establish a colony at the site
   - Prepare a bird management program for implementation at the site as soon as it opens to prevent birds from establishing a significant presence.

3) Determine, through consultation with interested parties, whether the site poses an unacceptable risk or whether the actions proposed to control birds will be acceptable as management techniques for preventing an unacceptable risk situation from developing. As noted earlier, these parties can include airport managers, airline pilots, Provincial and State regulatory agencies in Canada and the United States, committees such as the Bird Strike CommitteeCanada, or other local interest groups.

4) Obtain agreement from the regulatory authority with jurisdiction over the proponents application for a permit that the results of these negotiations can be accepted by that authority for use at the proposed facility.

5) Implement and continue a control program. A lull in the program could cause birds to establish and negate the effects of the above steps.

BIRD MANAGEMENT PROGRAMS AT EXISTING LANDFILLS

The control of birds at existing landfills can be a difficult task. Once birds have established, encouragement of them to leave is not always successful. Birds will normally only leave if significant danger is demonstrated to them by continual harassment. This harassment is often difficult and expensive to employ and usually involves one or more of the following activities:

1) The use of birds of prey. The species of bird of prey to be chosen for this task is important and must be one that invokes the necessary danger signals for the species of birds being controlled.

2) The use of pyrotechnics. Borrowed from the farmers field, the use of bird scaring noise makers are frequently used to control loafing birds. These instruments create load bangs which tend to get the birds airborne.

3) The use of distress calls. Taped distress calls of the species using the site can be effective in disturbing the birds.

4) Prevention of nesting on the property

5) Strategic placement of look-a-likes of injured birds

6) Restrictive wiring over loafing areas to prevent use of the site by gulls.

7) Manual patrols using a shotgun armed with screamer shells which tend to disperse airborne flocks

None of these methods will be very successful if the operation of the facility is not conducted to a high standard of practice to ensure that wastes brought to the site are quickly covered and not left exposed to become a food source for the birds. Other methods may be available which are more effective on particular species. The advice of the proponents expert bird control consultant should be sought to determine the scope and frequency of such a control program.

It should also be remembered that once a bird becomes accustomed to a program, others will learn quickly that no real danger exists from the control methods used. The centrepiece of the program therefore needs to be variety and unpredictable frequency of use.

BIRD MANAGEMENT PROGRAMS AT NEW LANDFILLS

The control of birds at a new landfill is proving to be an easier task. The key to this program is prevention of the establishment of regular use patterns. The important feature of such a program is to have the program properly designed before the facility begins operation, have the techniques and manpower available as soon as operations start and to be diligent with continuation of the use of a program throughout the operation of the facility. Similarly as with existing sites the proper management of the operations at the site, including daily covering of the wastes, is essential to discourage bird attraction.

The expert bird consultant will design the facility bird control program that has as its central purpose the prevention of colony establishment. The techniques used in this program will vary but will probably employ several of the methods noted above for existing sites.

Above all else, for this program to be successful, continual operation of the methods included in the program must occur.

SUCCESSFUL BIRD MANAGEMENT PROGRAMS AT BFI LANDFILLS LOCATED CLOSE TO AIRPORTS

In recent times, new landfills have tended to be located away from airports, and conversely, new airports generally have not been sited close to landfills. This is not always geographically possible. Two BFI case histories which illustrate each example are described below:

Denver, Colorado

The new Denver International Airport was opened in February of 1995. This airport is located adjacent to the BFI Tower Road Landfill, a site that has been operating since 1981 in harmony with the local citizens. The landfill is located within 10,000 feet of the end of the southernmost east-west runway. The new airport was sited with the full knowledge of the City of Denver, the County of Denver and the U.S. Federal Aviation Authority (F.A.A.), who approved the construction of the new airport in the late 1980's.

Because of the proximity of the new airport to the existing landfill, BFI initiated discussions with interested parties to ensure open communications and to avoid problems which would interfere with the continued operation of the landfill. Although the planned new runway was within 10,000 feet of the site, BFI approached this issue as though the Company was siting a new landfill adjacent to an existing airport to demonstrate that the facility was designed and operated in a manner which did not pose a bird hazard to aircraft.

BFI requested a working group of government agencies be established to assist the Company in its aims. Representatives of the F.A.A., U.S Department of Agriculture (Animal Damage Control Division), the City and County of Denver, and the Airport Authority met with BFI to review and evaluate reports and program proposals. As a result of the early and continuous open communication, landfill operations and airport construction continued without disruption.

Two years before the scheduled opening date of the airport, which then was October 1993, BFI retained L.G.L. Consultants of King City, Ontario to conduct baseline bird population studies at the landfill and in the Denver area to provide data for the design of any bird control program that might be necessary. The study revealed that gulls were present at the landfill year round but with some monthly fluctuation in numbers. The study also revealed that a steady stream of gulls flew back and forth during the day to a wetland that had been created on the new airport property. Many of these gulls entered airspace that would be used by aircraft on approach to the new runway.

The results of the baseline study indicated that a bird control program was necessary.

A bird control program was designed by L.G.L. which was initiated in August 1993 and continues to the present day. The goal of the program is to never allow a bird to land on the site. The components of the program include a reduction in attractiveness and the use of pyrotechnics at all times when the landfill is in operation and intermittently when the site is closed.

Since the inception of the control program, the numbers of gulls measured at the site have decreased by between 94.4% and 97.7% compared to prior to the program. The facility is now a minor attractant to gulls at worst.

Winnipeg, Manitoba

BFI has also received a permit for and has constructed a new landfill as part of an integrated waste management facility in Winnipeg, Manitoba. This facility is located beyond the exclusionary zoning radius of Winnipeg International Airport but lies under one of the airport flight paths. Significant discussions have taken place between those interested parties to this issue and BFI which resulted in the development of a bird control program for implementation at the commencement of the facility operation. Initial discussions were conducted with Transport Canada, Winnipeg International Airport and pilots associations. Manitoba Environment, although not having jurisdiction over this issue, was in attendance for informational purposes as the future issuer of the landfill licence. Each party at these meetings expressed their concern and interest relating to potential bird populations, particularly gulls, which could be attracted to this new facility.

BFI then employed the services of L.G.L. Consultants of King City, Ontario to study gull populations in the Winnipeg area with a particular focus on their current feeding and roosting areas and their flight paths between each area. As part of this work, L.G.L. predicted the impact of the new facility on the Winnipeg bird population and recommended that a bird control program be initiated at the outset of site operations. This course of action was agreed amongst those parties noted above.

The bird control program has two (2) components; one passive and one active. The passive component is comprised of a series of landfill operating measures designed to render the site unattractive to birds, primarily gulls. These measures include:

- prompt covering of the wastes as they are compacted in place to reduce the available feeding area,
- revegetating soil areas
- draining local areas of standing water

The active component includes a program of consistent harassment of the birds using standard techniques, such as pyrotechnics, to ensure that the birds cannot feed or loaf at the site.

BFI's Prairie Green Integrated Waste Management Facility received its permit from Manitoba Environment and constructed the first cell this summer. The site has been operating from October 11, and to date no birds have established at the site. Each day gulls pass over the site en-route to other feeding areas. On some occasions, the birds fly in to investigate but rarely stay due to harassment. A typical day will see only a handful of gulls flying close to the site and to date gull numbers in the area have not changed from the time prior to the site opening.

In summary, the use of effective bird control programs, such as employed at Tower Road and Prairie Green, demonstrate that potential bird hazard to aircraft can be effectively eliminated with the use of a consistent, comprehensive continuous bird control program.

UNSUCCESSFUL BIRD MANAGEMENT PROGRAMS

Unsuccessful bird management programs typically fall into one category; one where consistency and continuous management of the bird population is not employed. Many sites employ control programs during the working week of the site and shut them down on off days.

These facilities will usually exhibit higher bird numbers than those that use control techniques all the time. Similarly, those sites that do not use a control program can expect to see the highest numbers of birds.

Uncontrolled sites can be changed into well managed facilities with few if any birds through the use of proper control procedures which are used on a continuous basis.

CURRENT SITING RESTRICTIONS ON LANDFILL DEVELOPMENT

Siting restrictions include provisions that separate landfills and airports and are in place primarily because of the potential hazards from birds at the landfill.

Current restrictions in Canada apply to airports that are licenced by Transport Canada. Typically, Transport Canada restricts landfill development to areas beyond a radius of 8 kilometres from an airport under its control. Until recently, this exclusionary distance essentially doubled under flight paths into these airports. This exclusion was recently removed by Transport Canada after discussions with developers such as BFI and other interested parties. However, concern still exists with the risk of impact with towering birds in these areas. BFI, in Winnipeg for example, used the approach outlined above to develop an acceptable bird control program to mitigate against this risk.

In comparison, in the United States, the Federal Aviation Authority (FAA) has established guidelines for operations at publicly used airports which require airport owners to oppose incompatible land uses near airports. An operation is considered incompatible if it is:

1) located within 10,000 feet of any runway used by turbine powered aircraft
2) located within 5,000 feet of any runway used by piston powered aircraft
3) located within a 5 mile radius of a runway that attracts or sustains hazardous bird movements from feeding, water or roosting areas into or across the runways or approach and departure patterns of aircraft.

Landfill location restrictions in the United States are established by Federal landfill standards set by the U.S. Environmental Protection Agency (USEPA) and adopted and enforced by individual states. The USEPA restrictions require owners and operators of new or existing landfills or landfill expansions located within the exclusionary distances noted in 1) and 2) above to demonstrate that the facilities are designed and operated so as not to pose a bird hazard to aircraft. Owners or operators proposing to site a new landfill or an expansion within a 5 mile radius of any airport runway used by turbo-jet or piston aircraft must notify the Federal Aviation Authority (FAA) and the affected airport.

ARE SITING RESTRICTIONS TOO RIGID?

Are current siting restrictions adequate or too rigid? Can a landfill and an airport successfully co-exist ?

A case can be made for conditional exemptions to allow landfilling within the exclusionary zones from airport property. This should not be taken to mean that all landfills located beyond 8 km could not pose potential problems for aircraft as a result of potential bird hazards. Similarly, the establishment of an airport closer to a landfill than the Transport Canada minimum of 8 kilometres can be supportable. Both of these scenarios would receive BFI support under the following typical conditions:

1) In the case of a new landfill development near an existing airport:

- Completion of a detailed analysis of the existing state of birds that could be attracted to this facility from other locations. Would the night roosting flight paths be changed?
- Determination of a detailed bird prevention program.
- Detailed discussions with interested parties leading to a resolution of support for the zoning exemption
- Commitment to a continuation of the control program to prevent the establishment of a bird colony at the site. It has been demonstrated that non-continuous programs are usually unsuccessful.
- A mechanism is established for ongoing dialogue between interested parties to raise and discuss issues as they may occur.

2) In the case of a new airport near an existing landfill:

- If the existing landfill has been developed using the proactive continuous, comprehensive and consistent bird management approach discussed herein,.
- A commitment from the landfill operator to continue the program.
- A mechanism is established for ongoing dialogue between interested parties to raise and discuss issues as they may occur.

If these typical conditions cannot be satisfied, then relaxing of restrictions should be discouraged. If the above conditions can be satisfied, BFI believes that landfills and airports can be compatible neighbours and can co-exist close to each other without interference.

SUMMARY & CONCLUSIONS

This paper has discussed the issue of siting of landfills close to airports and vice-versa from the perspective of potential hazards to aircraft from birds, particularly gulls, which are often associated with uncontrolled landfill operations. This paper has presented suggested methods for compatible co-existence of landfills and airports in close proximity and has included two (2) case histories which demonstrate that this situation can in reality occur. The Tower Road and Prairie Green facilities discussed are examples of successful bird control programs in areas where concern for aircraft safety might otherwise be expressed in the absence of such programs.

Three (3) conclusions are made in this paper:

1) The use of effective bird control programs, such as employed at Tower Road and Prairie Green landfills, demonstrate that potential bird hazards to aircraft can be effectively eliminated with the use of a consistent, comprehensive continuous bird control program.

2) BFI considers the co-existence of landfills and airports as compatible neighbours provided that the landfill operator, in consultation with interested parties and regulators, commits to, establishes and continues to maintain a continuous, comprehensive and consistent bird control program.

3) The locating of new landfill facilities or the expansion of existing facilities should be permitted within airport exclusionary zones provided that a comprehensive bird baseline study has been conducted, that a subsequent bird control program that has been developed, reviewed and agreed to by interested parties at that particular location and that the developer has demonstrated that the facilities are designed and operated so as not to pose a bird hazard to aircraft.

ACKNOWLEDGEMENTS

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APPENDIX 16

Transport Canada Avifauna Study: Pickering Airport Lands

TRANSPORT CANADA
AVIFAUNA STUDY
PICKERING AIRPORT LANDS

LANDFILLS VS COMPOST SITES
A COMPARISON OF GULL FEEDING ACTIVITY

TRANSPORT CANADA AVIFAUNA STUDY
PICKERING AIRPORT LANDS

Presentation to

Bird Strike Committee Canada

November 6, 1996.

By

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I..0 Introduction

The Pickering Airport lands encompass approximately 7,530 ha of property located in the Region of Durham and the Region of York northeast of Toronto. The property was acquired in 1973 and 1974 by Public Works and Government Services Canada (PWGSC), on behalf of Transport Canada, for the purpose of developing an international airport facility in the future. The site has not been developed as an airport at the present time and currently exists as rural residential, agricultural and open space land.

Transport Canada is considering developing draft Airport Zoning regulations for the Pickering Airport lands, under the Aeronautics Act. These regulations would define a bird hazard zone where restrictions would be placed on activities or development which could create bird hazards to aircraft. The purpose of this study is to provide Transport Canada with the data and information required to define the bird hazard zone for the draft Airport Zoning regulations.

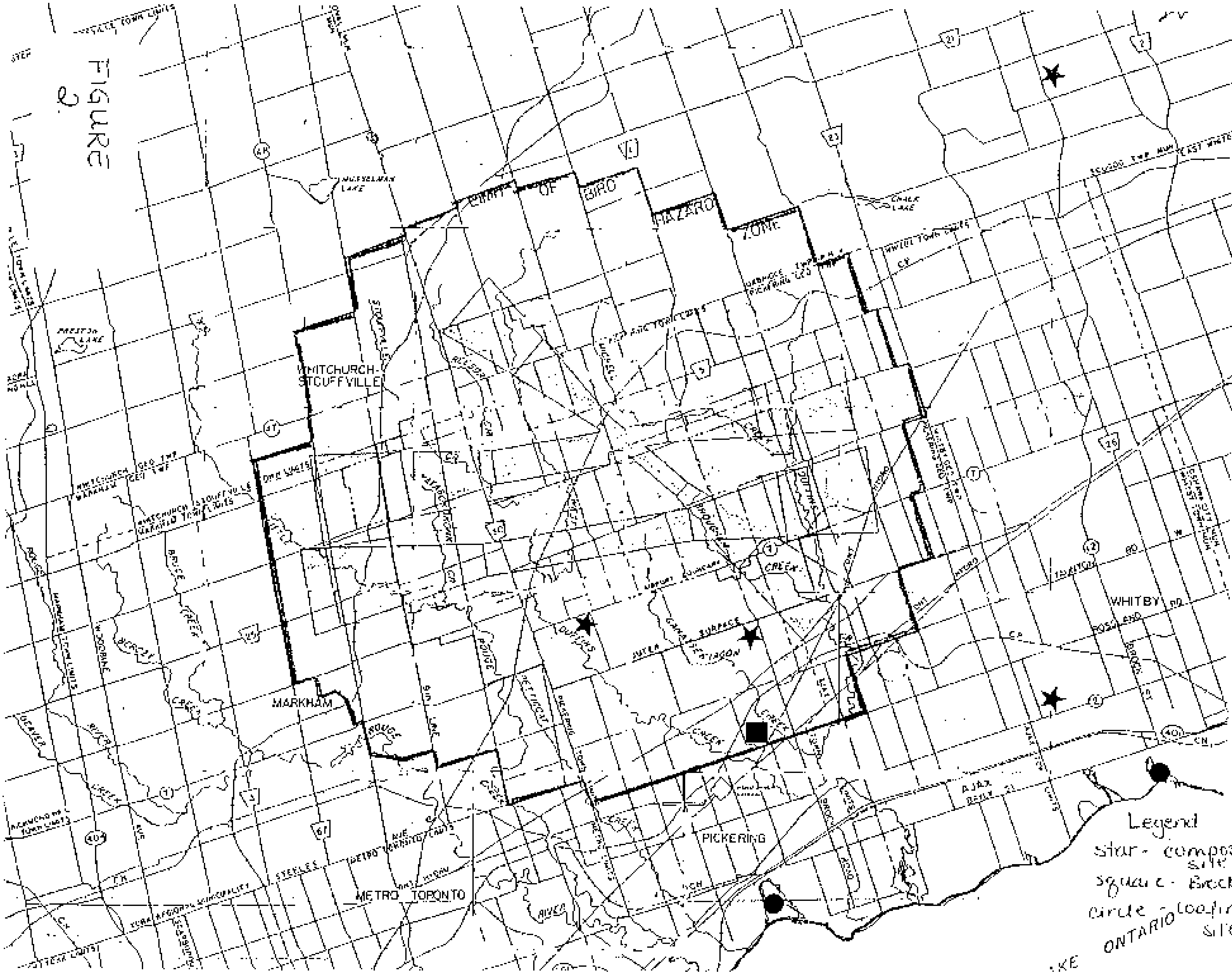
The primary focus of this study is within 15 kilometers of the proposed Pickering Airport reference point. The study also covered the area located between 15 and 50 kilometers from the proposed reference point (fig 1). The specific purpose of this presentation is to present preliminary results of total gull numbers in the study area and a comparison of gull activities at the Brock West landfill and compost sites.

2.0 Total Gull Numbers in the Study Area

The following details the gull population throughout the study period for the 15 km study area. To estimate gull numbers and seasonal fluctuations in the study area, surveys were conducted at a number of gull focal points within the study area (fig 2). The following feeding sites were identified as areas where gull concentrations occurred regularly on a day to day basis:

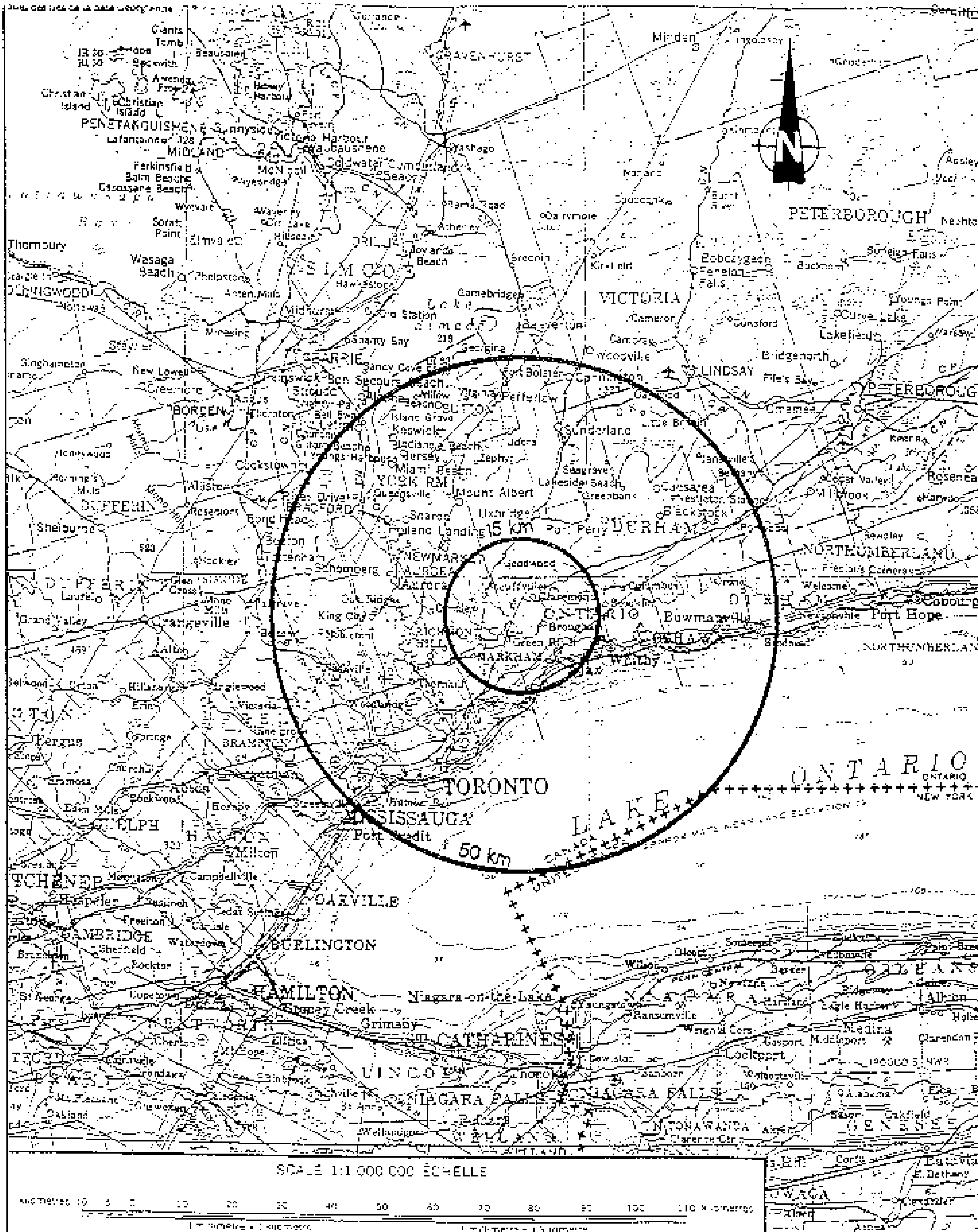
- Brock West Landfill
- Hall's Road Farm Compost
- Green River Farm Compost
- Whitevale Farm Compost
- Myrtle Farm Compost
- Frenchman's Bay
- Whitby Harbour

These sites were visited and gulls were counted on a weekly/bi-weekly basis throughout the study period. This survey method provided a weekly snap shot of gull numbers in the study area. Though these areas do not account for all the gulls which occurred in the study area at any one time, it is estimated that between 80% to 90% of the gulls which occurred in the study area could be accounted for by these 7 focal points. Counts were initiated in March 1996 and will end in February 1997.



LIMIT OF BIRD HAZARD ZONE
WHITCHURCH-STOUFFVILLE
MARKHAM
PICKERING
METRO TORONTO
WHITBY
AJAX
ONTARIO
Legend
star - compost site
square - Brock W
circle - looping site

FIGURE 2



AVIFAUNA STUDY - PICKERING AIRPORT LANDS

STUDY AREA

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Jacques Whitford

For the study area, the gull population showed dramatic fluctuations in total numbers and species composition. Figure 3 depicts the changes in gull numbers throughout the study period. Gull numbers peaked at 27,000 birds in the third week of March as waves of migrating Ring-billed and Herring Gulls arrived along the lake front during the month of March. Throughout April, gull numbers declined dramatically to 2921 birds in the first week of May. Due to the absence of a breeding colony in the study area, numbers remained low, 2000-3000 during the May-June breeding period. Gull numbers began to show a dramatic increase following post breeding dispersal in the last week of June, when numbers jumped to over 7000 birds. Gull numbers continued to increase throughout July and August due to post breeding dispersal as well as early migration of adult and immature Ring-billed Gulls and Herring Gulls. During this period, Ring-billed Gulls represented over 80% of the gull population.

The numbers of Ring-billed Gulls dropped suddenly from 13420 in the third week of August, to 8920 in the second week of September, indicating that a southward push from the region had begun. Conversely, starting in late August throughout September Herring Gull numbers continued to rise as they moved southward from northern breeding areas to the lake front. For example Herring Gulls represented only 9% of the gull population in the first week of August, this increased to 25% by mid September.

Gull numbers continued to increase through October as waves of Herring Gulls migrating southward began to accumulate along the lake front. Number reached 17,202 by the last week of October.

3.0 Brock West Landfill

The Brock West landfill is located in the central portion of the study area. This large landfill receives a significant portion of the Metro Toronto area's waste. Throughout the study period, of the total 244,257 gulls censused, 51% (123,717) were recorded occurring at the Brock West landfill. The results of the survey of the landfill are presented in fig 4. Gulls were recorded during all visits to the landfill. During the spring migration period, numbers peaked at 7,000 birds. During this time the majority of the gulls were adult birds (over 90%) with Ring-billed gulls representing 75% of the gulls, the remaining were Herring Gulls. Gull numbers dropped steadily to a low of 130 gulls in the last week of May. This drop in numbers is due to gulls moving to the breeding colonies and out of the study area. During this period, Herring Gull numbers dropped to less than 100 birds, most of which were immature non-breeding birds.

Numbers began to climb steadily following the post-breeding season beginning in July. The first juvenile Ring-billed gull arrived at the landfill in the first week of July. The number of juvenile birds at the landfill peaked in the first week of August at 2168 birds, representing 22% of the gulls. Post breeding numbers peaked at 13,279 in mid August, when 11,470 Ring-billed gulls (mostly adults) were recorded for the landfill. From this high, numbers begin to fall as the southward migration of the Ring-billed gull population began.

Figure 3: 15 Kilometer Study Area
Total Gull Numbers by Species

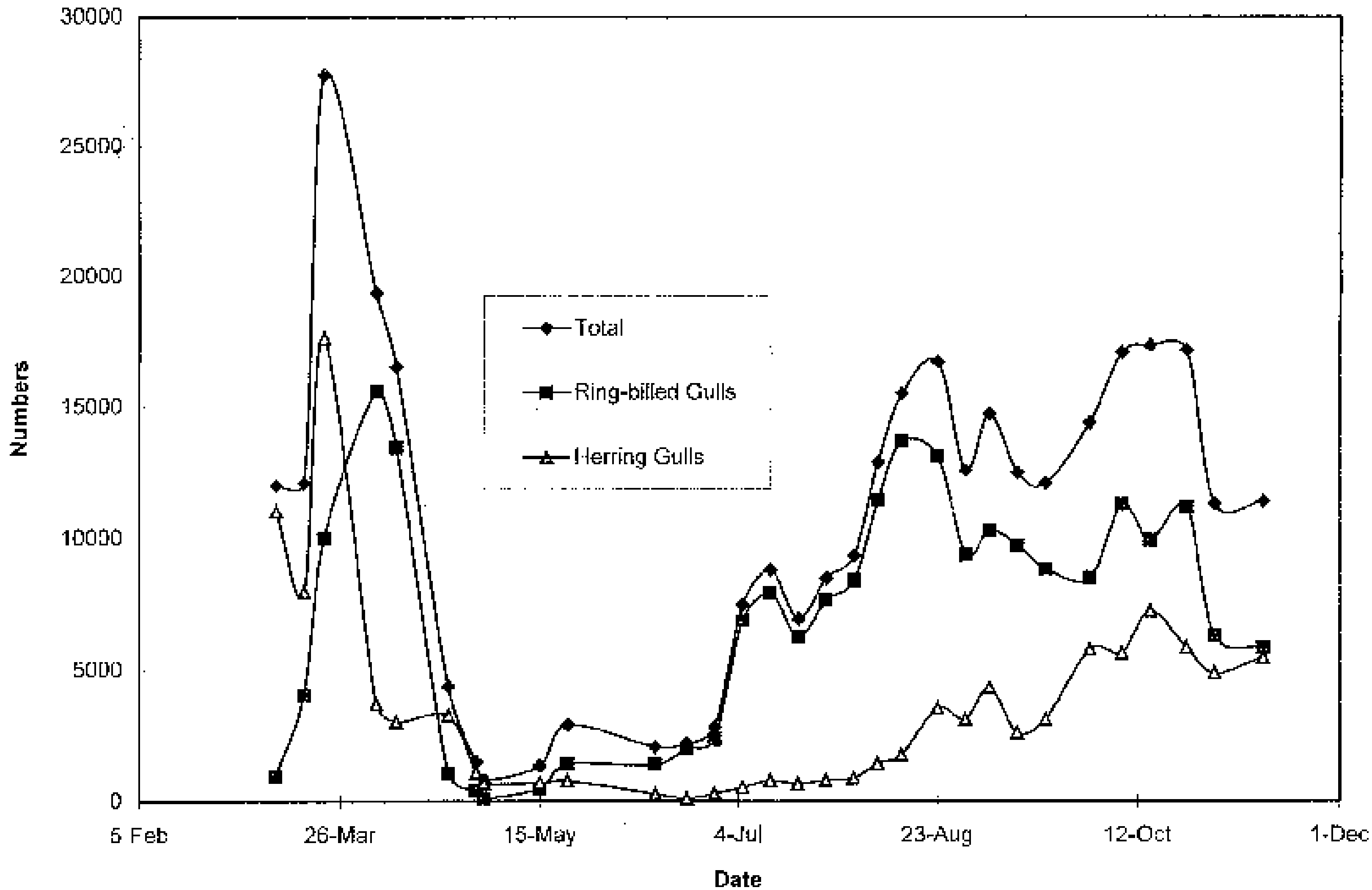


Figure4: Brock West Landfill (F2)
Total Gull Numbers by Species

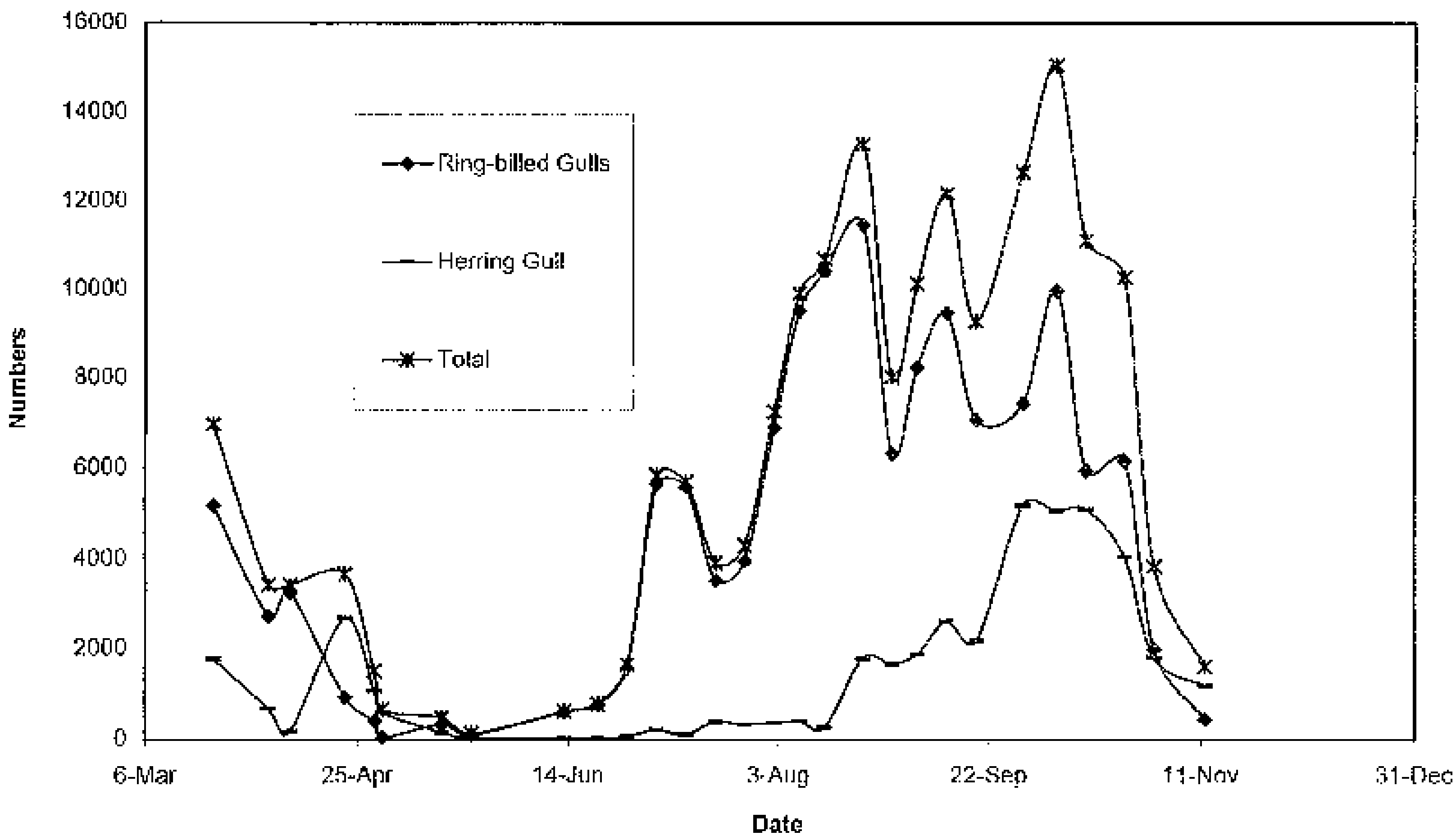
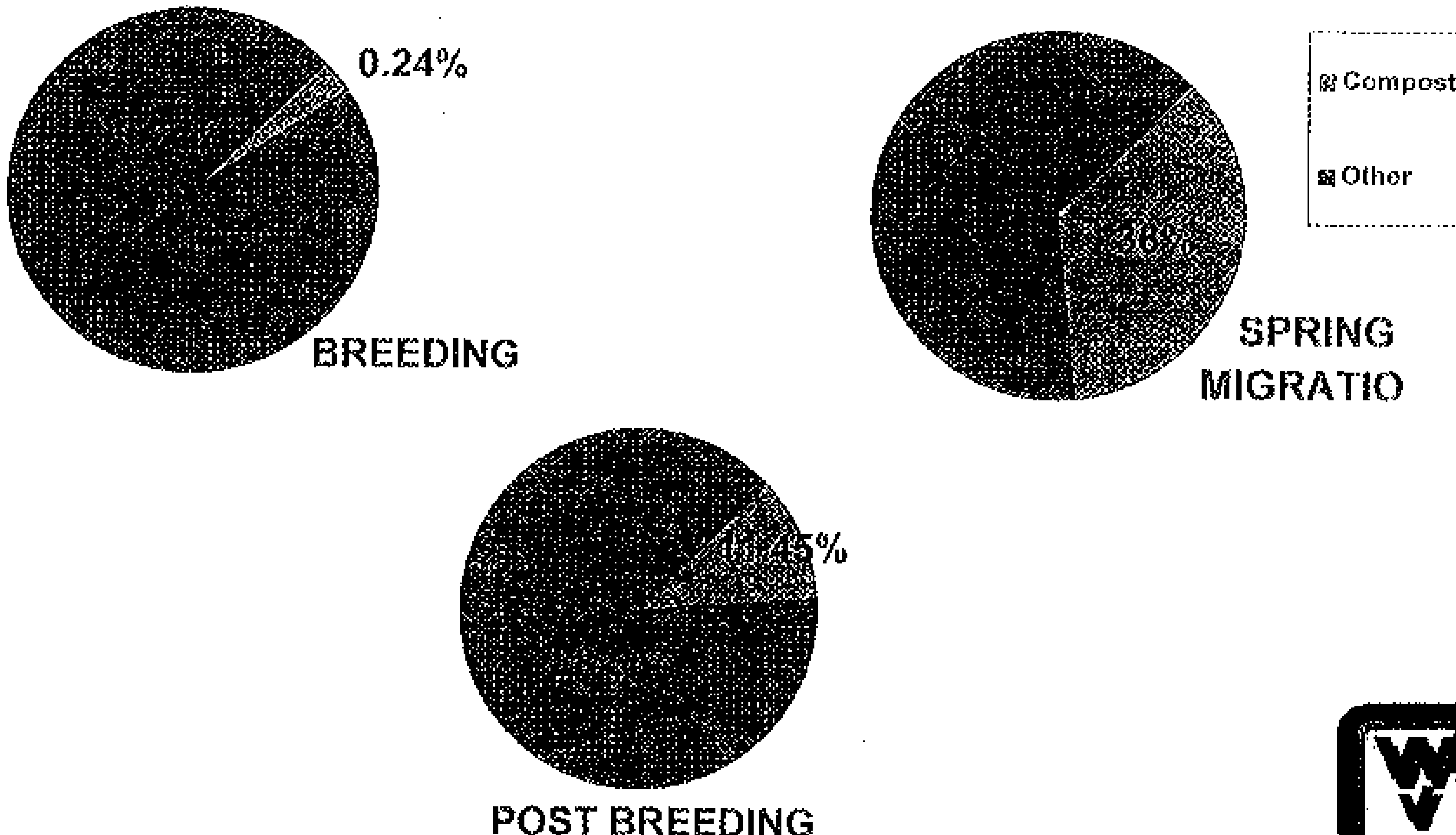


Figure 5: PERCENTAGE OF GULLS AT ALL COMPOST SITES IN STUDY AREA



Through September, the numbers of Ring-billed gulls fluctuated from week to week as waves of gulls arrived and then moved southward on migration. During this period Herring gull numbers began to steadily increase as they arrived from the north into the study area, with numbers reaching 17,000 in the last week of October. This number appears to be significantly higher than the 12,650 gulls reported for the month of October in the 1992 study (Harris and Davis 1994).

Figure 5 shows the composition of gulls during the post-breeding dispersal-fall migration period. Ring-billed gulls represented 88% of the gulls feeding at the landfill. Adult gulls (all species) represented 83% of the population, while immature and juvenile birds represented 6% and 11% respectively.

4.0 Compost Sites

For the purposes of this study, "composts" are defined as heaps of putrescible waste that is shipped into farming operations, ostensibly to feed pigs, and to a lesser extent for soil enrichment. Typically a farm which is feeding food waste to pigs will have established a number of regular suppliers (i.e. the farmer is contracted to accept and is paid for the service by the waste supplier), usually institutional sources such as restaurants, waste disposal companies or municipalities. The food waste is either brought to the farmer by the supplier or is picked up on a weekly basis. As a result the food waste stream to the farm is relatively constant throughout the year. Depending on the number of pigs a farmer is rearing at any one time, this could vary from a few to 100's, the amount food waste which arrives may exceed demand. As a general practice this left over waste is piled up in the farm yard forming a compost pile. The pile also immediately receives the lower quality waste as some sorting of food waste is also undertaken. In the fall and spring, it is common practice for the farmer to spread the existing compost material over fields which are to be actively cultivated.

Four farm compost sites were identified in the study area. These areas were found to attract large numbers of gulls throughout the study period. The quality and quantity of the food waste was found to vary from month to month and from site to site. The quality of food waste on compost pile varied from fruit and vegetables, to fish, meat, breads, and all manner of food waste. A typical compost pile was no greater than 5 X 5 meters square and was generally very localized on the farm yard.

Surveys conducted at the compost farms found that these area attracted significant numbers of gulls, starlings, crows, blackbirds and doves/pigeons. Numbers of starlings and black birds associated with the compost sites reached into the 1000 s in the spring and fall. The numbers of crows and pigeons would often exceed 100's. In addition, the abundance of birds, and probably rodents, at these compost sites also attracted higher concentrations of raptors, particularly Red-tailed Hawks. Large numbers of Turkey Vultures were also recorded associated with these sites during the fall migration period.

Figure 6: Hall's Road Compost (F1)
Total Gull Numbers by Species

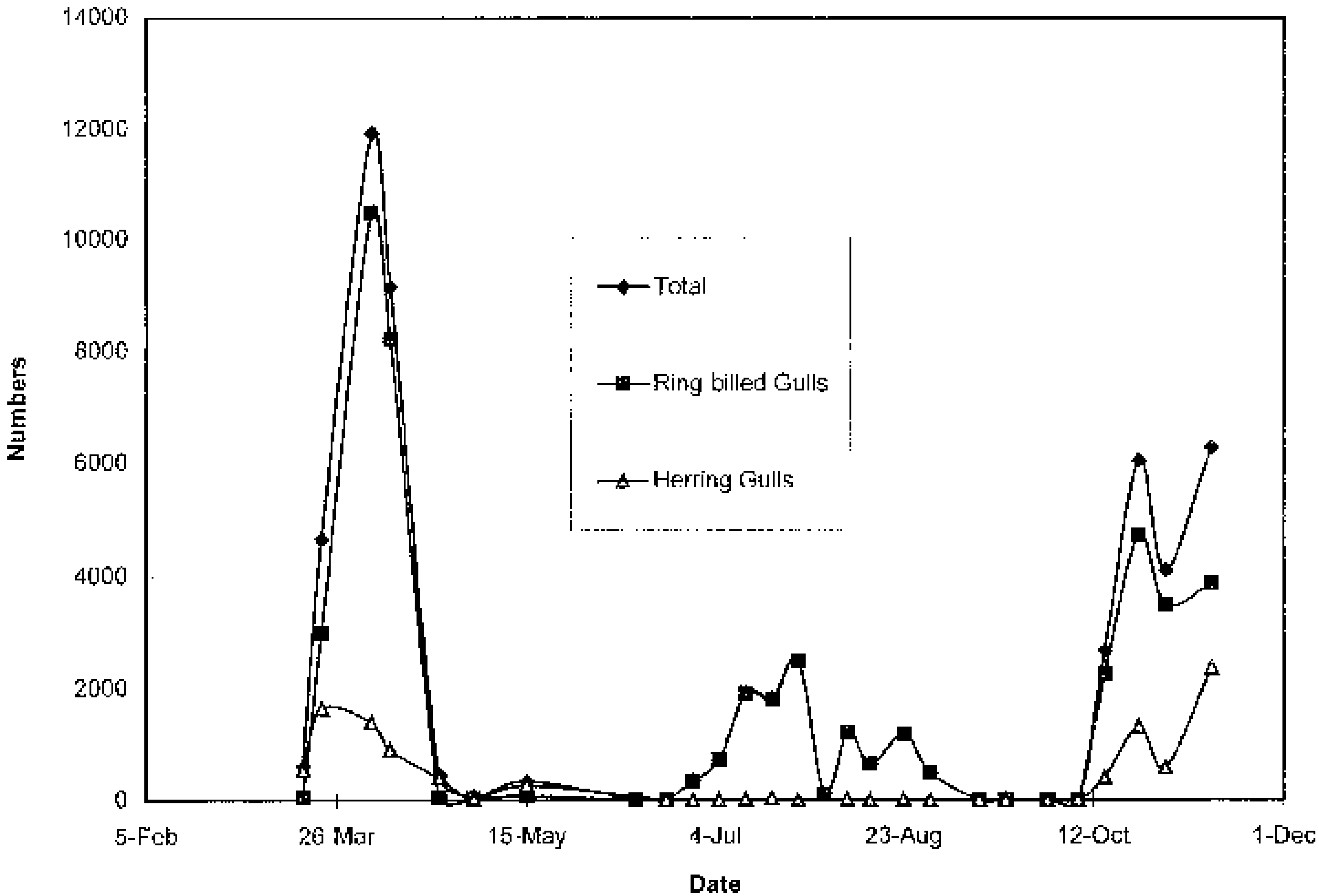
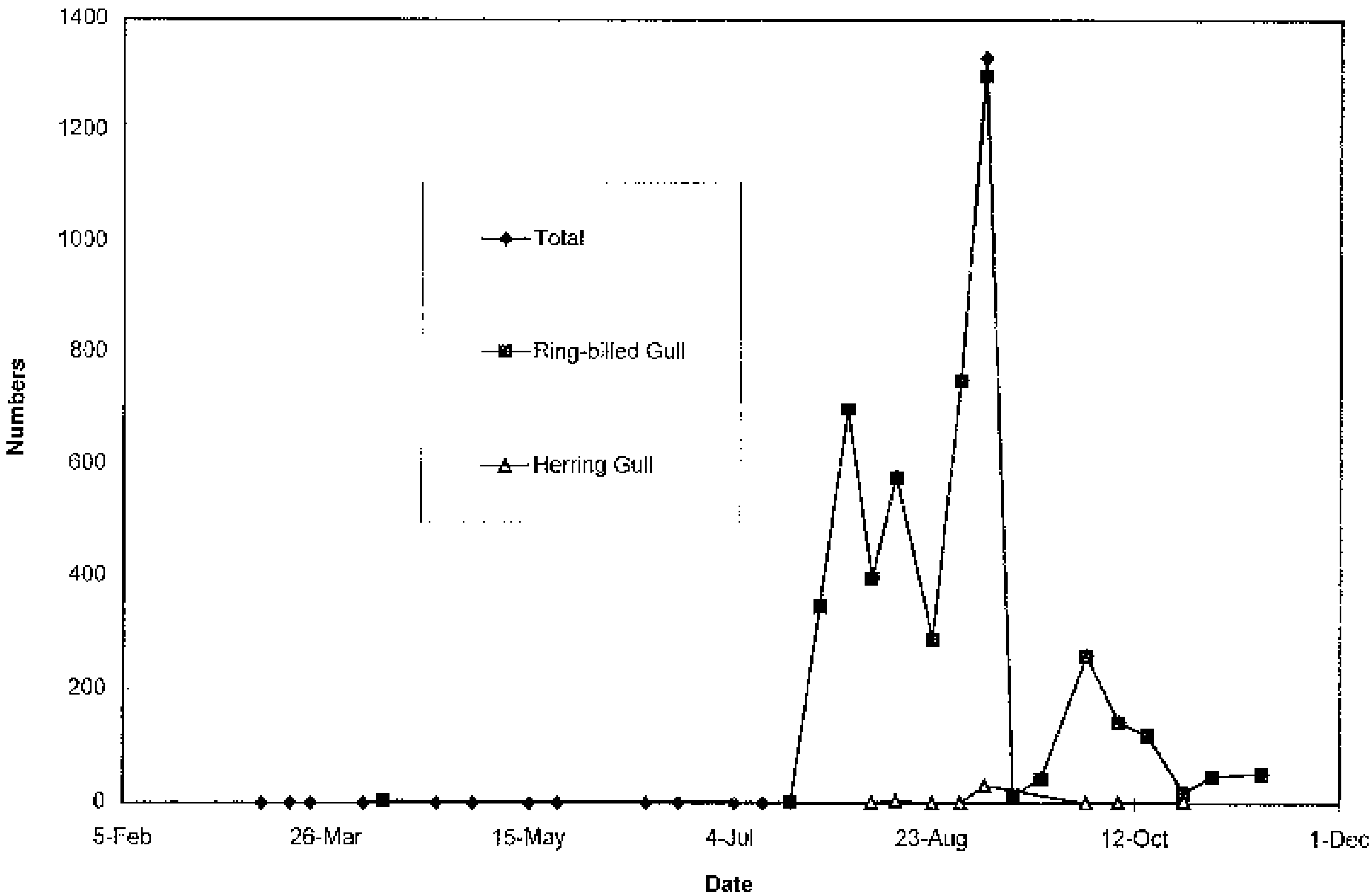


Figure 7: Whitevale Compost (F4)
Gull Numbers by Species



The following details each of the compost sites and associated gull numbers.

Hall's Road Farm

Of the four compost sites, this site lies closest to the Lake Ontario water front and is located directly north of lake front gull loafing and roosting sites Large concentrations of gulls have been recorded at this site for a number of years (Henshaw pers comm). This site differs from other compost sites in the study area in that much of the compost material is used for soil enrichment to grow vegetables. As a result the site usually contains a number of compost piles and the spreading of compost onto adjacent fields occurs regularly. As a result large quantities of food is available for gulls over a large area.

Figure 6 summarize the gull activity during the study period. The maximum number of gulls, 11,919, was recorded in the last week of March. The majority of the birds were adult birds (90%) dominated by Ring-billed gulls (88%). Herring Gulls totalled 1400 (12%). From the March high, numbers gradually decline to a low of 8 gulls during the breeding period. During the post-breeding dispersal period, numbers peaked at 2,499 Ring-bills in July. During July through August, the number of juvenile Ring-billed gulls averaged 350, representing 30% of the gulls which used the site. Numbers dropped to less than 10 birds during September, the reason for which is not clear, as food was available during this period. Gulls appeared again in large numbers during October.

Based on observations made during the surveys, it was clear that there was movement of gulls between this site and the Brock West landfill. In addition, during the breeding period, the direction of the arrival and departure of adult Ring-billed Gulls indicate that these birds were flying back and forth from the St Marys colony at Bowmanville.

The numbers of gulls which use this site is startling, with numbers which are comparable to those recorded for a number of landfills in the general study area, ie Town of Georgina and Brock landfills and far exceeds numbers at other landfills, ie North and South Mariposa, Bewdley, Eldon (Bird and Hale 1995; this study). The attractiveness of this sites to gulls as a feeding area may be attributed a number of factors, including the easy availability of food, the presence of large loafing fields which are directly associated with the site, and the sites close proximity to the Lake Ontario water front.

Whitevale Farm Compost

This large pig operation began in the spring of 1996. Gulls "found" the site during the Easter weekend, the farmer reported that thousands of gulls suddenly appeared in the thousands. On April 8th, a survey of the site recorded 2,500 adult Ring-billed gulls. Though it is not certain, it is likely that gulls moved through the landscape looking of an alternative food source as the Brock West was closed for three days during the Easter holiday period.

Figure 7 summarizes the gull activity at the site. Following the initial discovery of the site, gull did not reappear until the post-breeding season. From that time gulls were continually recorded for the site. During August, numbers averaged 500 gulls, all most all juvenile Ring-billed gulls. Numbers peaked at 1331 in the first week of September and then fell dramatically to less than 50 due to the southward migration of the Ring-bills.

The predominant use of this site by juvenile birds is of significance, as it is generally assumed that few inland feeding sites are utilized by juvenile gulls. Juvenile Ring-bills have been typically reported as occurring close to the waterfront and seldom in inland rural areas (Southern 1974, LGL 1974, Davis and Miller 1989).

Green River Farm Compost

This site has been in operation from the late 80's. It is a large piggery with numbers varying from a few hundred pigs to over 1000. Much of the food waste which arrives at the farm is used to feed the pigs, so the compost pile is usually not larger that a few square meters. Compost which has been accumulated through the winter is spread onto fields in the early spring.

Throughout the years this site has become well known by the local "birding community" for its significant gull numbers in the late winter and early spring. The site lies about 10 km inland from roost sites and is in line with two other feeding sites, Brock West and the Whitevale Farm. During the study period, gull numbers reached a maximum of 3,209 on the 10th of March, of which 95% were Herring Gulls (Fig 8). Numbers declined through March and by April, no gulls were observed. Gulls remained absent from the site until the Last week of June, when low numbers, less than 100, were recorded for the month. The gulls then left the site and were not recorded for the months of August and September. Discussions with the farmer found that from April through to September a large number of pigs had been raised and that little compost was available. This may account for the absence of gulls during this period. In addition, during the summer and early fall, few loafing sites are available as all the surrounding fields are planted with corn.

Myrtle Farm Compost

This site has been in operation from 1980's to 1995. In 1995 the farm assets were sold and operations stopped. The site is located approximately 8 km from the water front. In past years many thousands of gulls have been observed at this site. Henshaw, (pers comm) reports that numbers have reached over 10,000 gulls at this site in the late and early winter, however during this study gulls occurred in low numbers and were absent for much of the study (fig 9). At the start of the study 300 Herring gulls were recorded in the first week of March. Following this initial count, no gulls occurred at the site until the end of June. Low numbers (200 on average) of Ring-billed gulls were recorded during the month of July. No gulls were recorded for the site past the month of July.

The data collected for this site indicates, that gulls visited the site during the spring as it represented a known feeding area to the gulls. The return of gulls following the breeding season, may again represent an old feeding pattern by the local adult gull population. The continued absence of food at the site resulted in the final abandonment of the site in July. These results suggest that historic, well established feeding site, are revisited by gulls year after year, and that site fidelity is strong, even if food is absent.

Figure 8: Green River Compost (F3)
Total Gull Numbers by Species

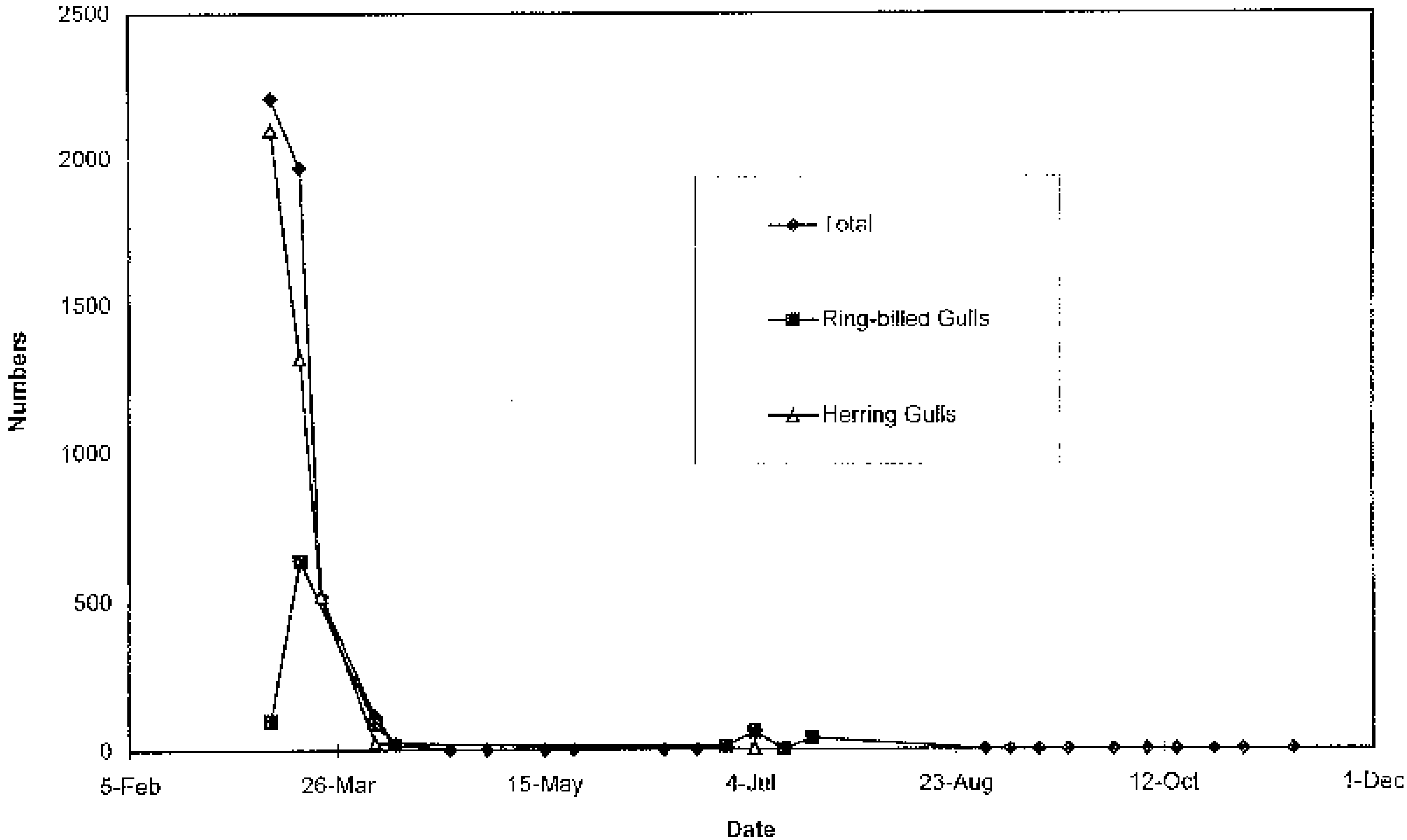
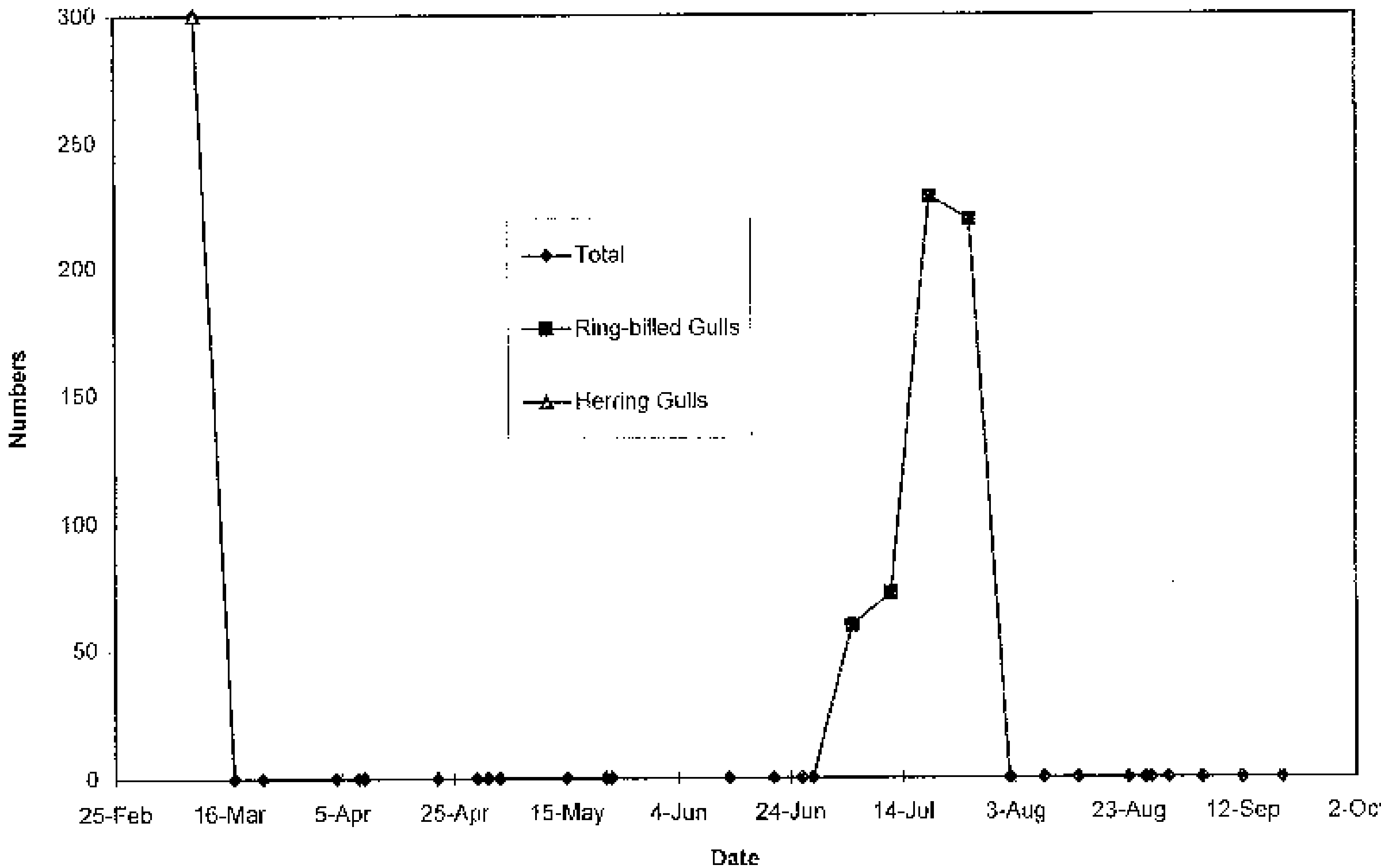


Figure 9: Myrtle Farm Compost (F5)
Total Gull Numbers by Species



5.0 Comparison of Gulls Numbers, Species and Age Class for Censused Feeding Sites

Figures 5 and 10 show the distribution of feeding gulls counted at the Brock West landfill and the four compost sites during the study. During the spring migration, 36% of the study area gulls were found feeding at compost sites. Only 16% of the gulls were recorded feeding at Brock West during this period. These low numbers at the landfill are a surprising result as other studies had shown that the landfill was the primary feeding site for the study area gulls during the spring (Harris and Davis 1994. Bird and Hale Ltd 1995, LGL 1974.). However, the most recent studies did not survey the study areas compost sites.

During the breeding period, when overall gull numbers were low, over 51% of the study areas gulls were counted at the landfill, compared to less than 1% at compost sites. Following the breeding period, 11% of the gulls were recorded at compost sites. The majority of gulls (72%) were to be found at the landfill.

Figures 10, 11 and 12 show a comparison of gull species and age class during the post-breeding fall migration period at Brock West and compost sites. Clearly the Ring-billed Gull is the dominant species (>85%), feeding at all sites during this period. Large numbers of Herring Gulls were only recorded at the landfill, with 12% of the gulls represented by Herring Gulls.

Following the breeding period, the age class composition at the Brock West landfill was as follows: Adults 83%, Juveniles 11% and Immature 6%. At the Hall's Road farm compost, adult birds represent only 64% of the gulls, while Juvenile birds were found in greater numbers at 30%. The difference in age class numbers are even more dramatic at the Whitevale farm compost site where 96% of the gulls were juvenile birds.

The analysis of age class distribution indicates that compost sites are particularly attractive to juvenile gulls. Studies undertaken at landfills have shown that young birds are less successful at finding food at than older birds (Verbeek 1977). Successful feeding at landfills requires the learning of a number of behaviors such as digging for food and opening bags and wrappers. Also competition for feeding space and food from older birds and other species, as well as piracy, may reduce the attractiveness of landfills to juvenile birds (Burger and Gochfeild 1983, Creig et al 1986, Monaghan et al 1986, Hackl and Burger 1988, Verbeek 1977). In contrast to landfills, the compost sites in the study area generally have fewer gulls, the food is easy to obtain and safe quiet loafing areas are available to young birds.

Figure 10: GULL COMPOSITION AT BROCK WEST LANDFILL DURING FALL MIGRATION

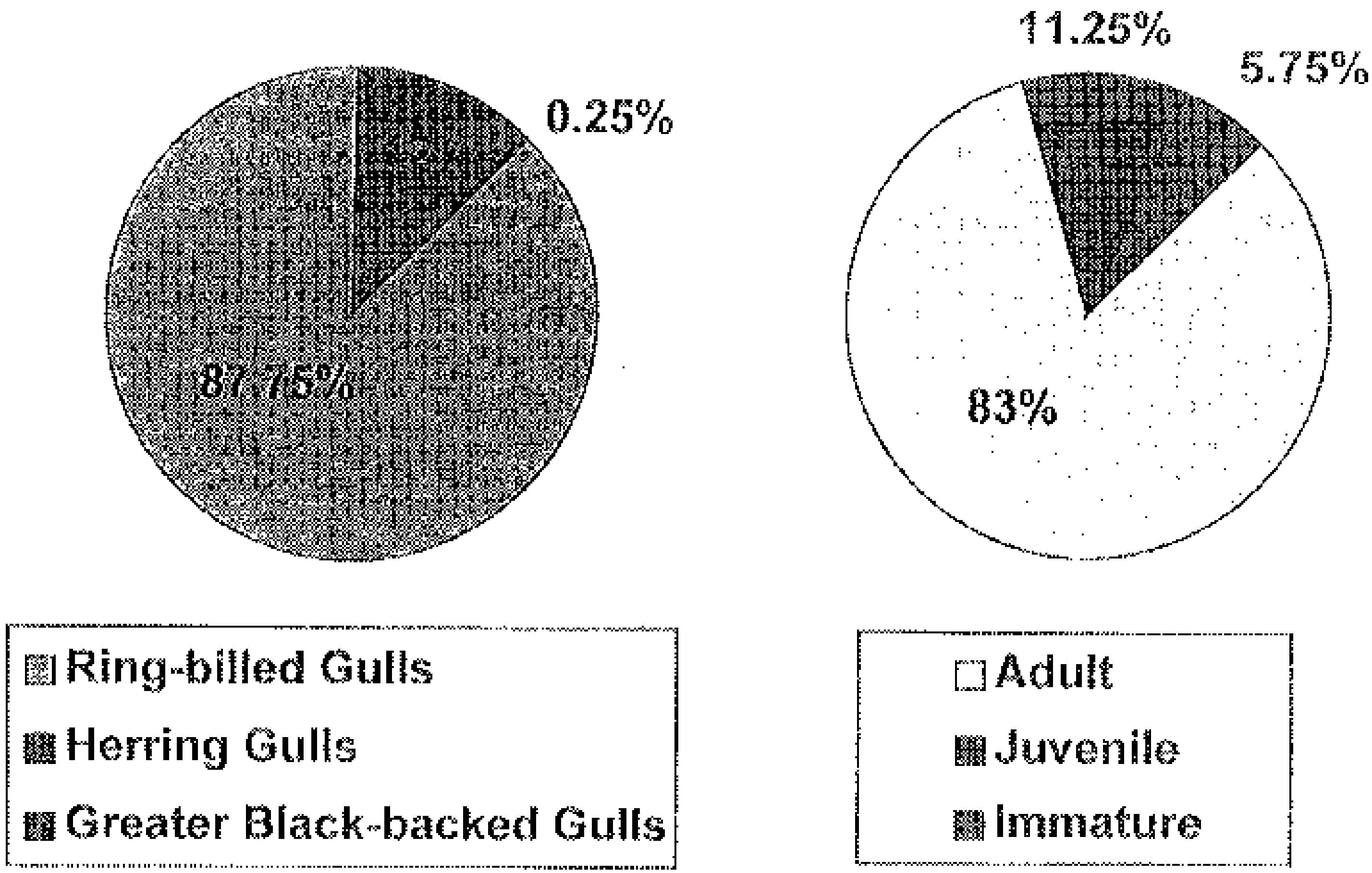


Figure 11: GULL COMPOSITION AT WHITEVALE COMPOST DURING FALL MIGRATION

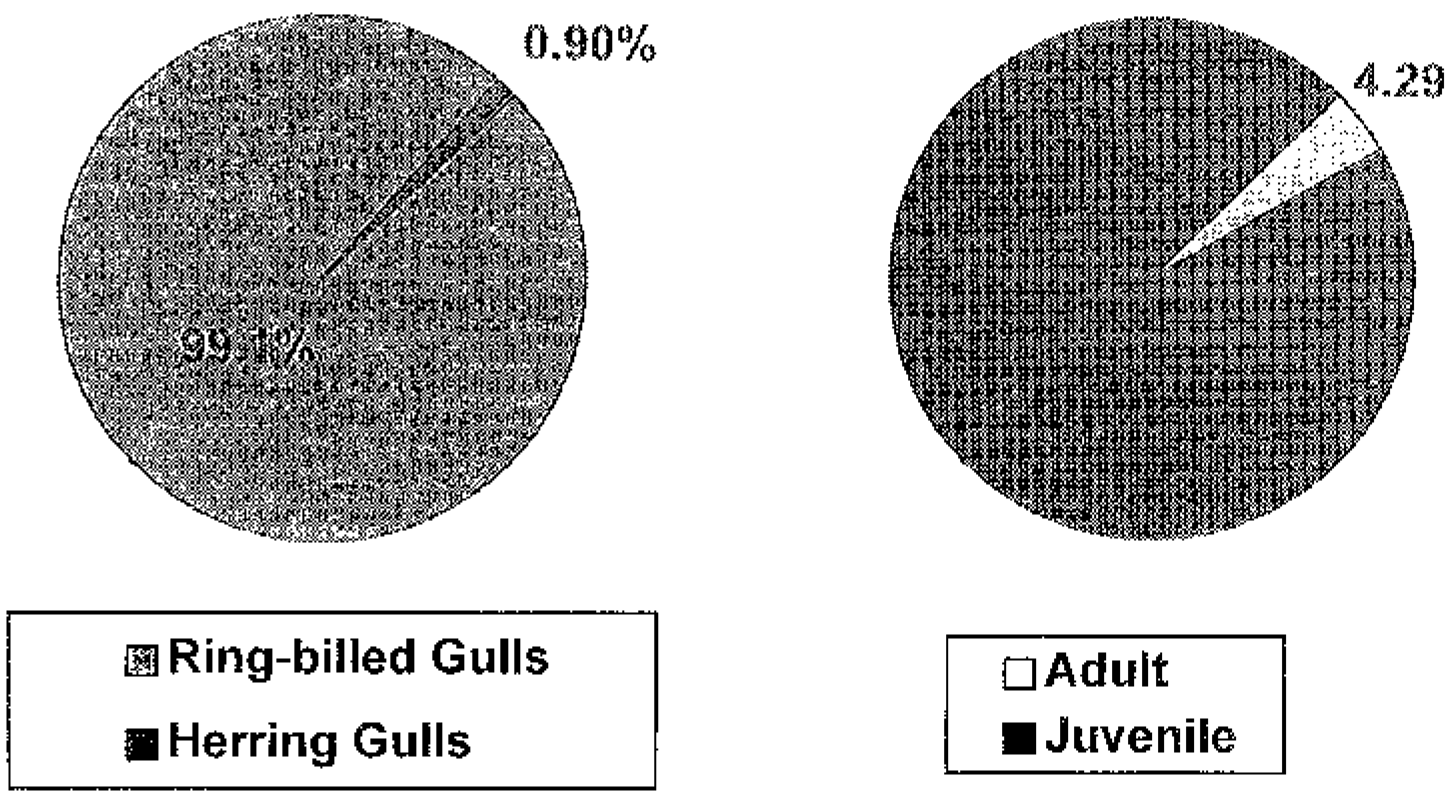
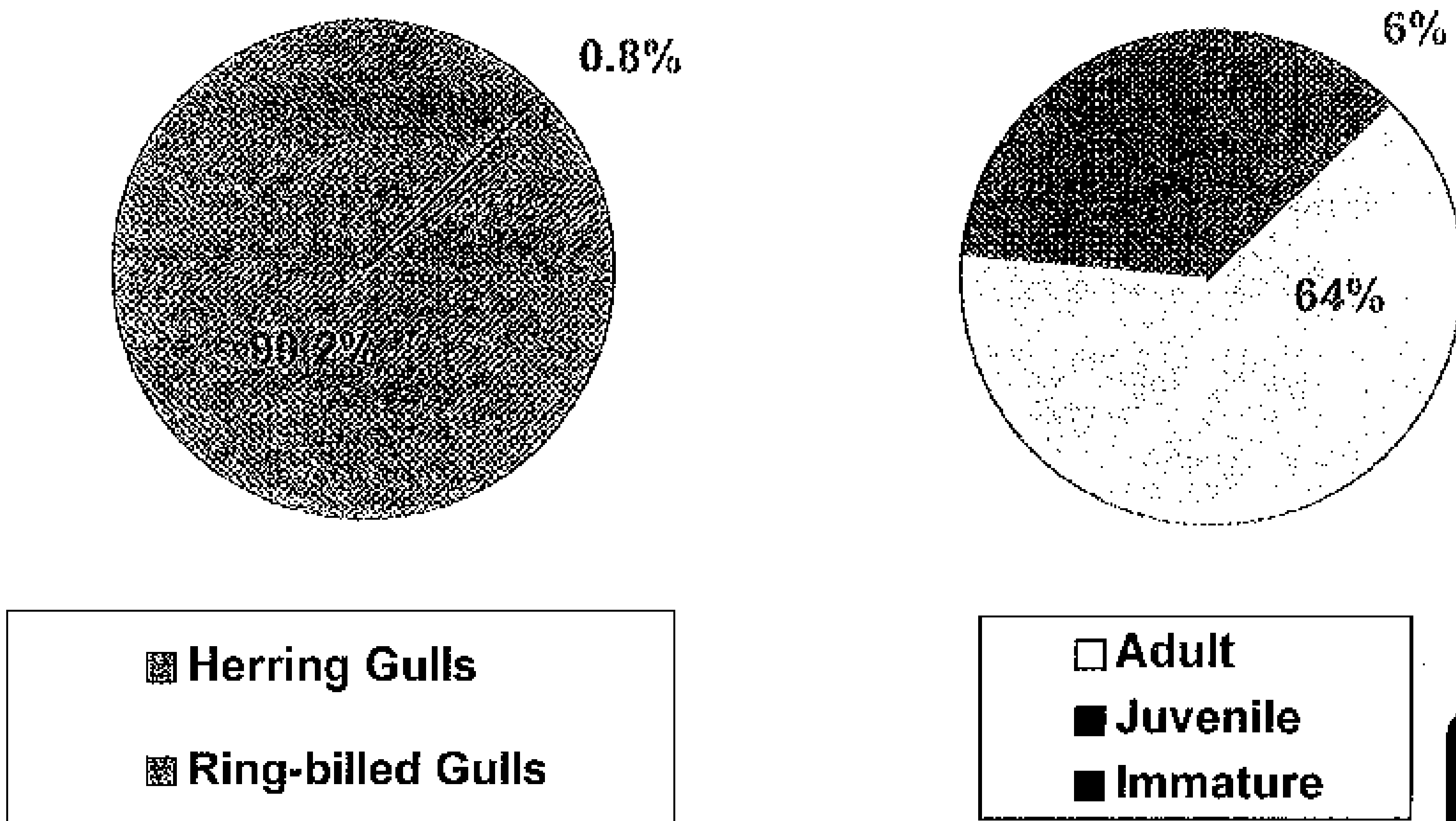


Figure 12: GULL COMPOSITION AT HALL'S ROAD COMPOST DURING FALL MIGRATION



6.0 Summary

Based on the study of the gull numbers and feeding activities in the study area the following summary statements can be made:

- In areas with large gull populations, Compost Sites can attract large numbers (1000's) of gulls.
- The numbers of gulls feeding at compost sites can be equal to or greater than those at local landfills
- Compost sites appear to be particularly attractive to juvenile gulls.
- Gull numbers at new compost site can increase significantly in a very short period of time (ie months).
- Gulls will travel considerable distances to feed at compost sites, even when alternative quality food sources are closer to roost sites.
- Gulls appear to show considerable site tenacity once a compost site has been established as a traditional feeding area.
- Compost sites in the vicinity of Airports should be considered to represent a significant potential bird hazard to aircraft.
- With respect to Airport zoning regulations, restrictions should be placed on compost sites which are similar to those for landfills.
- In the general vicinity of airports, Municipal and local planning authorities should be made aware that compost sites represent a potential bird hazard to aircraft and that this should be reflected in land use planning policies and zoning.

7.0 References

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APPENDIX 17

Vancouver Airport Authority: Wildlife Management Program

Bird Strike Committee Canada

#25

Ottawa

November 6 and 7 1996

Presentation by

David Ball

Vancouver Airport Authority

Bird Strike Committee Canada

Agenda

Personnel and Patrol Routes

Costs

In House Monitoring

Habitat and Vegetation Control

New Products

Projects

Wildlife program 1997

Vancouver International Airport has expanded its Wildlife Control Program to, cover Twenty- four (24) hours a day seven (7) days a week. This demand has seen the increase of personnel grow from four, (4) with full time and spares is now 11 Wildlife Officer. These officer patrol two (2) routes (see drawing) on airport lands, these routes cover both airside and groundside.

Costs have also increased and the estimated cost for 1997, for labour will be more than two hundred thousand dollars ($200,000), equipment and materials will be more than sixty thousand dollars ($60,000). The above costs do not include expenses for and additional test equipment or vehicles.

Monitoring programs jointly funded by the Airport Authority and Transport Canada, field test for worm control and grass cutting heights and insect control to be carried out by the Authority

With new direction and changes in personnel the program will now monitor and record bird information, species, types, numbers, dispersal technics, direction after harassment and location on the airport.

Programs that will deal with the habitat grass length, vegetation control, test programs with different grass variety (Canary Grass), these programs will include test sites, to gather a variety of information.

New products, such as the Scare Away system, this system consists of propane cannon's radio control or programable, the Ruggieri pistol and pyrotechnics equipment.

Projects to further remove areas of land that the birds have used in the past, netting ditches, installing Nix-a-Lite on the new airfield signs rather than Hot Foot. If approved in Canada for test uses Rejexit, could be used on grasses and ponding problems during the rainy season.

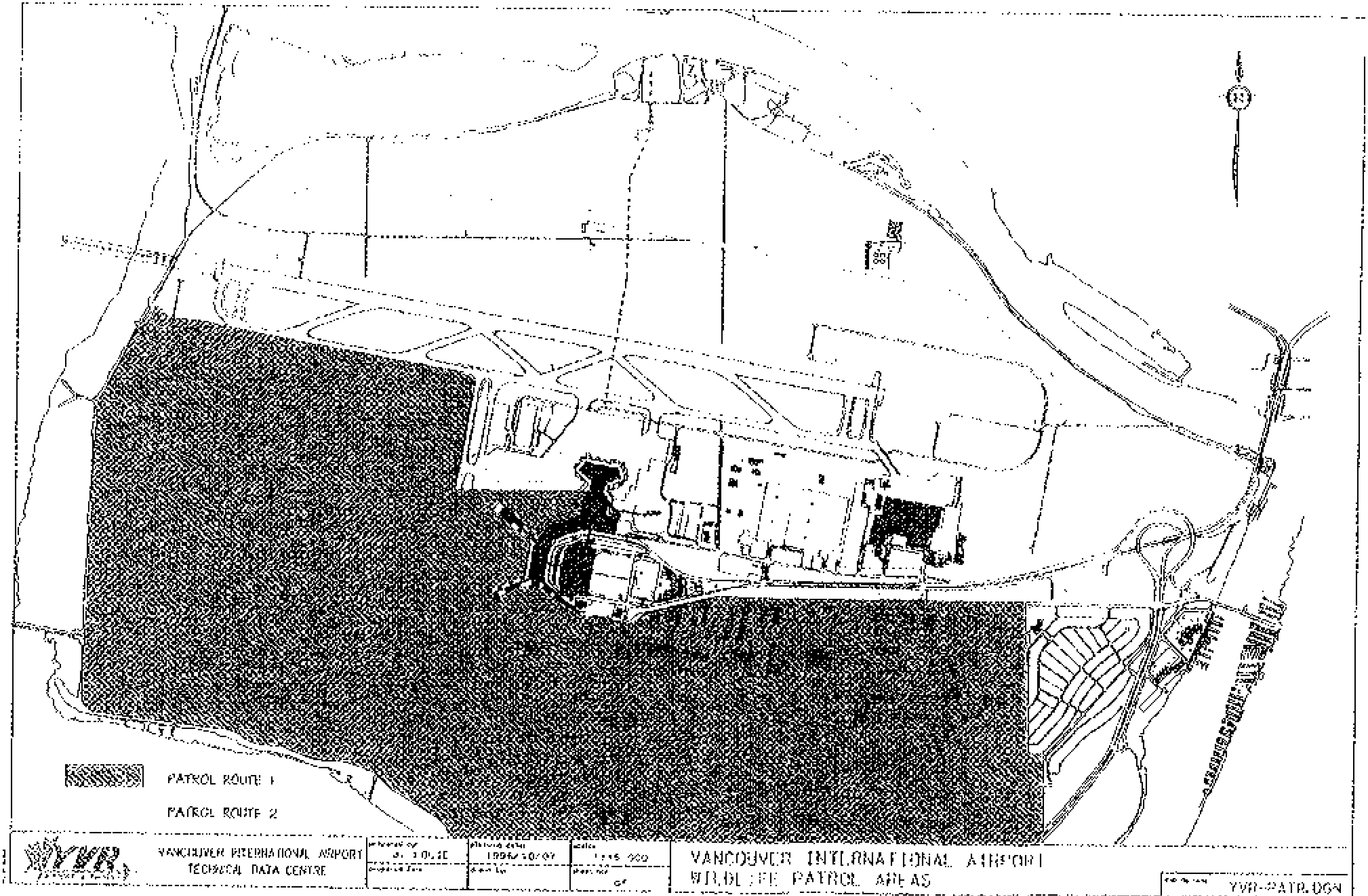
Supervisor, Wildlife & Landscape

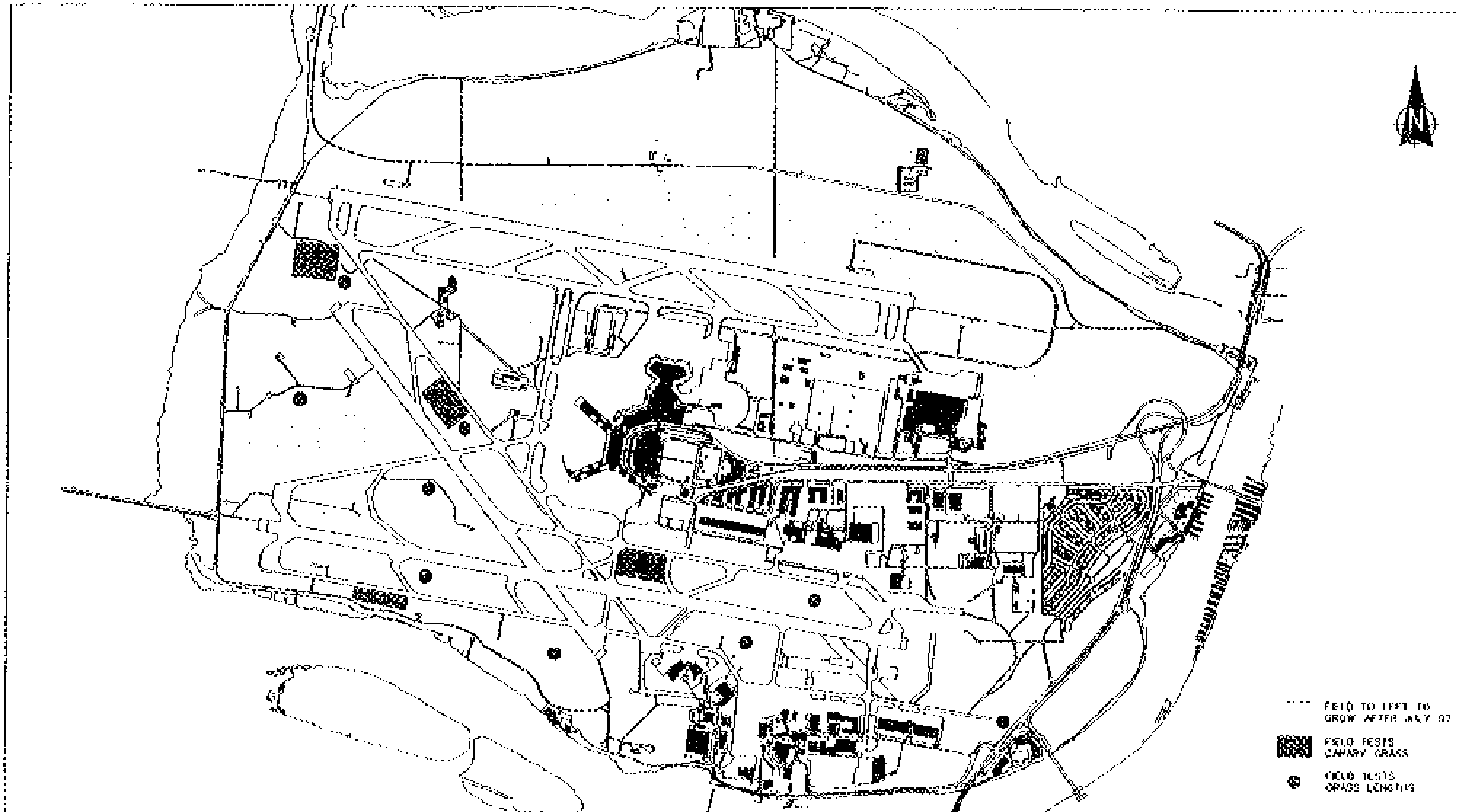
Bird Counts for the New Airfield

Sept 15 to Oct 15, 1996

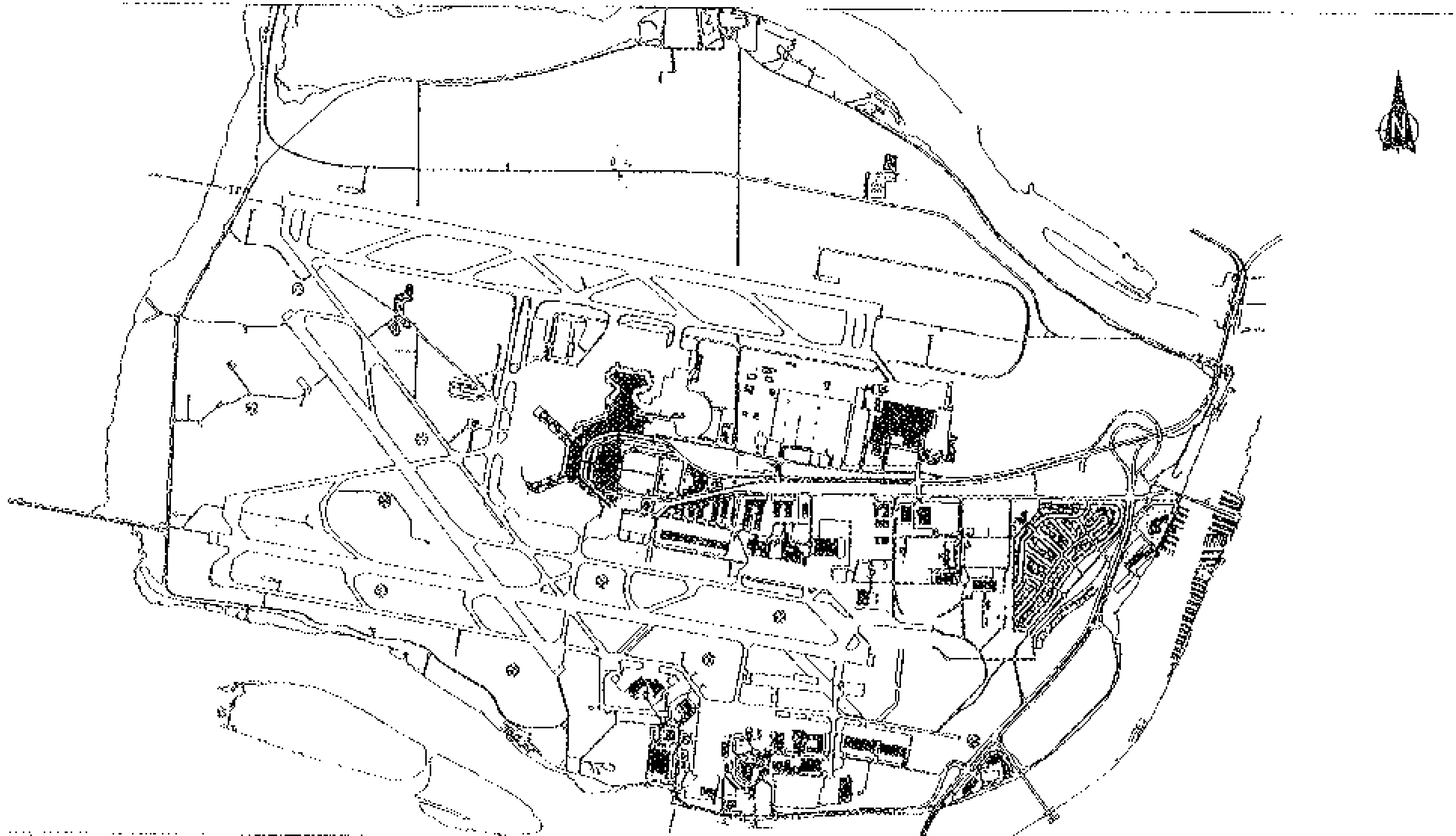
Gulls	Gull	601
Ducks	Amwi	200
	Duck	1174
	Gadw	2
	Mall	2603
	Pint	4
	Teal	1931
Geese	Cago	10835
Water BDS	Cbhe	127
Peeps	Dowi	6
	Dunl	529
	Kill	874
Raptors	Baea	2
	Baow	136
	Hawk	90
	Kest	14
	Merl	1
	Noba	116
Game BDS	Rnph	103
Passerine	Basw	310
	Nwcr	1058
	Sasp	259
	Sosa	34
	Star	8330
	Total	29,339

Raccoon 1 / Cat 1


PATROL ROUTE 1
PATROL ROUTE 2
VANCOUVER INTERNATIONAL AIRPORT
TECHNICAL DATA CENTRE
VANCOUVER INTERNATIONAL AIRPORT
WILDLIFE PATROL AREAS
YVR-PATR.DGN



YVR	VANCOUVER INTERNATIONAL AIRPORT TECHNICAL DATA CENTRE	plotting date: 1996/10/25 drawn by: A.CLARK	scale: NTS drawing: 1 of 5	CANARY GRASS TEST SITES 1997



YVR — VANCOUVER INTERNATIONAL AIRPORT TECHNICAL DATA CENTRE	plotting date: 1996/10/25	scale: NTS	GRASS TEST SITES 1996/1997
	drawn by: A. CLARK		

APPENDIX 18

Management of Canada Geese at North American Airports

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MANAGEMENT OF CANADA GEESE

AT

NORTH AMERICAN AIRPORTS

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Introduction

We are collaborating on projects designed to propel state of the art technologies toward the creation of fully operative warning systems to prepare the FAA for dangers presented by the growing number of Canada geese. With this powerful capability, the Tower will be able to instruct pilots how and when to avoid imminent collisions with avian hazards. Analogous technologies exists for wind sheer; we are utilizing additional factors inherent in biological systems in our research and development phase: these include Nexrad, satellite telemetry (Seegar et al. 1996a; 1996b), modified flight forecast models (Shannon et al. 1996), radar, and modeling to plot current goose trajectories that will collide with aircraft. We will expand this capability in the short-term and hope it will not require an aviation disaster to fund the project's completion and installation. This project has the potential to identify many risk-related bird species, we are conducting experiments at JFK with Canada geese because we recognize this problem needs our immediate attention.

Canada goose populations in North America and Europe are rapidly increasing, reaching all time highs in 1996. While the estimated number of migratory Canada geese (those migrating between Canada and the United States) doubled in the last 25 years. Non-migratory Canada geese in the United States, those that are raised and stay in the United States, have increased exponentially (MacKinnon 1996); the current number exceeds 1 million. The rapid increase in the number of geese is reflected in the increasing number of aircraft striking geese across the continent. Potential for future aviation disasters may be reduced with appropriate measures taken by permit issuing agencies, however, it is unlikely that Canada geese are going to cease to exist in our airspace due to slight modifications in Fish and Wildlife procedures, therefore, we need to develop plans with hardware and software to reduce the risk at our airports.

In 1995 North America's Canada goose strikes resulted in the deaths of 24 people and over $200 million dollars worth of damage to aircraft. At Port Authority airports (JFK and LaGuardia) alone we had three major incidents: one at JFK when the Air France Concorde struck geese on June 3, 1995 resulting in claims for $7.5 million dollars worth of damage; September 18, 1995 at LaGuardia Airport when a Northwest Airlines Airbus A320 struck 12 Canada geese and it cost the airlines $2.5 million; and on December 10, 1995 a Polar Air Cargo Boeing 747 struck a flock of migrating snow geese, which cost the carrier millions of dollars. No one was hurt in these incidents (Garber 1995a).

There have been 40 Canada geese struck at JFK during the 17 years from 1979 through 1995, with a total of 19 planes involved in incidents. This is an average of 2.36 Canada geese struck per year. Although this represents only about 1 percent of all the bird strikes at JFK, it accounts for over 2 percent of the total aircraft damaged or delayed due to bird strikes. During the first five years of record keeping at JFK (1979 through 1983) four Canada geese were struck, which is an average of .8 geese per year; during this period 3 incidents occurred, two involved just one goose, and the other involved two geese. This totals .6 incidents per year. During the next 12 years, from 1984 through 1995, 36 geese were struck, which is an average of 3 Canada geese struck per year. That is an increase of nearly 400 percent (375%); during these 12 years there were 16 incidents, 7 of which involved just one goose, and the other 5 involved multiple strikes. This totals 3.33 incidents during this period, which is an increase of 222 percent. We investigated other airports to find if any others reported increased bird strike activity due to Canada geese, and although other airports rarely have the data set that JFK has, there has been a dramatic number of recent goose strikes at other North American airports. We conclude that the number of Canada geese in the airspace surrounding JFK has increased significantly in recent years, and the number of birds flying in the family groups has also increased. This is probably because New York City and Nassau County raised juveniles have lower mortality than those raised in northern Canada. At least, those raised here encounter fewer dangers than those raised in Canada that have to survive migration, hunters, and other predators, on their way down here.

Until recently, Canada geese did not pose a significant threat to aircraft, in fact, their numbers had decreased significantly throughout the first half of the century, so that by 1950 their numbers and range were significantly reduced from what they had been 100 years earlier. However, the Canada goose situation changed markedly in the last few decades. Over the past several years wildlife managers across North America have reported a rapid increase in numbers of Canada geese that now breed where none previously bred.

Canada geese previously flew through New York's airways during spring and fall, but never spent the summer here. Canada geese have many recognized races or subspecies, each is usually identified by biogeographic variation, that is, where they breed, and there are recognized phenotypes, usually differing according to size; some range in size from three or four pounds, while others weigh about nine pounds. Each of the subspecies nests in the northwestern United States and Canada, and winters in the United States. They occur in greatest numbers along the coasts. Migratory geese continue to breed to the north, however many geese remain further south all year round.

Canada geese have adapted to the changing environment created by humans. The geese are attracted to short grass habitats near water. Such areas were comparatively rare throughout most of the United States before the forests were cut and urban and suburban habitats included patchwork of managed lawns, grassy street sides, and the occasional thousand acre golf course. We created perfect goose habitats. These areas were kept clear of potential goose predators, and humans liked to feed the geese with the ducks. In addition, many geese were kept as exotic pets at duck ponds across the country. The Canada geese could not fly away because their wings were flipped, so they stayed around our homes and bred. The young escaped and continued to breed locally, and these local populations increased in size. As the number of Canada geese continues to increase, so does the number of goose strikes; during recent months planes have been hitting geese in record numbers.

Strike Record at JFK

Regarding aircraft, the Canada goose is a dangerous bird in several respects: 1) it weighs an average of 10-15 pounds and is one of the heaviest and densest birds regularly flying through JFK airspace, 2) Canada goose bird strikes often involve flocks, which poses a greater risk to aircraft than birds that fly singly, and 3) this species is rapidly increasing in numbers in our area.

During the period from 1979 through 1993, 31 Canada geese hit aircraft at JFK (Garber 1995b). This was less than 1 percent of the total number of bird strikes at JFK. Of these Canada goose strikes, no one was hurt, and two aircraft were either damaged or delayed, which was 2 percent of the total aircraft that were either damaged or delayed at JFK during that period. The trend in Canada goose related aircraft collisions has remained constant over this period, averaging 1.2 geese struck at JFK per year, with a range from 0 to 3.

Even before Canada goose numbers were rapidly increasing, at JFK we still recognized them as a hazard to aircraft; this was largely due to when an aircraft struck a Canada goose at JFK on December 14, 1965; the plane was left with an 8 inch (20.3 centimeter) diameter hole that penetrated 10 inches (25.4 centimeters) deep into a horizontal stabilizer and this strike also left a 6 inch (15.2 centimeter) long indentation on the leading wing edge. Since 1979, three aircraft have been damaged or delayed at JFK due to Canada goose strikes. The total strike record for Canada geese at JFK since 1979 includes on goose struck on Runway 4R on May 1, 1979, two geese were struck Runway 13R on November 8, 1979, three on Runway 31L on May 14, 1984, two on Runway 4L on September 27, 1984, six on Runway 4L on May 9, 1985, two on Runway 13R on March 23, 1986, one on Runway 4R on October 10, 1988, three on Runway 4R on

March 5, 1989, one on Runway 4R on July 28, 1989, one on Runway 4R on March 29, 1990, one on Runway 13R on May 28, 1991, four geese were struck on Runway 4L on November 9, 1991, two were struck on September 6, 1992, one on Runway 4R on November 13, 1993, one on Runway 22L on April 9, 1994, one on Runway 31R on November 10, 1994, two on Runway 22L on March 21, 1995, and the Air France Concorde incident on Runway 22L on June 3, 1995 when five geese were struck. December 10, 1995 a Polar Air Cargo Boeing 747 12 to 15 miles from JFK, on its approach, while over water at 7,500 feet, struck a flock of Canada geese. Kent Scott, Polar Air's Vice President of Flight Operations spoke to the pilot of the aircraft who identified the birds as Canada geese. The pilot said the main landing lights were turned on at 10,000 feet, "which usually has an effect on bird activity, they'll wheel away if they can." As soon as the aircraft came out of the clouds the pilot saw a flash of white, which he thought was lightning, and then the instant before impact he saw a flock of Canada geese. When they hit the birds the airplane shuddered violently, the pilot and copilot thought they had lost the plane. You know something is terribly wrong when a 750,000 pound aircraft (when fully loaded) starts shaking violently. Kent Scott said this was the most violent incident he's heard about from any pilot during all his years as a pilot. The birds caused extensive structural damage to the aircraft. Two engines were replaced and there was major damage to the body of the plane.

Recent Strike Record at Other Airports

The growth in Canada goose populations across the United States is reflected in the number of goose-related incidents. In June 1993 a Boeing 737 was taking off from Calgary Airport in Alberta, Canada when it struck 80 ring-billed gulls that were at the end of the runway. The plane was too close to the end of the runway so it could not abort; instead it gained enough altitude to loop around and immediately land again. Two engines were damaged; luckily no one was hurt. In the autumn of 1993 12 Canada geese were involved in a strike with a KLM Boeing 747 that was landing at the Calgary Airport in Alberta, Canada. One engine was knocked out and there was considerable damage to the fuselage. The total damage amounted to $4-5 million. During the winter of 1994-1995 a two Canada geese were involved in a strike with a Boeing 747 which was taking off from Fort Meyers, Florida. The geese went through the plane's nose cone and the aircraft had to land in Orlando, Florida.

The Canada goose strike at JFK on June 3, 1995 occurred when an Air France Concorde was just about to land on Runway 22L and several geese hit the fuselage, and geese were sucked through two engines both of which caught fire and had to be shut off. Luckily no one was hurt, however an estimated $7.5 million dollars worth of damage occurred (according to the lawsuit Air France filed against the Port Authority of New York and New Jersey). August 22, 1995 a Continental Airlines Boeing 757 hit a flock of Canada geese just before touching down at Seattle-Tacoma International Airport. The 9 geese that were killed damaged the aircraft's nose cone, which contains the aircraft's radar. The plane landed safely and no passengers or crew were hurt.

Airport Operations at Washington Dulles International Airport in Herndon, Virginia reported a Canada goose strike on November 6, 1992. The strike occurred during the day, the aircraft was a BA-3200 (Dewey 1995). On November 3, 1994 there was what the airport identified as a possible Canada goose strike that occurred at night to an E120; the airline reported damage to the aircraft. May 12, 1995 a dead Canada goose was found on the runway at, but the strike was never reported by a pilot. Then on September 14, 1995 a Boeing 757 landing at Dulles International Airport struck 10 Canada geese at 7:30PM. The multiple strike damaged both engines, both wings, and the radome; no one was hurt.

On September 22, 1995 a Boeing 707 United States Air Force E-3B Advanced Warning and Control System, or AWACS, jet struck Canada geese when taking off at Elmendorf Air Force Base, just north of Anchorage, Alaska. Carla Dove of the Smithsonian Institution's Division of Birds examined the feather samples (personal communication) from two engines and made the positive identification. The $180 million four-engine aircraft lost power in two engines, which was sufficient to cause it to crash two miles from the end of the runway. All 24 people aboard were killed (22 Americans, 2 Canadians). The way $180 million was calculated is the Boeing 707 was worth approximately $30 million, the equipment on board and AWACS is valued at $150 million, and although normally the 24 people's lives would be valued at $2.5 million each, because this was the United States Air Force, no one can sue, so the additional $60 million is not part of the calculation.

Another goose-related bird strike occurred September 25, 1995 when the jet House Speaker Newt Gingrich, the Republican from Georgia, and his wife, were flying in was taking off from a small resort island in Michigan. No one was hurt when the small jet ran off the runway on Mackinac Island, Michigan after striking four Canada geese. Their Cessna Citation aircraft hit a flock of geese that was on the runway which scattered as the plane approached. The aircraft had just begun its ascent when it hit the birds. The pilots were very shaken when at least two geese were sucked into the right engine, while two others hit the leading edge of the left wing. The collision caved in a 14 inch portion of the wing. No one was hurt when the plane aborted its take-off, skidding to a stop 30 feet off the end of the runway. Obviously, the plane should never have been cleared for take-off with geese on the runway.

La Guardia Airport

There was a Canada goose strike at La Guardia Airport on September 18, 1995. A Northwest Airlines Airbus A320 was landing on a clear evening when Canada geese were seen and struck. Twelve geese were seen and struck; no one was hurt in the incident. Geese struck the radome, windshield, nose, engine #2, fuselage, landing gear, and the tail. Engine #2 was shut down; dollar estimate of the damage has been placed at $2 million, and the estimated cost due to loss of revenue from the 48 hours during which the aircraft was out of service was $500,000.

On October 2, 1995 a probable goose strike at LaGuardia Airport involved a U.S. Air Shuttle 727/225. It was a clear evening when the plane was taking off when one bird struck engine #2, which was damaged. The engine instantly flamed out; there was internal damage that resulted in the engine having to be rebuilt. The Estimated cost of repairs was $150,000 and an additional $20,000 was the other cost due to lost revenues.

On October 24, 1996 an American Airlines MD-80 (Flight 342 with 101 passengers and a crew of 5) landing at La Guardia Airport at 10:43 PM reported a bird strike on Runway 22. Runway 4-22 was closed until 11:10 PM for inspection and removal of 5 Canada geese near the Marine Air Terminal. No one was hurt, the plane was not damaged, and because Runway 13-31 was available, and due to the slow traffic at that hour, no delays occurred.

Growing Risk

While certain gull species are far more numerous and account for a greater percent of the total number of bird strikes at JFK, Canada geese account for an important risk that is growing across the continent. And in light of the fact that a large percent of goose-related strikes result in significant damage to aircraft, this species' behavior needs to be monitored and managed to the best of our ability. At JFK, the possibility of a goose-related strike exists throughout the year.

During the summer months most Canada geese in the Jamaica Bay area are located near the ponds at Jamaica Bay Wildlife Refuge (Burger et al. 1983; Garber 1995b), although some can be found in the vicinity of JFK. The habits of Canada geese continue to change rapidly, and we are on the constant lookout at JFK to be sure we keep the birds away from the runways. A particularly serious problem that increases in severity each year concerns the birds changing breeding behavior. With Canada geese breeding throughout a vast range south of where they were previously found, this species continues to increase in number throughout the area, raising issues that were never confronted before. They have become common on golf courses, parks and reservoirs, but only at airports are the goose-related problems really life-threatening. JFK has suitable breeding locations that could sustain a large breeding population, so vigorous efforts must be sustained to continue to keep geese from becoming established on, or near our property. The Port Authority of New York and New Jersey will continue to aggressively keep geese off JFK.

Abundance

Not too long ago this abundant migrant and winter visitor along the coast was only relatively common in the area. Inland most geese were just heard and seen during migration when chevrons flew overhead. With the changing habits during the past 40 years, Canada geese now commonly breed where they used to only spend the winter. And after breeding in areas where they used to just spend the winter, they remain through the winter. Jamaica Bay Wildlife Refuge has Canada geese present all year round. In addition, recent data we have accumulated from band recoveries, we are finding the goose populations in the Jamaica Bay vicinity are attracting recruits from New Jersey.

Meanwhile, the northern breeding stocks are declining in number, perhaps due to bad weather in the north during the past several years, or in part due to the increasing competition they receive from their conspecifics when the northern breeders are on their overwintering grounds. Many people are upset with the burgeoning numbers of Canada geese; they are not appreciated by those golfers who don't like stepping in goose plop (which looks like a small dog's feces). Home owners might disapprove of geese grazing in the backyard for the same reason. But we have only ourselves to blame. Canada geese were commonly raised in captivity and many escapes never went far from the roost. Instead of migrating north, after having been penned in and bred in these southern regions, their behavior was forever altered, and now their offspring are increasing in number like rabbits.

Canada geese have bred on the airport, and we are doing everything within our power to control this behavior. When we reported the first Canada goose nest on JFK to the United States Fish and Wildlife Service, we were informed we could not destroy the nest, harass the parents, addle or oil the eggs. It was not long afterward that an Air France Concorde hit several geese when landing at JFK.

Management

In the vicinity of JFK, Canada geese naturally eat cordgrass, widgeongrass, spikerush, sea-lettuce, naiad, glasswort, eelgrass, bulrush, and saltgrass (Martin et al. 1951). However, they have expanded their diet to include grazing on manmade lawns and fields, where they eat vegetation that previously were not part of their diet. Current long grass and water management aimed at reducing gull hazards is also recognized by airport personnel as a useful mechanism for controlling geese, since they graze in short grass areas. We will continue to monitor our selected grass heights and times during which we cut the grass to determine if we need to consider modifying the regimen to control any potential future goose incursions. To date, the vegetation and water management, in conjunction with our ongoing nonlethal harassment techniques, which include the use of pyrotechnics, has been successful. It needs to be added however, that because of the nest found on JFK in 1995, and the recognition that we must step up our efforts to control the potential future establishment of other geese on the airport, we interspersed nonlethal harassment techniques during the summer of 1995 with lethal techniques. When we received a federal permit to shoot 20 Canada geese, we judiciously chose the best opportunities to make the point known to the groups of geese that were resting on the airport at different intervals during the summer.

The areas at JFK where Canada geese are most likely to rest and graze have been identified and they are visited twice each day. If any geese are there they are harassed. The 20 geese that were shot this summer were shot during this harassment, which significantly affected the frequency with which these birds are found on or near the airport. But because new geese continue to find suitable habitats to rest on the airport, we continue to seek them out and harass them, significantly reducing the number of geese that fly through JFK airspace.

Future Work

Considering the risk involved from Canada geese, this is not a problem that the aviation community can afford to overlook. We need to anticipate the informational needs we will require to effectively manage this growing problem. At present, our information is limited because this problem has only appeared to be a real problem for several months at most. It is too early to know whether this is a growing problem, or if this series of goose strikes was just an odd coincidence. We helped convince Fish and Wildlife that they need to consider better management methods to bring non-migratory Canada goose populations in check. They recently issued a Draft

Environmental Assessment regarding permit issuance for control of injurious Canada geese by the Fish and Wildlife Service (Trost, Wilds, Kokel, and Schmidt 1996). While they are involved in this process that may not lead to an adequate resolution of the problems of geese and planes, we will advance our capabilities so we can develop a capability that provides instantaneous information about where geese are and when they might collide with aircraft. Our goal is to advance current technologies that lead to measures enabling us to reduce escalating risks from Canada geese at Port Authority of New York and New Jersey airports.

Nesting Geese

To address questions regarding where the geese are nesting in the area we have been surveying colonial breeding water birds near our airports. 90% of the most hazardous bird strikes at JFK, LaGuardia, and Newark Airports are due to species that just began nesting in the Port District. Several of these species are either rapidly increasing in number, or have the potential to increase exponentially. As numbers increase, strikes are predicted to increase. To manage the problem, we benefit from knowledge about the source of the problem.

To learn more about the populations of birds causing these problems we have been conducting surveys to monitor the colonies that potentially affect safe aviation. Cormorants, herons, and egrets have not posed a significant hazard to safe aviation at our airports, however, in recent years, Supporting these efforts helps Port Authority gain the data upon which we can make knowledgeable management decisions. In addition, this work fosters a more understanding relationship with other parties also interested in the Port of New York and New Jersey. Our ongoing effort to maintain annual breeding records that are correlated with strike rates is part of our bird hazard management program. The Port Authority has collaborated with the Sierra Club, Audubon Society, National Park Service, and the Baykeeper. The Port Authority has been supporting efforts to survey birds on Joco Marsh (and other islands in Jamaica Bay) near John F. Kennedy International Airport, as well as on Shooters Island, Pralls Island, Isle of Meadows, near Newark International Airport, and on South Brother Island, North Brother Island, and Rikers Island near LaGuardia Airport.

Laughing gull surveys have been instrumental in our gull management program. To avoid mute swan involvement in potentially disastrous aviation collisions, the Port Authority has been working with the National Park Service to keep swan productivity to a bare minimum. Canada goose surveys enabled us to receive our first permit ever in 1995 to control this species at JFK from the United States Fish and Wildlife Service. However, swans, geese, and gulls are increasing throughout the region.

LaGuardia has been having many more significant goose strikes than JFK. We investigated reasons for the greater risks there, and found high numbers of geese in the area. We learned that large numbers of Canada geese are nesting at Rikers Island, directly adjacent to LaGuardia, when we surveyed the island in 1996 for the first time ever. We also surveyed colonial nesting waterbird nests on other nearby islands and found swans have begun nesting on South Brother Island, adjacent to Rikers Island. Great black-backed and herring gulls are nesting on South and North Brother Islands at some of the highest rates ever.

This work is endorsed by the governmental regulatory agencies that advise the Port Authority's bird hazard program. We have no reason to argue with fellow conservationists who support efforts to bolster populations of herons, egrets, and cormorants, when these birds do not cause any serious problems at the region's airports (although we do have reason for concern when cormorants start a breeding colony on one of our airports - as was the case in 1996 at JFK).

Gulls, geese, and swans, however, are often in need of management, since these species both account for the greatest number of strikes and damage to aircraft at Port Authority's airports. The fact that certain environmentalists also see the need to manage some of these bird species creates the potential for cooperation. We hope the surveys we are conducting and data we gather on and near our airports will lead to permits that will enable us to improve aviation safety.

Flightless Geese

July 22, 1996 with John Nolan we surveyed the flightless geese in the immediate vicinity of JFK. There were none on the airport, there were no flightless geese at Springfield and Brookville Parks because the geese have no protection from dogs and raccoons at these parks. The ponds aren't large enough to give the geese protection from dogs. There isn't as much food as is available at Baiseley and North Woodmere Parks. However, we did see 6 at Springfield Park, and 24 at Brookville Park, but there were geese that had flown in now that some had begun to fly again. The Nassau County Flood Control Area had 24 geese which had been there through the flightless season; they bred there. At Baiseley Park there were 350 flightless Canada geese. North Woodmere Park had 200 Canada geese.

Several hundred geese continued to frequent these areas throughout August and most of September, however, before the Canada goose migration began, the number of geese in the area began to grow very rapidly. This was an apparent response to the 1996 September Canada goose season that had never existed before. The New York State Department of Environmental Regulation responded to the growing number of geese throughout the state by opening a September hunting season, however, New York City was a protected area for the geese. Therefore areas of Nassau and Suffolk counties located at least 150 yards inland of mean high tide of tidal waters had a hunting season from September 3 through September 25 and all other areas of Nassau and Suffolk counties had an open goose season from September 16-25.

Immediately after the beginning of this first time ever hunting season the number of geese in the JFK area increased 10 fold (John Nolan, personal communication; JFK Bird Control Unit estimates), and this was followed by geese that started grazing on the landside of the airport for the first time ever. September 8 was the first day they came to the airport; two families of geese landed here about 5:00PM and grazed near the Van Wyck Expressway. The next day more families were attracted and on September 10th there were over 300 geese grazing on the landside near Federal Circle. Without using any lethal means we scared them off on foot on the 10th, in a car on the 11th (when there were only half as many, and they fled more readily), and by car and on foot on the 12th (when the number was further reduced by 50%. On the 12th family groups of Canada geese were grazing elsewhere on the airport. After several days of harassment, by the 13th, there were only 3 family groups found on the entire airport, which we scared off. None returned for several days, and then two family groups appeared at one of the locations, so we continued to scare them off as appropriate. None of these birds were migratory Canada geese, rather they were all residents. We know this because migration had not begun yet according to Frank Phillips (personal communication), the New York State Department of Environmental Conservation's expert on waterfowl.

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APPENDIX 19

John F. Kennedy International Airport: Rodent-Eating Raptor Survey

Garber, S.D. 1996. John F. Kennedy International Airport Rodent-Eating Raptor Survey. In: Proceedings of the Twenty-Fifth Meeting of Bird Strike Committee Canada. November 6-7, 1996. Transport Canada. Ottawa, Ontario, Canada.

JOHN F. KENNEDY

INTERNATIONAL AIRPORT

Rodent-Eating Raptor Survey

Steven D. Garber
The Port Authority of New York and New Jersey
New York, New York

Joseph Bopp, Chip Foster, and Shannon Murphy
New York State Museum
Albany, New York

Raptors at John F. Kennedy International Airport in New York City

We analyzed the risk at JFK posed by raptors struck by aircraft. We considered suggestions made by the USDA that we poison mammals to eliminate "rodent-eating raptors." The USDA based their assertions on the number of rodent-eating raptors struck at JFK, however, we feel their conclusions are erroneous. We provide results from our mammal research and show how the USDA allegations were wrong when they told us "252 rodent-eating raptors have been struck between January 1, 1979 and September 30, 1996."

We show few rodent-eating raptors are struck at JFK each year, and an explanation is provided why raptors apparently provide a net positive factor for safe aviation at this airport. We conclude at this time, not to take the USDA's advice, and opt not to poison mammals living at JFK because the numbers do not support such a decision. In addition it is our opinion that the management strategy recommended by the USDA would lead to other problems, by endangering other animals, and therefore passengers flying in and out of JFK due to secondary poisoning (Garber 1989a, 1989b, 1989c). Hurt and sick birds are dangerous at an airport because they hang around, draw in other birds, and pose a risk of being struck by aircraft.

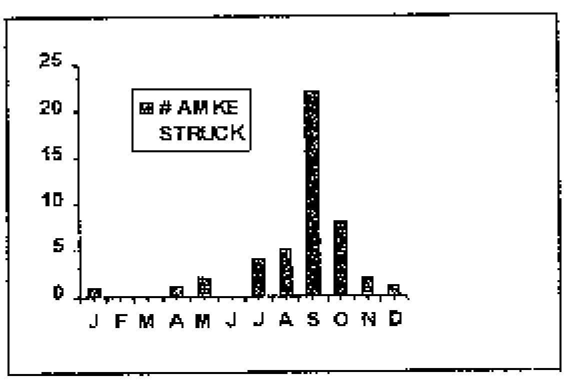
Raptor Strikes at JFK from 1979-1995

Golden Eagle	0
Bald Eagle	0
Turkey Vulture	0
Black Vulture	0
American Kestrel	46
Merlin	1 (1996)
Peregrine Falcon	14
Osprey	16
Red-shouldered Hawk	0

Red-tailed Hawk	2
Broad-winged Hawk	0
Rough-legged Hawk	2
Northern Harrier	15
Northern Goshawk	0
Cooper's Hawk	0
Sharp-shinned Hawk	0
Gyrfalcon	0
Common Barn Owl	113
Snowy Owl	15
Long-eared Owl	3
Short-eared Owl	35
Burrowing Owl	1
Northern Saw Whet Owl	0
Total	**253 (1 of which - the Merlin, was a 1996 strike, all the rest are from 1979-1995)**

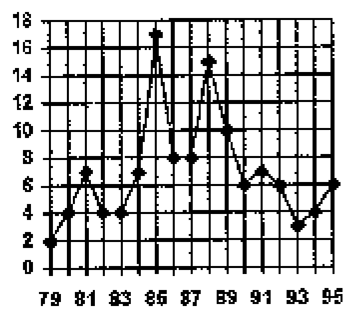
Of these, the American kestrels struck at JFK are primarily those coming through our area during fall migration. During this time they are not at JFK for rodents, rather we see them constantly catching insects, usually grasshoppers.

NUMBER OF AMERICAN KESTRELS
STRUCK BY MONTH AT JFK
FROM 1979-1995



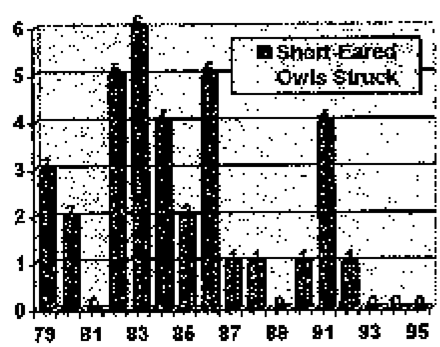
Although barn owl strikes represent a large proportion of the USDA's list of "rodent-eating raptors," the number of barn owls struck at JFK has declined considerably since we shut the surrounding landfills down. As the landfills were capped and successional vegetation covered the vast rodent feed lots, we saw a concomitant decline in barn owls at the airport. Yet, we expect the barn owls to recoup slightly as the number of barn owl boxes in the area increases, as part of the National Park Service's continued efforts to bolster their numbers in the Jamaica Bay Wildlife Refuge. We expect this to lead to a continued trend toward slightly more barn owl strikes at the airport.

NUMBER OF COMMON BARN OWLS STRUCK AT JFK FROM 1979-1995



Regarding short-eared owls, the trend in strikes at JFK has also been decreasing dramatically, as can be seen below.

NUMBER OF SHORT-EARED OWLS STRUCK AT JFK FROM 1979-1995



Together, we do not regard ospreys (16 strikes) as "rodent-eating raptors." They eat fish. The kestrels (46 strikes) coming through, as we have shown, eat insects. The short-eared owls (35 strikes) are so rare at JFK now we no longer consider them a problem (for now at least). And barn owl strikes (113 strikes), as we have explained, are also down considerably. The lone burrowing owl (1 strike) struck here was an anomaly, because they virtually never occur this far north. In addition, peregrines (14 strikes) are bird-eaters, not rodent eaters, as are merlins (1 strike in 1996), as well as a large proportion of the diets of other raptors that come through our airspace. Therefore, we have determined that (216 strikes) 85% of the raptor strikes (ospreys, kestrels, peregrines, merlins, short-eared owls, and barn owls) really are not a problem In addition, long-eared owls (3 strikes) are small and not considered by us to pose a threat to safe aviation.

We have struck no golden eagles, bald eagles, turkey vultures, black vultures, red-shouldered hawks, broad-winged hawks, northern goshawks, cooper's hawks, sharp-shinned hawks gyrfalcons, or northern saw-whet owls, and have no reason at this point to manage the airport in a manner to reduce the miniscule risk they might pose at this time.

American kestrels struck at JFK are primarily those coming through our area during fall migration (Garber 1996). During this time they are not at JFK for rodents, rather we see them constantly catching insects, usually grasshoppers. Although barn owl strikes represent a large proportion of the USDA's list of "rodent-eating raptors," the number of barn owls struck at JFK has declined considerably since we shut the surrounding landfills down. As the landfills were capped and successional vegetation covered the vast rodent feed lots, we saw a concomitant decline in barn owls at the airport. Yet, we expect the barn owls to recoup slightly as the number of barn owl boxes in the area increases, as part of the National Park Service's continued efforts to bolster their numbers in the Jamaica Bay Wildlife Refuge. We expect this to lead to a continued trend toward slightly more barn owl strikes at the airport.

Regarding short-eared owls, the trend in strikes at JFK has also been decreasing dramatically. Together, we do not regard ospreys (16 strikes) as "rodent-eating raptors." They eat fish. The kestrels (46 strikes) coming through, as we have shown, eat insects. The short-eared owls (35 strikes) are so rare at JFK now we no longer consider them a problem (for now at least). And barn owl strikes (113 strikes), as we have explained, are also down considerably. The lone burrowing owl (1 strike) struck here was an anomaly, because they virtually never occur this far north. In addition, peregrines (14 strikes) are bird-eaters, not rodent eaters, as are merlins (1 strike in 1996), as well as a large proportion of the diets of other raptors that come through our airspace. Therefore, we have determined that (216 strikes) 85% of the raptor strikes (ospreys, kestrels, peregrines, merlins, short-eared owls, and barn owls) really are not a problem. In addition, long-eared owls (3 strikes) are small and not considered by us to pose a threat to safe aviation.

We have struck no golden eagles, bald eagles, turkey vultures, black vultures, red-shouldered hawks, broad-winged hawks, northern goshawks, cooper's hawks, sharp-

shinned hawks gyrfalcons, or northern saw-whet owls, and have no reason at this point to manage the airport in a manner to reduce the miniscule risk they might pose at this time.

The remaining raptors struck at JFK account for a relatively small number of strikes per year. As of October 17, 1996 most of the raptor strikes at JFK for the year are in keeping with what we expected. It is noteworthy that there were 2 short-eared owl strikes (1 struck in January, 1 struck in February; certain years more short-eared owls come out of the north, but generally the number struck at JFK has been very low during the past several years). 1 red-tailed hawk was struck in January, however, during the summer and autumn when the JFK Falconry Program was in effect, we had no red-tailed hawk strikes. 5 northern harriers were struck; 2 in February on the 27th, 2 in May on the 8th, and 1 on June 5. For with this wingspan (42 inches), harriers are very light because they hunt by soaring much of the time, which is accomplished with the high wing surface to weight ratio. Therefore, it is not likely with so few strikes that one is going to cause a crash. We had our first merlin strike here in 1996 ever (September 29) which was very unusual.

The 6 barn owl strikes this year were all struck from July through September These birds may have been attracted to JFK because they were unable to successfully feed as efficiently on their normal feeding areas during the summer because it was wet and not very hot, which created thicker vegetation, making it harder to see potential prey. As a result, JFK may have had more hungry barn owls feeding where there are more open areas. If this is the case, then 1996 should prove to be an anomaly. Don Riepe of the National Park Service, Chris Nadareski of the New York City Department of Environmental Protection, both of whom are involved with efforts to increase the number of barn owls nesting in the Jamaica Bay Wildlife Refuge, and I felt this year's unusually thin barn owls when handing them while banding them as part of our ongoing collaborative research concerning airport avian risk management. Data from the next several years will prove useful in determining barn owl strike trends. As expected, the 6 kestrels struck this year were all struck during fall migration (August through October) when they were eating grasshoppers.

Results of JFK Small Mammal Survey

In cooperation with the New York State Museum, JFK conducted a small mammal survey in which we were testing for relative abundance in different habitats. We set traps for 4 nights at 80 stations. Each station had 3 snap traps and 1 pit trap, with a total of 320 traps (231 rodents were caught in 1,280 snap trap and pit trap nights). The study was conducted on September 28, 29, 30, October 1, and 2, 1996.

Experimental plots included:

Wetlands

1) wet shrubland (red maple, Kalmia angustifolia, Sphagnum sp., Drosera rotundifolia, and Lycopodium adpressum) (4' high)

Peromyscus leucopus	34
Microtus pennsylvanicus	11
total	45

2) wet grassland (sedge, rush, and switchgrass) (5' high)

Peromyscus leucopus	10
Microtus pennsylvanicus	10
Mus musculus	5
Rattus norvegicus	1
total	26

3) coastal Phragmites habitat (8' high)

Peromyscus leucopus	11
Microtus pennsylvanicus	13
Mus musculus	1
total	25

Forest

4) stand of gray birch (20' high)

Peromyscus leucopus	22
Microtus pennsylvanicus	2
total	24

Shrubs

5) high bayberry shrubs (8' high) and switchgrass (35" high)

Peromyscus leucopus	31
Microtus pennsylvanicus	7
Mus musculus	1
total	39

6) switchgrass interspersed with some low bayberry shrubs (35" high)

Microtus pennsylvanicus	7
Mus musculus	3
total	10

Dry Grassland

6) switchgrass interspersed with some low bayberry shrubs (35" high)

Microtus pennsylvanicus	7
Mus musculus	3
total	10

7) mowed field (grass 4" high)

Microtus pennsylvanicus	1
total	1

Wet Grassland

2) wet grassland (sedge, rush, and switchgrass) (5' high)

Peromyscus leucopus	10
Microtus pennsylvanicus	10
Mus musculus	5
Rattus norvegicus	1
total	26

3) coastal Phragmites habitat (8' high)

Peromyscus leucopus	11
Microtus pennsylvanicus	13
Mus musculus	1
total	25

Wetlands	(n = 3, mean = 32)
Wet Grassland	(n = 2, mean = 25.5)
Shrubs	(n = 2, mean = 24.5)
Forest	(n = 1, mean = 24)
Dry Grassland	(n = 2, mean = 5.5)

List of Mammals Raptors Might Eat at JFK

Eastern Gray Squirrel (Sciurus carolinensis) %

It is unlikely that many eastern gray squirrels are eaten by raptors at JFK, considering how few live on the airport. There are not large numbers anywhere because we do not plant their preferred tree species, large-acorned oaks and hickories are far more numerous in many city parks. In addition, few airport squirrels ever get fed, unlike in urban parks.

Muskrat (Ondatra zibethica)

Muskrats inhabit marshes, ponds, lakes, and streams where they utilize a range of habitat and vegetation. Their diet includes a variety of plants, clams, fish, and frogs. They were found at JFK between the 4s in the many ponds and nearby marshy areas (United States Department of the Interior Fish and Wildlife Service 1976) as recently as 1976 and the muskrats survived until their habitat was destroyed as better drainage was provided, and low areas were filled. During the winter of 1989-1990 one of the immature bald eagles overwintering at JFK ate a muskrat, although I cannot be certain where the rat was captured. If there are still muskrats on the airside, their numbers are far fewer than in previous years when there was much more appropriate habitat available. Muskrats are still be found in small numbers on the airport. On airside there is a small population in a fresh water wetland east of the 4s, and on landside suspicious looking roadkills have been seen by Ogden's building near Federal Circle.

Muskrats are common at Gateway National Recreation Area. May 2, 1996 when in the field with Mike Moran and George Cook at Newark International Airport, checking the area where they plan to extend the runway, we saw a muskrat in one of the wetlands.

Big Brown Bat (Eptesicus fuscus)

There has never been a reported bat strike at JFK. I cannot say whether this is because bat species are not particularly common in the area, bat sonar enables them to avoid aircraft, or because the Bird Control Unit never sees bats when doing their patrols. It is safe to say that bats do not constitute a major danger to aircraft at JFK, probably because the species that inhabit the area are small and do not fly in large groups. The only bats that cause risks to aviation, to my knowledge, are fruit bats (Megachiroptera), which are much larger than any North American bats (Microchiroptera). It is unlikely that the few bird species in the area that are bat predators would be attracted to JFK, because the local avian bat predators take only an occasional bat, largely because the two groups are temporally allopatric (Garber 1977). More than likely, bat predators would probably benefit safe aviation by reducing the number of bats in the area. Sparrow hawks have been observed feeding on bats (Garber 1977), and sparrow hawks, or kestrels, are common here, but this behavior has been observed on only a small number of occasions. In any event, to watch for bats when they emerge from hibernation, they first appear when flying insects begin to emerge, which is usually on warm evenings ranging from the high 40s to mid 50s Fahrenheit, not much sooner than late March. I saw my first bat of the season on March 25, 1996 in Central Park when it was 54°F; small insects were out (probably gnats or related small dipterans), and the second bat I saw in Central Park was on March 31 when it was 49°F. Large numbers continued to be seen flying over several of the park's open areas throughout the summer. Most recently, I saw bats in Central Park as it was getting dark during the evening of August 7, 1996, I believe these were small brown bats, but I have also seen big brown bats in Central Park.

Black-Tailed Jack Rabbit (Lepus californicus)

Black-tailed jack rabbits have been at JFK for years, and they are still here living on the airside of the airport. How and when they were introduced is open for speculation. Connor (1971) wrote jack rabbits had been introduced to certain limited areas in western and central Long Island, New York. They were here in 1969 (Wilcox 1977). Chevalier (1995, personal communication) said they were here when he first worked at JFK in October 1957. He felt the rabbits escaped from a shipment. I have heard people say they escaped when a crate of jack rabbits broke open.

My feeling is that during Easter season each year, when pet shops sell baby ducks and rabbits, many crates of rabbits come through the airport and it is possible that some escaped at such a time. But even more likely, children or their parents often tire of their Easter bunnies when the bunnies have turned into rabbits. Children's parents become interested in finding new homes for their pets, and in the process many get dumped. We know people drive by Rockaway Boulevard and release unwanted animals at JFK, so it would not be surprising if jack rabbits were initially introduced in this manner.

At present there are approximately 150 jack rabbits living at JFK, most occur from Kilo east, however on occasion they are also seen west of Kilo along the Bay Runway. Occasionally one gets runover by Port Authority vehicles, but usually they stay under cover and are eaten by large raptors, primarily snowy owls and red-tailed hawks. In 1996 the first voucher specimen from JFK was donated to the New York State Museum in Albany (the rabbit was caught on October 18, 1996 by Hildie Bird, a Harris' hawk that was part of JFK's Falconry Program).

Should jack rabbits ever be considered a significant threat at JFK their numbers could be significantly reduced if not entirely eliminated by allowing the Harris' hawks to regularly take them. At this time, however, there is no data that indicates they pose such a problem. It should be mentioned that JFK's bird strike record does not include information about mammal strikes and therefore we may have a larger jack rabbit problem than we realize. At this point we cannot say with certainty if a problem exists or not, so we have no plans to purposefully reduce the airport's rabbit population.

Eastern Cottontail Rabbit (Sylvilagus floridanus)

In addition to the black-tailed jack rabbit, the eastern cottontail rabbit is the other rabbit found at JFK. They are common on the airport's airside, but they are considerably smaller than the jack rabbits, and therefore far less likely to ever cause a problem with a plane when crossing a runway. At JFK the jack rabbits are far more common from Kilo east, whereas the cottontails are more common from Kilo west, along the Bay Runway.

Orly Airport, in France, and Charles de Gaulle Airport in Roissy, France, just northeast of Paris, the other main Paris airport, both have huge rabbit populations. At Charles de Gaulle Airport there are an estimated 50,000 rabbits. The airport employs two full-time gamekeepers to try to keep the rabbit numbers down, but in 1995 they reduced the number by less than 8 percent. As they say at Charles de Gaulle, "the day a rabbit can jump 400 feet in the air, we'll get more serious about them." Because they have so many and have yet to have any significant incidents I am aware of, it does not appear that we need to worry about our cottontails causing any safety problems of note at JFK.

White-footed mouse (Peromyscus leucopus)

Common at JFK, occur in relatively high numbers (relative to other habitats surveyed throughout New York State).

Meadow Vole (Microtus pennsylvanicus

Common at JFK, occur in relatively high numbers (relative to other habitats surveyed throughout New York State).

House Mouse (Mus musculus)

Occasionally found in fields, but usually associated with buildings. Omnivorous eaters.

Norway Rat (Rattus norvegicus)

Their burrows are seen on airside near the water. Very little garbage exists in these habitats, and there are large numbers of raptors, to keep their numbers low. Occur in low numbers on airside field, shrub, and woodland habitats. It appears that none live on the Joco Marsh complex.

Conclusions

Regarding any suggestions that mammals should be poisoned or killed at JFK to keep raptors off the airfield, we conclude at this time that raptors do not pose a significant risk, rather, at JFK they probably do more good than harm. We understand that other airports may have either an ongoing problem or a growing problem with raptors, but at JFK we continue to make the airport safer with innovative integrated wildlife management decisions, including the use of avian predators to reduce the risks from other bird species. If mammals attract the birds that keep other birds away, then these mammals may provide the airport a certain benefit. In addition to tallying a list of the mammal species we have observed at and adjacent to JFK since 1957, JFK conducted a mammal survey in 1996, in association with the New York State Museum. We set trap lines in 7 airside habitats to determine mammal species composition and relative abundance in our efforts to improve wildlife management methods at JFK and other airports.

231 rodents were caught at JFK in 1,280 snap trap and pit trap nights (18% catch rate). Chicago's O'Hare International Airport tallied 495 small mammals were captured in 2,560 snap-trap nights (19% catch rate) Both surveys found similar rodent densities. O'Hare's survey was conducted in 1995 with the assistance of Chicago's Field Museum of Natural History and the USDA. JFK's was conducted with the assistance of the New York State Museum. O'Hare's experimental design tested differences in mammal numbers in plots of grass with lengths of 4, 8, and 12 inches, as well as fallow plots. Each grass length was tested in four 30 to 50 acres plots on the airport. Most were meadow voles (Microtus pennsylvanicus) and deer mice (Peromyscus maniculatus). Fallow and 12 inch grass had 4 times as many rodents as did 4 inch grass, whereas 8 inch grass had intermediate numbers. It was concluded that rodent populations increased to higher numbers within four months of the establishment of the higher grass length

At JFK we found the airside's wetlands have the greatest density of rodents (mean = 32), wet grasslands have the second greatest density of rodents (mean 25.5), followed by shrublands (mean = 24.5), then forest (mean = 24), with the least number of rodents in the dry grasslands (mean = 5.5). Short grass, recently mowed fields had the fewest rodents, however, these had the greatest number of crows, and many other birds were attracted to these habitats, so we warn any airport operators before they choose the shortest driest habitats.

Managing for the fewest rodents is not always the wisest decision. Some airports have raptor problems and therefore do not want rodents. At JFK, however, we have gull problems, followed by waterfowl problems, as the 2 greatest bird-related risk groups. Raptors both do not pose a large risk and they appear to keep certain birds from flying through our airspace, and raptors increase the likelihood that breeding birds and their young leave shortly after completing the breeding season. Therefore, rodents might have a positive benefit at some airports, such as JFK.

From our work at JFK, as well as work conducted at O'Hare, we determined that while both airports have comparable rodent densities. These airports have Peromyscus spp. (deer mice, and white-footed mice) and Microtus spp. (meadow voles) primarily, feeding on seeds and insects in wetlands, forests, shrublands, fallow and 12+ inch grasslands. Several raptor species feed on the rodents in these airport habitats.

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APPENDIX 20

John F. Kennedy International Airport: Piping Plover Survey

JOHN F. KENNEDY

INTERNATIONAL AIRPORT

Piping Plover Survey

Steven D. Garber, Ph.D.

The Port Authority of New York and New Jersey
New York, New York

October 28, 1996

PIPING PLOVERS BREEDING AT JOHN F. KENNEDY INTERNATIONAL AIRPORT IN NEW YORK CITY

Piping plovers (Charadrius melodus) have never been involved in any bird strike incidents at JFK. Although several pairs of piping breed at Breezy Point, the part of Gateway National Recreation Area that is on the westernmost tip of Long Island, they are rare in the area, occurring only in spring, summer, and early fall. Piping plovers are have not been seen at JFK since 1985, however, they bred here in 1968, 1983, and 1984. Some were banded here too. These data indicate piping plovers do not require pristine habitat to breed. Here they chose newly created, highly disturbed habitats that were not always immediately adjacent to the shore, along the first dune line, as is the case where they breed at Breezy Point. And, at JFK they have bred in areas where planes are very close on a regular basis.

Sammy Chevalier trapped a female piping plover on its nest at JFK on May 20, 1970 (Garber 1996) that had already been trapped and banded on its nest on June 29, 1968 at Shinnecock Bay, Long Island, 62 miles away (Garber 1995). This nest was in a highly disturbed area where fill had just been brought onto the airport. From this nesting record we know piping plovers do not have to nest in the same location each year, rather, they can move many miles to a new nest site.

Piping plover breeding data from the Long Island Colonial Waterbird and Piping Plover Surveys (1993-1995) are presented below: In 1983 two pairs nested at JFK, in 1984 1 pair bred here, none bred here from 1985-1988, the airport was not surveyed from 1989-1990, none nested here from 1991-1993, the airport was not surveyed in 1994. I didn't see any in 1995 and 1996, my first 2 summers working at the airport, but I will continue looking.

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APPENDIX 21

Rock Dove *(Columba livia)* Strike Rates at John F. Kennedy International Airport in New York City

Garber, S.D. 1996. Rock Doves *(Columba livia)* at John F. Kennedy International Airport in New York City. In: Minutes of the Twenty-Fifth Meeting of Bird Strike Committee Canada. November 6-7, 1996. Transport Canada. Ottawa, Ontario, Canada.

Rock Dove *(Columba livia)* Strike Rates at John F. Kennedy International Airport in New York City

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Ottawa, Ontario, Canada. Transport Canada
November 6-7, 1996

Rock Dove *(Columba livia)* Strike Rates at John F. Kennedy International Airport in New York City

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Pigeon Strikes at Airports

When a Boeing 747 was taking off from Los Angeles in Septermber 1989, several pigeons (*Columba livia*) were in engines #1 and #2 (both of the engines on the left wing). Each engine lost power and a disaster was narrowly averted when the crew safely landed the aircraft.

Pigeons (also called rock doves) commonly occur near airports, and due to their potential for causing disaster, The Port Authority of New York and New Jersey has focused energy on reducing this risk at John F. Kennedy International Airport, Newark International Airport, and La Guardia Airport. Here I report primarily on what has occurred recently at JFK with regard to pigeon control.

From 1979-1995 JFK has had 3,943 bird strikes (counting the birds reported by pilots, the FAA Tower, and by the JFK Bird Control Unit). During this period 1.8% of all the bird strikes were pigeons (17 years; 71 pigeons struck; mean = 4.18/year; min = 0; max = 27; number of years with no pigeons struck = 3).

Of the 71 strikes at JFK, one (1.4%) resulted in either delay, engine damage, lost tires, or dumped fuel. In this case it was engine damage. The incident involved a Boeing 747 and it occurred on September 2, 1988; 4 pigeons were struck. In all, during this 17 year period JFK has had 9 multiple pigeon strikes; the number of pigeons in each multiple strike ranged from 2 to 10. Multiple strikes occur with regularity because pigeons often flock, and racing pigeons fly in particularly tight flocks. Of all the years in our strike record, 1994 stands out as the worst, because 3 of the 9 multiple strikes in 17 years occurred then.

During this 17 year period (1979-1995), 94 percent of the strikes occurred during the 6 months from April through September. Based on 14.25 hours of surveys (number of surveys = 9) conducted during four of the months during which we have the fewest strikes, (surveys conducted from November 13, 1995 through February 1, 1996; survey hours were from 7:00 AM to 2:00

PM) a total of 2/849 birds observed on JFK's airside were pigeons.

August and September precede young pigeon racing season. This is when pigeon racers prepare their young birds for races, regularly releasing thousands training them for the upcoming races. Racing pigeons are considerably larger than common, wild pigeons. Racing pigeons weigh about a pound, twice that of regular street pigeons. In training flights racing pigeons commonly fly in tight groups of approximately 50 birds. Often, in a short period of time, several groups of 50 pigeons or more have been seen flying through JFK airspace on their way to pigeon lofts in eastern Long Island.

These birds are often struck by aircraft and the risk exists for a disaster in the future. Here we summarize recent efforts focused on pigeon problems at JFK and we present many of JFK's related projects aimed at reducing risks from pigeons.

Solid Waste Management

Taxi-Related Problems

Taxicab drivers waiting to pick up a fare were repeatedly cited as creating on-airport attractants to birds. Some fed birds, others threw garbage out of their vehicle. Signs prominently stating DO NOT FEED THE BIRDS were not sufficiently effective. Efforts with the Queens District Attorney's office to enact a law forbidding bird feeding at New York airports were initiated so Port Authority Police could fine violators. Concurrently, efforts were made to find other possible solutions. We found if all the taxis were held in one central taxi hold, while waiting for their fares, instead of in the nine smaller areas as had been the case, we might be able to manage the on-airport attractants more effectively.

Now, all the holding areas have been centralized at the Central Taxi Hold which holds 350+ taxis. The Central Taxi Hold, located at 148th Street off the JFK Expressway, was opened May 9, 1995 and the T.U.C.S. Cleaning Service was awarded the contract to keep the area freed of garbage and all other possible bird attractants. We continue to monitor the area and are pleased to report that it is clean, there is no garbage on the pavement, taxi drivers are no longer feeding the birds, in part because there is no garbage to attracted birds to feeds, and because there are no birds in the area in the first place, and the garbage canisters have been designed to be bird proof. T.U.C.S. Cleaning Service continues to do an excellent job of keeping the area bird fee, and should we ever have any complaints, Marianne Pellegrino, the Manager of Unit Terminal Buildings, will take care of the situation immediately.

Commenting on JFK's innovative improvement to the safe operations of our airport, Dr. George H. Haas, the Migratory Bird Coordinator of the United States Fish and Wildlife Service, who serves as the chair of the Bird Hazard Task Force that advises the airport on issues related to bird hazards, wrote that "this is a very practical method to resolve this potential attractant" (Haas 1995, personal communication).

Due to recent cutbacks in airport operating expenditures, the cleaning contract at the Taxihold was cut back as well. No one was on duty during the middle of the night. This created more garbage in the morning, which attracted more birds, and for some reason more garbage seems to attract more garbage, so the taxi hold was always dirtier and had more birds. We communicated our displeasure with this situation to Manager of Unit Terminal Buildings, who promised to take care of the situation immediately. Then on January 12, 1996 it was announced that "extreme usage of the current general cleaning contractor for snow removal services during the months of December and January has necessitated further cutbacks to cleaning services around the airport in order to keep expenses within authorized levels. As a result of these cutbacks, for the remainder of January and the entire month of February, cleaning of the Central Taxi Hold will only take place during the 6:30 AM to 3 PM shift (2 people) and during the 2:30 PM to 11:00 PM shift (1 person).

Central Taxi Hold Expansion

JFK has reassessed its success with the Central Taxi Hold that was opened in May of 1995, because it continues to eliminate the ongoing, most often cited solid waste problem at the airport. We feel that it is important to insure the long-term success of this effective elimination of an entire category of on-airport bird attractants. Our constant monitoring has determined that the Central Taxi Hold has become a permanent solution to the solid waste problem cited in the Record of Decision that was responsible for attracting large numbers of birds to the airport. With proper follow-ups, we are insuring the continued success of this costly and initially controversial attempt to solve a major problem. We received many complaints from the taxi drivers, who threatened to boycott JFK, but we prevailed, and seem to have made this Central Taxi Hold operated efficiently for everyone involved.

Because we were able to solve what had been one of the most intractable problems on the airport, we felt it was important to insure the taxihold's continued success. Projections indicate traffic at the airport has a good chance of increasing over the next few years. Our estimates were that this could lead to overflow at the Central Taxi Hold. Therefore, we felt it was important to plan ahead, so the solid waste problem, that was solved, did not become a problem again if there was an overflow of taxis when the Central Taxi Hold became overloaded. Therefore, with the Master and Site Planning Department, we prepared a functional drawing for the Central Taxihold Expansion at the Building 84 parking lot, which is presently under lease to United Parcel Service and El AL. The expansion can accommodate and additional 120 taxis.

Nesting Sites in Garages

During 1996 we have worked to manage pigeon problems at JFK. To date we have focused efforts on Building 269 and the Parking Garage in Parking Lot #2. These sites were chosen because the problem was a concern due to safety, and because the buildings are managed by Port Authority personnel, so we could offer our services to people we worked with. There is a problem with pigeons in the Delta Terminal that has to be taken care of. To date, a member of the Bird Control Unit stopped there and told them to stop feeding the birds, but the problem cannot be solved by eliminating feeding alone. There is a pervasive garbage problem in the area. We will work to eliminate this attractant.

Bridge and Building Design

We worked with the designers and engineers on the proposed TOGA to keep birds from nesting and roosting there after it is built. Working with Warren Kroeppel, to answer his inquiries I spoke with Dick Batten at Nixalite of America, Inc., 1025-16th Avenue, P.O.. Box 727, East Moline, IL 61244. 1-800-624-1189. FAX: 1-800-624-1196 about netting designs and Nixalite, which covers an area with sharp pointed projections. Nixalite is the material that was ruled out for the rafters in a hangar at LaGuardia Airport because of the difficulties with installing it over such a vast array of potential habitat. However, when considered as part of the initial design, with a much smaller area, this could be a cost-effective bird roosting deterrent. Mr. Batten said Model S is the recommended design for birds cover this range of sizes. I have calls out to a number of people to find out first hand what the industry has to say about Nixalite's efficacy with roosting starlings and pigeons. The netting recommended for this design is a 1/2 inch by 1/2 inch polypropylene construction. I will receive samples of each, should you want to see them. Nixalite has a design department that would be happy to discuss their recommended methods for affixing the Nixalite to round piping.

La Guardia Airport

There are more pigeon problems at LaGuardia than JFK. This is probably because LaGuardia is smaller, so the planes are closer to buildings and people, which brings them closer to the pigeons. Surveys activity that is usually close to near buildings and people landside interacts more frequently with the airside, resulting in a higher risk.

Most of the aircraft activity at JFK, however, is further from pigeon activity, which is why, I believe, we have fewer pigeon strikes here. Therefore we have taken measures to insure that we reduce the number of pigeons at LaGuardia. American Airlines has successfully dealt with the pigeon problem in their hangar by hiring contractors who are using the bird frightening agent (toxicant) Avitrol (4-Aminopyridine), as are we. We evaluated most of the alternatives (see section on chemicals in Chapter 8 of the John F. Kennedy Wildlife Management Plan).

Chemicals

After evaluating the alternatives, we decided to test Avitrol, which appeared to be the best available option. This chemical is applied to food that which causes an unpleasant physiological response when it is eaten. This response is thought to be sufficiently unpleasant that the birds avoid the area afterward, possibly due to a fright response. This material is therefore most useful when attempting to deter birds from either established feeding sites, or sites that are established first, before adding the Avitrol to the feed. Untreated bait is first strategically placed near the feeding sites, or in a new site that is to be turned into a feeding station. After the birds are trained to feed there, treated bat is added to the untreated bait for the desired effect. Usually just a small portion of treated bait, on the order of 1-3% is adequate. Many falconers feel that secondary kill, due to Avitrol, accounts for peregrines dying in many cities. This however, has been difficult to prove. Nevertheless, for this reason we do not use Avitrol when raptors are in the area. Applications are repeated as often as is necessary, but if applications are needed more than 4 times a year, then we will seek out another method, in our efforts to minimize secondary kill. The other alternatives that have been considered are:

Methyl anthranilate is not legal in New York State, although we conducted a legal trail test at JFK and found that it effectively eliminated gulls from remaining around standing pools of freshwater when it is placed in the water. Because rock doves do not exhibit similar behavior with regard to being attracted to pools of freshwater, methyl anthranilate was also deemed inadequate for dealing with this species. In addition, it was determined that methyl anthranilate is expensive, labor intensive, and there were more effective methods of eliminating standing water.

Alpha chloralose is a stupefying agent that produces and anesthetic affect inducing a sleep-like stupor in affected animals. The material is administered on a bait and is most useful for situations where capture and transport of animals to other locations is the bird removal method of choice. The United States Government is completing its series of tests and approval mechanisms for this chemical. There is not current operational policy at JFK to regarding its future use.

Contact poisons were ruled out because they are lethal and very labor intensive. Netting could work in some areas, but in the hangars there are large areas that netting cannot eliminate as suitable nesting habitat. In addition, netting is very costly and must be removed when cleaning or painting, or maintenance procedures need to provide access. We used wooden owls and deemed them to be ineffective after a brief time when the pigeons initially noticed them. It appears it doesn't take long for pigeons to realize the fake owls do not pose any threat whatsoever. Ultrasonic devices were used to no avail; the pigeons continued to use the hangars in large numbers. Bird scare eyes, which are balloons with eyes designed to scare birds, didn't have any effect on the number of birds using the hangars. Nixalite was ruled out by our Maintenance people because of the difficulties with installing it over such a vast array of potential habitat. Avitrol was considered an interesting option because it reputedly does not kill most birds, but rather gives the birds muscle spasms and then the birds avoid the area.

Avitrol is a registered pesticide under the Federal Insecticide, Fungicide, and Rodenticide Act. The New York State Department of Environmental Conservation said we could use Avitrol which is approved in the State of New York. Next we sought approval from the New York City Health Department for this specific application. The Deputy Commissioner gave us permission over the phone; it is NYC Health Department policy not to give such permission in writing.

Our certified Pesticide Applicators are certified by the New York City Health Department, which enables us to purchase and use Avitrol. We conducted an Avitrol test in August 1995. For two weeks we baited the area with 4 cups of corn per hundred birds on a daily basis. Because we were feeding 200 birds, 8 cups were consumed each time the food was laid out. Within a short number of days the birds were there to feed at feeding time. After feeding them for two weeks we applied 1 part Avitrol-treated corn to 9 parts untreated corn. 6 to 7 percent of the pigeons died, only 25 birds returned, the rest left the premises and did not return. The young called for several days after and then went silent. Apparently the young just remain in place and starve to death, which is unfortunate. Three months later the number of pigeons increased to the point that another treatment was necessary. This time, in November 1995, there were 100 pigeons. The birds were baited for two weeks with 4 cups of corn each day. Then instead of using Avitrol in a 1 to 9 ratio, we used 1 to 19 to avoid such a high mortality, however still 6 to 7 percent of the birds died, and all but

15 birds left the premises. And again, the young called with a chirping sound for days afterward.

Estimating Number of Pigeons

Counting the number of pigeons flying over JFK or living at JFK is not an easy exercise. Estimating the total number of pigeons is important if you hope to reduce the number. For instance, if you hire a firm to do the work, how can you evaluate whether you are receiving the service you have purchased without appropriate censusing before the contract begins, and then during the duration or at the conclusion of the contract?

One method would be to bait and trap pigeons, band them, then bait and trap, and do a Lincoln Index to calculate the total population. Another method would be to conduct a survey, count the number of pigeons seen, and then utilizing the identical methodology, conduct surveys at other times and compare. This will not give you an accurate absolute number of birds in a given area, however, it will give you a useful index. Or you could count the number of birds in the winter flocks in an area and assume that that number is a meaningful index of the total number of birds where you are conducting your survey. Or you can bait birds in using a regular feeding schedule, and count the number that come in at different locations, and assume that within reason, you are counting all the hungry adult pigeons in your vicinity.

No matter what method you use, counting the number of pigeons in a small area is not an easy exercise, nor is it any easier estimating the number of pigeons in a larger area, such as in all of New York City. But such estimates can be useful in that they help us to make educated decisions that enable us to manage the bird hazards at the airport.

Writing about the number of pigeons in New York City I wrote in *The Urban Naturalist* (Garber 1987) "it has been estimated that there are seven million of them in New York City, almost as many pigeons as people. While this figure may be high, these birds are amazingly successful in cities, due, in part, to their opportunism." But, if you will notice, I did not mention where this estimate came from. I read it some where, but the source gave no indication what the number was it based on. They didn't say. Such figures show up in newspaper and magazine articles. Someone out there generates quotable figures. Scientists know that if they say something fantastic that is supposedly true, even if its accuracy is way off the charts, it will be quoted forever. Like Terry Erwin, I believe, who said there were 50 million species, or 50 million species of beetles. He extrapolated his figure from the number of beetle species he found on one tree top in the Amazon. Before he said 50 million species, nearly everyone said there were about 1 million species of everything in the world, including beetles, and since we were finding new species the time, some people thought we might eventually name as many as 2 million species. Nevertheless, Erwin's fantasy number is quoted as the gospel.

Fisher (1940) similarly wrote there were 100 billion birds in the world. He also estimated there were 120 million birds in Britain. It has also been estimated that at the beginning of breeding season, the United States has 5.5 to 6 billion birds (Fisher and Peterson 1964).

I would be quite content if we could do 2 things at JFK: reduce the number of bird strikes, and reduce the risk to aviation. To do this we have to reduce the risks from each species. Pigeons appear to come from two sources at JFK. We have resident birds living on the airport, as well as the small number coming in from the nearby surroundings, and we have racing pigeons flying through our airspace. We can reduce the number of pigeons living on the airport by eliminating suitable nesting sites, eliminating many of their sources of food, and trapping pigeons that live here and moving them far enough away that they do not return. To be certain they don't return, we can band them, and determine with continued trappings whether we have moved them far enough away or not.

As for the racing pigeons, we have birds from Long Island that have been released to the south and west of the airport that on their return to eastern Long Island they fly through our airspace. We know these are the racing pigeons being struck from their bands, so we are currently working with the International Federation of American Homing Pigeon Fanciers, Incorporated to see if they might consider possible solutions to this problem that is causing the death of their racing pigeons and is causing a risk to aviation at JFK. One possible change that has been suggested is that the IF change the release sites for their birds to areas north of eastern Long Island, so on the birds' return trips they will not fly over JFK.

Laws

New York State Law regarding rock doves, based on New York's Department of Environmental Conservation Law 11-0515, is as follows:

"1. No person shall at any time, by any means or in any manner capture, kill or attempt to capture or kill any Antwerp or homing pigeon, wearing a ring or seamless leg band with this registered number stamped thereon, nor shall any person remove such mark. No person except the lawful owner shall detain, possess, or transport Antwerp or homing pigeons wearing a ring or seamless leg band with the registered number thereon.

2. Notwithstanding any other law to the contrary, the local legislative body of any city, town or village, or in the city of New York the Department of Health may take or issue a permit to any person to take pigeons at any time and in any humane manner in such municipality, whenever such body or administration finds that pigeons within such municipality are or may become a menage to public health or a public nuisance; provided, however, that no pigeon may be taken in a manner which will endanger other animal life, person or property."

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Garber, S.D. 1996. Rock doves (Columba livia) at John F. Kennedy International Airport in New York City. The Port Authority of New York and New Jersey. New York, New York

APPENDIX 22

Shooting Gulls to Reduce Strikes with Aircraft at John F. Kennedy International Airport, 1991-1996: Draft Summary

SHOOTING GULLS TO REDUCE STRIKES WITH AIRCRAFT AT JOHN F. KENNEDY INTERNATIONAL AIRPORT, 1991-1996

DRAFT SUMMARY

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This is a draft summary of the 1996 shooting program. A final report will be issued in January 1997. Please contact the authors if you want a copy of the final report.

SPECIAL REPORT FOR THE
PORT AUTHORITY OF NEW YORK AND NEW JERSEY
JOHN F. KENNEDY INTERNATIONAL AIRPORT

October 1996

DRAFT SUMMARY

SHOOTING GULLS TO REDUCE STRIKES WITH AIRCRAFT AT JOHN F. KENNEDY INTERNATIONAL AIRPORT, 1991-1996

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ABSTRACT: The collision of birds with aircraft is a serious problem at John F. Kennedy International Airport (JFKIA), New York. Laughing gulls (Larus articilla) accounted for 52% of the bird strikes (an aircraft striking ≥1 bird) from 1988-1990, averaging 157 strikes/year. This species is present from May September in association with a 7,600-nest colony (1990) in Jamaica Bay adjacent to the airport. A program to reduce gull collisions with aircraft was undertaken from May-August 1991-1996 in which 2-5 people stationed on airport boundaries used shotguns to shoot gulls flying over the airport. In 5,636 person-hours of shooting, 48,695 gulls were killed (14,866, 13,466, 7,340, 3,981, 6,759, and 2,623 in 1991-1996, respectively), comprised of 44,359 laughing gulls and 4,336 other gulls. The number of aircraft striking laughing gulls during the shooting period (20 May-15 Aug) declined by 66% in 1991 and 76-89% in 1992-1996, compared with the mean of 136 strikes during the same time period for 1988-1990. Strikes by the other gull species were reduced by a comparable amount. In spite of the removal of 44,359 laughing gulls in 1991-1996 (about 2.9 times the number of adults in the Jamaica Bay colony in 1990), the nesting colony declined by only 38% from 1990-1996 (7,629 to 4,730 nests). Thus, although shooting is an effective means of reducing the incidence of bird strikes, the program has not caused a major decline in the nearby nesting colony. Our recommended long-term solution is to relocate the nesting colony away from JFKIA. A seasonal shooting program, coupled with other management programs to deter gulls from the airport, should continue to minimize the number of gull-aircraft collisions until this relocation is achieved.

TABLE 3. Person-hours expended, shots fired, and gulls killed at John F. Kennedy International Airport, May-August 1991-1995.

Year	Dates of shooting	No. of days shooting	Person-hours shooting	No. shots fired	No. of gulls[a] killed: LAGU	HERG	GBBG	RBGU	Total	No. gulls/ person hr[b]	No. gulls/ 100 shots[c]
1991	20 May- 8 Aug	62	896	26,947	14,191	508	128	59	14,886	16.6A	55.2A
1992	15 May- 4 Aug	61	1,310	31,183	11,847	1,338	150	131	13,466	10.3B	43.2B
1993	25 May- 9 Aug	52	1,195	20,492	6,496	554	121	169	7,340	6.1C	35.8C
1994	21 Jun- 5 Aug	31	717	12,510	3,688	184	73	36	3,981	5.6C	31.8C
1995	20 Jun-17 Aug	42	861	16,216	6,167	430	97	65	6,759	7.9BC	41.7B
1996	19 Jun- 9 Aug	34	657	7,651	1,970	191	57	45	2,263	3.4C	29.6C
Total		292	5,636	114,999	44,359	3,205	626	505	48,695	8.6	42.3

[a] LAGU = laughing gull, HERG = herring gull, GBBG = great black-backed gull, RBGU = ring-billed gull.

[b] Number of gulls killed/person-hr is different among years ($F = 50.8$; 5, 1115 df; $P < 0.01$); yearly means with different letters are different ($P < 0.05$).

[c] Ratio of shots killing gulls to shots not killing gulls is different among years ($F = 53.5$; 5, 1105 df; $P < 0.01$); yearly means with different letters are different ($P < 0.05$).

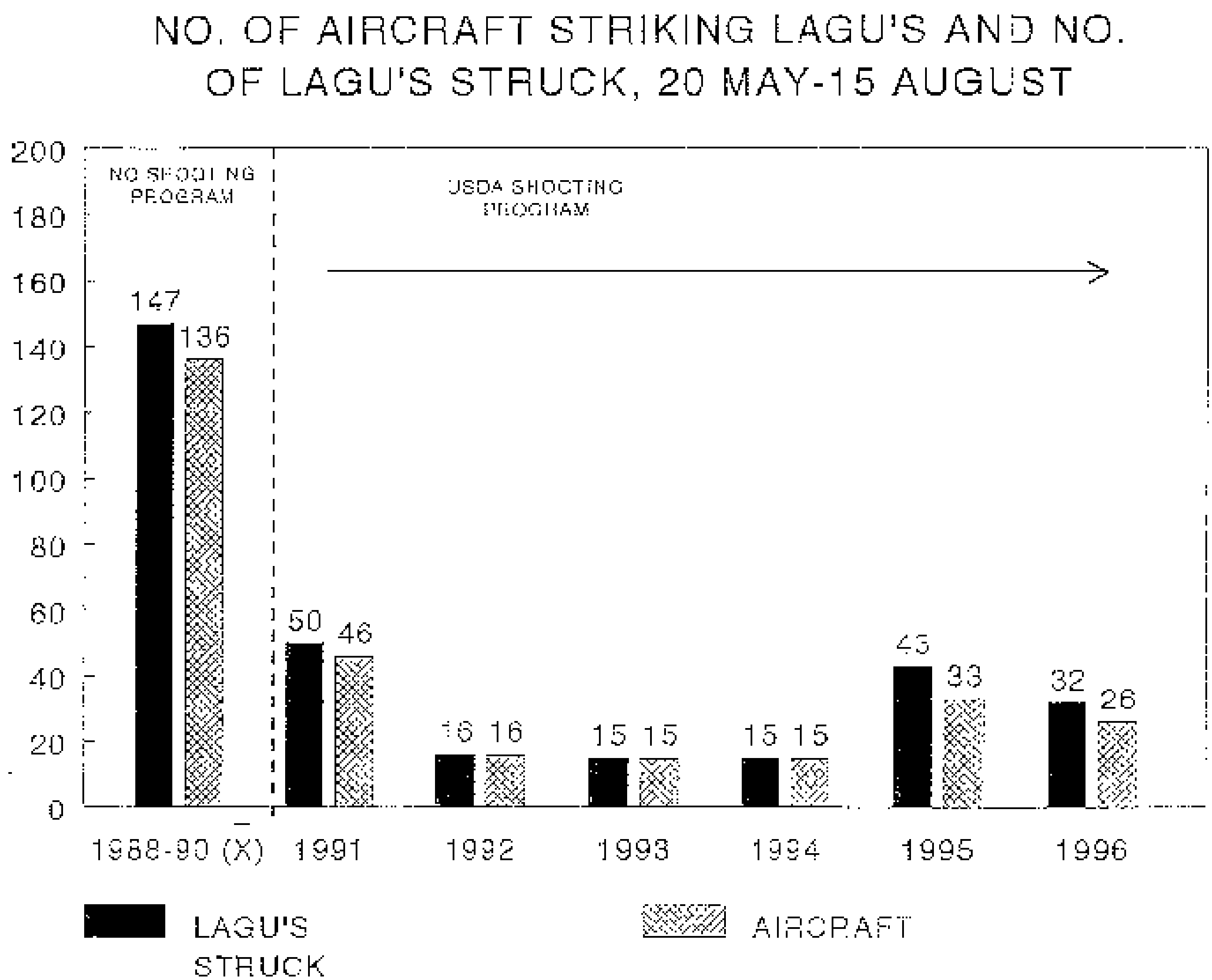


FIGURE 2. Number of aircraft striking laughing gulls and total laughing gulls struck at John F. Kennedy International Airport, 20 May-15 August, 1988-1996.

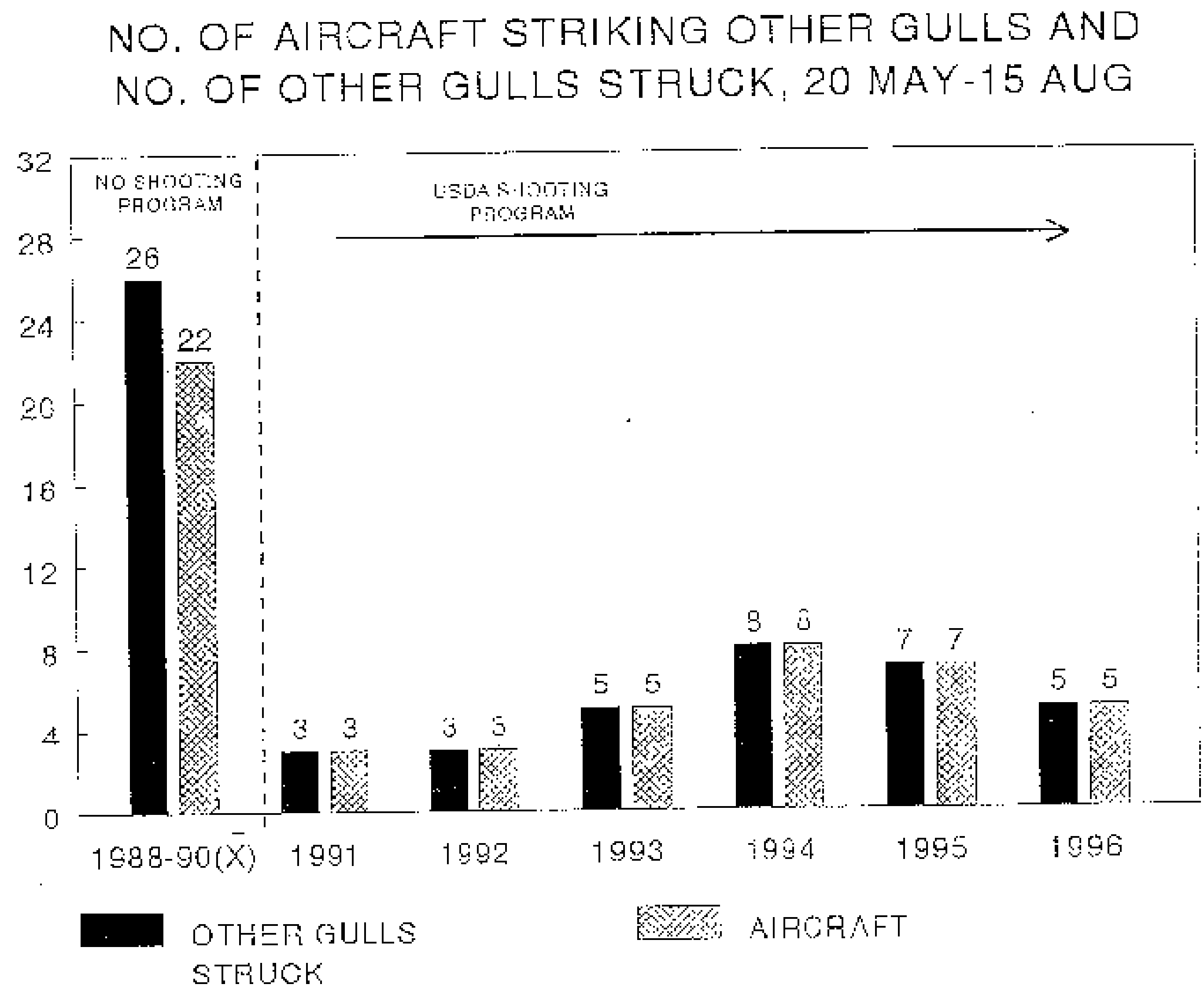


FIGURE 3. Number of aircraft striking other gulls (herring, great black-backed, ring-billed) and total other gulls struck at John F. Kennedy International Airport, 20 May-15 August, 1988-1996.

APPENDIX 23

Do Populations of North American Canada Geese Pose an increasing Hazard to Aviation?

DO POPULATIONS OF NORTH AMERICAN CANADA GEESE POSE AN INCREASING HAZARD TO AVIATION?

John L. Seubert

Bird Strike Committee USA Meeting

Phoenix, Arizona July 14-17, 1996

A. INTRODUCTION

THE PURPOSE OF THIS PAPER IS TO DRAW FURTHER ATTENTION TO THE INCREASES IN RESIDENTIAL POPULATIONS OF LARGE CANADA GEESE IN NORTH AMERICA, AND THEIR POTENTIAL HAZARDS TO AVIATION. THIS PAPER WAS PROMPTED BY THE LOSS OF THE U.S. AIR FORCE AWACS AIRCRAFT AND CREW IN ALASKA LAST FALL WHEN CANADA GEESE WERE INGESTED INTO TWO ENGINES ON TAKEOFF.

B. CANADA GOOSE PROBLEM

SAFETY, NUISANCE, AGRICULTURAL, AND HEALTH PROBLEMS HAVE BEEN WELL DOCUMENTED. THESE LARGE GEESE ARE THE "GIANT (*Branta canadensis maxima*) AND THE "WESTERN" (*B.c. moffitti*) SUBSPECIES. BECAUSE OF RECENT LOSSES AND DAMAGE TO AIRCRAFT DUE TO CANADA GEESE (AWACS, CONCORDE), THE HAZARD IS RECEIVING MORE ATTENTION. THE PAPER BY ALLAN AND FEARE IS AN EXCELLENT REVIEW, AS WELL AS THE RECENT AIRPORT WILDLIFE MANAGEMENT BULLETIN PREPARED BY BRUCE MACKINNON OF TRANSPORT CANADA.

C. CANADA GOOSE POPULATIONS (See Appendix)

IN NORTH AMERICA, FOUR ADMINISTRATIVE WATERFOWL FLYWAYS ARE USED IN THE MANAGEMENT OF MIGRATORY WATERFOWL--THE ATLANTIC, MISSISSIPPI, CENTRAL, AND PACIFIC. MID-WINTER POPULATIONS OF CANADA GEESE ARE COUNTED IN NOVEMBER/JANUARY. THE 1995 STATUS OF FLYWAY AND NORTH AMERICAN POPULATIONS ARE AS FOLLOWS:

-- ATLANTIC FLYWAY

TOTAL GOOSE COUNT	1,390,000
MIGRATORY	653,000
RESIDENT	737,000

THE MIGRATORY POPULATIONS THAT INCLUDE THE SUBSPECIES *B.c canadensis, B.c. interior*, AND *B.c hutchinsii* HAVE BEEN DECLINING FOR ABOUT THE PAST DECADE. HOWEVER, THE "GIANT" AND "WESTERN" RESIDENT POPULATIONS HAVE INCREASED. THUS, THE OVERALL ATLANTIC POPULATION HAS INCREASED.

-- MISSISSIPPI FLYWAY

TOTAL GOOSE COUNT	1,649,000
MIGRATORY	1,264,000
RESIDENT	385,000

BOTH MIGRATORY AND RESIDENT POPULATIONS ARE INCREASING.

-- CENTRAL FLYWAY

TOTAL GOOSE COUNT	1,472,000
MIGRATORY	946,000
RESIDENT	526,000

BOTH MIGRATORY AND RESIDENT POPULATIONS ARE INCREASING.

-- PACIFIC FLYWAY

TOTAL GOOSE COUNT	253,000
MIGRATORY	160,000
RESIDENT	93,000

BOTH MIGRATORY AND RESIDENT POPULATIONS ARE INCREASING.

-- NORTH AMERICAN MID-WINTER CANADA GOOSE COUNTS

TOTAL GOOSE COUNT	4,764,000
MIGRATORY	3,023,000
RESIDENT "LARGE GEESE" (36% OF TOTAL)	1,741,000

DURING THE PAST 10 YEARS (1986-95), THE NORTH AMERICAN CANADA GOOSE POPULATION HAS INCREASED BY 66 PERCENT. THE RESIDENT COMPONENT HAS INCREASED ABOUT THREE-FOLD.

D.1. NUMBER OF OPERATING JET AIRCRAFT (See Appendix)

FOR THE YEARS 1985-95, THE NUMBER OF OPERATING JET AIRCRAFT IN THE WORLD INCREASED FROM 7408 TO 12,452 (68%). THE COMBINED CANADIAN AND U.S. FLEETS INCREASED FROM 3863 TO 5828 (51%). THE NUMBERS INCLUDE ALL LARGE JET AIRCRAFT, E.G. AIRLINES, FED-X, UPS. IN 1995, 11,877 AIRCRAFT WERE OPERATED BY AIRLINES. THERE ARE ABOUT 100 SCHEDULED AIRLINES IN THE U.S.

A PAPER GIVEN AT THE BIRD STRIKE COMMITTEE EUROPE METING IN LONDON IN MAY 1996 BY AN AVIATION INSURANCE UNDERWRITER INCUDES AN ESTIMATE OF THE NUMBER OF TRANSPORT AIRCRAFT THAT WILL BE NEEDED IN FUTURE YEARS. THE AUTHOR PROJECTS AN INCREASE IN THE WORLD JET FLEET OF ABOUT 9,000 NEW AIRCRAFT BY THE YEAR 2014. IF THIS IS A REALISTIC

ESTIMATE, THE AIRCRAFT INDUSTRY WOULD HAVE TO PRODUCE AN AVERAGE OF 9.6 AIRCRAFT PER WEEK.

D.2. AIR CARRIER ACTIVITY - U.S.

DATA OBTAINED FROM THE AIR TRANSPORT ASSOCIATION INDICATES THAT DEPARTURES BY U.S. SCHEDULED AIRLINES INCREASED FROM 5,448,000 IN 1985 TO 7,510,000 IN 1994, A 29 PERCENT INCREASE . THESE FIGURES INCLUDE NON-PASSENGER FLIGHTS, E.G. FED-X.

E. WORLD POPULATION GROWTH/INCREASED DEMAND TO AIR TRAVEL

CANADA GOOSE POPULATIONS, OPERATING JET AIRCRAFT NUMBERS, AND AIR CARRIER ACTIVITY ARE INCREASING. MAYBE WE SHOULD CONSIDER ANOTHER IMPORTANT ELEMENT--THE HUMAN POPULATION? ACCORDING TO THE POPULATION REFERENCE BUREAU, THE EARTH'S POPULATION OF 5.8 BILLION WILL INCREASE BY 88 MILLION IN 1996 AND WILL DOUBLE IN 46 YEARS TO 11.6 BILLION. I WONDER WHAT IMPACT SUCH GROWTH WILL HAVE ON AIR TRANSPORT AND ON AVIATION SAFETY VIS-A-VIS BIRD HAZARDS?

F. CANADA GOOSE STRIKES ON AIRCRAFT

ALTHOUGH INFORMATION ABOUT THE GOOSE SPECIES INVOLVED IN BIRD STRIKES IS QUITE LIMITED, SOME DATA WERE ACQUIRED FROM THE INTERNATIONAL CIVIL AVIATION ORGANIZATION (ICAO), THE FAA, AND JFK. THE ICAO RECORD SHOWS THE INCOMPLETENESS OF STRIKE REPORTING, WITH 63% OF THE GEESE NOT IDENTIFIED BY SPECIES. HOWEVER, A SUBSTANTIAL IMPROVEMENT IS SEEN IN RECENT YEARS (Tab. 1)

CANADA GOOSE STRIKE DATA FOR THE U.S. DURING THE 1993-95 PERIOD WAS COMPILED FROM THE FAA BIRD STRIKE DATA BASE. (Tab. 2) CANADA GEESE DAMAGE ENGINES, BUT ONLY SMALL DIFFERENCES ARE SEEN BETWEEN YEARS IN TOTAL GOOSE STRIKES AND IN THE NUMBER OF DAMAGED ENGINES. MORE YEARS OF RELIABLE DATA ARE NEEDED. NOTE THAT 60% OF THE GEESE WERE NOT IDENTIFIED BY SPECIES.

CANADA GOOSE STRIKES HAVE OCCURRED AT JFK AIRPORT FOR MANY YEARS. EXCEPT FOR 1995, ONLY SMALL DIFFERENCES ARE SEEN IN THE NUMBER OF STRIKES EACH YEAR (Tab. 3) SO, I AM NOT ABOUT TO INFER THAT THE THREAT HAS INCREASED. ONE, SIX-MILLION DOLLAR STRIKE TO THE CONCORDE AT JFK IN 1995 IS A GOOD EXAMPLE OF HOW THERE MAY NOT NECESSARILY BE A CORRELATION BETWEEN THE NUMBER OF STRIKES AND THE DEGREE OF HAZARD TO AVIATION. A FEW STRIKES WITH HIGH HAZARD SPECIES (GEESE) IS A MUCH GREATER THREAT THAN MANY STRIKES WITH LOW HAZARD SPECIES (SONG BIRDS).

IT IS UNFORTUNATE THAT WE HAVE NOT BEEN ABLE TO OBTAIN BETTER IDENTIFICATION OF A BIRD AS CONSPICUOUS AS A CANADA GOOSE. ALTHOUGH WE FIND IT DIFFICULT TO EVALUATE THE OVERALL MAGNITUDE OF

TABLE 1

North American Goose Strikes Reported
ICAO Data Base - 1985-94

Year	Canada Goose	Brant and Snow Geese	Unid. Species	Total
1985	5	2	5	12
1986	4	0	17	21
1987	3	0	18	21
1988	7	2	3	12
1989	2	0	36	38
1990	14	1	16	31
1991	0	0	1	1
1992	16	1	25	42
1993	5	2	2	9
1994	8	2	2	12
Totals	64 (32%)	10 (5%)	125 (63%)	199

TABLE 2

GOOSE STRIKES TO CIVIL AIRCRAFT - U.S. 1993-95*

Year	All Goose Species	No. Eng. Damaged	Canada Geese	No. Eng. Damaged	Unid. Geese	No. Eng. Damaged
1993	76	7 (9%)	26	5 (19%)	44	1 (2%)
1994	80	7 (7.5%)	28	3 (11%)	49	3 (6%)
1995	84	15 (18%)	31	6 (19%)	51	8 (16%)
	240	29 (12%)	85	14 (16%)	144	12 (8%)

* From FAA bird strike data base (R.A. Dolbeer, pers. comm.)

Note: 60% of geese unidentified!!

Table 3

CANADA GOOSE STRIKES AT JFK - 1979-96*
(R. Dalbeer, pers. commun.)

	YEAR	NO. STRIKES	NO. GEESE
	1979	3	3
	1980-82	0	0
	1983	1	1
	1984	3	5
	1985	1	6
	1986	2	2
	1987	0	0
	1988	1	1
	1989	2	4
	1990	1	1
	1991	2	5
	1992	1	2
	1993	1	1
	1994	2	2
	1995	5	10
*	1996 (to 7/1)	1	1
	TOTAL	26	44

THIS HAZARD FOR LACK OF MORE RELIABLE INFORMATION. AVIATION INTERESTS SHOULD NOT HESITATE TO IMPLEMENT CONTROL PROCEDURES IF RESIDENTIAL CANADA (OR OTHER GEESE) ARE ON OR IN CLOSE PROXIMITY TO AIRPORTS, ESPECIALLY, WHERE HEAVILY LOADED SCHEDULED AIRLINES TAKE OFF. I BELIEVE THAT CANADA GEESE ARE A SERIOUS HAZARD TO AIRCRAFT, AND THAT CONCERNED PARTIES SHOULD TAKE APPROPRIATE MEASURES TO OBVIATE THIS THREAT. THAT IS, ANTICIPATE AND PREVENT.

THE HAZARD POSED BY CANADA GEESE DOES NOT APPLY ONLY TO CANADIAN AND U.S. AIRLINES. EUROPEAN AIRLINES ALSO ARE AT RISK, SINCE IN JUNE 1996, THEY MADE ABOUT 1000 INTERNATIONAL DEPARTURES EACH WEEK FROM 27 CANADIAN AND U.S. AIRPORTS. CANADA GEESE POSE A THREAT AT 20 OF THESE AIRPORTS.

G. GENERAL COMMENTS

ACCORDING TO JIM COOPER AT THE UNIVERSITY OF MINNESOTA, CANADA GEESE ON OR NEAR THE MINNEAPOLIS-ST. PAUL, AIRPORT (MSP) WERE CONSIDERED AN AVIATION HAZARD IN 1981. HAZARD REDUCTION TECHNIQUES RECOMMENDED INCLUDED HABITAT MODIFICATION, VISUAL OR ACOUSTICAL HARASSMENT, TRAPPING AND TRANSLOCATION, AND THE KILLING OF BIRDS. HARASSMENT AND HABITAT MODIFICATION WERE EITHER INEFFECTIVE OR NOT FEASIBLE. ABOUT 40,000 GEESE HAVE BEEN TRAPPED DURING THE FLIGHTLESS PERIOD AND TRANSLOCATED. COOPER NOW BELIEVES THAT TRANSLOCATION SHOULD NOT BE DONE, BECAUSE THERE ARE TOO MANY GEESE. THE PRESENT PROGRAM INCLUDES SOME SHOOTING AND TRAPPING, AND PROCESSING GEESE FOR FOOD. HE ESTIMATES THAT AT LEAST 2500 GEESE WOULD HAVE TO BE REMOVED EACH YEAR.

COOPER ALSO CONFIRMED THAT IF SUB-FLOCKS OF CANADA GEESE USING AN AIRPORT AREA CAN BE IDENTIFIED AND ELIMINATED IN THEIR REARING AREAS, GOOSE NUMBERS WILL BE REDUCED AT AN AIRPORT. HE ALSO SUGGESTS THAT INTENSIVE HARASSMENT, ROCKET-NETTING AND REMOVAL, OR SPECIAL HUNTS COULD BE USED TO CONTROL MIGRANT GEESE.

DON RUSCH OF THE UNIVERSITY OF WISCONSIN, IS ALSO VERY KNOWLEDGEABLE ABOUT "GIANT" CANADA GEESE IN THE MISSISSIPPI FLYWAY (MF). HE HAS THE FOLLOWING OPINIONS ABOUT CANADA GOOSE POPULATIONS IN THE FLYWAY:

-- ONE HALF OF THE GEESE ARE RESIDENTIAL.

-- THE RESIDENTIAL POPULATION IS GROWING TWICE AS FAST AS THE MIGRANTS.

-- CANADA GEESE NOW BREED IN 48 STATES, IN ALL CANADIAN PROVINCES, AND ON TWO CONTINENTS BESIDES NORTH AMERICA AND IN NEW ZEALAND.

-- GIANT CANADA GEESE IN THE MF HAVE THE HIGHEST REPRODUCTION AND SURVIVAL RATE OF ANY SUBSPECIES.

-- GIANT CANADA GEESE WEIGH MORE, BREED EARLIER IN LIFE, HAVE LARGER CLUTCH SIZES, HAVE HIGH AND CONSISTENT REPRODUCTIVE SUCCESS, AND HAVE LOWER EXPOSURE TO HUNTING.

-- THE MANAGEMENT OF GIANT CANADA GEESE SHOULD CONTINUE TO ENCOMPASS PROTECTION, SUSTAINABLE USE, AND DAMAGE CONTROL.

CANADA GOOSE EXPERTS, NELSON AND OETTING, DISCUSSED THE RESIDENTIAL CANADA GOOSE PROBLEM AT AN INTERNATIONAL CANADA GOOSE SYMPOSIUM IN 1991 AND MADE THE FOLLOWING POINTS:

-- THE RAPID EXPANSION OF GIANT CANADA GEESE IN NORTH AMERICA DURING THE PAST 30 YEARS IS ONE OF WILDLIFE MANAGEMENT'S GREAT SUCCESS STORIES.

-- MANAGERS HOWEVER, HAVE BEEN UNABLE TO CONTROL EXPANDING RESIDENT CANADA GOOSE POPULATIONS WITH SOCIALLY ACCEPTABLE METHODS.

-- THERE ARE THREE KEY MANAGEMENT QUESTIONS:

1. HOW LARGE IS ENOUGH?
2. WHAT CONTROL MEASURES WILL BE NECESSARY TO KEEP POPULATIONS AT A DETERMINED LEVEL?
3. HOW ARE THESE GEESE MIXING WITH OTHER MIGRATORY POPULATIONS AND IMPACTING DATA BASES ON POPULATION SIZES AND HARVEST ESTIMATES?

H. <u>DEPREDATIONS PERMITS - U.S.</u>

THE U.S. FISH AND WILDLIFE SERVICE IS CONSIDERING A MODIFICATION IN THE SYSTEM OF ISSUING DEPREDATIONS PERMITS THAT WOULD AUTHORIZE STATES AND/OR THE ANIMAL PLANT HEALTH AND INSPECTION SERVICE, U.S. DEPARTMENT OF AGRICULTURE, TO CONTROL SAFETY AND OTHER PROBLEMS CAUSED BY RESIDENTIAL CANADA GOOSE POPULATIONS. DEPREDATIONS PERMITS ARE REQUIRED, IF THE EGGS AND NESTS OF MIGRATORY BIRDS ARE TO BE TAKEN, OR IF THE YOUNG OR ADULTS ARE TO BE TRAPPED OR KILLED.

I. <u>RECOMMENDATIONS</u>

-- AIRPORT MANAGERS SHOULD DEVELOP AND IMPLEMENT MEASURES TO PROMPTLY DETECT, REPEL, AND CONTROL CANADA AND OTHER GEESE THAT ARE ON, OVER, OR IN CLOSE PROXIMITY TO AN AIRPORT. CERTAIN PROGRAMS MAY REQUIRE COORDINATION WITH STATE, PROVINCIAL, AND FEDERAL RESOURCE MANAGEMENT AGENCIES AND OTHER INTERESTED PARTIES.

-- PROGRAMS SHOULD BE IMPLEMENTED TO IMPROVE THE IDENTIFICATION OF BIRDS INVOLVED IN STRIKES ON AIRCRAFT ENGINES, ESPECIALLY THE LARGE FLOCKING SPECIES SUCH AS GEESE.

-- IF U.S. AIRPORT MANAGERS, ENCOUNTER DIFFICULTIES IN OBTAINING FEDERAL DEPREDATIONS PERMITS NEEDED FOR THE CONTROL OF CANADA GOOSE HAZARDS (OR OTHER SPECIES), THE DIRECTOR OF THE U.S. FISH AND WILDLIFE SERVICE SHOULD BE CONTACTED WITHOUT DELAY. I AM VERY SERIOUS -- SOMETIMES IT ONLY TAKES ONE BIRD.

J. ACKNOWLEDGMENTS

I WISH TO ACKNOWLEDGE THE ASSISTANCE OF EXPERTS IN THE ECOLOGY AND MANAGEMENT OF CANADA GEESE WHO PROVIDED THE INFORMATION PRESENTED. DAVE SHARP, CENTRAL FLYWAY REPRESENTATIVE OF THE OFFICE OF MIGRATORY BIRD MANAGEMENT, U.S. FISH AND WILDLIFE SERVICE, WAS ESPECIALLY HELPFUL IN THE PREPARATION OF THE FLYWAY SLIDES USED. SANDY WRIGHT AND ALISTER PINOS WERE MOST HELPFUL IN PROVIDING GOOSE STRIKE DATA.

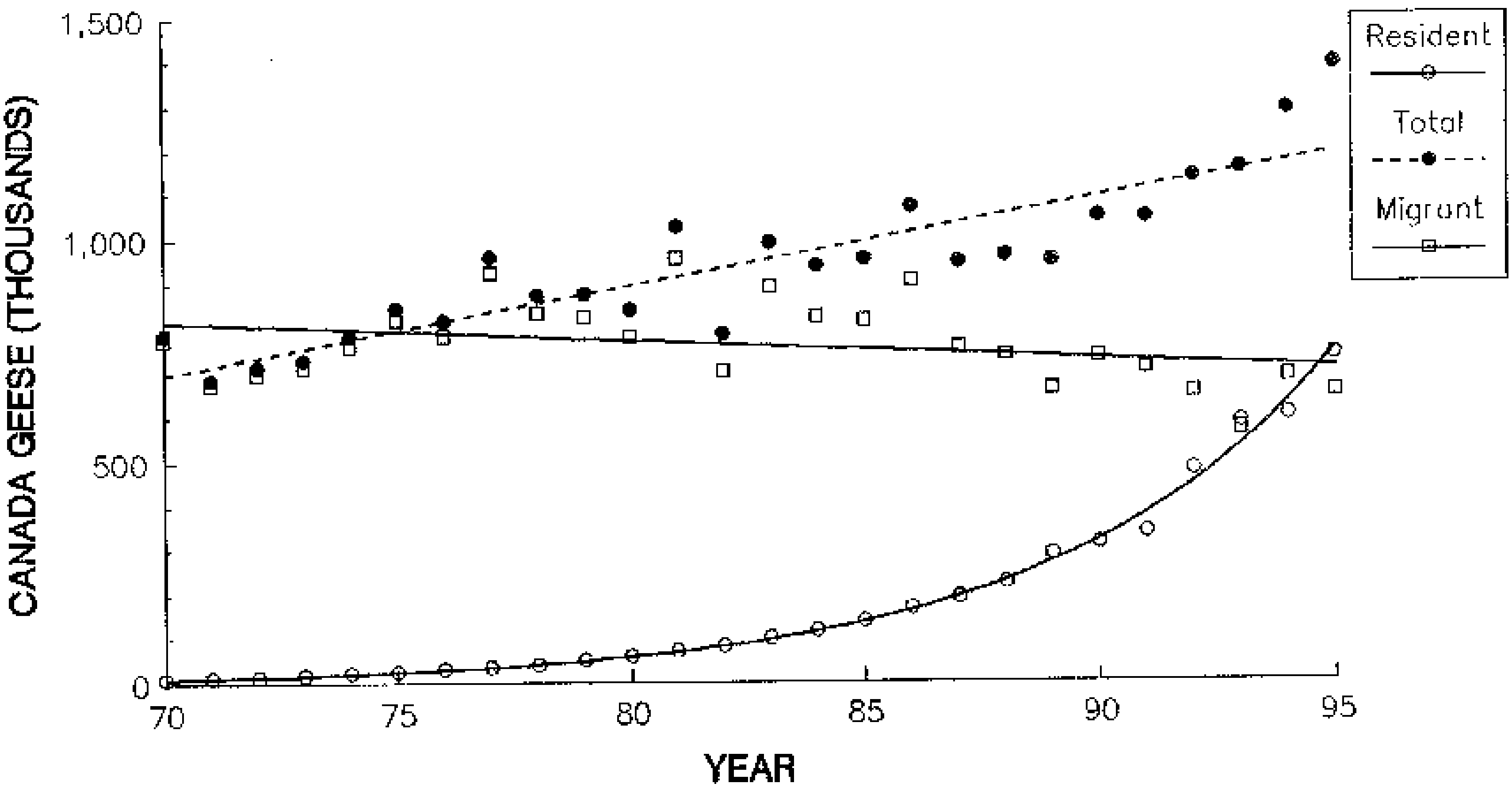
THANK YOU

APPENDIX

North American Canada Goose Population Trends

CANADA GOOSE POPULATION STATUS

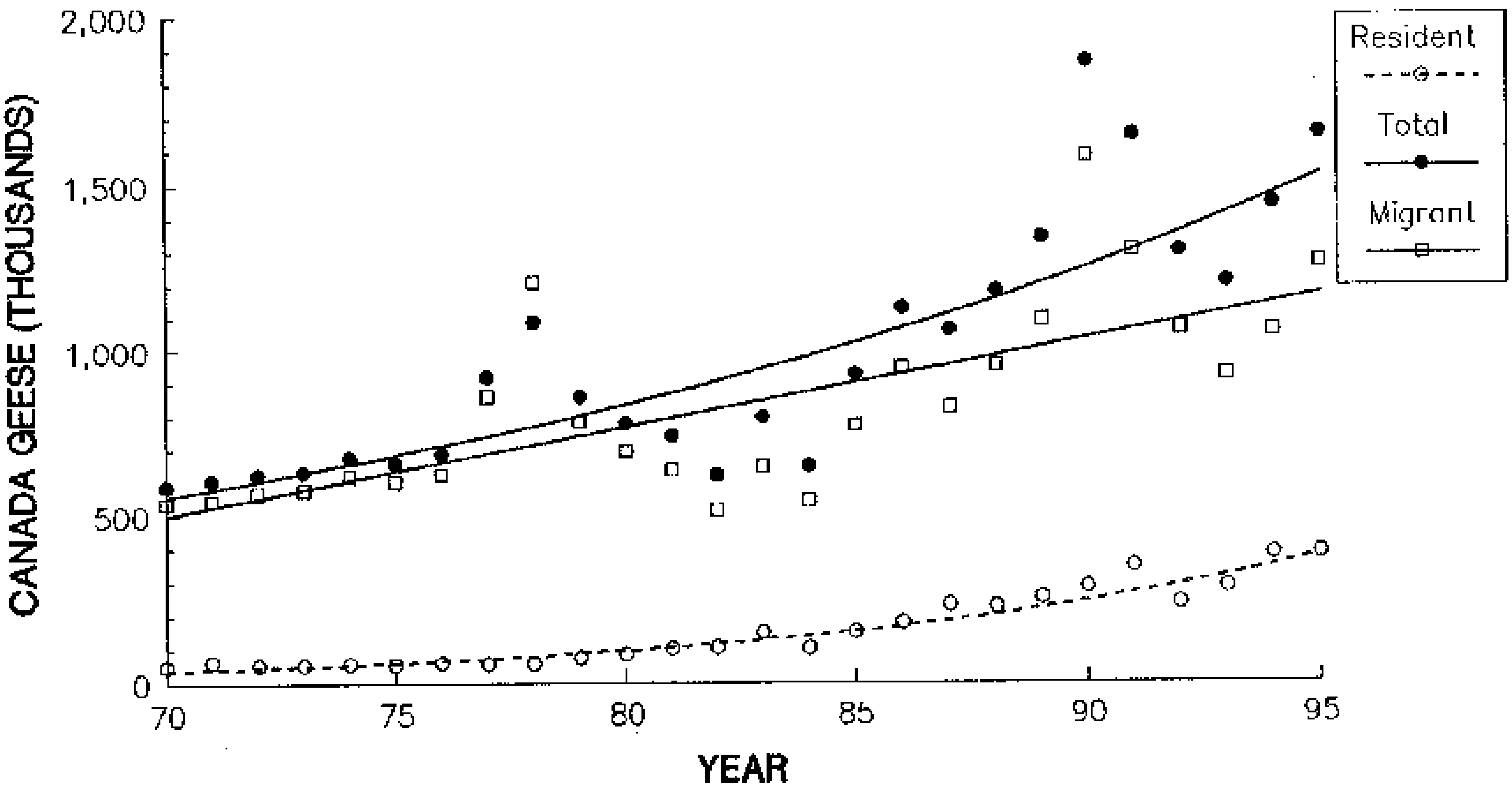
ATLANTIC FLYWAY
1970-95



CANADA GOOSE POPULATION STATUS

MISSISSIPPI FLYWAY

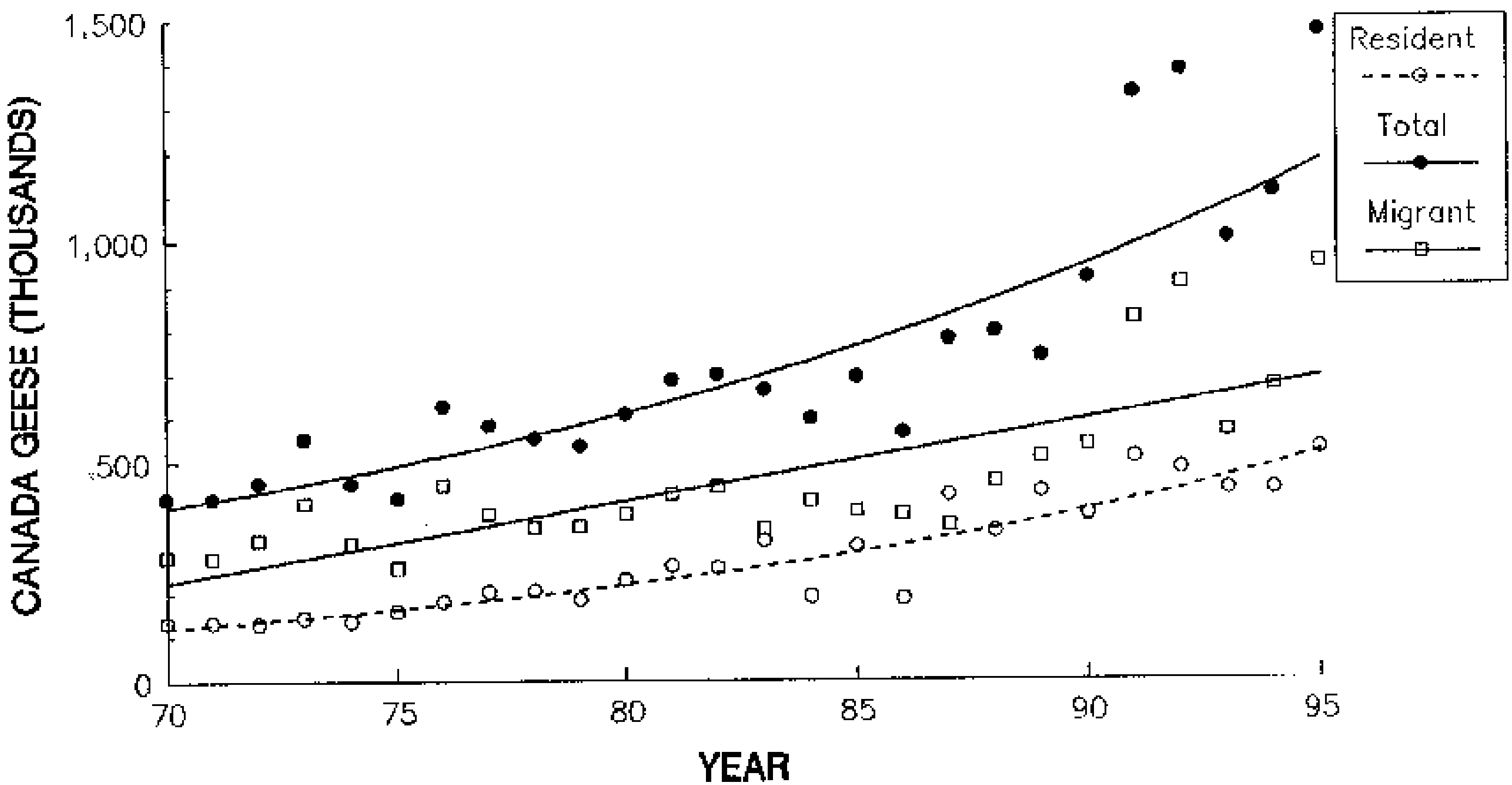
1970-95

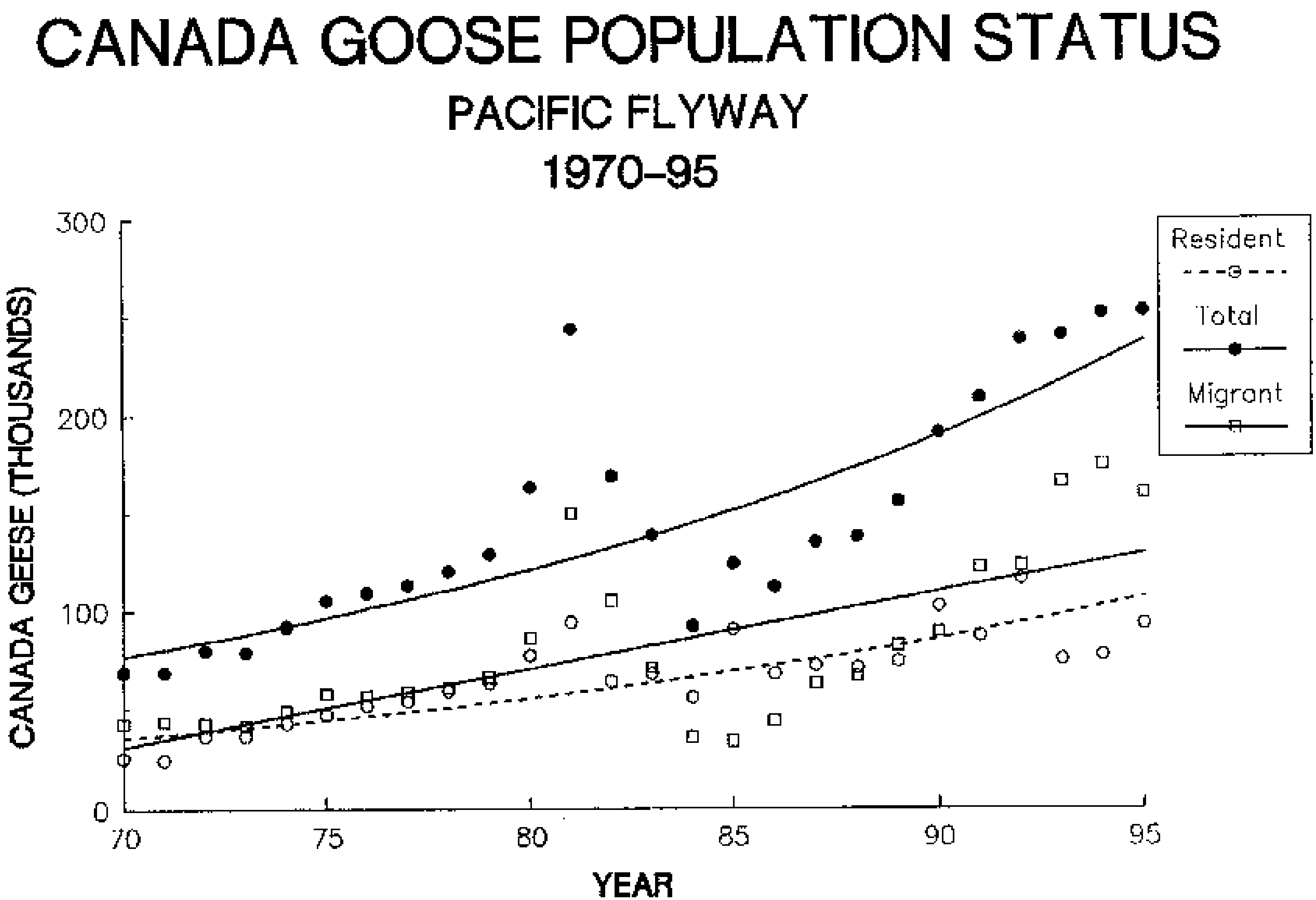


CANADA GOOSE POPULATION STATUS

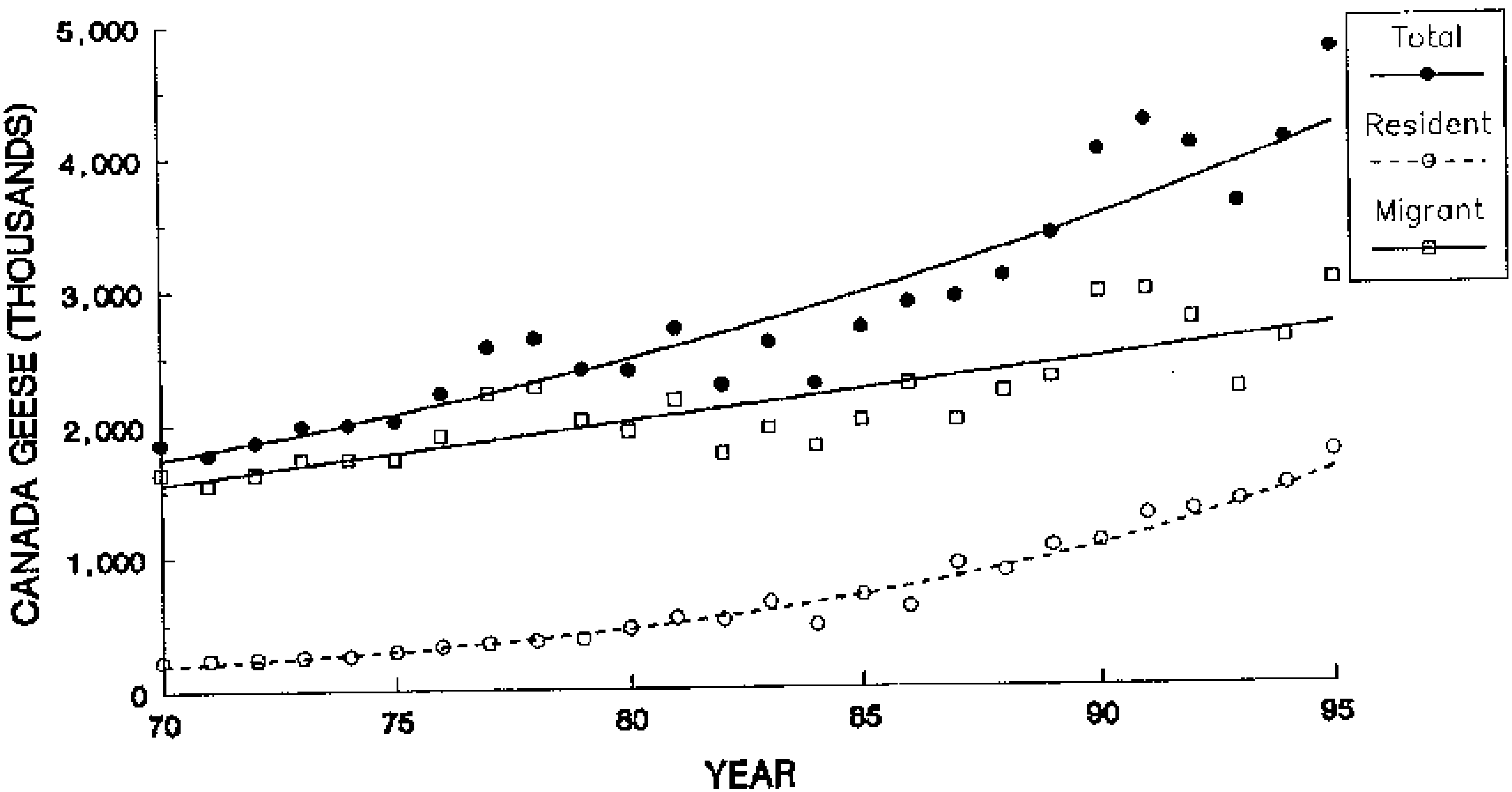
CENTRAL FLYWAY

1970-95




CANADA GOOSE POPULATION STATUS
PACIFIC FLYWAY
1970-95
CANADA GEESE (THOUSANDS)
300
200
100
0
70
75
80
85
90
95
YEAR
Resident
Total
Migrant

NORTH AMERICAN CANADA GOOSE POPULATION STATUS 1970–95



INTERNATIONAL CIVIL AVIATION ORGANIZATION
ORGANISATION DE L'AVIATION CIVILE INTERNATIONALE
ORGANIZACIÓN DE AVIACIÓN CIVIL INTERNACIONAL
МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ГРАЖДАНСКОЙ АВИАЦИИ
منظمة الطيران المدني الدولي
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15 November 1996

Ref.: AN 4/9.1-96/87

Subject: Studies relating to bird hazard reduction
Action required: To note

Sir/Madam,

I have the honour to transmit to you the attached data emanating from a statistical study of bird strikes reported to ICAO and occurring during the period 1990 to 1994. This ongoing study is being conducted to better understand the problems posed by bird strikes in the vicinity of airports. The study also provides background information for future work to be done by the Secretariat in this respect.

States are invited to make full use of the IBIS programme for general safety studies and bird strike reduction programmes. To this end, special analyses of bird strike data stored in the IBIS system may be obtained on request by writing to the Secretary General.

ICAO is now in the process of collecting data on bird strikes which occurred in 1995. If your State has not already reported such information, may I urge you to transmit it so as to reach me as soon as possible.

Please accept the assurances of my highest consideration.

for

Philippe Rochat
Secretary General

Enclosures:
Statistical data on the ICAO bird strike information system (IBIS)

Table 4. Bird strikes by bird species

Bird Species	1990	1991	1992	1993	1994	Total
Gulls and Terns	861	437	869	399	903	3469
Perching birds	770	504	872	584	917	3647
Raptors	322	306	313	270	335	1546
Lapwings, Plovers etc.	217	184	150	115	129	795
Pigeons, Doves	174	124	243	116	265	922
Other	308	235	362	196	521	1622
Unknown	2433	3377	2796	1747	3027	13380

Percentage Distribution

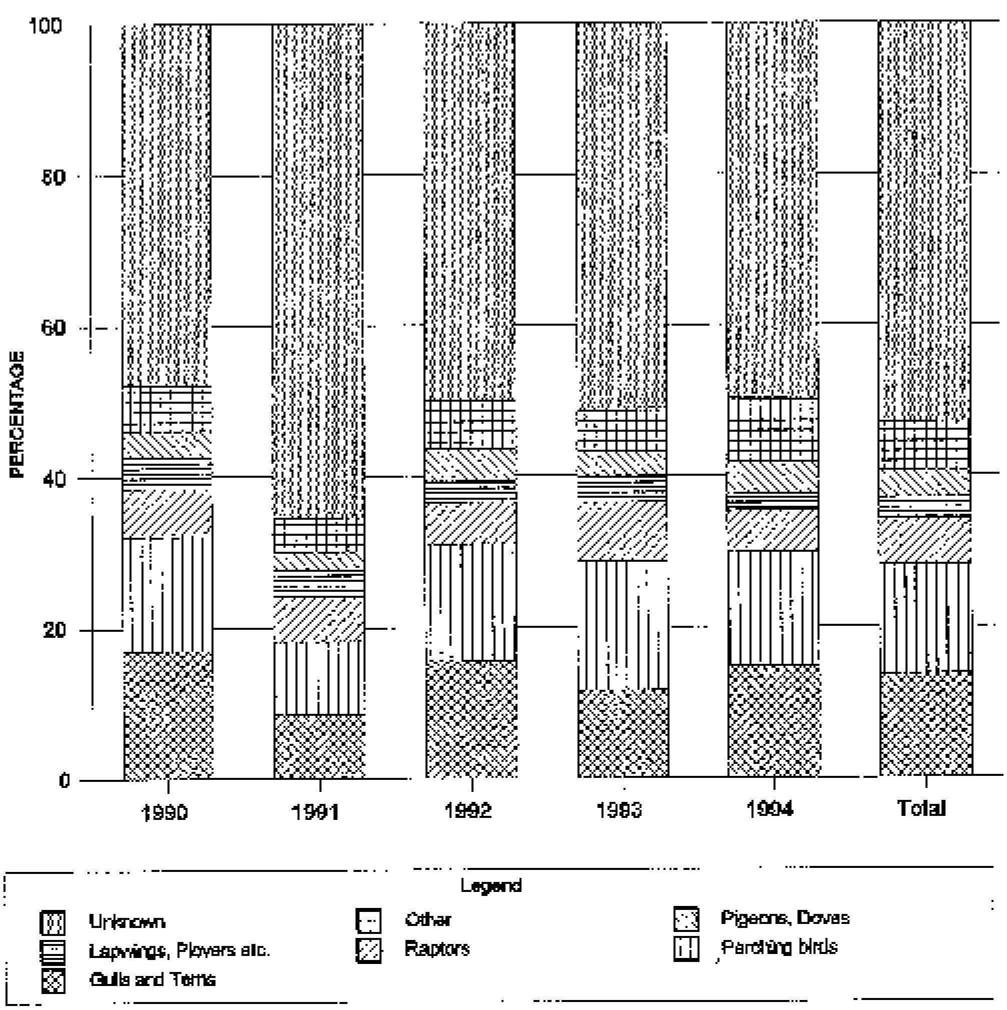


Table 5. Bird strikes by part of aircraft

Part of Aircraft	1990	1991	1992	1993	1994	Total
Nose	521	680	840	548	972	3561
Engines	740	853	965	771	1056	4385
Wings	542	614	800	527	806	3289
Windshield	504	590	812	507	1061	3474
Fuselage	461	540	629	438	846	2914
Radome	454	531	721	508	737	2951
Landing Gear	229	236	333	211	411	1420
Other	244	218	412	181	326	1381

Percentage Distribution

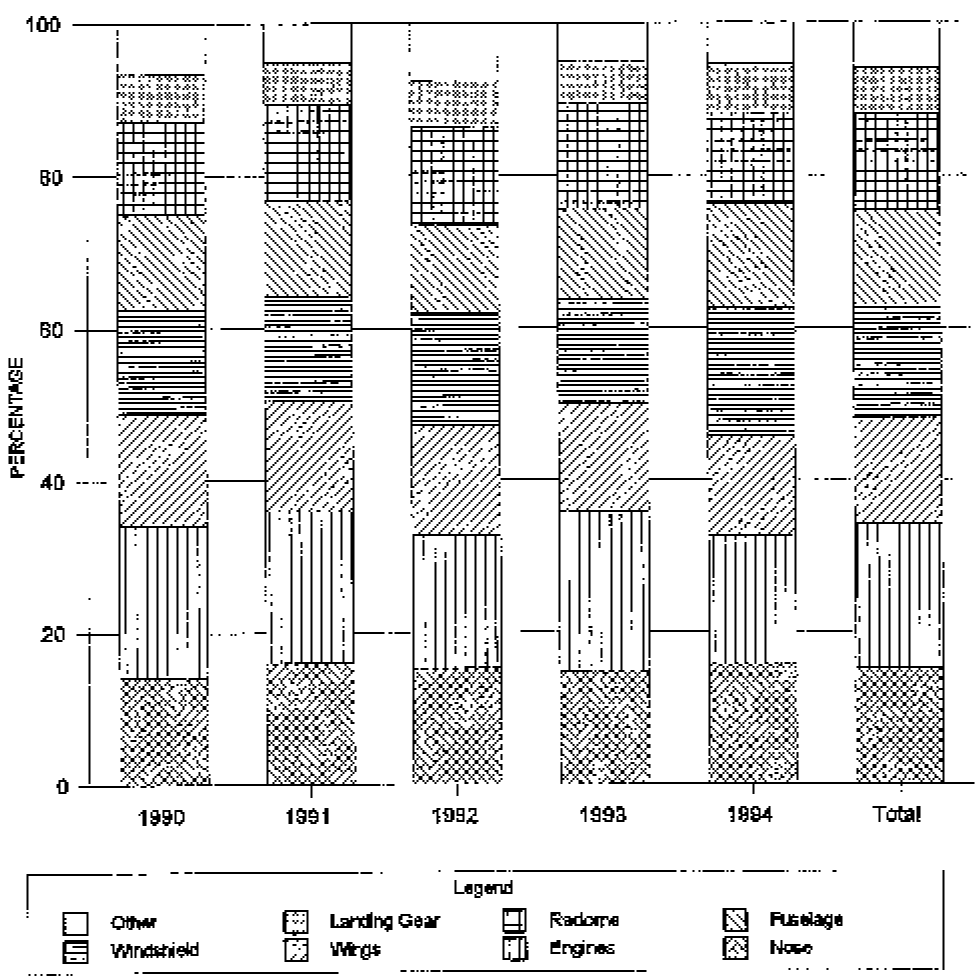


Table 6. Bird strikes by effect on flight

Effect on Flight	1990	1991	1992	1993	1994	Total
Precautionary Landing	173	97	216	86	209	781
Aborted Take-off	91	63	97	53	140	444
Engine Shut Down	36	28	17	9	33	123
Vision Obscured	1	10	6	4	6	27
Other	6	4	23	7	8	48

Percentage Distribution

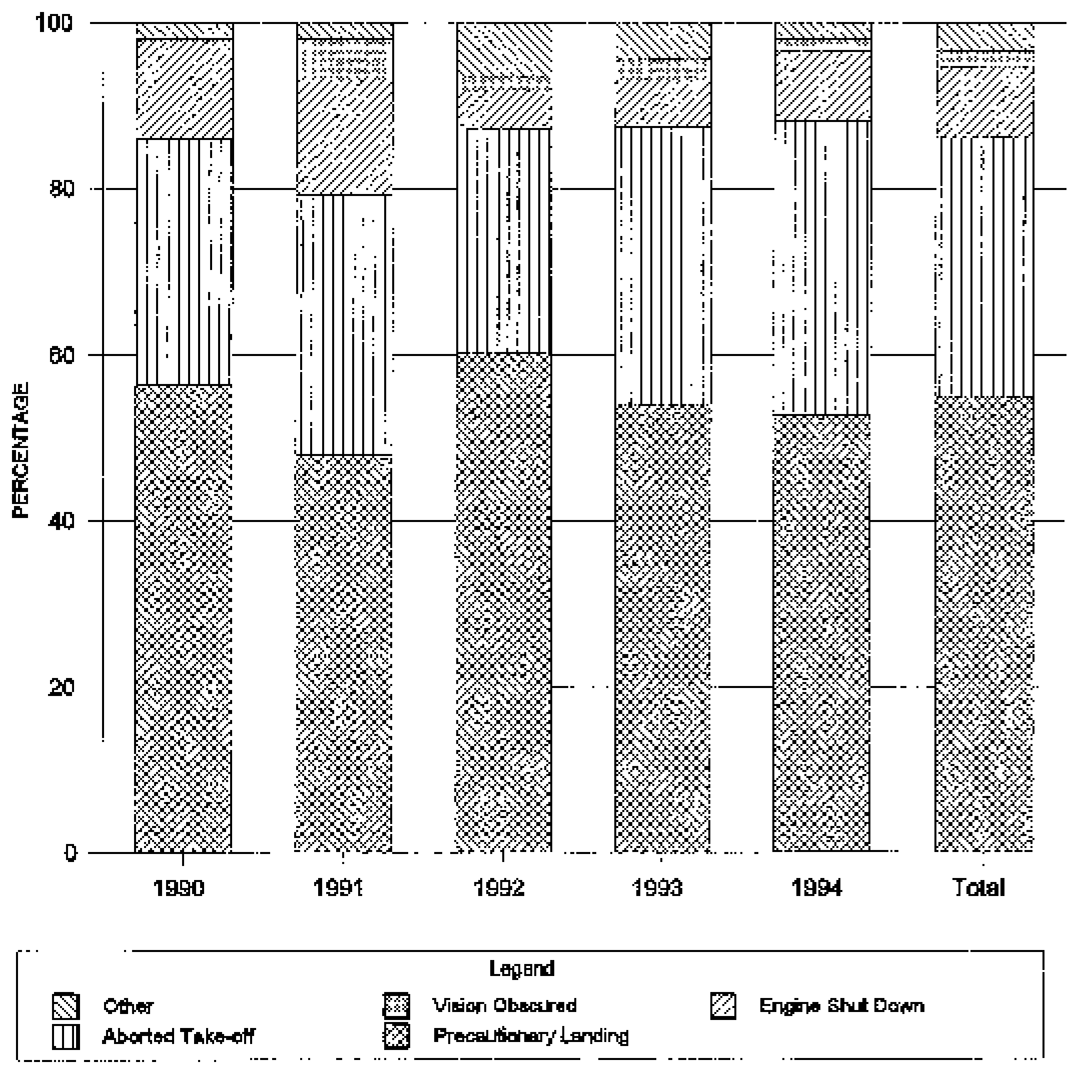
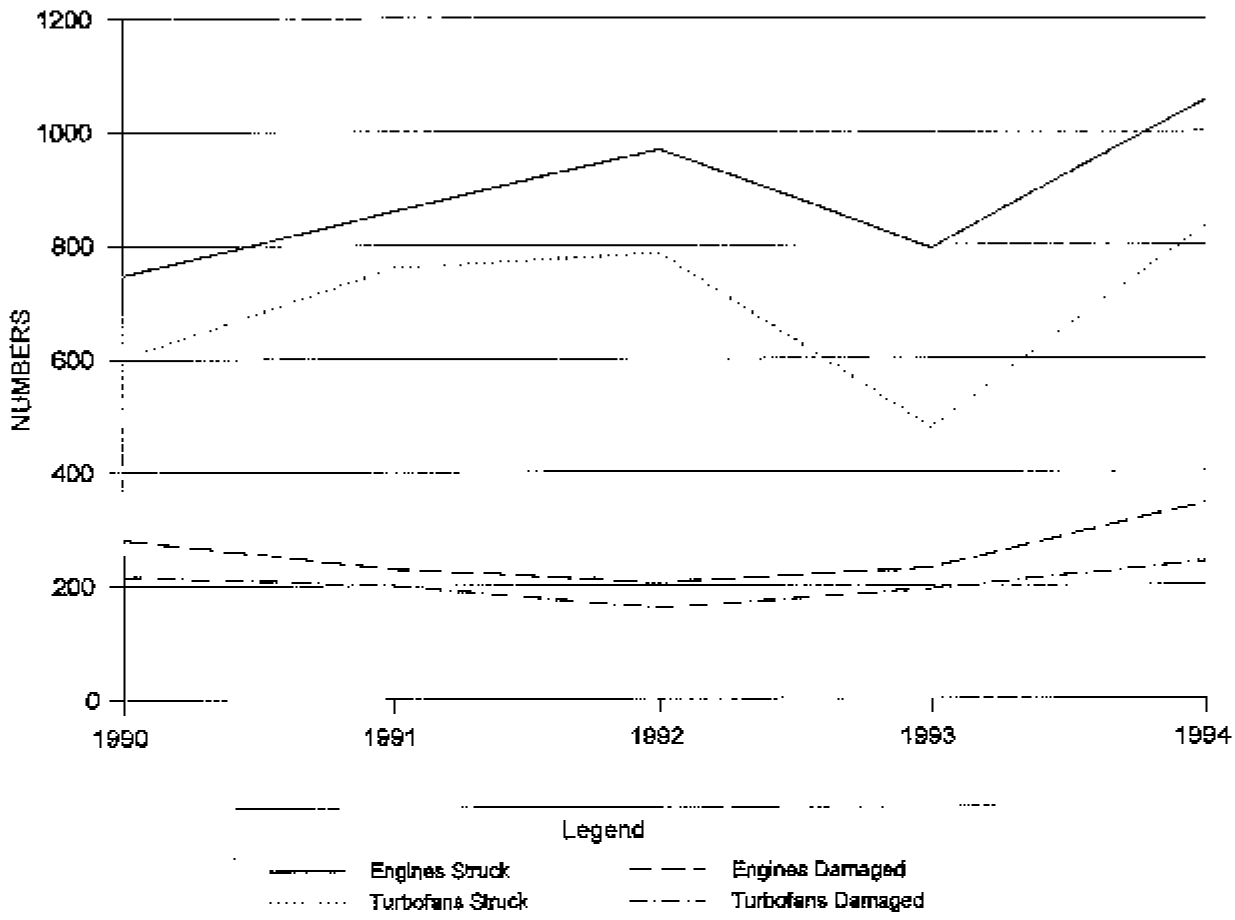


Table 7. Engine struck (S)/damaged (D) due to bird strikes

	1990	1991	1992	1993	1994
Engines Struck	747	859	968	794	1056
Engines Damaged	281	229	204	230	327
Turbofans Struck	602	760	785	478	834
Turbofans Damaged	217	200	160	193	242

Numerical Distribution



Result of your *Air Letter On-line* search for "Eindhoven C-130 crash":

* Bird strike caused Dutch C-130 crash

* Amsterdam: A flock of birds caused a Belgian Lockheed Martin C-130 Hercules military transport to crash at Eindhoven airport in the Netherlands in July, according to an official report published last week. Thirty-four of the 41 people aboard died in the crash. The report, compiled by the Royal Netherlands Air Force, the Interior Ministry and emergency services, found that up to 600 starlings and lapwings, out of view of the airport┤s control tower, took flight as the C-130, returning members of a Dutch army brass band from Italy, came in to land on July 15. The birds smashed into the aircraft cockpit and the left wing, with dozens of them ending up in the engines. As the aircraft lost power and altitude, the pilot, who died in the crash, attempted to abort his landing. But, with only one of four engines still running, the C-130 veered left and ploughed into a field, erupting in a fireball as its fuel tanks were ruptured. The report criticised the emergency services and traffic control for poor communications before and after the crash. It took over 35 minutes before fire services were told that there were more than the four crew members on board the aircraft. The Defence Ministry said that the air base commander, duty traffic controller and fire chief had been suspended from duty pending further inquiries.
Edition date: Monday, 7 October, 1996 Edition: 13593
Section: Military Page number: 6

* Hercules crash death toll rises to 34

* Amsterdam: The death toll from last Monday┤s crash of a Belgian Air Force Lockheed Martin C-130 Hercules at Eindhoven airport rose to 34 as two more injured died of burns in Dutch hospitals. Seven seriously injured survivors remain in the hospital. The investigation into the cause of the crash will take several months.
Edition date: Tuesday, 23 July, 1996 Edition: 13540
Section: Military Page number: 5

* Dutch probe C-130 Hercules crash

* Amsterdam: The Belgian Air Force Lockheed Martin C-130 Hercules that crashed on landing and killed 32 people had no flight data recorder, but authorities said Tuesday that the pilot┤s final words might yield clues to the crash. The C-130 crashed and burned Monday in the worst peacetime military air crash in the Netherlands, the Defence Ministry said. Among the dead were members of a Dutch army band and all four crew members. Nine people survived and all were hospitalised with serious burns. A 23-member Dutch-Belgian investigating team is searching the wreckage on the side of the runway in the Welschap military sector of Eindhoven Airport, 120 miles south of Amsterdam. A Defence Ministry spokesman said the C-130 did not have a flight data recorder. In its absence, officials will analyse the tape of the pilot┤s exchanges with ground control, he said.
Edition date: Thursday, 18 July, 1996 Edition: 13537
Section: Military Page number: 4

*** Dutch C-130 crash death toll rises to 32**

* Amsterdam: Thirty-two people were killed when a Belgian Air Force Lockheed Martin C-130 transport crashed and burst into flames at Eindhoven airport in the southern Netherlands Monday, the Dutch ANP news agency said. ANP quoted Dutch junior defence minister Jan Gmelich Meijling as confirming the fatalities. Earlier reports said 27 people on board the military transport had died. The Hercules, carrying 36 members of a brass band, including a Belgian crew of four, banked steeply at low altitude as it came into land and crashed into a field inside the airfield's military section, witnesses said. A Dutch-Belgian investigation team is now working to try and establish the cause of the crash, a military spokesman said.

Edition date: Wednesday, 17 July, 1996 Edition: 13536
Section: Military Page number: 5

Write Offs

Accident Reports

Jul 3 | 8 Saudi AF | - | 2 x F-15C | Saudi Arabia | 2 K

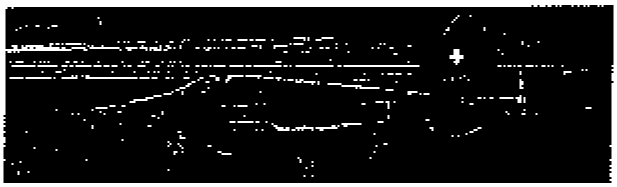
Collided and crashed during a training mission in eastern Saudi Arabia, killing both pilots.

Jul 4 | Peruvian Army | - | Mi-17 Hip | Peru | 6 K

Reported missing near the Ecuadorian border whilst en route to El Milagro military base, Ampama, in the northern Amazon jungle region, on a supply mission from Ciro Alegria military base. Wreck found the following day in a remote region near the northern port of Galilea — all six on board were killed.

Jul 4 | Swiss AF | - | F-5E J-3028 | Schänis | 1 OK

The aircraft had just completed an ACT sortie with two other F-5s and was returning to Dubendorf when — during an inverted, negative-g manoeuvre — the ejection seat suddenly fired without warning and the pilotless aircraft dived into the ground, shortly before 1100hrs, only 65ft (20m) from a children's playground near the village of Schänis. The pilot suffered only minor injuries and a family in the playground also escaped unhurt. Because the aircraft buried itself 50ft (15m) into the ground, the wreckage will probably not be recovered due to the cost involved. All 101 Swiss F-5s were grounded immediately after the crash but because initial investigations could find no mechanical cause for the crash, the grounding order was lifted the following day — with the proviso that no high-g manoeuvres were flown.



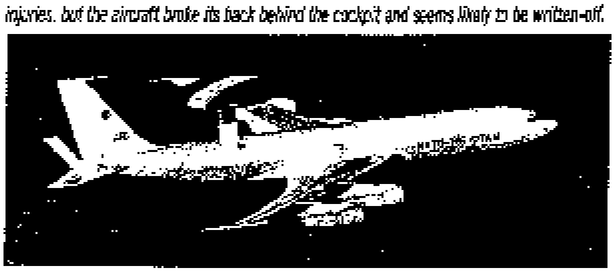
Above: Swiss AF/FlSt 13 F-5E J-3028, seen here at Dubendorf on August 26, 1994, was destroyed in a crash near Schänis on July 4. (Arnaud Bouman and Kees van der Mark)

Jul 11 | USAF | 20th FW | F-15C | Pensacola | 1 OK, 1 K, 2 inj

Crashed at about 1530hrs into a house in a residential area of Pensacola, Florida, following engine failure about 20 miles (32km) north of Pensacola whilst en route from Shaw AFB, South Carolina to Eglin AFB, Florida, to avoid Hurricane Bertha. The pilot had attempted to reach Pensacola Regional Airport for an emergency landing but was forced to eject two miles (3km) short of the airfield. A child in the house, which was destroyed by fire, is missing and presumed killed, whilst a man and a woman in the house also suffered burns. The pilot's condition was said to be good.

Jul 14 | NATO | NAEWF | E-3A Sentry LX-N90457 | Greece | 16 OK

Aborted take-off from Aktion/Preveza due to an unspecified malfunction and overshot runway into the Ionian Sea. All 16 crew escaped safely, only one Canadian officer sustaining light injuries, but the aircraft broke its back behind the cockpit and seems likely to be written-off.



Above: NATO NAEWF E-3A LX-N90457 which came to grief in an aborted take-off at Aktion/Preveza on July 14. (NATO)

Jul 15 | Belgian AF | 15 Wing/20 Sqn | C-130H CH-06 | Eindhoven, Holland | 34 K, 7 inj

Initial reports suggest that the aircraft appeared to approach normally for landing at Eindhoven air base, Holland, at 1805hrs after a flight from Villafranca, Italy, with members of a Dutch military band. However, as it flared for touchdown, it appears the crew decided to overshoot, the aircraft veered sharply and the port wing hit the runway, breaking off the outer portion and swinging the aircraft round violently before it impacted the ground at the side of the runway and caught fire. All four crew and 27 of the 37 Dutch military personnel on board, mostly musicians from a Dutch Army band, were killed, whilst all ten survivors suffered severe burns and one died in hospital soon after. A further two died in hospital on July 21. The cockpit and most of the fuselage forward of the wing were completely destroyed in the post-crash fire. Initial reports of a number of dead birds near the wreckage suggest that a multiple bird strike may have been the cause of the crash. Empty fire extinguishers found in the wreckage also suggest that the crew may have attempted to put out the fire before being overcome by fumes.

Above: Belgian Air Force/15 Wing/20 Squadron C-130H CH-06 at its Melsbroek base in June 1995. The aircraft was destroyed in a fatal crash at Eindhoven on July 15, bringing to an end almost 25 years of accident-free flying with the type in Belgian service. (Dirk Lamarcue)

Jul 17 | Slovak AF | Biele Albatrosy | 2 x L-39C Albatros | Kosice | 4 OK

Collided in mid-air over the city of Kosice at about 0830hrs during a training flight. One aircraft crashed in an open area of the outskirts of the city after the two crew had ejected, whilst the other was able to land safely at its Kosice base.

Jul 18 | Indian AF | - | MiG-21 | Nr Salempur | 1 OK

Crashed near the city of Salempur, Punjab state, following engine failure on a training mission. The pilot ejected safely and there were no casualties on the ground.

Jul 19 | Philippine AF | - | UH-1H | Rosario | 3 K, 2 inj

Crashed into a riverbank at Rosario, La Union province, in the northern Philippines, 125 miles (200km) northwest of Manila, whilst returning to a military camp in nearby Tarlac province. The pilot, co-pilot and one other crew member were killed and the two remaining crew were both injured. The cause was believed to be mechanical failure and the Air Force ordered all its UH-1s grounded pending investigation.

Jul 20 | Russian AF | - | Mi-24 and Su-25 (?) | Chechenia | Unk

Chechen separatist forces claimed to have shot down an Mi-24 Hind and an unspecified ground-attack bomber during fighting near Shatoy. Russian sources, however, denied that there had been any losses on that date.

Jul 20 | Sri Lankan AF | 6 Helicopter Sqn | Mi-17 Hip | Alampil | Unk

During heavy fighting with LTTE forces at Alampil, a coastal village 6 miles (10km) from the Mullaittivu army camp, the helicopter was shot down and crash-landed whilst bringing in Army reinforcements. Although it is known that 37 personnel were on board, no figures for the number of casualties were immediately available.

Jul 23 | R Malaysian AF | 9 Sqn | Hawk Mk 208 | Labuan | 2 OK

Suffered unspecified problems immediately after take-off from Labuan air base during a three-day exercise, crashed into a small gully near the airfield and exploded in flames. Both crew ejected safely and suffered only minor injuries.

Jul 24 | RAF | 41 Sqn | Jaguar GR.1A | Alaska | 1 OK

Crashed at 1135hrs on uninhabited military land about 20 miles (32km) from Eielson air force base, near Fairbanks, Alaska, whilst taking part in the annual Cope Thunder exercises. The pilot ejected safely and was picked up by a rescue team from the Alaska Air National Guard.

Additional material from: Arnaud Bouman, Wei-Bin Chang, Vladimir Cettolo, Peter Gunti, Grzegorz Holdanowicz, Eric Katerberg, Koen Kempeneers, Kees van der Mark, Javier Mosquera, Mario Flores Ponce, W John Richardson and Roberto Yañez.

AVWEB NEWSWIRE

written by Dave Higdon (dhigdon@avweb.com)
edited by Bob Kaputa (bkaputa@avweb.com)
updated Monday, October 7, 1996

....

BIRDS BROUGHT DOWN ~~DUTCH~~ Belgian HERCULES: The mass of birds smashed into the plane's cockpit and the left wing, with dozens of them ending up in the engines, according to a report compiled by the Dutch air force, the interior ministry and emergency services. Thirty-four of 41 aboard died in the July 15 crash caused by up to 600 starlings and lapwings which, out of view of the airport's control tower, flew into the Herc's approach path on its return from Italy with members of a Dutch army brass band.

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Return to AVweb welcome page.

This page was last updated Monday, October 07 1996

Above: ***Argentine Navy Super Etendard 0753/3-A-203 seen at Comandante Espora on May 18, 1996. Eleven days later on May 29 it was lost in a fatal crash at Punta Indio.*** (Javier Mosquera)

the lead UH-60 and their main rotors intermeshed. The rotors of the lead helicopter then suddenly jammed but its undamaged tail rotor continued to turn and, without any torque to counteract, caused sufficient stress to buckle the tail boom which crumpled to the left, breaking along the top and then shearing off completely and falling to the ground, after which the front section then quickly nosed into the ground. The trail helicopter remained relatively intact after the collision but also quickly fell to the ground. (August)

June 19: McDonnell Douglas/USN F/A-18C Hornet which crashed was 165189. (August)

June 25: German AF/JG.73 MiG-29 *Fulcrum* lost is reported to have been 29+09. (August)

June 25: Yugoslav AF helicopter which crashed was an SA341 Gazelle. (August)

July 11: USAF 20th FW F-16C lost was from the 77th FS. (September)

July 14: Cause of the accident to NATO/NAEWF E-3A Sentry LX-N90457 is believed to have been due to a multiple bird strike at high speed on take-off from runway 25R at Aktion. (September)

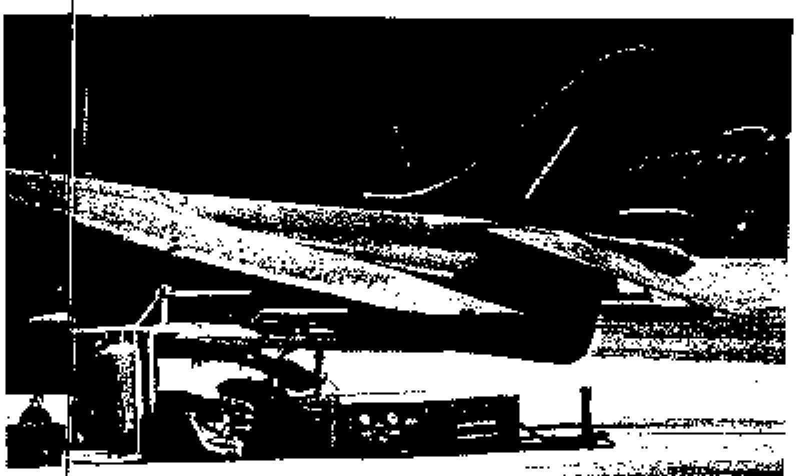
July 19: Philippine AF UH-1H lost was 66-16224 (c/n 5018) from the 205th Tactical Air Wing. The helicopter was en route from Wallace Air Station, La Union, to Camp Aquino in Tarlac province whilst participating in the joint Philippine armed forces Exercise *Aguilar*. (September)

July 24: RAF Jaguar GR.1A lost was XZ362/'GC' from 54 Squadron, but flown by a 41 Squadron pilot. (September)

Above: ***Jaguar GR.1A XZ362/'GC' of 54 Squadron at Eindhoven show on July 3, 1993 — the aircraft was lost in Alaska on July 24.*** (Roy Ashby)

Above: ***RNZAF/75 Sqn A-4K Skyhawk NZ6203 which was lost in a crash during a sortie from Ohakea on June 29 — see* Write-Offs, *August.*** (Jim Winchester)

Below: ***Still dumped at Thessaloniki, northern Greece on April 1, 1996, was the wreckage of Mali Air Force Antonov An-24 TZ-347 which had crashed on approach on August 31, 1995, after mistaking an adjacent road for the runway — see* Write-Offs, *November 1995 and May 1996.*** (Richard Balon)



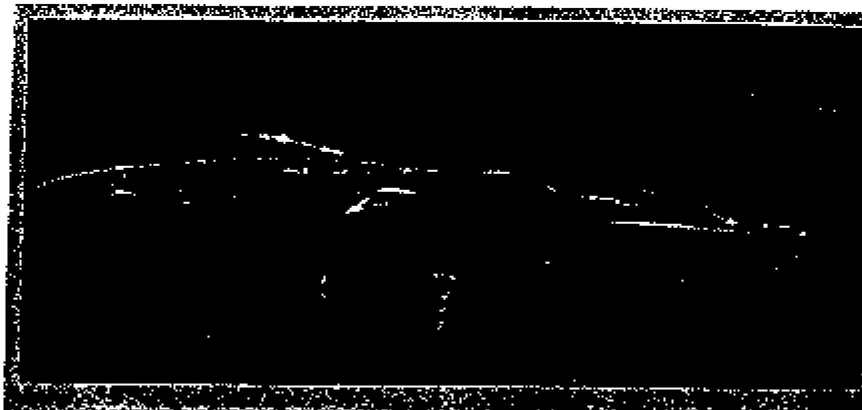
Above: ***Royal Jordanian Air Force/Jordanian Falcons Extra 300 JY-RNB taxiing in at its home base, Amman-Marka/King Abdullah air base, Jordan, on April 22. The aircraft was involved in a landing accident in Wales on June 12 — see* Write-Offs, *August, p60.***

Left: ***USMC/VMA-542 AV-8B 163516/'WH-17' at MCAS Cherry Point on August 11, 1994. The aircraft crashed off Japan on September 1, 1995 during a sortie from Iwakuni. See* Write-Offs *January, March and August.*** (Rene van Rijn)

Launch Co.'s goal of first launch in mid-1998 remains on schedule, the company said. Boeing, Kvaerner of Norway, RSC-Energia of Moscow and Ukraine's Yuzhnoye space organization are partners in the project. Home Port construction plans include upgrading 202,000 sq. ft. of existing warehouse, office and storage space, constructing two new buildings for processing spacecraft and improving a 1,000-ft. pier.

CATHAY PACIFIC AIRWAYS of Hong Kong saw profits in the first half of the year reach HK$1.65 billion ($213 million) on revenues of HK$15.2 billion ($1.97 billion). The profit picture was aided by a HK$514 million ($66 million) exceptional return on the sale of part of the airline's stock in Dragonair, a regional carrier. Even without that bonus, profits were up 12.5% over a year ago. They came despite a disadvantageous exchange rate for the U.S. dollar and increased fuel prices, Chairman Peter Sutch said. Revenues were up 7% for the same period. In April, Cathay sold 17.66% of its joint shareholdings with Swire Pacific in Dragonair to China National Aviation Corp., which is controlled by Chinese authorities (*AW&ST* May 6, p. 31). Swire is a London-based trading company that is Cathay's stockholder.

AIR FORCE OFFICIALS punished 16 officers involved in the April crash of a CT-43 aircraft near Dubrovnik, Croatia, that killed U.S. Commerce Secretary Ron Brown. Brig. Gen. William E. Stevens, former commander of the 86th Airlift Wing, and his operations commander, Col. John E. Mazurowski, were punished with Article 15 reprimands for dereliction of duty. They constitute the most serious punishment short of a court martial. They lost their commands in June, but criminal charges will not be brought and the Article 15 punishment closes the cases. Letters of reprimand went to Maj. Gen. Jeffrey Cliver, former director of operations for U.S. Air Forces in Europe, and Col. Roger Hansen, former vice commander of the 86th. In addition, four colonels and two lieutenant colonels received administrative letters of admonishment; two lieutenant colonels and two majors received administrative letters of counseling; and two lieutenant colonels received verbal counseling. The actions were directed by Gen. Michael Ryan, commander of U.S. Air Forces in Europe.



A U.S. NAVY F-14 FROM VF-103 drops a laser-guided GBU-24 for the first time during recent tests at China Lake, Calif. The Oceana, Va.-based "Jolly Rogers" squadron is the first F-14 unit equipped with a Lantirn targeting system, enabling delivery of laser-guided weapons (*AW&ST* June 10, p. 30).

WATER AND CRASH damage to a NATO E-3 that ran off the runway at Aktion, Greece, on July 14 is still being assessed. NATO officials in Germany said a recovery team has not yet been able to pull the aircraft from the water, even though its location at the end of the runway restricts operations from the NATO forward operating base. NATO teams are attempting to strip as much equipment from the aircraft as possible before again attempting to pull it out. The aircraft's nose and engines are still in the water, so NATO officials do not yet know if the aircraft can be repaired or if it will be cannibalized. E-3s are difficult to replace since production has ceased. A suspected multiple bird strike caused the crew to abort the takeoff at high speed. The E-3 ran off the runway and along a stone pier projecting into the water before veering to the right. Impact broke the fuselage between the wings and cockpit, but there were no serious injuries.

KLM ROYAL DUTCH Airlines' net profit for the first quarter of the 1996-97 fiscal year increased to $163.2 million, up from $81.9 million. However, the Dutch carrier included in the quarter's results a $107.3-million profit resulting from the resale of nonvoting shares to Northwest Airlines Corp. KLM's traffic increased 6%, but overall load factor declined 1.6 points to 70.7%. British Airways' first-quarter net profit increased 11.3% to $179.6 million, a positive trend tied to strong sales and higher yields, company officials noted. Lufthansa German Airlines' operating profit fell 47% to $67 million during the first half. In the next five months, Lufthansa German Airlines is scheduled to implement measures expected to cut operating expenses by as much as $128 million.

EUROCOPTER'S 7-8-SEAT EC135 twin-engine helicopter obtained FAA certification for two versions equipped with Pratt & Whitney PW206B or Turbomeca Arrius 2B turboshaft engines. Ten EC135s will be produced in the next five months, Eurocopter officials said. Last week, the first production EC135 was delivered to the German police's Stuttgart-based air rescue unit.

THOMSON-CSF AIRSYS and Terma Elektronik last week concluded an agreement to jointly upgrade the Danish air force's Hawk air defense missile systems.

[illegible] has joined *Aviation Week & Space Technology* as a contributing editor based in Singapore. [illegible] previously written for Asia-Pacific Aerospace and Vietnam Business News. He will report on aerospace industry developments in Singapore, Malaysia, Indonesia and Vietnam. [illegible] joins Hong Kong Bureau Chief Michael Mecham and contributing editor Eiichiro Sekigawa in Japan as part of the magazine's growing presence in the Pacific Rim.

T145/96

Netherlands

Hercules C130: the emergency services were badly informed

If the fire service had known that the Hercules C130 had passengers on board, on 15th July last, they would have been able to save some of them. But the communication from the control tower was not properly passed on.

AMSTERDAM
From our Correspondent

On 15th July last, a Hercules C130 plane crashed at Eindhoven, killing 34. Following the Belgo-Dutch inquiry into this drama, sanctions have fallen: the Commander of the Eindhoven military base, the Commander of the fire brigade and a control tower official were dismissed on the spot. The Mayor of Eindhoven, Mr. Welschen has apologised to the public.

The inquiry concluded in fact that it was the chaos of the emergency services, as much as and perhaps more than the actual accident, which was fatal for the victims.

However, in July, all the authorities concerned had praised the speed and organisation of the assistance and when, a few days later, it was revealed that the emergency services only expected to find the four crew members on board, the Mayor of Eindhoven immediately affirmed that this mistake had had no consequences on the number of victims.

The fatal error

The report presented on Thursday last proves the contrary. The Lieutenant-General of the Belgian Air Force, Mr. Vanhecke, has retraced the film of the events in Eindhoven. Just after the plane crashed at 18.09 hours on 15th July, the control tower, in communication with the fire brigade, thought it was unnecessary to send the emergency services. It retracted this a few minutes later and again contacted the fire brigade. It was at that moment that the doubtlessly fatal error was made: the tower control official affirmed that there were about 25 people on board. But the person he was speaking to did not understand and asked again if there were any passengers. The official, who thought he had been understood, only stated that he "did not know exactly" (meaning: the number of passengers).

The fire service understood from this that there were no passengers on board. As the plane's cockpit was on fire, they also thought that the four members of the crew were already dead. Action plan no. 2, intended for small-scale catastrophes, was put into effect. Once arrived on the spot, the firemen set themselves simply to putting out the fire. Thinking there were no survivors on board, they did not attempt to enter the plane quickly.

In fact, during this time, the survivors were doing everything they could to try and open the emergency exits which were all jammed.

It was only at around 18.40 hours that the first firemen entered the interior of the plane. At that moment, they were dumbfounded on discovering passengers dying or already dead. Ambulances, oxygen, stretchers - none of these were on site since such a situation had not been expected. In the midst of the catastrophe a suitable rescue plan was then triggered which was only completed an hour later.

The report is formal. Without these serious errors in communication, the rescue operations would have been able to start some 25 minutes earlier. In such circumstances where toxic gases are released, every minute counts. Mr. Siemons, Head of the Health Inspectorate, who took part in the inquiry, affirms that an earlier rescue attempt could have limited the number of deaths as well as the harm caused to the injured.

At present, five of the seven survivors are still in a serious condition. Besides the four Belgian crew members, the 30 other persons killed were all young Dutch people. Members of the Brass Band of the Dutch Land Forces, they were returning from Italy where they had given a series of concerts. Furthermore, the inquiry has shown that it was neither a technical failure nor a human error which was the cause of the accident. It was a flock of about 500 starlings which were caught in the plane's two port engines on landing which caused the aircraft to swing sharply to the right, thus causing the accident.

From LE MONDE
8th October 1996

END

APPENDIX 26

Avian Ecology and Air-Traffic Safety at Vancouver International Airport

Avian Ecology and Air-Traffic Safety at Vancouver International Airport

Non-Winter Monitoring, 1996

by

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December 1996

EXECUTIVE SUMMARY

Data on the distribution, abundance, and behaviour of birds were collected near the Vancouver International Airport (YVR) during the non-winter period of April through September, 1996. These data were compared with those collected over the same period during 1994. The status of bird hazards and risks to aircraft at YVR since the reports by Demarchi and Searing (1995a; 1995b) were assessed. The Parallel Runway became operational on 4 November 1996, and as such, was not used by aircraft during either the 1994 or 1996 periods presented in this report. Unless stated otherwise, comparisons of bird-related air-safety issues between 1994 and 1996 are made under the same conditions of airport operations (*e.g.*, air-safety concerns during 1996 were not seen as greater than during 1994 simply due to the propinquity of the opening of the Parallel Runway).

Diurnal Raptors in SICA

Compared to the winter period (all years) and the non-winter period of 1994, the number of raptors in SICA was very low during the non-winter period of 1996. With the possible exception of soaring raptors, air-safety hazards posed by SICA-based diurnal raptors were negligible during the non-winter period of 1996. SICA-based raptors should continue to be monitored until Parallel Runway operations are fully underway and the habitats of northern Sea Island are no longer undergoing radical changes due to the construction of the Parallel Runway. The extent of soaring by raptors should also continue to be monitored.

Habitat Changes

Aside from the habitat changes due to the construction of the Parallel Runway as noted by Demarchi and Searing (1996), the single largest difference between the habitats during the non-winter periods of 1994 and 1996 was that for most of the non-winter period of 1996, much of the large grass field of northeastern Sea Island was not hayed. Consequently, a tall sward of reed canary grass (*Phalaris arundinacea*) became established there. The grass in that field was then cut late in the summer. As a result, it is expected that substantially more birds (primarily Great Blue Herons and waterfowl) will be attracted to that area during the winter of 1996/97 than if it had been left uncut. Birds using that area have the potential to pose hazards to aircraft using the Parallel Runway. The most effective means of dealing with these hazards are to expand the area over which wildlife controllers operate and to minimize disturbances of such birds by the general public that recreate there.

Bird-related Air-safety Issues

The overall status of the air-safety concerns at YVR for each species group of birds during the non-winter period of 1996 compared to the same period of 1994 is summarized below.

Despite considerable growth of the Great Blue Heron breeding colony in Pacific Spirit Park, no increase in Great Blue Heron-related safety issues were evident. Movement rates of Canada Geese during the latter part of the non-winter period of 1996 were much greater than during 1994—suggesting that hazards posed by this species increased since 1994. The affinity of Canada Geese for the habitats adjacent to the Parallel Runway has much greater implications for air-safety after 4 November 1996, when the Parallel Runway became operational. No change in air-safety hazards or risks as posed by ducks, Bald Eagles, or gulls were noted during 1996 compared with 1994. Although no changes in air-safety hazards by crows were noted, the implications for air-traffic safety near the Parallel Runway as brought about by the location of the flight paths used by Northwestern Crows during the late evening period, warrants reemphasizing. A slight reduction in the risks to air-safety as posed by European Starling was noted during 1996, but the high reproductive capacity and ecological flexibility exhibited by this species suggests that safety concerns could fluctuate widely during any non-winter period.

Summary of changes in bird hazards to aircraft at YVR during the non-winter period of 1996 compared to the same period during 1994. Ratings: -- no change; ↑ modest increase; ↑↑ substantial increase; ↓ modest decrease; ↓↓ substantial decrease.

Species/Group	Overall Change in Hazard Status During 1996 (c.f., 1994)
Great Blue Heron	--
Canada Goose	↑
Ducks	--
Bald Eagle	--
Northern Harrier	↓↓
Red-tailed Hawk	↓↓
Gulls	--
Northwestern Crow	--
European Starling	↓

Continued monitoring of the avifauna near Sea Island is seen as an effective means of ensuring that bird-related air-safety concerns can be mitigated in a timely and effective manner; given the vast numbers of birds that use the habitats of the Fraser Delta during the course of a year. In addition to identifying bird hazards and long-term trends in local populations of avifauna, the database created by a long-term monitoring program will provide an effective benchmark against which the effectiveness of the Wildlife Control Program at YVR can be assessed and adaptively managed. A long-term monitoring program with a consistent protocol of data collection and analysis is an essential part of aviation safety at YVR.

MISCELLANEOUS PAPERS

Appendices 27-38

APPENDIX 27

Avian Ecology and Air-Traffic Safety at Vancouver International Airport: Non-Winter Monitoring 1996

BD540/EA636.1

Avian Ecology and Air-Traffic Safety at Vancouver International Airport: Monitoring

by

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June 1996

EXECUTIVE SUMMARY

On behalf of Transport Canada, in 1994, LGL Limited began investigating avian ecology as it relates to existing and potential hazards to air-traffic safety at the Vancouver International Airport (YVR). Findings of research conducted in 1994/95 are presented in Demarchi and Searing (1995a; 1995b). This report presents the results of continued monitoring, with a focus on the concerns about aircraft safety and information gaps pertaining to avian ecology as outlined by the Blue Ribbon Panel Report. Data in this report span the period of October 1995 through April 1996, inclusive. Results from the remainder of the monitoring period (*i.e.*, April 1996 to September 1996, inclusive) will be presented in a subsequent report. Except where noted, bird hazards to aircraft as identified by Demarchi and Searing (1995a) continued to exist during the present reporting period.

Habitat Changes

Construction of the Parallel Runway continued to change the habitat composition of the study area since the initial study of avifauna and air safety was conducted in 1994/95. Construction activities increased the amount of "disturbed" habitat in the study area through the conversion of long grass, hedgerow/shrubland, and mixed woodland habitat types.

Diurnal Raptors in SICA

Seven species of diurnal raptors were observed during 165 events (143.3 hr) during October 1995 through March 1996. Seventy of the 165 events ended without the raptor leaving SICA. Although the Commercial Development Zone (CDZ) was the location most frequently used by raptors moving out of SICA, few of those birds continued southward over the Parallel Runway and beyond.

None of the raptor species displayed a tendency to move southward from SICA towards airside. The pooled events indicated that while 23.0% of the events were terminated by the observer or when the observer lost sight of a bird in SICA, the majority (66.1%) ended when the observer lost sight of a bird flying away to the west, northwest, north, northeast, or east from its original location. Only 10.9% of the events ended with the observer losing sight of a bird flying to the southeast, south, or southwest—*i.e.*, southward towards airside. For Red-tailed Hawks, the most frequently sampled species, there was a strong tendency to avoid flying southward, as events ended with birds flying in a direction other than southward 4.9 times more often than expected by chance alone (χ^2=15.9, df =1, P <0.10). Avoidance of habitats south of the CDZ likely resulted from the low densities of prey and perches that occurred in those areas.

The movement patterns and flight directions of SICA-based raptors remained essentially unchanged from similar observations collected during the previous study. The findings of this study are consistent with those presented in Demarchi and Searing (1995a), which indicated that SICA does not promote hazards to aircraft by attracting diurnal raptors. Furthermore, by discouraging hazardous species of flocking birds such as waterfowl, gulls, shorebirds, and passerines, the habitat of SICA is likely contributing to air-traffic safety at YVR. Therefore, SICA should continue to be managed as raptor habitat.

Perch Poles and Red-tailed Hawks

The availability of perch poles did not influence the proportion of time Red-tailed Hawks spent engaged in flying and non-flying behaviours. Although perch poles were readily used when available, alternate perches (*e.g.*, trees, shrubs, and power poles) were very abundant and thus, were used to a greater extent by hawks when perch poles were unavailable. Because perch poles did not influence Red-tailed Hawk behaviour, the presence or absence of perch poles is not expected to have implications for raptor conservation or air-traffic safety, assuming that alternate perches remain available. Perch poles should remain in place because they are used by birds that are not currently posing hazards to aircraft.

Bird Abundance and Movement

Twelve pairs (*i.e.*, 24 individual surveys) of non-breeding bird surveys were conducted from October 1995 to April 1996, inclusive. Twenty-two surveys of bird movements were conducted from 13 October 1995 to 26 March 1996, representing 257 hr of observation.

Double-crested Cormorant

Overall, the weekly movement rates of Double-crested cormorants during 1995/96 were slightly lower than during the same period of 1994/95. Locations used by flying cormorants during 1995/96 remained unchanged from those observed during 1994/95. Most cormorants were observed flying eastward, over or near the Middle Arm of the Fraser River in the morning, and westward over and near the Middle Arm in the evening.

Great Blue Heron

The abundance of Great Blue Herons on and near Sea Island fluctuated during the present study. The numbers of Great Blue Herons during 1995/96 were mostly lower than those observed during 1994/95. The mean number of Great Blue Herons observed in the airside portion of the survey area was also lower during the present study than during the previous one. Under the hypothesis that the numbers of voles in the study area were less during 1995/96 than during 1994/95, the reduced numbers of herons observed in the study area was likely a direct result of the reduced availability of that prey.

The pattern of movement rates of Great Blue Herons observed during 1995/96 was very similar to that observed during 1994/95. The distribution of flying herons during 1995/96 also remained very similar to that during 1994/95; with the exception that proportionately fewer birds were observed near southwestern Sea Island, while proportionately more were observed near north-central Sea Island.

Safety concerns regarding this species from October to April continue to be highest over northern Sea Island where aircraft will be using the Parallel Runway. Increases in vole populations that may occur normally in future years might cause the number of herons flying over Sea Island to rise.

Snow Goose

In general, the numbers of Snow Geese observed during 1995/96 were very similar to those observed for the same period during 1994/95. Unlike during 1994/95, Snow Geese were not observed in the airside zone during 1995/96. The reason(s) for this difference in distribution between studies is unclear.

As during 1994/95, Snow Geese were one of the most numerous species encountered during the movement surveys of the present study. This species remained strongly associated with the saltmarsh habitats along the western foreshores of Swishwash Island and Sea Island. The movement rates of Snow Geese in 1995/96 remained very similar to those observed during 1994/95. The main difference between observations of Snow Geese during 1994/95 and 1995/96 was that in the latter period, the vast majority of Snow Geese were observed near southwestern Sea Island, while fewer birds were observed near northwestern Sea Island.

Safety concerns regarding this species declined during 1995/96 because Snow Geese made substantially less use of airside habitats than they did during 1994/95. However, as long as Snow Geese are permitted to use the foreshore of Sea Island, this situation could easily revert in the future. Hazards posed to aircraft by this species continue to be highest from fall through spring for aircraft that approach and depart YVR from and to the west, respectively.

Canada Goose

From October until December, and from early January until late March, the numbers of Canada Geese were very similar between 1994/95 and 1995/96. From December until early January, the numbers of Canada Geese in the study area were considerably greater during 1995/96 than during 1994/95. Despite that difference, the mean number of Canada Geese in the airside zone was lower during the present study compared to the previous one. The most likely reason for this reduction is that many parts of the "disturbed" habitat (*i.e.*, locations associated with Parallel Runway construction), were supporting new growth of vegetation that appeared to be highly preferred by these birds.

The movement rates of Canada Geese from late October to early December and from early February to late March were relatively similar between studies. However, during the present study, the weekly movement rates of Canada Geese from mid December to late January were much greater than those observed during 1994/95. Despite these differences in movement rates between studies, the overall distribution of this species remained proportionately similar; most birds were observed flying over the mowed and disturbed habitats of northern and eastern Sea Island.

The increased numbers of Canada Geese that were observed during 1995/96 should be of concern to airport managers. It is likely that the population of Canada Geese in the Fraser Delta is continuing to increase sharply.

Ducks

Due to large numbers of American Wigeon, Scaup sp., Green-winged Teal, Mallard, and Northern Pintail, ducks were the most commonly recorded and most abundant group of birds. In general, the numbers of ducks observed from October to mid February during the present study were slightly greater than those observed during the same period of 1994/95. Numbers of ducks observed from late February until late March were lower during 1996 than during 1995. The numbers of ducks in the airside zone was similar during both studies. Standing water and foraging opportunities in the airfield continued to attract Mallards, American Wigeon, Northern Pintail, and Green-winged Teal from the nearby saltmarsh and river habitats.

Weekly movement rates of ducks fluctuated greatly, and the rates during 1995/96 were higher than those during 1994/95 for most of the study period. Although the numbers of ducks were greater during 1995/96 than during 1994/95, the overall distribution of this species remained similar between the studies. Most ducks continued to be observed flying N-S in the vicinity of the foreshore of western Sea Island, flying parallel with the river channels, and flying in most directions over the fields of northern and eastern Sea Island.

Bald Eagle

Numbers of Bald Eagles from October to late January were very similar between 1994/95 and 1995/96; however, the numbers of birds observed thereafter tended to be less during the present study than during the previous one. The mean number of Bald Eagles observed at airside locations remained unchanged between the two studies.

The numbers of Bald Eagles detected during movement surveys remained similar between the two study periods until early January 1996. At that time, the numbers of Bald Eagles rose sharply and, in general, remained greater during the 1995/96 study than during the 1994/95 study. Most eagles continued to be observed flying near the foreshore of western Sea Island.

Hawks

Numbers of Northern Harriers were similar during the month of October during both studies, but numbers during the present study were consistently lower than those observed during 1994/95 during the remaining months. The mean number of harriers in the airside zone was lower during the present study than during the previous one. This decrease likely reflected the reduced number of harriers in the entire study area, which in turn was probably caused by reduced vole populations.

Numbers of Red-tailed Hawks in October were similar during both studies, but the large influx of migrant birds that occurred during November and December of 1994 did not occur during the same period of 1995. Compared to the previous study, the mean number of Red-tailed Hawks in the airside zone was much lower during the present study. This decrease likely reflected the reduced number of Red-tailed Hawks in the entire study area, which in turn was probably caused by reduced vole populations.

Very few Rough-legged Hawks were recorded during the present study. Numbers of Rough-legged Hawks were higher during October 1995 than during October 1994, but for the remaining months, consistently fewer individuals of this migrant species were observed during the present study. As with Red-tailed Hawks, the influx of migrant birds in early winter that was observed during the previous study did not occur during the present study.

During movement surveys of both the 1994/95 and 1995/96 studies, the two most abundant hawks were Northern Harriers and Red-tailed Hawks. Weekly movement rates of hawks during both studies were similar. No overall trends in rates were evident from October to April in either study. Counts of hawks were consistently higher on the north half of Sea Island. The distribution of hawks in the study area remained similar between studies. With the exception of N-S movements over northwestern Sea Island, no strong trends in direction of travel were evident.

Falcons

The total numbers of falcons detected during the movement surveys of both studies were very small. Overall, detection rates remained relatively constant during the study period, averaging less than one falcon per survey throughout the study. No pattern of falcon distribution around Sea Island could be identified from data collected during the present study due to small sample sizes.

Shorebirds

Numbers of Dunlin fluctuated widely during the 1995/96 study period, with peaks of abundance occurring during early November, late December, and late January. The patterns of abundance exhibited by this species differed greatly for most months between the studies. The mean number of Dunlin in the airside zone was much lower during the present study compared to the previous study. It is unclear what caused this difference, but it may have been due to chance alone because the maximum numbers of Dunlin observed in the study area were similar during both studies.

During both studies, Dunlin comprised more than 96% of the identified shorebirds during movement surveys. The movement rates of shorebirds from October to January were much lower during 1995/96 than during 1994/95. From January until April, movement rates were very similar between the studies. During both studies, the majority of flying shorebirds (namely Dunlin) were observed heading N-S over Sturgeon Bank near northwestern Sea Island.

Gulls

The numbers of gulls observed in the two studies were similar, except that during the present study, the peak in gull numbers occurred approximately one month before the peak during the previous study. In addition, the late-winter decline in gull numbers observed during the previous study was not as protracted as that during the present study.

Seven species of gulls were detected during the movement surveys of both studies. During 1995/96, the most abundant species were Glaucous-winged Gull and Mew Gull. Unlike during 1994/95, the detection rates of gulls during 1995/96 showed considerable fluctuation with no strong seasonal trend in movement rates. The distribution of flying gulls around Sea Island remained very similar between studies. Gulls continued to present hazards to aircraft as these birds moved between nocturnal roosts on Sturgeon Bank and inland feeding sites.

Northwestern Crow

Peak numbers of Northwestern Crows were similar between the 1994/95 and 1995/96 studies, but more crows were observed from October to mid December during the previous study. Further, the peak of abundance during the previous study occurred approximately one month later than during the present study. The mean number of Northwestern Crows observed in the airside zone was lower during the present study than during the previous one. It is unclear why the numbers of crows in the airside zone were lower during the present study, but was likely the result of fewer crows occurring in the study area for most of the study.

The overall movement rates of Northwestern Crows were lower during the present study than during 1994/95. During the present study, the movement rates of Northwestern Crows fluctuated from October to January, at which time, low and stable numbers of crows were observed until the end of March. The relative distribution of Northwestern Crows differed greatly between the studies at some countpoints. This spatial shift in crow distribution might have resulted from changes in the distribution of freshly disturbed soil (due to Parallel Runway construction). Despite these changes in the locations of flying crows, most birds were observed flying eastward over northern Sea Island during both studies.

European Starling

With the exceptions of October and November, overall numbers of European Starlings were lower during the previous study than during the present one. However, the mean number of European Starlings observed in the airside portion of the survey area was much greater during 1995/96 compared to 1994/95. This increase was likely the result of a large flock that was frequently observed foraging in the mowed grass habitat of the airside zone.

During the present study, the rates of starling movement ranged widely from October to February, after which time, they remained low and stable. From October until December the movement rates of starlings were higher during the present study than during the previous study. From December until February, no clear difference in movement rates between the studies was evident. Movement rates in February and March 1996 were consistently lower than those observed during the same months during 1995. As for crows, changes in the distribution of European Starlings may have been due to changes in the distribution of freshly disturbed sites used for foraging.

Remaining Issues

The increased numbers and movement rates of ducks observed during the present study suggest that potential hazards caused by these species increased since 1994/95. Standing water in the airside zone continues to be the single largest factor aggravating the strike hazards posed by this group of birds. The recommendations of the Blue Ribbon Panel and Searing *et al.* (1996) are expected to partially mitigate these hazards.

The "grit dump" on Iona Island continues to attract and support many gulls, Rock Doves, Northwestern Crows, and European Starlings. No steps to alleviate this situation have been taken.

Canadian Airlines International has completely overhauled the food-waste handling procedures for CaterAir. Food waste is no longer attracting birds to the vicinity of the Canadian Airlines International hangar.

The data collected in this study and in Demarchi and Searing (1995a; 1995b) have been effective in identifying the hazards birds pose to aircraft at YVR. Many of the hazards that have been identified are expected to be adequately mitigated by the revised Wildlife Control Program (see Searing *et al.* 1996). However, the dynamic nature of the avian community around Sea Island and the changes that are occurring to the landscape there require that an ongoing monitoring program be conducted to ensure that safety concerns can be managed proactively. In addition to identifying hazards and long-term trends in local populations of avifauna, the database will provide an effective benchmark against which the effectiveness of the Wildlife Control Program at YVR can be assessed and adaptively managed. We believe that a long-term monitoring program with a consistent protocol of data collection and analysis is an essential part of aviation safety at YVR.

APPENDIX 28

Gulls Association with the St. John's Airport and the Robin Hood Bay Waste Disposal Site, Newfoundland Phase II Progress Report

GULLS ASSOCIATED WITH THE ST. JOHN'S AIRPORT AND THE ROBIN HOOD BAY WASTE DISPOSAL SITE, NEWFOUNDLAND PHASE II - PROGRESS REPORT

By

LGL Limited
environmental research associates
P.O. Box 280, 22 Fisher St.
King City, Ontario L7B 1A6

For

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LGL Report No. TA2131-1

15 August 1996

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Introduction

Transport Canada has identified a safety concern associated with the large numbers of gulls that occur on and around the St. John's Airport at certain times of the year. These high numbers are strongly influenced by the presence of the Robin Hood Bay Landfill, a few km to the east of the airport. Transport Canada funded a study of potential problems associated with wintering gull populations in the St. John's area from mid November 1994 to mid March 1995. The report of the Phase 1 study is

Davis, R. A. and B. Mactavish. 1995. *Gulls Associated with the St. John's Airport and the Robin Hood Bay Waste Disposal Site, Newfoundland.* Report by LGL Limited to Transport Canada, Ottawa. 37p.

The Phase 1 report documented very large numbers of gulls at the Robin Hood Bay Landfill and substantial flights that passed near to the airport as the gulls traversed between night roosts on Conception Bay and feeding areas at the landfill. The results of Phase 1 indicated that it was very important to determine gull numbers and movement patterns at other times of the year.

Transport Canada commissioned LGL Limited to conduct a Phase 2 survey from mid June to 30 September 1996. The present brief progress report provides summary information collected during the first half of the study. The data are presented solely to provide the Project Manager with information on how the study is progressing and to identify some of the main findings to date. The report contains raw data that have not yet been fully checked. Thus, the specific results should not be released, although the general findings can be reliably used for planning purposes.

Survey Coverage

Surveys have been conducted by Ross Harris, LGL Limited, King City, and Jytte Selno, St. John's. Unfortunately, surveys did not begin until the latter part of June due to delays in finalizing the contract and in scheduling the first surveys by Ross Harris. However, gull behaviour patterns should be fairly stable during June which is the incubation and early chickrearing phase of the annual cycle. The survey coverage has emphasized the Robin Hood Bay Landfill and the Airport.

All of the gull day-use areas found in the Phase 1 winter study are regularly covered during Phase 2. The reader is referred to Figure 1 (taken from the Phase 1 report) for the locations of the various features in the St. John's area.

Numbers of Gulls

There were some significant differences in the numbers and movements of gulls in this study area compared with the late fall and winter situation. The Robin Hood Bay Dump remains the major terrestrial attraction for gulls in the St. John's area. However, very few gulls used any of the other fall/winter day-use areas. Large numbers of gulls frequented capelin and herring coastal spawning areas in late June and July.

Robin Hood Bay Landfill

The numbers of gulls at the landfill during 19 surveys are listed in Table 1. The species breakdown for selected dates is also presented in Table 1. About 7,500 gulls were present at the landfill in late June with about 95% being herring gulls and 5% great black-backed gulls. The numbers present were fairly steady through July ranging from about 4,000 to 8,500 gulls. Clearly, more gulls actually used the landfill as there was significant gull traffic throughout the day between the landfill and the nearby nesting colonies. Again, most of the gulls present were herring gulls (Table 1).

There was a significant decline in the numbers of gulls present at the landfill at the end of July and in early August (Table 1). Non-weekend numbers ranged from about 400 to 1,500 birds. The decline coincided with the fledging of young gulls from the nearby colonies. Banding results from the late 1960's and early 1970's indicate that young-of-the-year and yearling herring gulls move from north from the nesting colonies in August, perhaps following capelin which spawn in August in northern Newfoundland and Labrador (Threlfall 1978, Bird-banding 49:116-124). The adult gulls may also move north after the young have left the colony. These movements may explain the decline in gull numbers at the landfill in early August 1996.

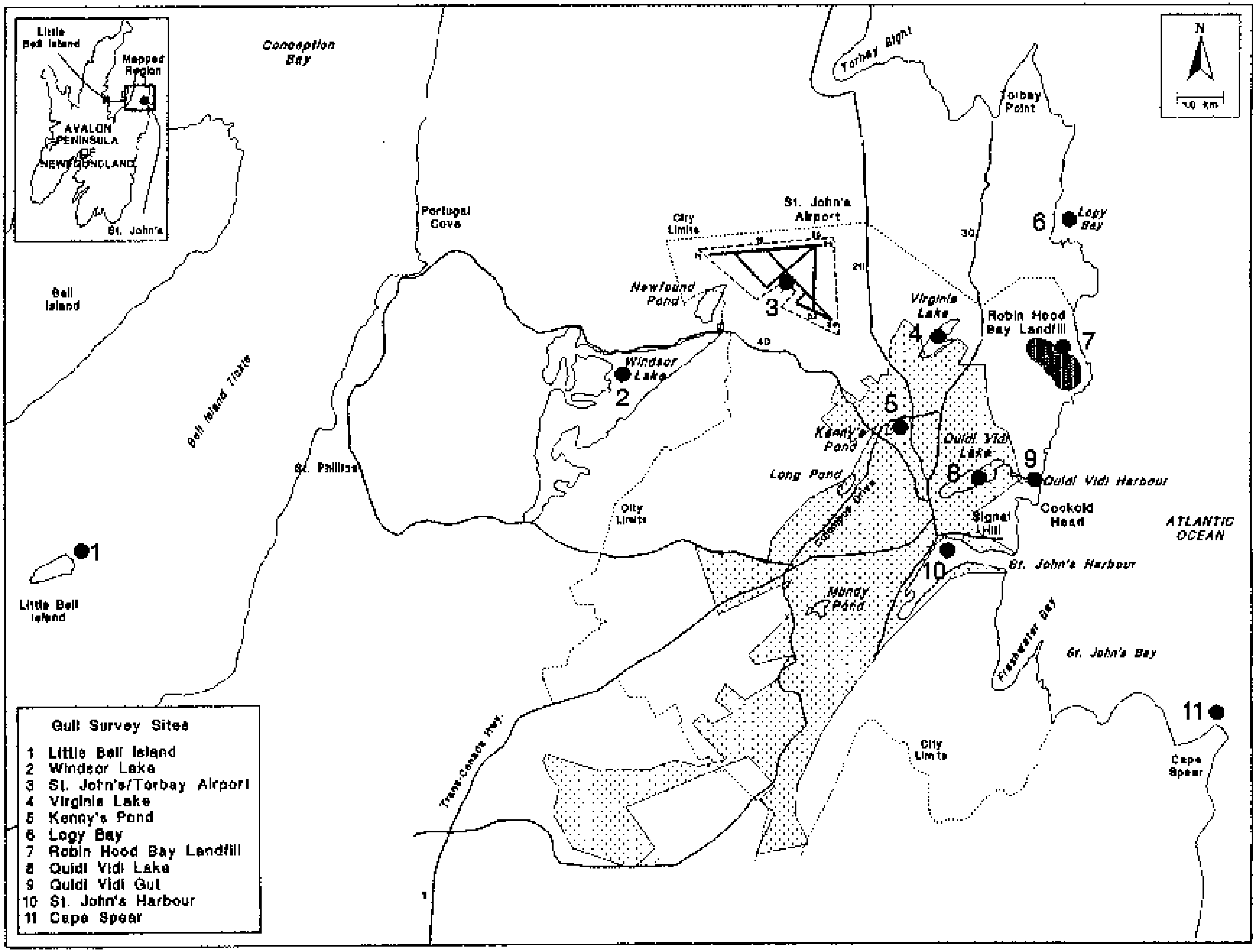


Figure 1. Principal features affecting gull distribution in the St. John's, NF area.

Table 1. Numbers and species of gulls at the Robin Hood Bay Landfill, St. John's, NF, June-August 1996.

Date	Number of Gulls	Herring Gull		Great Black-backed Gull		Other
		#	%	#	%	#
June 26	7,400					
27	7,558	7,174	95	383	5	1
July 3	3,907					
4	4,344	2,972	68	1,371	32	1
9	5,735					
11	6,980	6,317	91	662	9	1
12	5,740					
15	8,490					
16	5,876					
18	4,250					
19	4,144	3,708	89	435	10	1
23	3,725					
28 (Sun)	328					
29	840	731	87	107	13	2
30	1,044					
31	370	305	82	63	17	2
Aug 1	445	356	80	86	19	3
5	1,509	1,376	91	131	9	2
6	965	872	90	90	9	3

Day-Use Areas

As noted earlier, very few gulls frequented the day-use areas used by gulls in the fall and winter. Most notably, Qidi Vidi Lake which hosted thousands of gulls in the winter usually supported fewer than 20 gulls on visits in the summer. Similar small numbers were present at other day-use areas. Numbers at Windsor Lake and the lakes to the west were usually less than 30.

Flight Lines

A major effort in the present study has been to determine the main flight paths used by gulls moving among feeding, loafing and night roosting areas. Of particular relevance are gull flightlines in the vicinity of the airport.

St. John's Airport

In the fall and winter, there had been major movements of gulls across the Avalon Peninsula between a night roost in Conception Bay in the west and feeding (Robin Hood Bay Landfill) and loafing (Qidi Vidi Lake) areas on the east side of the peninsula. These flightlines took gulls near to the approach/departure paths of aircraft using the St. John's Airport. These east-west movements were not present in the late June to early August period.

Although very few gulls were seen at the airport during this study period, there were two flightlines used by gulls near the airport. The more heavily used was an east-west flightpath that passed just south of the airport. The second path was used by fewer gulls; it was parallel to Runway 11/29 and about 1 km north of it.

Robin Hood Bay Landfill

Gulls potentially approach the landfill from four directions. Because of the size and configuration of the landfill, observations from each of four directions must be made. This involves using two observers on two consecutive mornings. In summary, the arrival/departure observations indicated that very few gulls arrived at the landfill from the west, the direction of the airport. The main gull movements were along the coast both north and south of the landfill. Thousands of gulls nest on cliffs along the east coast of the Avalon Peninsula. Major nesting areas occur on the cliffs in Freshwater Bay to the south of St. John's and along the cliffs from St. John's north.

Gull movements occurred between the landfill and the nesting areas. Gulls followed the coast and entered the landfill from the southeast (Bobbie's Cove) or the east (Green Gulch). A major flightline from the north moved south from Logy Bay and entered the landfill from the northwest. None of these coastal flights affected the safety of aircraft at the airport.

Conclusion

Although it is too early to reach any definitive conclusions, it is apparent that gull behaviour during the late June to early August period is less likely to create bird hazards to aircraft problems than is the behaviour that occurs in late autumn.

It is not known when gull numbers will begin to increase again but increases are expected to begin by late August/early September. It is unfortunate that there will be a gap in the coverage between this Phase (ends 30 September) and Phase 1 (started on 17 November). The October-early November period is likely to be a key period.

APPENDIX 29

The Northeast Association of Wildlife Damage Biologists
Information Sheet

Subject: The Northeast Association of Wildlife Damage Biologists Information Sheet

To: Wildlife Management Professionals

The Northeast Association of Wildlife Damage Biologists (NEA-WDB) was founded on February 27, 1991 at a meeting in Leominster, MA. This organization fills a long awaited need to provide technical development and in-service training to biologists.

The goals of the NEA-WDB are:

1. to enhance the professional image of wildlife damage biologists;
2. to provide a support base and advocacy group for all federal, state, and private biologists;
3. to provide in-service technical training; and
4. to exchange technical information through field trips.

The organization's jurisdictional area is the 13 northeastern states and seven eastern Canadian provinces. The NEA-WDB meets once a year in conjunction with the Northeast Association of Fish and Wildlife Agencies conference. At each annual meeting, the organization holds technical sessions, provides animal damage control training, and conducts animal damage control field trips. Additionally, a newsletter, NEA-WDB's "Technical Notes", is provided to members three times a year. This publication provides a forum for wildlife biologists in the northeast to exchange ideas, philosophies, and management techniques.

The present officers of the organization are:

President:	Richard Chipman, Montpelier, VT
President-Elect:	Russell Mason, Philadelphia, PA
Treasurer:	James Forbes, Albany, NY
Secretary:	Jessica Dewey, Leesburg, VA

All eligible biologists from the northeast are invited to join. A membership application is enclosed.

Jessica Dewey

Jessica Dewey, Secretary
Northeast Association of Wildlife Damage Biologists

Enclosure:
Membership Application, NEA-WDB

Membership Application
Northeast Association of Wildlife Damage Biologists

Regular Membership: Voting membership is available to any person holding a professional degree in wildlife management, or related field, who has completed at least two years of college training, and whose professional duties include wildlife damage management, within the jurisdiction of the organization. All applicants for the Regular Membership category must be sponsored by a current NEA-WDB member.

Associate Membership: Associate membership is a non-voting membership for individuals, businesses, or industries who provide animal damage control equipment, material, or services.

Student Membership: Student membership is available to any student enrolled in a program of education in the area of wildlife management or related field. They have full voting privileges.

Retired Membership: Retired membership is available to any former Regular Member or person who formerly worked in the wildlife damage control/management field. They have full voting privileges.

________	Regular Membership -	$10.00
________	Associate Membership -	$25.00
________	Student Membership -	$ 5.00
________	Retired Membership -	$ 3.00/yr; $5.00/2yrs
________	Donation	$________

Check or money order payable to: **Northeast Association of Wildlife Damage Biologists**

NAME______________________________ PHONE______________

ADDRESS____

CITY______________________ STATE__________ ZIP__________

Mail to: James E. Forbes, Treasurer; NEA-WDB
RD 4, Box 33
Averill Park, NY 12018

APPENDIX 30

Aviation Safety Letter: Birds

Transport Canada Aviation
Transports Canada Aviation

Aviation Safety Letter

TP 185E
ISSN 0709-8103

Learn from what others are doing right...

Issue 3/96

Birds

"Something has come through the windshield! I can't see!"

The PA-28 pilot was en route from Brampton to Hamilton, Ontario in February 1994. He was orbiting the bay waiting for clearance into the control zone when he suddenly reported a strike on his windshield. Using radar, the tower controller gave the pilot his position and headings to steer. But the pilot was disoriented and unresponsive, repeating only that something had come through the windshield, he could barely see, and he couldn't see the instruments. Radar showed him flying erratically over Lake Ontario. Twelve minutes later, the pilot stopped responding, and five minutes later the aircraft disappeared off the radar. Despite an intensive search, it was never found.

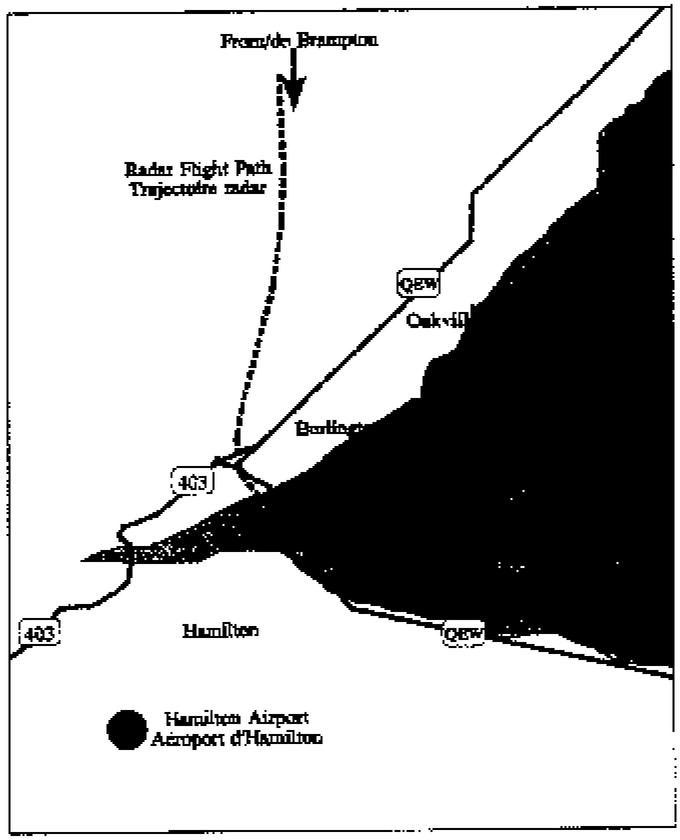
The first fatal bird strike was in 1912. Famed flying pioneer, Cal Rodgers, who had recently flown across the USA, was cruising along the shore at Long Beach, California when he flew through a flock of birds. A gull jammed the flight controls, causing the aircraft to crash into the sea.

Since that day, gulls have been a major menace to aircraft. Slow and clumsy fliers, gulls account for more than half of all reported bird strikes world wide. But they are not the only species involved.

The worst bird strike in aviation history occurred in October 1960. A Lockheed Electra departing Boston Logan Airport hit a flock of starlings, disabling No 1 engine. Then two other engines lost power, and the aircraft spun into the sea, killing 62 people. Miraculously, there were 10 survivors.

In January 1995, 10 people died when a Falcon 20 crashed after ingesting a flock of lapwings.

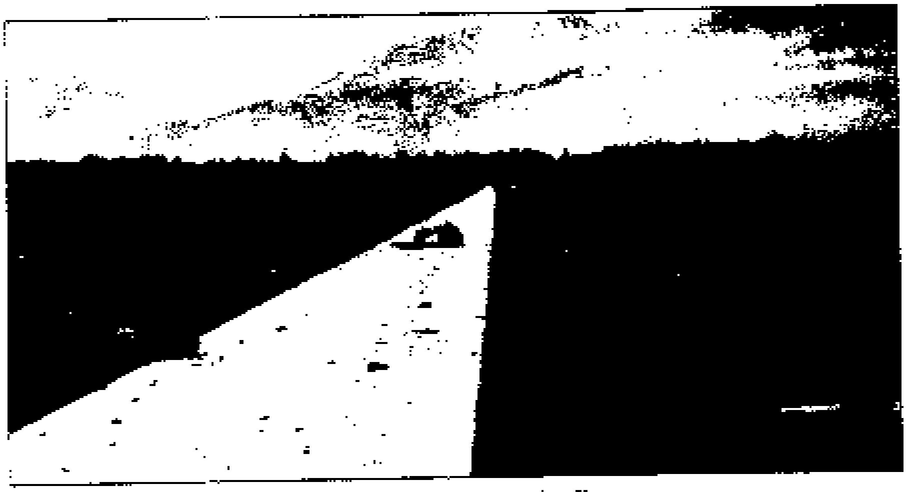
A DC-10 was totally destroyed by fire during an aborted takeoff from Kennedy Airport, New York in November 1975. The aircraft passed through a flock of gulls at a speed of 155 knots (just below Vr). No 3 engine disintegrated, and the broken fan blades punctured the wing fuel tank, starting a massive fire. Fortunately, those on board were all airline employees thoroughly trained in emergency procedures. All 139 escaped.



Not so the seven people on board a Learjet out of Atlanta in 1973. It struck a flock of cowbirds during takeoff and everyone died in the crash.

A routine flight ended in catastrophe at Elmendorf, Alaska on September 22, 1995. All 24 crew members of an E-3B AWACS died when their aircraft hit a flock of Canada geese as it was beginning the rotate for lift-off. Several birds were ingested, causing the failure of No 2 engine and compressor stalls in No 1. The crew did everything humanly possible to fly the aircraft out of an unflyable situation. The aircraft began a slow left-hand climbing

Canada



Remains of geese littered the runway after AWACS takeoff.

turn, and struck a wooded hill less than a mile off the runway. The aircraft was totally destroyed.

The geese had been flushed from the infield. The tower controller told witnesses he had watched the birds wheel directly into the path of the departing aircraft.

Just two minutes earlier, a departing Hercules had flushed a flock of geese on the same runway. The controller had seen this flock also, but did not warn the AWACS crew or airport management. The geese had been roosting in the infield adjacent to the runway.

The airport had a well-developed plan for bird control which defined this situation as an "immediate safety hazard." However, their control measures were inadequate during migratory season. The USAF accident report noted: "Specifically, there was no augmentation to airfield patrols, no static deterrents, such as sound cannons, and no spotlighting of the infield areas during hours of darkness."

In the past, control measures had been effective when geese were seen and reported. For two weeks prior to the accident, management had dispersed geese seven times, and just two days before, had killed geese that would not disperse. The report noted, however, that "the procedures to detect and deter geese were inadequate and lacked perseverance."

While the ultimate accident cause was ingestion of geese into two engines, the reports named two major contributing factors. First, management lacked an aggressive program to detect and deter the birds during the migratory season. Second, the tower controller failed to notify either the aircraft crew or management that geese were roosting in the infield.

The unreported presence of geese, the failure to disperse the birds, and the resulting accident was a system failure.

A bird hits an aircraft with incredible force (it's a function of the square of the speed). Birds may look soft, but a six-ounce specimen strikes with the force of a 45-caliber bullet when hitting a high speed aircraft. A PA31 departing Slave Lake struck a single gull in May 1992. The impact left a 14 inch wide, three inch deep dent in the left wing. At 50 knots, a four pound seagull produces an impact of about 14,000 foot-pounds. At 200 knots, the same bird delivers a knockout punch of 225,000 foot-pounds. At 420 knots the impact reaches nearly a million foot-pounds.

Most bird strikes occur below 200 feet, during landing or take-off. However, birds, like pilots, often look for a good tailwind, especially during migration, and will go to great heights to find it. There are records of a mallard strike at 17,000 feet, an eagle/jet rendezvous at 21,000 feet and a condor/airliner conference at FL 370. These high level meetings are more damaging because the birds are bigger and the aircraft speeds greater. In 1981, a loon penetrated the windshield of a Learjet 23 at 4000 feet. The impact killed the co-pilot and injured the pilot.

Pilot involvement is critical in minimizing the risk.

1) Be alert for information on bird activity — NOTAMS, ATS advisories, ATIS, pilot reports, etc.
2) When warned of bird activity, think about changing runways, changing flight times, changing airports; slowing down; or not flying at all.
3) There is evidence that strobe lights and landing lights help disperse birds. They tend to turn and dive away from your lights.
4) Turn on your windshield heat. Warmer glass has greater flexibility in case of an impact.
5) Avoid low flying, particularly near lakes and rivers during the migratory season.
6) If you do have a mid-air meeting with a bird, slow the aircraft to a minimum safe speed, especially if the windshield is cracked or delaminated, and do a controllability check. When safely back on the ground, do a very careful post-flight examination.

In 1995, there were 837 bird strikes reported in Canada. The charts on page 3 are from the *1995 Summary Report, Bird Strikes to Canadian Aircraft.* A full report is available from Transport Canada Airports, Environment and Support Services (AKP), 18C, Place de Ville, Ottawa, Ontario, K1A 0N8.

Surprisingly, most strikes occur not during spring and fall migrations, but in July and August, when young birds are just learning to fly. Perhaps we should improve their ab initio training by including "aircraft avoidance" in their syllabus. There are also a large number of night fliers. A lot of birds obviously have their Night Endorsement. Approximately 30% of bird strikes occur during hours of darkness.

As shown, most strikes occur at low level, close to an airport. An airport is an environment we can control only with the full participation of all those involved. Here are some danger signs to watch for.

- Grassy infields encourage nesting and feeding.
- Slow drainage brings out worms after heavy rains. This attracts birds.
- Land zoning permits incompatible land use. Landfills have contributed directly to many a bird strike.
- Adjacent open water can be dangerous.

Bird strikes are costly, even when no human casualties occur. In Canada, they cost more than $6.5 million in three years in the mid-80s. Moreover, reported costs, like those of most accidents, don't account for lost use of the aircraft and other uninsured costs, which can be up to seven times the insured ones.

A flock of birds (with their night endorsement) did more than $2 million damage to a Boeing 767 during a night takeoff from Vancouver on March 30, 1996. Immediately after rotation, at about 50 feet, and while accelerating through 180 knots, the aircraft flew through a large flock of birds. The crew felt serious engine vibrations. But as they continued the post-takeoff checks, and reduced the engines to climb power, the vibrations all but disappeared.

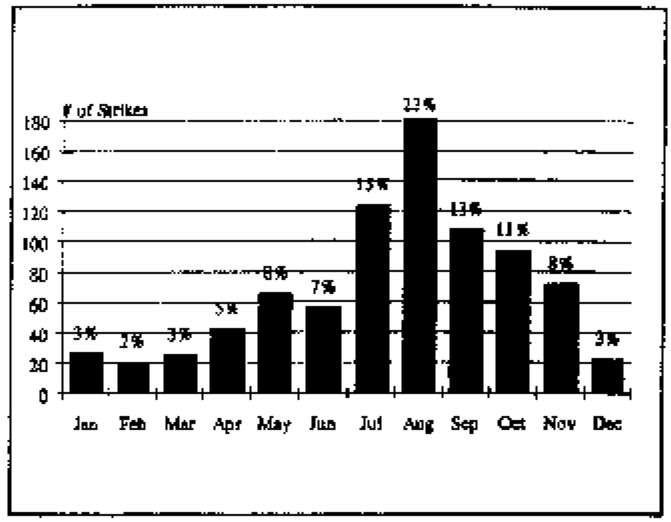
Meanwhile, airport personnel checked the runway for debris and discovered 50 dead ducks littering the runway. The controller advised the crew, who wisely decided to dump 16,000 kgs of fuel and return for a precautionary landing with ERS standing by. After the successful overweight landing, ERS checked the brake temperatures on the runway before the crew taxied to the gate to end a hair-raising evening.

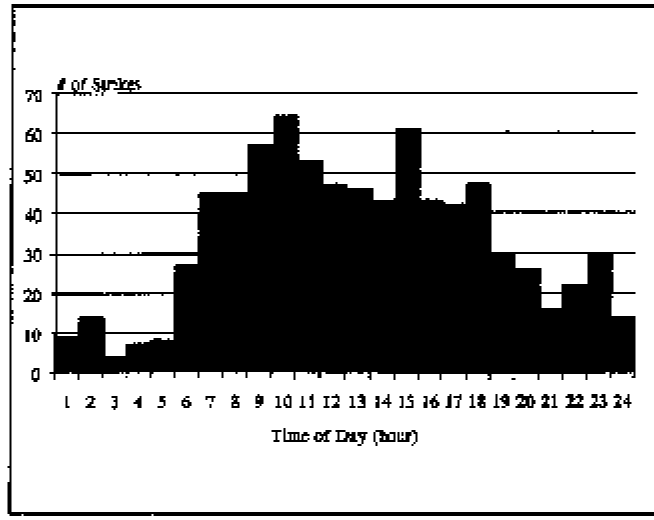
Inspection revealed extensive damage. Birds had damaged the N1 fan in the right engine and dented the engine intake casing. The right wing between the nacelle and the fuselage had six separate dents, skin fractures and holes. Bird impacts had also damaged the flap fairing cover and shattered a landing light.

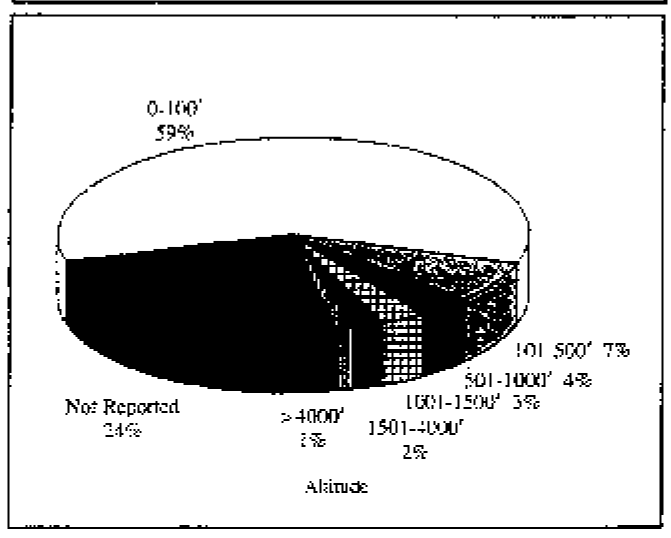
At the time, Vancouver Airport had an active dawn-to-dusk bird control program. Unfortunately, the crew had just gone home when this accident occurred. Immediately after the accident, airport management recalled the crew and they were back on full alert within hours. Vancouver's bird control program is now around-the-clock!

Effective efforts to minimize the bird hazard requires aggressive cooperation among operators, airport management, community officials and environmentalists. The bird hazard control program must address not only on-field reporting, control

1995 Bird Strike Statistics







and deterrence but it must also create a surrounding environment that will minimize the hazard.

Canadian efforts in the past two decades have led to a significant decline in the number of reported bird strikes. The improvement is a tribute to all involved (except the birds). But as the latest statistics prove much can still be done. △

APPENDIX 31

Aviation Safety Letter: Birds and Bedlam

Birds and Bedlam

Takeoff aborted by bird strike.

Birds are beating up aircraft — badly — and recent history suggests that they may be winning the world-wide air war.

March 30, 1996: A B767 lost one engine on takeoff from Vancouver Int'l Airport after striking a flock of ducks (*ASL 3/96*). The aircraft returned to the airport for a precautionary landing after dumping fuel over the ocean. Damage — $2M plus.

May 18, 1996: A B747 lost one engine to a bird strike on takeoff from Lester B. Pearson Int'l Airport and dumped thousands of pounds of fuel over Lake Ontario before returning for a precautionary landing.

January 20, 1994: A Falcon 20 departing Le Bourget struck Lapwings causing an uncontained engine failure and a fiery crash killing 10 people.

January 1, 1996: A Boeing 747-200 on takeoff from Cairns, Australia struck several large birds destroying two of its four engines.

> ***A dramatic increase in the bird population has raised the stakes.***
> ***Are the birds winning the war in the sky?***

We estimate that bird strikes cost the North American aviation industry more than $500 million per year. Rapid growth in air travel and bird populations are leading to a growing awareness of this serious threat to aircraft and passengers. As well, high profile accidents in the United States in 1995 have attracted significant attention.

June 3, 1995: A Concorde, on final approach to JFK Int'l Airport, struck a large number of geese. After the emergency landing, all passengers evacuated safely, but the geese had destroyed engines #3 and #4. Damage: $6 million.

September 18, 1995: An A320, landing at LaGuardia Airport, struck Canada Geese. Engine and airframe damage totalled $2 million. Loss of service added another $500,000.

September 22, 1995: A Boeing 707 E3 AWACS aircraft crashed after takeoff from Elmendorf Air Force Base, Alaska (*ASL 3/96*) killing all 24 crew members. 31 dead geese were found on the runway. Added to the tragic loss of life, dollar costs reached $189 million.

September 25, 1995: A Cessna Citation carrying Newt Gingrich, Speaker of the U.S. House of Representatives, struck geese on takeoff from Mackinac Island. The pilot aborted the takeoff but couldn't keep the aircraft on the runway. Luckily, nobody was hurt.

December 10, 1995: On a night approach to JFK Int'l, a B747 struck geese at 7500 ft. AGL. The crew saw a flash of white before being struck by what felt like sandbags. The impact destroyed two engines and extensively damaged the airframe. Repairs cost approximately $6 million.

The dramatic increase in bird numbers, particularly large birds, has raised the stakes. Ring-billed Gull populations in the Lower Great Lakes region have increased approximately 12% per year since the mid-1970s. In the Ottawa area alone, the population has grown from 5 nesting pairs in 1974 to over 6000 pairs in 1995. Approximately 30% of Canadian bird strikes involve gulls.

The number of Canada Geese migrating through North America has doubled in the past 25 years, with a noticeable influx of non-migratory, resident geese. Canada Goose populations in other parts of the world are increasing by 8% per year.

Some results of this population explosion have been a 400% increase in goose strikes to aircraft at JFK Int'l Airport since 1984, and over 237 strikes involving gulls in Canada during 1995. The increasing population is not good news for air traffic.

The Israeli Air Force has lost more aircraft to birds than in war. In Europe and Israel, more than 168 military aircraft have been confirmed lost to bird

Cont. on page 11

Birds and Bedlam

Cont. from page 12

AWACS wreckage.

strikes since 1950. Are the birds winning the war in the sky?

Large birds are the greatest threat to aircraft. The force of impact depends on the the bird's weight and the aircraft's speed. A large number of heavy birds striking an aircraft travelling at high speed can exceed the design limits of its airframe and engines.

Most of today's engines are designed to absorb a 1.5 lb. bird volley, although early designs and smaller engines were not built to this standard. The latest generation of high bypass ratio turbofan engines are required to withstand a 2.5 lb. bird volley, but their larger intake areas and reduced noise means they are struck more frequently.

Reporting is critical to managing this hazard. The FAA estimates that only 15% of bird strike incidents are reported in the U.S. Despite our much lower level of aircraft activity, Canada had 28.5% as many reported strikes as the U.S. in 1994. In 1993, Canada accounted for 21.3% of the world's bird strikes reported to ICAO. We estimate that only 30% of Canadian bird strikes are reported.

Approximately 85% of reported bird strikes occur within the airport environment, 60% occuring during takeoff or landing. In 1995, Canadians reported 58 precautionary landings, 18 aborted takeoffs, 15 forced landings, 22 engine ingestions, 3 engine shutdowns, and 8 penetrated airframes as a result of bird strikes. Pilot reports increased from 132 in 1994 to 319 in 1995 — a 141% jump! That's good news, if the increase reflects better reporting and not a growing problem.

Bird strike reports help engine and airframe manufacturers improve designs, and airport operators make environment management decisions. The bird hazard is serious. As a pilot, you have a vital role to play by reporting birds and bird strikes, and if you see birds near the runway, you may want to postpone your takeoff decision until the birds are dispersed.

For bird strike report forms and more information on the hazard contact:

Bruce MacKinnon
Transport Canada (AKPP)
18C, Place de Ville
Ottawa, Ontario, K1A 0N8
Phone: (613) 990-0515
Fax: (613) 957-4260 △

Just Briefly

Good Night Pre-flight Check?

The Cessna 150 pilot was planning local night circuits. Immediately after takeoff, he experienced attitude control problems. Only with the control column fully forward could he maintain level flight. He declared an emergency and managed to complete one circuit landing with the emergency response crew standing by.

The emergency crew removed the 85-pound cement tie-down weight that was still attached to the tail.

How Thorough is Your Test Flight Pre-flight?

Maintenance had just completed a check that required a wing removal on the DC-3. As the test-flight crew levelled the aircraft after takeoff, they used aileron trim to correct a left-wing-heavy condition, but trimming only made the problem worse. They immediately reversed the trim selection and turned for home, landing safely.

Post-flight investigation revealed that the trim was operating in reverse — not the first, nor probably the last time for "Murphy" to strike.

Little patience on a Not-so-good Day!

On final approach to the runway, the Piper Malibu struck a snow bank 125 feet short of the threshold. The impact and the following hard landing caused substantial damage to the wings and the landing gear. The pilot taxiied to the hangar where he inspected the damage.

No doubt angry with himself, frustrated and impatient, he decided to taxi the aircraft into the hangar, but did not appreciate that the damaged aircraft now sat on the ground in a tail-high, nose-low attitude. As he entered the hanger, the aircraft's vertical fin hit the top of the door and the propeller slammed into a steel tow bar. △

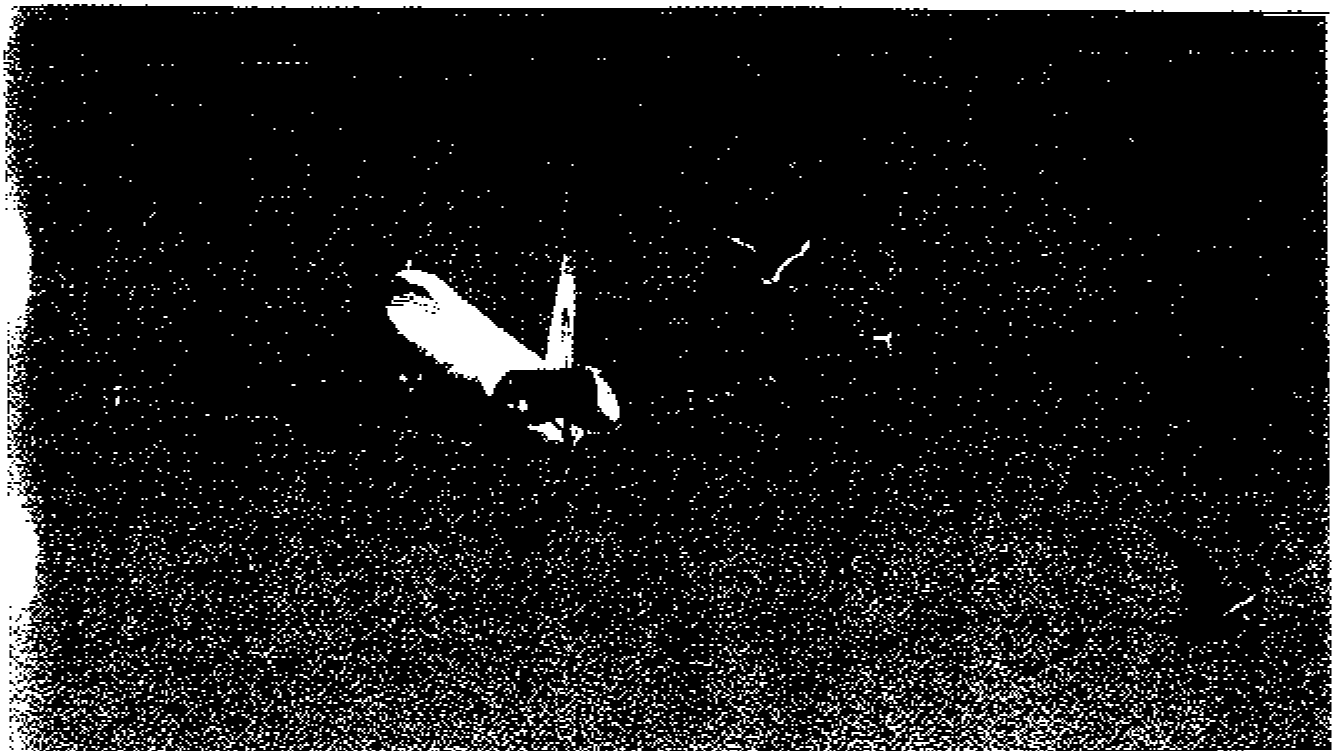
APPENDIX 32

Air Transport World: Sharing the Skies

Bird strikes • U.S./U.K. bilateral • Reno Air

Air Transport World

The Magazine of World Airline Management · A Penton Publication · November 1996



Sharing the skies

As the numbers of birds increase, so does the risk of a serious accident involving a flock

By J.A. Donoghue

Air travel is becoming less safe, thanks to environmental-protection efforts. The problem is birds, so many birds: birds that get in the way of aircraft, and get chopped by fans and turbines, smashed against radomes, rammed into landing gear that cause damage, disrupt schedules and threaten life.

Restrictions on pollutants, the use of pesticides—especially DDT—and good wildlife-management practices have cleaned up and protected the environment to the point that bird populations are exploding. The rapid increase in the numbers of large birds is bad news for the airline industry.

The problem is that bird strikes can bring down an airliner. Despite this sobering fact, the threat of bird strikes has not ranked very high in the hierarchy of airline safety concerns. Judging the threat from history would give an encouraging but erroneous picture: Seven fatal civil transport accidents worldwide have been attributed to bird strikes since 1912, accounting for 200 deaths. In addition, industry moves to minimize the danger through tougher designs—especially in engines—has improved the chances of surviving encounters with a few birds.

But history also has shown that design cannot prevent severe damage from multiple

When bird strikes happen

SOURCE: FAA

collisions with large birds and that the best defense against encounters with birds is avoidance. However, an avian population explosion, especially among big birds, makes avoidance increasingly difficult. This is one safety trend that has the potential to run counter to other addressed hazards and actually worsen before it gets better.

How real is the danger of bird strikes? Air transport officials' attention was focused by last year's crash of a U.S. Air Force E-3, a military equivalent of the Boeing 707, after takeoff from Elmendorf Air Force Base, Alaska. All 24 crew members were killed. Thirty-one dead Canada geese were found on the runway.

The list of civil aircraft encounters with birds is not short. Gratefully, the list of fatalities remains brief, with but one fatal jet transport crash, an Ethiopian Boeing 737 accident in 1988 that caused 35 deaths and 21 serious injuries, according to John Thorpe, chairman of Bird Strike Committee Europe.

Could this happen to a modern aircraft with high-bypass engines? Absolutely. Last New Year's Day, a Boeing 747-200 departing Cairns, Australia, sucked in several large birds that destroyed two engines. It was able to circle and land. In March, a Boeing 767 departing Vancouver encountered a flock of ducks and lost an engine. It, too, landed. In May, a British Airways 747 leaving Toronto lost an engine to bird strike on takeoff. It landed after dumping fuel. Last year at New York JFK, a Concorde on short final flew into a flock of geese, resulting in fires that destroyed two engines, and a Polar Air Cargo 747 at 7,500 ft. and descending at night struck a flock of geese, suffering two destroyed engines and extensive fuselage damage.

Also last year, a 737-400 in Turkey, a 737-400 at Portland, Me., and a 737-200 at Hannover all suffered significant engine damage. Only on the Portland aircraft did one of the engines escape damage. Thorpe reports that European airlines continue to experience about 20 events each year in which more than one engine ingests birds.

Proving the extent of the hazard of bird strikes or the trend of increasing or decreasing threat is nearly impossible due to the slack attitude the industry has taken to submitting and gathering bird-strike statistics.

Since 1988, the U.S. FAA has had a reporting system to tally aircraft damaged by all sorts of wildlife encounters. But reporting is voluntary and participation spotty. Worse, agency handling of the data until several years ago was uninspired, to say the least. Untrained personnel handling the data made numerous mistakes, resulting in reports such as 500 aircraft strikes over the U.S. involving a type of gull found only in Europe.

FAA now has a cooperative agreement with the U.S. Dept. of Agricult... to assure the accuracy of the data inputs and to review and correct previously entered da...

Corrected data for the 1993... period are the basis for FAA es... mates of $153 million of ... aircraft damage in the U.S. ... ally from wildlife enco... with about 95% of this total fr... bird strikes.

Still, says Ed Cleary, staff wi... life biologist at FAA, report... remains voluntary and indus... awareness questionable. Clea... believes that only 15-20% ... damage is reported to the sy... tem. Judging trends unde... a system becomes impo... making analysts guess wheth... increased reporting means ... actual damage increase or ju... an elevated awareness of th... problem.

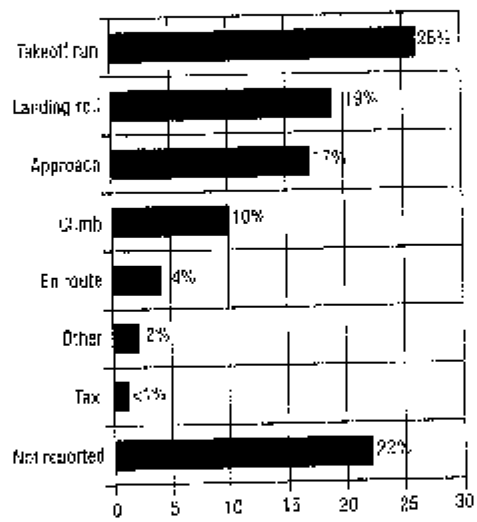
Cleary further says that th... threat rise comes about not on... from the undeniable bird-popu... lation increases but als... the fact that aircraft are ... have bigger engines and a... takeoff, go faster sooner. All ... these factors allow an airplane ... "sneak up" on birds accustom... to the noise and bustle arou... an airport. The larger-diamet... engines provide more surface a... for impact and to some exten... more suction to assure ...

"The chances of a bird strik... are going up," Cleary told AT...

Canada appears to have devel... oped a more comprehensi... bird-strike-reporting system. ... Transport Canada also is unce... tain about its ability to refle... trends accurately. When 199... bird-strike reports so... 857, 28% over the pre... year, the Ministry could not tell w... the rise was real or was due to ... reporting and increased awarenes... This uncertainty extends to worldwi... reporting as well. In 1993, when ... ICAO countries reported 3,427 bi... strikes, Canada accounted for 21.2% ... the world total and the 655 Canadi... reports in 1994 were 28.5% of ... total. While Canada certainly is ... abundant wildlife, it also has fe... craft movements than Chicago O'Ha... Airport. In 1992, O'Hare had 70 ... strikes resulting in $8 million of air... damage.

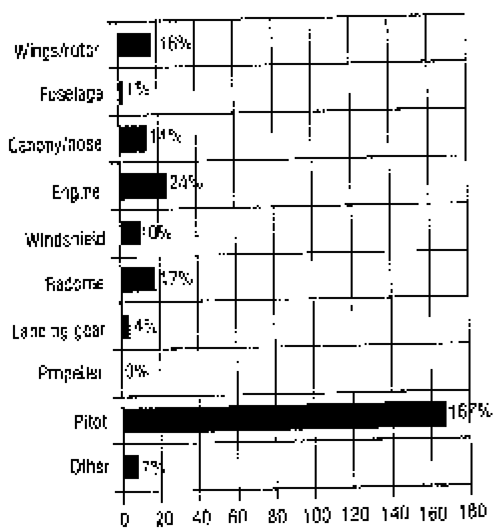
Many of the reported Canadian strik...

Bird strike phase of flight



SOURCE: Transport Canada 1994 data

Aircraft parts struck and damaged



SOURCE: Transport Canada 1994 data

involved transport aircraft and resulted in 15 forced landings, 58 precautionary landings, 22 engine ingestions, 18 aborted takeoffs and eight penetrated airframes.

A Boeing study of the period 1994 to early 1996 recorded 175 events in its database, all large-transport aircraft. At least 100 caused damage and 11 resulted in a rejected takeoff at speeds of 100 kt. or higher.

With the majority of bird strikes occurring within 2,500 ft. of the ground, military low level operations have a greater exposure to the hazard. The USAF reports more than 3,000 strikes each year, causing more than $50 million in damage. Worse, 14 aircraft and 11 crew members were lost between 1987 and mid 1995, before the E-3 crash. The Israeli Air Force says it has lost more aircraft to birds than to combat.

Running second to the pure safety considerations involved in bird strikes is the not insubstantial consideration of financial losses. The extent of this problem is as difficult to grapple with as the number of strikes.

An Air Transport Assn. foreign object damage (FOD) study over the last few years has gathered a mixed bag of damage reports from an ever-changing group of volunteer airlines. This study offers the estimate of $13.2 million for 1995. Since damage to the Polar 747 alone was $6 million, this number seems far below true U.S. experience.

Figures probably much closer to the truth are in an FAA study, buttressed by United Airlines data. Estimating that U.S. operators report less than 20% of all strikes, the FAA study extrapolates known figures into a range between $52 million and $260 million of damage per year to U.S. operators. The study settled on an estimated average loss of $153 million per year and 635,000 hr. of aircraft down time.

United's study estimates that birds account for one-third of the U.S. industry's $350 million annual loss to FOD, or about $117 million.

But what is the true cost of a bird strike, or any other sort of FOD, for that matter? Yossi Leshem of Tel Aviv University's department of zoology, in a paper presented this year in London, points out that calculating just the cost of the repair falls far short of the total cost, a cost that must include loss of use of the equipment and other indirect costs.

Leshem cites reports that civil operators report only about 15-20% of their actual strike damage, probably due to the insurance deductibles that run as high as $1.2 million per incident. Actual losses could run as high as 1,300 engines per year for civil aircraft worldwide, he said.

Accepted industry wisdom is that total costs are 4–5 times the amount of the damage, he said.

Leshem cites the case of an El Al 747 that ingested a hooded crow last April during takeoff from Ben-Gurion Airport bound for New York. Symptoms of engine-power problems led the crew to land in London, where the bent fan blades were confirmed. The passengers were housed and rerouted, a replacement engine flown in from Amsterdam and three other flights were canceled while the repairs were completed. "This domino effect cost El Al five times more than the direct cost of the damage to the engine," Leshem writes.

Bruce MacKinnon, manager-wildlife control in the airports group of Transport Canada, reports that a Canadian study based on conservative numbers estimates total annual North American costs to be around $500 million. The threat is real, so the fact that the numbers of birds are increasing must reflect an increasing threat.

Richard Dolbeer, a specialist at the Dept. of Agriculture, says the problem is of our own making.

"It boils down to the fact that we as a society have done a reasonable job of wildlife management in the past 50 years. We've cleaned up the environment, established wildlife refuges and kept a close watch on hunting and harvesting of wildlife. But now, that creates other problems."

The result is the North American population of Canada geese has increased from 2.8 million to 4.7 million in a 10-year period. More important, conservation efforts and the adaptability of these large birds has resulted in an explosion in the number of "resident" Canada geese, that is, geese that no longer migrate but reside in one place year round. During that same 10-year period, this group has tripled in size, from 600,000 to 1.8 million. These are large birds, reaching as large as 12 lb., historically causing the most damage per strike. Further, they are attracted to water and fields of short-cut grass, just the sort of combination found so often around airports.

Seven fatal civil transport accidents since 1912 have been attributed to bird strikes, with 200 deaths.

Once found only in the Western Hemisphere, Canada geese have been reported in the U.K.—a population of 60,000 growing 8% annually—and all the way to the eastern Baltic region, including Finland and western Russia.

The eastern Baltic region also is experiencing an influx of greater cormorants. Jevgeni Shergalin, a reporter to Bird Strike Committee Europe, predicts that in 5-10 years, both species "near coastal airdromes will be a real threat for aviation in the eastern Baltic area, as it already is in Western Europe."

Statistically, the bird most often hit by airplanes is the gull. That population has increased 20-fold in the Great Lakes region of North America in 40 years, with other areas showing strong growth, albeit not as dramatic. "Gull populations are doing very, very well," Dolbeer says, in part due to the trash available to feed adolescent birds until maturity. Gulls also engage in flocking behavior. "It is not unusual to see 50,000 gulls at Freshkill landfill [in New York] feeding at one time." In addition, these adaptable birds have begun nesting on rooftops. Three thousand gulls live on the flat gravel roofs in downtown Cleveland, posing a hazard for Burke Lakefront Airport.

And double-crested cormorants have come back from a very small population in the Great Lakes region to increase their population 400-fold in 25 years to more than 100,000.

"At some point, the environment

reaches its carrying capacity and the population begins to level off but we don't know what that point is," Dolbeer says. He does suggest that the gull populations are beginning to stabilize but geese and cormorant populations are still climbing.

If birds weren't bad enough, the deer population in North America is nearing 30 million, about the number thought to exist when Europeans first landed more than 400 years ago. These, too, create runway hazards.

Although unreliable for tracking the frequency trends of bird strikes, studies have shown clearly where the danger of a strike is during a flight and what portion of the aircraft is most vulnerable. The location is on and near airports at altitudes under 2,300 ft., and the engine is the most important high-frequency impact area.

While the bad news about the high-bypass engines is the increased exposure to multiple strikes, the good news is that a bird is much more likely to be ejected with the bypass flow, sparing the core unless fan blades disintegrate. Yet, fan damage is not to be taken lightly.

Regulatory authorities had this fact in mind while increasing the weight of the bird-impact tests over the years. Initially, multiple 1½-lb. strikes had to be survived, and then 2½-lb birds. Following impact, engines must be capable of producing 75% of takeoff thrust and operating for 20 min. The FAA requirement for a large-bird strike is that after a single 4-lb. bird impact, the engine must be capable of being shut down within 15 sec. without creating a potentially hazardous situation for the aircraft, according to Thomas L. Alge, propulsion system safety engineer at GE Aircraft Engines. FAA has proposed this bird test be increased to 6 lb. for medium-sized engine inlets and 8 lb. for the largest inlets.

But as has been said, with 8-12-lb. Canada geese flying around in tight formation a toughening of a design can help control damage but avoidance is the only complete solution.

Airports have a major stake in keeping birds away, not only for the safety and efficiency of operation but also to minimize legal liability in the event of an accident.

"The bottom line is that airport managers need to take this [threat of bird strike] seriously," Dolbeer said. "It is not an insurmountable problem" if the correct combinations of approach are taken and attention paid.

Dolbeer reports that in the past five years, airports have made major strides toward adopting sophisticated wildlife-management programs, hiring professional wildlife managers to replace the previous industry-standard worker with a few days of training.

"The larger airports are realizing that wildlife management is a complex problem that requires professional people who know what they're doing and can deal with state, federal and international laws dealing with wildlife."

An example of the problems wildlife managers face is that after the discovery of Canada goose nests in and around JFK several years ago, federal law prevented airport officials from harming the eggs.

An example of the complexity of the problem is if airport grass is allowed to grow long to discourage Canada geese, small rodents are encouraged. This attracts hawks, which also hurt airplanes. But at least, hawks don't flock.

THE TOP'S THE TARGET

MacKinnon says airports must make their buildings bird-proof and prevent perching on lights and other runway components. The classic scare techniques of wounded-bird calls and pyrotechnics don't work for long by themselves. But if occasionally assisted by staff shooting a few birds—those birds at the top of the flock so the rest can see them fall—the scare tactics are reinforced, he says.

JFK Airport, directly adjacent to a bird sanctuary, has a major problem. The Port Authority of New York and New Jersey has a 30-member wildlife-management department and a budget of $1 million a year to deal with one of the highest bird-strike rates in the U.S.

This year, after using all the standard bird-control procedures, including insect management, flora control and shooting thousands of gulls each year, the managers turned to falconry, a technique used with success in Canada, the U.K., France and Spain.

After years of study and effort to gain government approvals, the program's initial efforts this year, using 11 raptors to harass the gulls and upset their nesting, were considered promising. Gull strikes were reported down 75%.

The need for increased bird-control efforts such as this is obvious, with bird populations soaring and air traffic increasing. Sufficient warnings have been posted that trouble's ahead. Airport programs and airline-awareness efforts must keep pace with the increasing threats.

APPENDIX 33

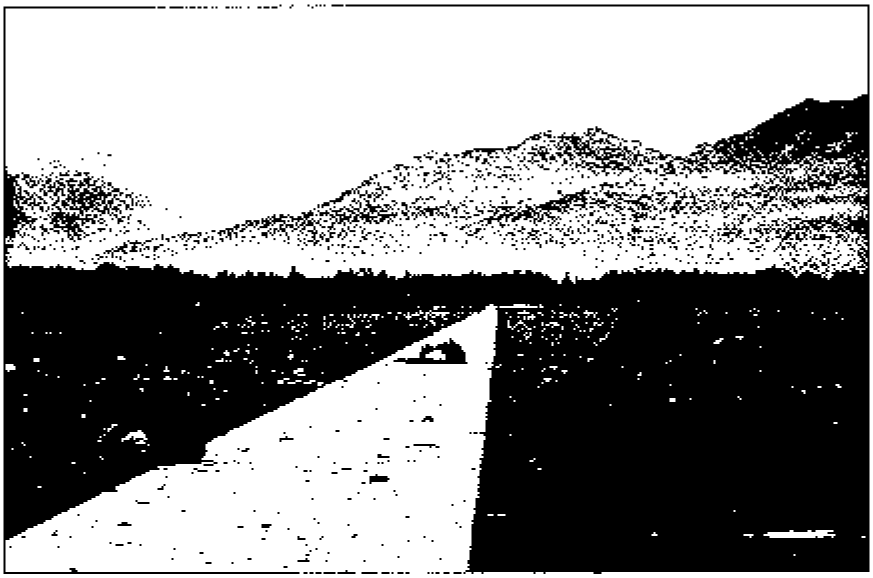
Wing Bird and Mammal Control Programs: DND Flight Comment
January 1996

WING BIRD AND MAMMAL CONTROL PROGRAMMES

The recent crash of a USAF E-3 AWACS in Elmendorf, Alaska has clearly highlighted the dangers that birds cause to aircraft. The investigation revealed that the numerous birdstrikes sustained by two of the four engines caused the aircraft to crash.

While this Headquarters has no indication that the continuation of wing bird and mammal control programmes are at risk, it is important to note that the use of risk management to evaluate proposed downsizing of various programmes and/or personnel costs must be considered very carefully. The old adage 'an ounce of prevention is worth a pound of cure' is certainly apropos when deliberating the effectiveness and cost benefits of a pro-active bird and mammal control programme.

The cost to repair or replace today's sophisticated aircraft, or any loss of life, far outweighs the cost of a Wildlife Control programme. AIRCOM is experiencing a steadily improving safety record with respect to bird strikes and this improvement translates into immediate and significant cost savings for the Air Force. While the need for cost cutting through re-engineering and/or downsizing is understood, we must exercise caution when considering reductions to wildlife control programmes. This recent accident at Elmendorf AFB reveals the possible downside of accepting too much risk. ◆



The tragic causes of the Elmendorf, Alaska AWACS accident.

CHANNELIZED PRESSING

During the Gulf War, our C130 encountered engine problems and we were forced to spend four days on the ground in Taif, Saudi Arabia, waiting to be fixed. During the fix, as time dragged on, Ops in Lahr were growingly concerned on when our aircraft would be returned to the airlift flow. This, combined with my desire to get back to Germany created the illusion that I had to get that aircraft back, pronto!

On the morning we were finally fixed, my plan, channelized as it was, only included one destination…Lahr. I figured we could make it, but only with an 18 hr crew day. As events transpired…an airtest was required…we had to refuel in Cyprus…the flight engineers crew day had started well before the pilots…it was obvious that reaching Lahr was impracticable…obvious to all except myself.

Under my direction as Aircraft Commander, we continued to Lahr…the crew was complaining, was tired…and we all fell asleep at varying times during our transit. We arrived at Lahr well over a safe crew day. We should have stayed in Cyprus and I should have listened to my crew and recognized the warning signs. Flight safety was compromised due to my channelized pressing. ◆

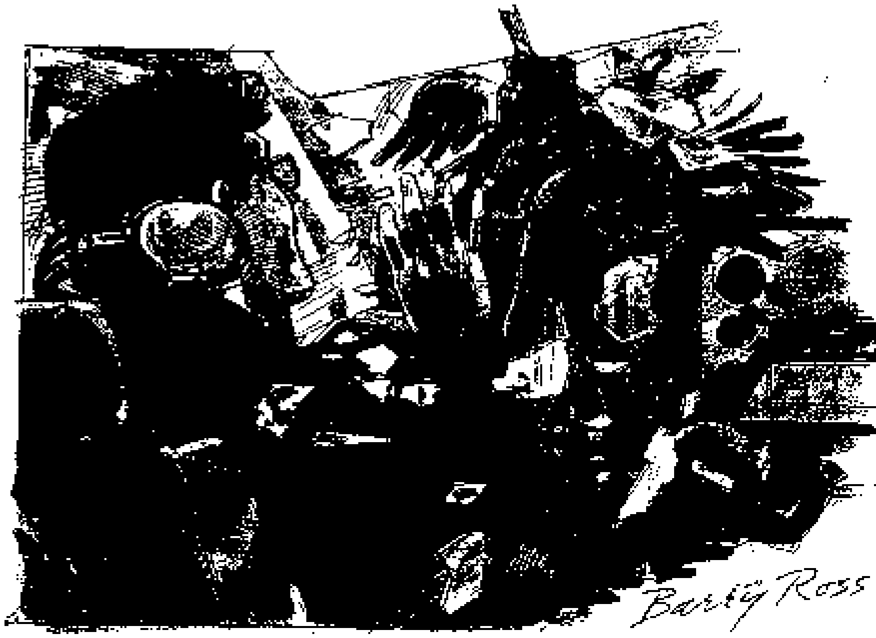
APPENDIX 34

I Learned About Flying From That: Crosswind Turkey

I LEARNED ABOUT FLYING FROM THAT

CROSSWIND TURKEY

NO. 679 • BY BOB DICKINSON



As I reached my 40s and my career became far less rewarding and far more lucrative (funny how that works), I started yearning for something new. Flying! It took one introductory flight for me to know that I was hooked. Five months and a few well-deserved gray hairs on my instructor's head later, I had my ticket. The very next week I marched into my flight school and booked a Cessna 172RG (Cutlass), and my instructor of course. A complex endorsement seemed to be the next step. I really wanted out of 152s. With that signature I was finally ready to carry passengers in style. So there I was that beautifully clear November morning, clutching the keys to the Cutlass. I was planning a pleasure flight the upcoming weekend, but before subjecting passengers to the terror of a new pilot's landings in an unfamiliar airplane, I thought some solo touch-and-goes were in order.

Napa Tower ATIS advised that the winds favored Runway 18 (left or right). Landings were my objective, so I opted for the mile-long right. Taxiing out I noticed that a very indecisive but full windsock had varying opinions as to where the wind was coming from. The temperature was increasing rapidly and there was that extreme dryness that we Californians associate with the Santa Ana winds, which are strong winds from the east. But if this was indeed a Santa Ana, shouldn't I be using Runway 6?

After runup, while I was holding short, the tower mentioned the wind had shifted and was blowing from the north. The Piper just ahead of me, who asked to remain in closed traffic, did not seem to experience any problems doing a tailwind takeoff, so I took the runway despite the wind direction. With all that concrete ahead of me, it was a long but uneventful takeoff.

As I turned downwind, another pilot entered the pattern behind me. The new arrival asked for a wind check. The wind had shifted again to 090 at 14; it was indeed a Santa Ana. The pilot behind me (with certainly more hours than I) chuckled to the tower that a 90-degree crosswind at that velocity was more than he cared for, and asked for Runway 6. The tower granted the request. Meanwhile I was number two for touch-and-go behind the Piper.

On final everything seemed in order. I had run my checklist and was correctly set up for a stiff crosswind landing. Suddenly a turkey buzzard appeared from below and flew directly into my flight path. This happens occasionally at Napa, which has a large bird population. As I had seen before, he glided down and out of the way. After all, who was the bigger bird here anyway? With the runway made I added the final notch of flaps. It was then that my feathered fellow aviator returned, only this time he was totally out of control. Tumbling up the left side of the engine cowling he spread his enormous wings out just as he hit the windshield.

A blast of Plexiglas, bird body fluids, feathers and hot air hit my face. It is funny how slow this all seemed to happen, unrealistic, not like real life at all. I was having trouble believing that the windshield had actually given way, but there was some pretty good evidence to support this fact. During all my study and training, I couldn't remember a single reference to bird strike procedures. The checklist (which at this point had blown back into the baggage compartment with almost everything else) had no emergency section on flying without a windshield. I was getting real suspicious that I might be on my own on this one. Little did I know at the moment that things could get worse . . . a lot worse.

I soon woke up and started flying again. Assessing the situation, I was still on short final and somehow still at an appropriate orientation to the runway, what little I could see of it. There was an 18-inch jagged hole in the windshield directly in front of me. My feathered hitchhiker had lodged himself there rather securely, blocking my view. One of the poor creature's large three-foot wings had flopped down over the instrumentation, blocking the basic six instruments and the radio. I decided not to try to dislodge the bird. The potential of being hit and knocked out by a Thanksgiving-sized bird did not appeal to me.

As the shock wore off I became vaguely aware of the radio chatter. For some reason the touch-and-go in front of me had decided to become a stop-and-go - probably that pesky crosswind. I apparently was barreling down on an occupied runway. The tower, unaware of my situation, issued a go-around to me. At moments like these you want to sound like John Wayne; unfortunately what came out was closer to Roseanne Barr. In a shrill voice I announced that I had to land because I just hit a bird. Later while talking to the tower over the phone, I learned that my lack of detail as to how critical my situation was led to a slack reaction from the tower. Hitting a bird is one thing, not having a windshield is another.

Somehow the airplane in front cleared in time and I did a rather good crosswind landing. But either shock or inexperience caught up with me and I failed to follow through on the ground roll. The 172RG started to weathervane and I knew I was going to lose it. No matter how good the earth felt at that moment, I decided I had to go around after all. Applying full throttle and jamming carb heat in, I announced my intentions to the tower. Even after removing two notches of flaps that Cutlass didn't want to gain velocity or altitude.

Hitting a bird is one thing; not having a windshield is another. My lack of detail led to slack response from the tower.

For those of you who have not had the pleasure of flying a single-engine aircraft without a windshield, there are two things that stand out about the experience. The first is that the noise and wind generated by the prop are astounding (my headset blew back off my ears from the force). The second is that the craft no longer seems to be interested in flying. Passing the end of the runway, I was maybe 50 feet above some very hard fields.

Birdie remained lodged in the gaping hole despite some violent fluttering. I was rather fearful that he might work loose, hit me and expedite the landing process. Adding to the chaos, the tower was attempting to switch runways. I informed the controller that I no longer could hear the radio (I did not want to take my hands off the controls to reposition my headset) and that I was having difficulty gaining altitude. I learned later that there were airplanes everywhere in the runway shuffle; and there I was, floundering around without communication in the middle of it.

I continued in a slow upwind climb till I felt that I had sufficient altitude to maneuver. Announcing my intentions into the headset microphone resting on my chest, I started a slow right turn toward Runway 06. On final I could see out the left window that big pink sock pointing right at me; nothing could have felt better. I brought the airplane in with almost full power. Under the circumstances I think I made a rather nice landing. Taxiing off the runway I pulled to a stop, and found I was physically shaking. I could hear a squeaky voice coming from the headset around my neck. It was the tower calmly instructing me to contact ground, followed by the clearance for another aircraft to land.

After taxiing to the maintenance hangar, I found "the boys" on a coffee break in the back room. I told them I hit a bird and they indicated I should write it up. "No, I think you should come take a look," I told them. Within minutes I was surrounded by landing pilots who had heard the drama over the radio. Many had words of congratulations and praise for handling the situation so well. But I knew different.

If I had better judged my abilities, it never would have been as critical at all. The bird strike was unavoidable, but the go-around was due to lack of experience with crosswind landings. Maybe without the bird I would have been able to make the landing; but why land in unfavorable conditions when there are other options? I accepted the prescribed runway without question, but now I know to ask for the runway that best suits my abilities. The other mistake was not informing the tower as to exactly how critical my situation was. Without that knowledge they didn't know to clear the area. Thankfully this did not complicate the situation, but just think of what could have happened.

Of course I felt like I would never fly again, but after sitting around the airport for a couple of hours, I calmed down. Still in a shirt covered in bird juice, I checked out a trainer and flew the pattern a few times. It seemed I would never escape the 152. After landing, and feeling much better, I contacted the FBO for fuel. The lineman asked if I was "Buzzard Bob," a nickname that I hoped would not stick. □

APPENDIX 35

Airline Outlook

AIRLINE
outlook

COMPILED BY FRANCES FIORINO

DOMESTIC HELP

The long-standing proposal by Singapore Airlines and India's industrial TATA Group to start a new domestic carrier on the subcontinent may be near fruition. Indian civil aviation sources say the proposal to create TATA-Singapore Airlines (TSA) is likely to receive government approval in October. The plan has been under consideration since June, 1994 (*AW&ST* June 3, p. 68). TSA would have an equity capital base of the equivalent of $500 million, with 60% Indian and 40% foreign participation. TATA and the Indian public would hold 60%. The remainder would be held by minority partner Singapore Airlines ($120 million) and Air India and Indian Airlines (less than $30 million combined). According to TATA officials, plans call for acquiring 19 aircraft during the first five years and the hiring of 2,500 employees. In its first year, TSA might purchase seven 150-seat aircraft and two 70-seaters several years later.

AT THE HEART OF THE BATTLE

United Airlines is the latest to set its sights on Indonesia. The carrier is seeking rights to Jakarta via Osaka's Kansai Airport. Not surprisingly, United says everyone but the Japanese is ready to approve the deal, which includes the right to pick up passengers at Kansai. Beyond rights are at the heart of the battle between the U.S. and Japan concerning an extension of a 1952 air services agreement. United insists it has unlimited beyond rights out of Japan; the Japanese want it to limit pickups to no more than 50% of its loads. With a U.S. presidential election campaign underway, don't expect a resolution until after November. Meanwhile, All Nippon Airways likes what it sees in business and tourist travel to Jakarta. It expects to start twice-weekly flights from Tokyo's Narita Airport to Jakarta, with an extension to Denpasar (the gateway for Bali), as of Oct. 30. ANA hopes a code-sharing agreement with Garuda Indonesia will give it even more frequencies to compete with the 13 weekly services offered by Japan Airlines and its Japan Asia Airways subsidiary to Jakarta/Denpasar from Narita and Kansai.

(MEGA) FLOATING AIRPORT

Japan's Ministry of Transport has given the Megafloat Technology Research Assn. a 7.5-billion-yen ($69-million) subsidy to continue research into building a floating airport for Tokyo. The Megafloat group includes 17 steel and shipbuilding companies and already has a 200 X 1,000-ft. test structure in the water off Yokosuka, south of Tokyo. The study is to evaluate the magnetic influence of the steel structures on aircraft instrumentation as well as the structural effects of vibration and sea movement on the building and its environmental consequences on marine life. As the studies continue, backers say construction of a larger test article will be necessary. One idea is to build a 3,200-ft.-long structure for $120-140 million. The aim is to apply the float technology to construction of a third airport for Tokyo and a crosswind runway at Kansai International Airport, which now operates with a single runway on a manmade island in Osaka Bay.

PLANNING STRATEGY

Royal Brunei Airlines has big plans for Myanmar (formerly Burma), the Southeast Asian country whose human rights record has brought criticism from Western nations—although not from its neighbors in Southeast Asia. The airline has accelerated its plans for beginning London-Yangon (formerly Rangoon) services by a month to Sept. 12 and expects to start connecting services from Yangon to Brisbane, Australia, this winter. The airline's twice-weekly Boeing 767 services from London would stop in Abu Dhabi on the Persian Gulf before reaching Yangon and continuing to Brunei.

BOARDING BOOM

Passenger boardings at Cincinnati/Northern Kentucky International Airport may top 18 million this year, an increase of nearly 3 million during the last calendar year. The airport recorded 10.8 million passengers in the first seven months, up 28%. This compares to a U.S. national average growth rate of 4.6%. Delta Air Lines and its Delta Connection partner, Comair, have hubs at the airport. These carriers have added 80 daily departures since May, 1995.

STRIKEOUT CALL

Commercial transport aircraft in Japan suffered about 1,100 bird strikes in fiscal 1995, a number that the Ministry of Transport thinks is far too high. It has launched a two-year study to see if the strike count can be lowered. The ministry has tried this approach before; it has held four sets of talks with bird specialists during the past 20 years. But with air services increasing, officials say they are concerned that the bird strike situation could get out of hand. Presently, the ministry can afford only periodic bird patrols at 15 of the country's 83 airports. It is to publish results of the new study as a bird strike prevention manual in March, 1998.

APPENDIX 36

Saturday Night: Why Did the Chicken Cross the Road

Magazine article taken from: Saturday Night. September 1996

Published by Saturday Night Magazine Limited and edited by Kenneth Whyte

Fodder

Why did the chicken cross the runway?

Anyone who's ever sat on an airplane, waiting for takeoff and watching the gulls float over the tarmac, has probably wondered what would happen if a bird were to get sucked into a jet engine. Not to worry. Aircraft-engine manufacturers must meet stringent "bird-ingestion certification requirements" before their products are put on the market.

Engineers test prototype engines by loading defrosted birds into a sort of Gatling gun with up to four fifteen-foot-long barrels, and then firing a volley of fowl into the blades of a revved-up engine. The birds pass through the engine "in a big blast of mush," says Bruce MacKinnon, manager of wildlife control for Transport Canada. "It's similar to a cuisinart."

The engines of an Airbus A300 must withstand a volley of up to eight 1.5-pound birds without stalling or suffering serious damage. A B777 engine must shut down safely after ingesting a single eight pound bird.

Until recently, the engineers used defrosted chickens and turkeys. But since the chances of a plane running into a flock of chickens are slim, they now use gulls, ducks and Canada geese. Researchers are working on dummy birds that simulate the size, weight, and density of real birds.

– Janet Whitman

APPENDIX 37

Internet Address's

Facsimile from the office of

BIRD STRIKES COMMITTEE CANADA
COMITE CANADIEN SUR LE PERIL AVIAIRE

Captain Mario Larose
Staff Officer- Air Traffic Services and Regulation
Air Command Headquarters
Westwin, Manitoba, Canada
R3J 0T0

Phone: (204) 833-2103
AVN: 257-2103

Fax: (204) 833-2604
AVN: 257-2604

TO: Name: Bruce MacKinnon

Posn: Safety and Technical Services

Phone No: 990-0515

Fax Number: 957-4260

Number of Pages (Including Cover Sheet): 1

SUBJECT: Internet Address

REMARKS: The address for the AWACS page on the Internet is:

http://jam.jam.net/aewa/listserver/maillist.html#00810

Then look for CRASH.PHOTOS

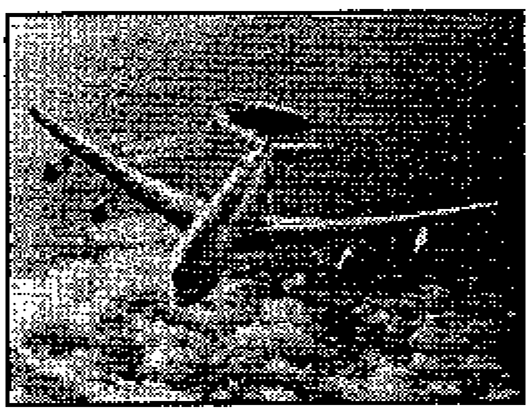
The Fehlen's Home Page

Welcome to our home page. Like most individual pages, this is more for personal fulfillment and advertisement more than anything else. My guest book is currently still being implemented, but feel free to send e-mail if you enjoy the view or need any information. As the title states, this is the Fehlen's home page. I have a beautiful, wonderful wife and an adorable, smiling baby (both requested to be unpictured as they are very camera shy). Enjoy.

Anything L○○k Interesting?

Airborne Warning and Control (AWACS)	My Resume	Military Accomplishments
Favorite Links	Sign my Guest Book	Photos

E-3 SENTRY (AWACS) - EYES OF THE EAGLE



For those of you that may not have a clue as to what an E-3 is here's a picture. As usual, clicking on the picture will get you a **BIGGER** picture suitable for download. I have been flying on E-3's for all of my military career. My position is called a Computer Display Maintenance Technician or CDMT. Everything onboard the E-3 runs through a modified IBM 360 mainframe. I perform the initial program load and then keep it operational while inflight. Although arcahic and often tempermental, it is a constant reminder of the roots of today's personal computer. Beyond the computer system, flying is a great oppurtunity to see the world and a lot of fun.

For those who like to see aircraft fact sheets, this is for you:

(Yes, I user to have all this info available at this site, but why slow down an already stifling server.....)

(Yes, I user to have all this info available at this site, but why slow down an already stifling server.....)

Official Airforce E-3 Fact Sheet

E-3 SENTRY (AWACS) - EYES OF THE EAGLE

News Flash from Greece....

As some of the old-heads may already know, a NATO E-3 went down in Greece. Thankfully all crewmembers (foreign and domestic) made it out with only one person being injured. Here's some pictures flown all the way in from Germany just for your viewing pleasure...... (Yes these pics were available directly, but I thought I'd try to speed up the page load a little)

E-3 picture from the nose.

E-3 picture from the right.

E-3 picture from the left.

Chuck Yeager and SSgt Peachy (IART).

Chuck Yeager and the 966th crew.

Chuck Yeager signing autograph.

Professional Experience

August, 1990 to Present - United States Air Force, 552 Air Control Wing Tinker AFB, OK

Assistant Lead Programmer - Special Projects

Picked to be member of a 6 man team tasked to develop a client-server database (MS Access v2.0 - Oracle). The Air Force mission-critical project, MPS (Mission Planning System), was designed to schedule and track academic training, flight currency requirements, vacation time, personnel performance reports and decorations, and day-to-day appointments for aproximately 5,000 personnel and flying hours, maintenance needs, and location of over 32 aircraft. MPS was also designed for worldwide reachback capability via TCP/IP, using SQLNet as middleware. Personnally responsible for 50% of the over all logical design and directly responsible for the physical design and coding of 3 out of 5 Version 1 modules.
Designed, coded, and documented (user manual, Help files, and maintenance manual) program for the submission of Quality Improvement Recommendations (QIR). Written in Microsoft Access v2.0, the program was designed to allow users to submit QIRS from anywhere in the world via E-mail back to the unit. The program was benchmarked by the 552 Air Control Wing and implemented within all 13 subordinate units.

Instructor Computer Display Maintenance Technician Assigned to the 966 Airborne Air Control Squadron, an elite squadron formed exclusively of exemplary E-3 Sentry Instructors. Responsible for training students who have never flowen on an E-3 aircraft to execute their mission essential duties while airborne and perform as a productive member of an airborne mission crew. Also responsible for teaching academic courses on new equipment and currency training to all Compute Display Maintenance Technicians within the 552 Air Control Wing (aproximately 350 individuals)

Computer Display Maintenance Technician

Assigned to the 963 Airborne Warning and Control Squadron (AWACS). Was responsible to perform sortie crucial operation, troubleshooting, and maintenance of modified IBM 360 onboard the E-3 Sentry surveillance and early warning aircraft. Tasked to operate in different worldwide theaters (Desert Calm, Saudi Arabia; Operation Provide Comfort, Turkey,...) and stateside exercises (Green Flag, Nevada; Red Flag, Nevada).

Education

1995 to present
Rose State College
Pre-engineering degree
President's Honor Roll Spring 1995, Summer 1995, Fall 1995, Winter 1995

1990 to Spring 1995
Community College of the Air Force
Tinker AFB, OK
Degree in Electronic Systems Technology

Stroud's CWS Apps

Stroud's is the absolute must have link for anyone wanting
shareware software that has been tested and reviewed.
Don't buy what you don't have to or don't know if you will like.

Dilbert Comics

Tired of dealing with people that want to climb the ladder at your expense?
Tired of working with people who make lots of money , but
don' t have a clue as to what' s really going on?
Or do you just need a laugh.
Dilbert is definetely for anyone who has ever been
called "computer geek", "hacker nerd", or "Engineer". Enjoy!

Java

If you still think Java is a warm brew for a cold night, it's time to become enlightened.
Some criticize, others praise. Either way until Microsoft catches up,
Java's here to stay.

Garbo's Windows apps collection

I very good source for anything for windows. Not a pretty page, but alot to look at including neural networks, fonts, and windows programming.

Gospel Communications Network

Everything from a daily verse (even though it's often NIV) or devotional to information about camps and other Christian events.

Guest Book

It may seem tacky to some, but I am truly interested in who visits my family's page. So if you are a relative, prospective employer, or just passing through and wish to say hello, please fill in the following and send it to me (Obviously you can send me E-mail direct form below. This form is provided for those who maybe newbies or other).

CONSTRUCTION ZONE

Please tell me your name:

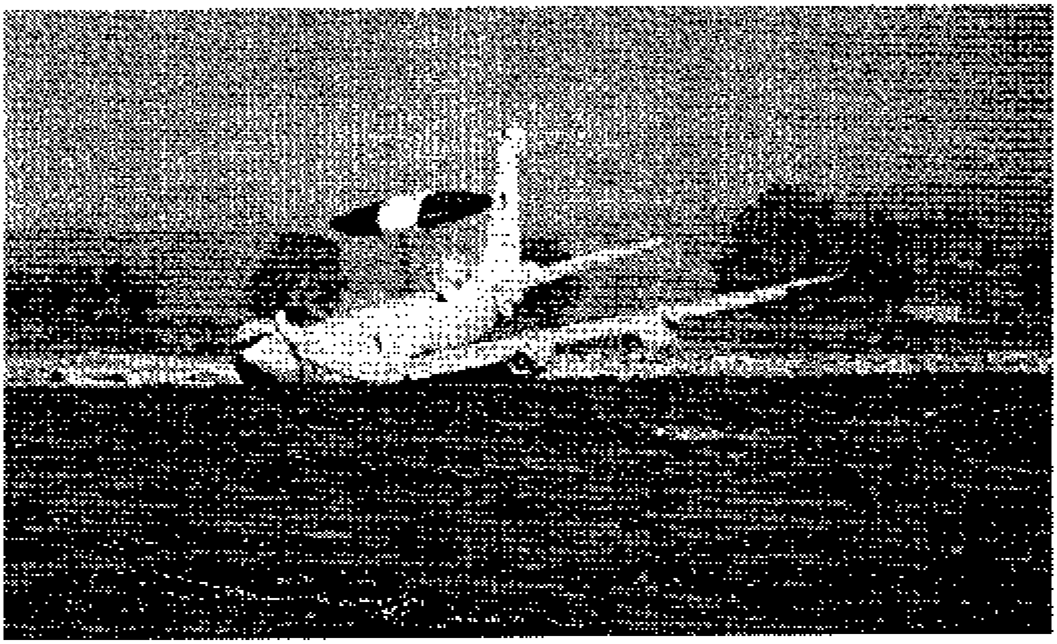
What is your E-mail address

Is there anything special you would like to add?

Submit Query

This HTML Document created by Ron Fehlen.
Last Updated August 22, 1996

GIF image 317x315 pixels http://www.icon.net/~sentry/e-3_1.gif



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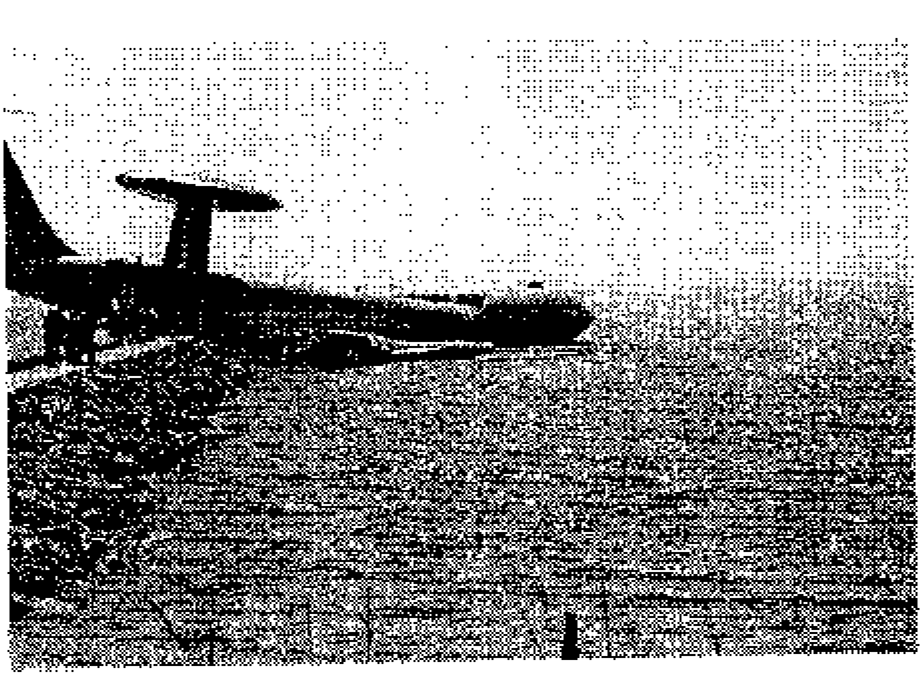

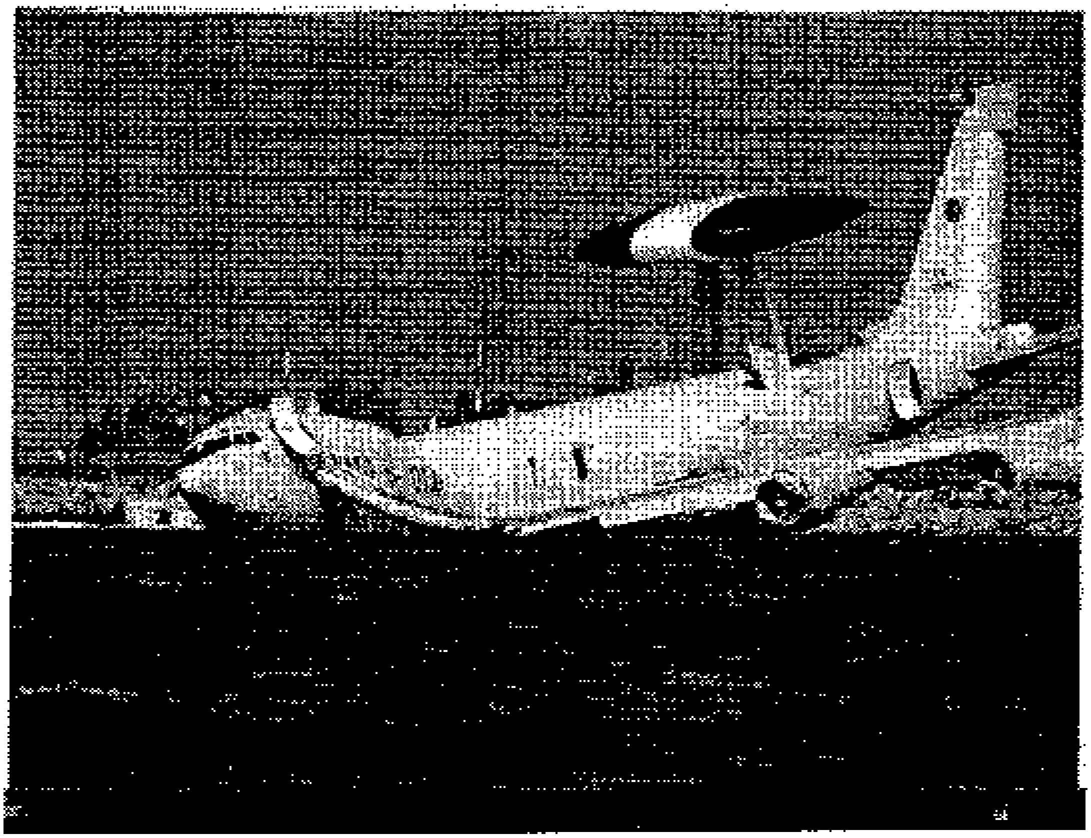

APPENDIX 38

Military Boeing 707 Strikes Birds After Liftoff; Damage to Engines No.1 and No.2 Results in Loss of Power and Impact with Terrain

Vol. 53 No. 11 *For Everyone Concerned about the Safety of Flight* November 1996

Military Boeing 707 Strikes Birds After Liftoff; Damage to Engines No. 1 and No. 2 Results in Loss of Power and Impact with Terrain

U.S. Air Force personnel at Elmendorf Air Force Base in Alaska knew that geese posed a danger to aircraft and acted to disperse them. Nevertheless, their efforts to detect or deter roosting geese were inadequate, an official U.S. Air Force accident report says.

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FSF Editorial Staff

The crew of the U.S. Air Force E-3B, a modified Boeing 707 equipped with sophisticated airborne warning and control systems (AWACS), was holding short of Runway 5 at Elmendorf Air Force Base (AFB), Alaska, U.S. As the crew waited for takeoff clearance, a Lockheed Martin C-130 that was departing Runway 5 disturbed a flock of Canada geese that were roosting in the infield adjacent to Runway 5. A controller in the Elmendorf air traffic control tower saw the geese become airborne but did not notify the E-3 crew or Elmendorf airfield management.

The E-3 (call sign "Yukla 27") was cleared into position on Runway 5. Approximately two minutes after the C-130 had departed, Yukla 27 was cleared for takeoff at 0745:30 hours local time, Sept. 22, 1995, and the crew began the takeoff roll. As the aircraft rotated for liftoff, the senior tower controller observed geese take flight and turn directly into the path of the E-3. Numerous birds were ingested into the aircraft's no. 1 (left outboard), and no. 2 (left inboard) engines, resulting in a catastrophic failure of the no. 2 engine and compressor stalls in the no. 1 engine, the report said.

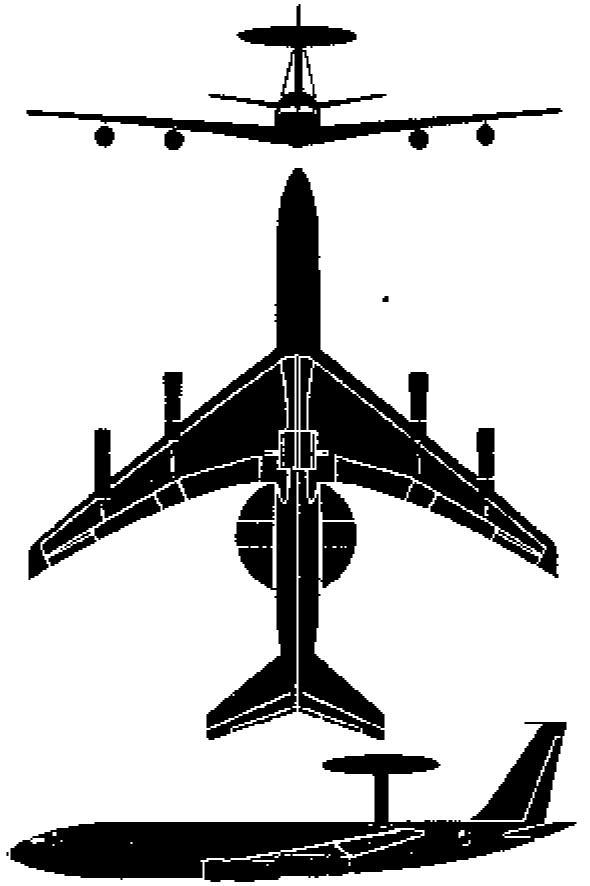
At 0746:43, the copilot radioed: "Elmendorf tower, Yukla two seven heavy has an emergency. Lost ah no. 2 engine, we've taken some birds," the report said.

Witnesses observed the aircraft enter a slow, climbing turn to the left. Six seconds later, the flight engineer said, "Starting dump fuel," the report said. The aircraft commander responded, "Start dumping." Four seconds later, the stick shaker activated and stayed on for the remainder of the flight.

At 0746:56, the copilot radioed: "Yukla zero two heavy's coming back around for an emergency return," the report said. Ten seconds later, the copilot radioed: "Two seven heavy, emergency," the report said. This was followed shortly by a transmission on the tower frequency: "Roll the crash, roll the crash."

At 0747:11, the aircraft commander said, "We're going down," the report said. The aircraft impacted a hilly, wooded area on the base, less than 1.6 kilometers (one mile) from the departure end of the runway (Figure 1, page 3). The aircraft broke up, exploded and burned. All 24 crew members were killed in the accident.

The official U.S. Air Force accident investigation report concluded that the accident "was directly caused by the ingestion of Canada geese into [engine no. 1 and engine no. 2]. Furthermore, two factors substantially contributed to the accident. First, the [3rd] Wing lacked an aggressive program to detect and deter geese; specifically, the bird hazard reduction working group [BHRWG] did not adequately prepare for the migration season, airfield management's efforts to detect and deter geese were inadequate and an earlier safety agency staff assistance visit [SAV] had [misled] the Wing to believe that [the Wing] was prepared.



Boeing E-3B Sentry

The E-3B Sentry airborne warning and control systems (AWACS) is a mobile, jamming-resistant high-capacity radar station and command, control and communications center installed on a Boeing 707 airframe.

The first development aircraft, known as the EC-137, first flew in 1972. The E-3B has a basic operational crew of 20, including four flight crew members and 16 AWACS specialists, although this number can vary depending on the mission.

The aircraft has a maximum takeoff weight of 147,417 kilograms (325,000 pounds), a service ceiling of 29,000 feet (8,850 meters) and a maximum level speed of 460 knots (853 kilometers per hour). It has an endurance on station of 870 nautical miles (1,610 kilometers), six hours from base, and a maximum unrefuelled endurance of 11 hours.

Source: *Jane's All the World's Aircraft*

"Second, the tower controller failed to notify the [accident] aircraft or airfield management that geese were present in the infield."

The ingestion of the geese into the aircraft's engines caused a loss of thrust that "rendered this aircraft incapable of controlled flight," the report said.

The accident aircraft was assigned to the 962nd Airborne Air Control Squadron, 3rd Wing, at Elmendorf AFB, the report said. The accident flight was a scheduled 6.2-hour routine training mission. "This incident was the first loss of an E-3 so local and national media attention was high," the report said. The aircraft, valued at US$70.2 million, was destroyed.

The accident occurred during twilight and in visual meteorological conditions (VMC). Weather was not a factor in the accident, the report said. Sunrise on the day of the accident was 0742, the report said.

Witnesses on the ground described the accident sequence in subsequent interviews with Air Force accident investigators.

"He was off the ground, front tires [6.1 meters (20 feet)], back tires [three meters (10 feet)], and not very far, just broken ground," one witnesses said. "Loud popping noises. He wasn't gaining any altitude, the gear wasn't coming up, he wasn't trying to gain altitude, he was in trouble."

Another witness, who was driving along a road near the runway, told investigators: "I saw the no.1 and no. 2 engines on fire; I heard compressor, what sounded like compressor stalls -- big loud booms coming out of the engines. Um, I knew, I knew something was wrong immediately. I sped up as fast as I could because ... they were flying ... [they just] passed over me. ... It appeared to me that they didn't hardly have any speed, and eventually they were not climbing ... and all of a sudden I saw the tail start dropping and that's when they went into the woods."

The report said that Elmendorf AFB crash, fire and rescue vehicles were alerted before the aircraft impacted the ground. The accident aircraft crashed at 0747:12. "Base fire and rescue vehicles were alerted at 0746:44 when the tower controller activated the primary crash alarm system (PCAS)," the report said. "The wreckage was located and the first fire fighter was on [the] scene at 0758. The first crew member was located at 0832 and the last body was found at 1938."

Rescuers had difficulty reaching the accident site, because of the topography, the report said. "Although the [accident] site was on base, there were no access roads leading to the site," the report said. "[Accident]-response fire fighters initially proceeded to the scene on foot until a bulldozer created better access. The fire burned for several hours. The fire crew was able to get water hoses to the scene at 0901. Units from nearby Ft. Richardson [a U.S. Army base] also assisted in the crash response," the report said.

The report commented: "Overall, given the terrain and lack of access roads, [accident] response was very effective, and people were on [the] scene relatively soon after the [accident]. Due to the severity of the impact, however, [accident]-response and rescue efforts were not a factor in this [accident]."

The weather was not a factor in the accident or in rescue efforts, and "the sun was up and lighting conditions were good," the report said.

Postmortem examinations of the 24 crew members "revealed injuries that were consistent with damage to the aircraft and the crew members' duties on the [accident] flight," the report said. "Due to the nature of the accident and resultant injuries, the crew members died instantaneously and did not suffer."

Toxicological examinations of the 24 crew members were negative for alcohol and drugs, the report said.

Investigators reviewed the flight and wreckage path of the accident aircraft. "The [aircraft] lifted off and flew approximately [1.28 kilometers (0.8 mile)] before contacting trees," the report said. "The [aircraft] then flew approximately [0.72 kilometer (0.45 mile)] before making contact with the ground and crashing in a fireball."

When investigators reviewed the debris on the runway, their examination "did not reveal any parts of leading-edge slats, leading-edge flaps, wing leading-edge skins, horizontal leading-edge skins, etc.," the report said. "The parts found on the runway were limited to engine items such as fan blades and stators, one engine-nose dome and one engine-nose cowl." Numerous remains of Canada geese were also found on the runway, the report said.

The report noted: "Other than damage to the engine(s), there is no physical evidence to suggest that the [aircraft] fuselage, wing structure, empennage structure, flight controls or systems were degraded in any way prior to the first contact with the trees."

Investigators determined that the aircraft made initial ground contact with an antenna probe on the left wing tip, the report said. "The left-hand wing tip was found on the right-hand side of the crash path, suggesting that it had been thrown by wing-tip vortices," the report said. "A large section of the left-hand stabilizer was found on the right-hand side of the initial touchdown point with the elevator attached, indicating that the [aircraft] was yawed significantly to the left at time of impact. The no. 1 engine separated completely from the left wing upon or before initial ground contact."

The evidence also suggested that "the left-hand wing bent upward significantly between the no. 1 and no. 2 engines at the initial ground contact before the main ground-impact area," the report said.

The main ground-impact area began approximately 91.5 meters (300 feet) from the initial ground-impact point and extended approximately 45.7 meters (150 feet) to the peak of a hill, the report said.

The report described the wreckage path: "At approximately [96 meters (315 feet)] from the initial ground impact, there is a broken tree approximately [41 centimeters (16 inches)] in

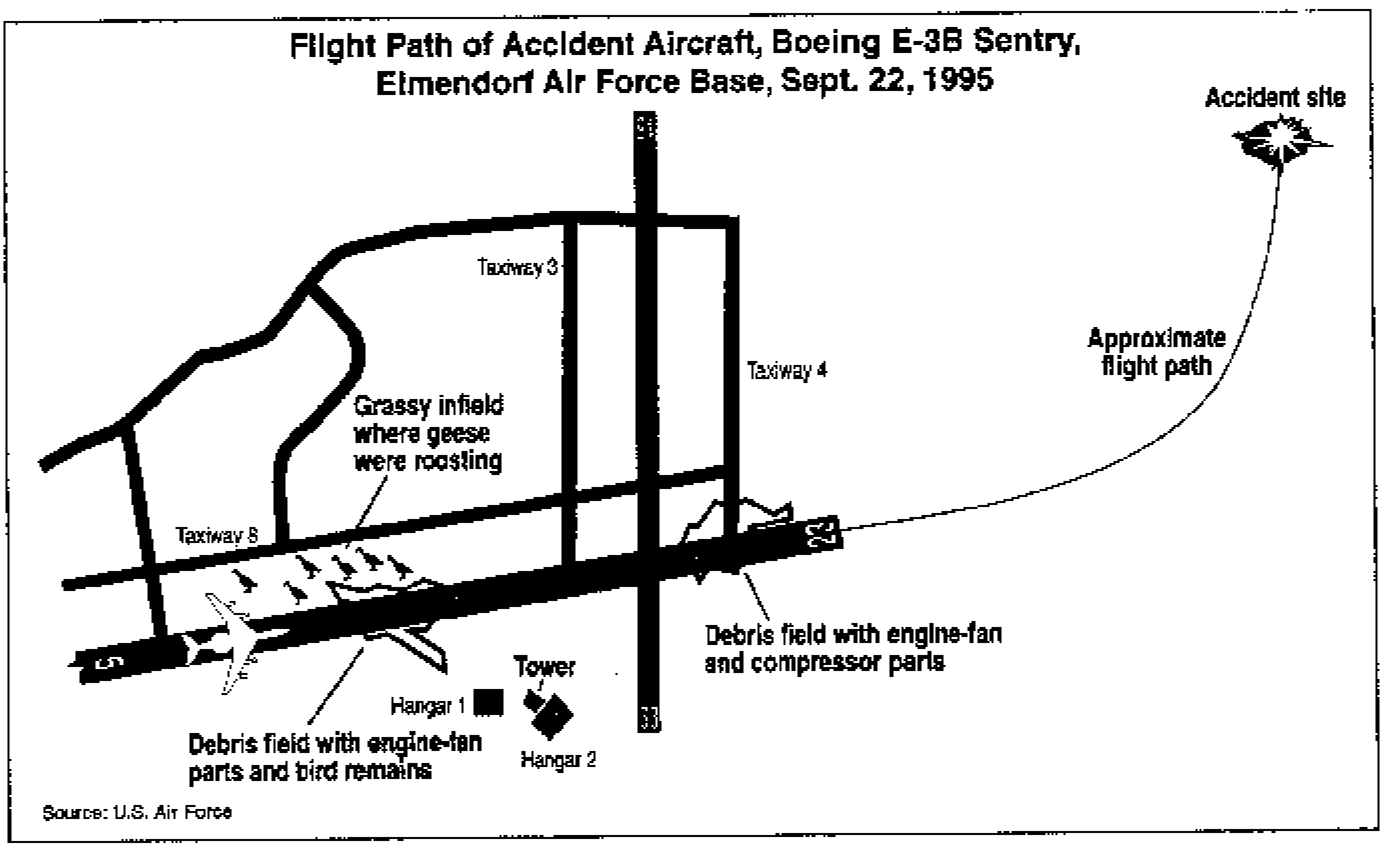


Figure 1

diameter where the nacelle from the no. 2 engine impacted approximately [15 centimeters (six inches)] above ground level. Based on the patterns of fire damage, this tree caused significant structural breakup of the left wing."

The report continued: "Further to the right are trees left standing that should have been hit by the right-hand wing. This suggests that the [aircraft] was already extremely right-wing high, as would be expected with the left wing producing significantly less lift than the right. The direction of the no. 4 engine with the [aircraft] in a left yaw, right-wing high, at the point of main ground-impact points directly to the point where the no. 4 engine landed. This suggests that the no. 4 engine departed the [aircraft] at this point and that the engine was developing significant thrust."

Just before the crest of the hill, investigators found the "left-hand leading-edge flaps, slats, actuators (extended), trailing-edge flap drives and tracks (extended 17 degrees), left- and right-hand flaps, left-hand skin panels (curled under at the leading edge), nose-gear cylinder, and nose- and main-gear doors," the report said.

The wreckage continued over the peak of the hill and continued downslope toward a second hill. Beyond the peak of the first hill, approximately 137 meters to 201 meters (450 feet to 660 feet), investigators found "right-hand pieces such as landing-gear doors ... on the extreme right side of the path mixed in with upper and lower left-wing skins, left-hand wing roots and other left-wing parts, suggesting that the [aircraft] slid along the crash path on its left-hand wing and had not flipped over to this point," the report said.

"Had [the] fuselage been straight and level throughout the crash, the crash probably would have been survivable by all crew members."

The report also noted: "The [aircraft] had to be nose-first throughout this phase of the [accident, as] evidenced by a piece of the left-hand wing root found lying on top of the largest section of the nose radome."

Investigators determined from this portion of the wreckage path that the landing gear was down and locked during impact, the report said.

As the aircraft slid to the top of the second hill, located approximately 201 meters to 238 meters (660 feet to 780 feet) from the initial impact point, the empennage broke off, the report said. "As the [aircraft] cleared the second hill, it rolled over," the report said. "The fuselage broke up as the [aircraft] rolled. The outboard right wing impacted on the left side of the wreckage, the right-hand wing broke off and the rotodome section impacted on its back, breaking up the rest of the aircraft."

The report noted: "The lack of right-wing parts and the amount of fire damage at the bottom of the crash site is evidence that the right wing was full of fuel up to the time it broke from the [aircraft], probably just after the second hill. The fuel fire destroyed almost all evidence of how the fuselage broke up and how the right wing broke up. The fuel remaining in the right wing at the time it broke up probably resulted in the fireball that consumed most of the fuselage sections in its path."

Investigators calculated the forces encountered by the aircraft during the crash sequence. The forces encountered by the forward fuselage "probably did not exceed 16 Gs forward; however, it probably exceeded -5.5 Gs up and +/- 4 Gs side," the report said. The forces on the tail section "probably did not exceed 16 Gs forward; however, it probably exceeded -1.5 Gs aft and -5.5 Gs up and -1.5 Gs aft."

The report commented: "The [aircraft] was designed to sustain the specified limit loads in one direction, not all acting at once. The [aircraft] becoming inverted, and possibly its angle to the trees on the second hill, resulted in most of the fuselage breakup and most of the cabinets and seats breaking loose from the floor beams, with limit-exceeding or near limit-exceeding forces acting in several directions at once. Had [the] fuselage been straight and level throughout the crash, the crash probably would have been survivable by all crew members."

All four engines on the accident aircraft were recovered and examined. Engine no. 1 was found to have experienced a bird strike (one major-size hit and two minor-size hits) seconds after rotation, the report said. "Within four seconds, [the] engine was operating at diminished power (approximately 50 percent TO [takeoff]), then [it] stalled four or five times and struck a tree upstream of the initial engine ground scar," the report said.

Engine no. 2 was found to have experienced a bird strike (three major-size hits) seconds after rotation. "Within eight seconds, this engine lost enough first-stage fan blades to severely damage and then fragment the IGV [inlet guide vanes] case," the report said. "[The] nose cowl was then free, [and] flipped up over the wing and departed the [aircraft]. Then the engine either fell to a 'hung' operating condition or flamed out and windmilled to ground impact," the report said.

There was no evidence to suggest that either engine no. 3 or engine no. 4 had experienced a bird strike, the report said. Both engines continued operating "at TO conditions until being pressed to a higher thrust condition by [the accident] crew within eight seconds after bird strikes on engine [no.] 1 and [no.] 2," the report said. "This operating condition continued until ground impact."

Many of the cockpit instruments were recovered and examined, although many of the instruments were unreadable because of heat damage. "All of the items had sustained impact damage and severe heat damage," the report said. "The heat damage was sufficient to have destroyed any pointer impact marks that may have existed."

After all the available instruments were examined, the report commented: "Nothing was noted during this analysis that indicated instrument or instrument system failure prior to impact or loss of signal input."

The accident aircraft was equipped with both a cockpit voice recorder (CVR) and a flight data recorder (FDR). Both recorders were recovered from the wreckage and delivered to the U.S. National Transportation Safety Board (NTSB) for analysis of the FDR data, the report said. When the recorders were disassembled, they showed substantial heat damage. "However, both tapes survived with minor warpage due to the extreme heat," the report said.

A transcript of the CVR data was obtained, the report said. But retrieval of the FDR data was limited because of technical problems. Documentation for the conversion equations, which were required to convert the raw data on the FDR tape into engineering units for analysis, was unavailable. Data tables from the Royal Saudi Air Force version of the installation, and equations from the British version, were substituted, the report said. But the resulting conversion equations were only approximations of those for the accident aircraft's FDR.

When technicians began reading the FDR data they encountered further problems. Many of the parameters were frozen [and] some were behaving erratically," the report said. Because of the documentation problems, investigators "could not determine which, if any, of the data [were] valid." Because the NTSB had several other accidents to investigate, its additional involvement in the Elmendorf accident would have been delayed. Air Force investigators contacted the Transportation Safety Board of Canada (TSB), which was able to assist in obtaining valid data for course altitude, throttle no. 1 position and engine pressure ratios (EPRs) for engines no. 1, no. 2 and no. 4. All other parameters were nonfunctional or could not be verified, the report said.

Because of the limited FDR data, investigators were able to determine only the following about the accident flight:

- "The aircraft lost power on engines no. 1 and no. 2 within six seconds after rotation;
- " ... The aircraft was airborne for approximately 42 seconds after takeoff and 37 [seconds] to 39 seconds after losing power to the engines; [and,]
- "The maximum altitude the aircraft got above the runway elevation was approximately 250 feet [76.2 meters] +/-16 feet [4.8 meters] ... ."

The maintenance history of the accident aircraft was reviewed. "This aircraft had a good statistical record while assigned to the 962 AACS," the report said. "Over the past year, [the accident aircraft] had an 83 percent mission-capable rate and an 81.5 percent maintenance-fix rate. Additionally, this aircraft had only three ground aborts and six air aborts for FY [fiscal year] 1995."

A review of the maintenance documentation on the accident aircraft "revealed no discrepancies that contributed to the accident," the report said.

A review of the training records for the dedicated crew chief and the assistant dedicated crew chief on the accident aircraft found that both "were thoroughly trained and current on all assigned maintenance tasks," the report said. "No maintenance practice or procedures were related to this [accident]."

Investigators reviewed the Air Force regulations and the threat of bird/aircraft strikes at Elmendorf AFB. "Air Force Regulation [AFR] 127-15, *The Bird Aircraft Strike Hazard (BASH) Reduction Program*, gives policy and guidance for implementing an effective bird aircraft-strike hazard-reduction program," the report said. "It designates the Air Force agencies that are responsible for carrying out the program and evaluating its effectiveness. It outlines procedures for developing a Wing-level BASH program and establishes requirements for its operation," the report said.

Air Force personnel have counted the goose population at Elmendorf AFB since 1990, the report said. The population has increased from 1,000 geese in 1990 to 2,700 geese in 1995. On the day of the accident there were approximately 900 geese on the base, the report said.

In reviewing safety data, investigators found that "the only recorded incident of geese striking an aircraft [at Elmendorf] occurred in September 1993, when a C-130 aircraft struck several geese on the runway after ... landing," the report said.

During a two-week period preceding the accident flight, Elmendorf base operations and wildlife personnel had dispersed geese from the infield areas of Runway 5 and Runway 33 on several occasions, the report said. "Clearly, 3rd Wing was on notice that geese were indeed locating in infields as well as on hard surfaces such as runways and taxiways," the report said. "On two occasions, [conservation personnel] had to kill geese with shotguns in order to disperse the flock. The geese were beginning to establish themselves and occasional dispersal was not deterring them from returning."

Investigators reviewed the efforts of the BHRWG at Elmendorf as required by Air Force regulations, the report said. "The BHRWG did not formulate a concrete plan to deal with changing bird activity levels or the presence of geese in the airfield," the report said. "3rd Wing had an effective OPLAN [operations plan], but the BHRWG was responsible for ensuring that the implementation of this plan resulted in effective geese detection and deterrence at all times of the year."

The efforts of Elmendorf airfield management personnel to detect and deter geese were reviewed. "Roosting infield geese went undetected because airfield management had no controlling plan to locate them," the report said. "It is evident that personnel knew geese posed a danger to aircraft, and they acted to disperse them on several occasions; but their efforts to detect or deter infield geese were inadequate. Few, if any, of the suggested patrol and deterrent methods suggested by AFR 127-15 were in place," the report said.

The report noted: "Airfield management did not sufficiently check these infield areas for the presence of geese. Base operations personnel and supervisors of flying [SOF] were engaged in little other than vehicle sweeps of runways and taxiways. A cursory glance at the infield would not result in the detection of geese. These patrols were effective, if at all, during daylight hours only. Prior to the accident, there was no illumination of infield areas before first light."

The report noted that the "last runway check ... occurred nearly 3.5 hours before the accident aircraft began takeoff roll."

Investigators found that "the worst possible combination [of circumstances] existed: there were infrequent patrols of the airfield, nearly no checking of infields and no placement of static deterrents," the report said. "Those aircraft that began takeoff roll at or before dawn were at risk that those geese would move into their flight path, as it happened in this accident," the report said.

An Air Force BASH Team conducted an SAV at Elmendorf AFB in July 1995, when the goose population was low, the report said. "This team emphasized habitat management but did not discuss the particulars of [the] 3rd Wing's plan for migration season," the report said. "The team did advise airfield management personnel to prevent geese from establishing themselves in the airfield."

The Air Force officer in charge of the accident investigation concluded: "I believe the BASH team's endorsement of the [3rd] Wing's OPLAN convinced the BHRWG that nothing else was required to prepare for migration season. ... It is possible that airfield management personnel did not routinely check infields because, based on the SAV, they assumed there would be no geese there."

The Elmendorf AFB airfield manager was interviewed during the investigation. "She [the airfield manager] was well aware of the BASH plan and had been personally briefed by the BASH team during the July 1995 [visit]," the report said. "I [the investigating officer] attempted to establish her understanding of airfield management's specific responsibilities in the OPLAN, but she invoked her right to remain silent."

The investigating officer interviewed the senior tower controller and another controller who were on duty in Elmendorf tower at the time of the accident. Both controllers, who had "an excellent view of the runway area," invoked their rights to remain silent, the report said. Witnesses told investigators that after the accident,

CVR Transcript of Yukla 27 Boeing E-3B Sentry

0745:29	**RDO-TWR:**	Yukla two seven heavy, the wind three one zero at one one, cleared for takeoff Runway five. Traffic is a C-130 three miles north of Elmendorf northwest-bound, climbing out of two thousand.
	CAM:	[light switches]
0745:39	**AC?:**	In sight.
0745:41	**RDO-CP:**	And Yukla two seven heavy cleared for takeoff, traffic in sight.
0745:44	**CP:**	Cleared for takeoff, crew.
0745:45	**FE:**	*check complete.
0745:45	**CAM:**	[Engines spool up]
0745:47	**AC:**	Engineer, set takeoff power.
0745:49	**CAM:**	[Engines spool up]
0746:09	**CP:**	Eighty knots, copilot's aircraft.
0746:11	**AC:**	Your airplane.
0746:20	**AC:**	V_1.
0746:28	**AC:**	Rotate.
0746:28	**CP:**	All the birds.
0746:31	**FE:**	Lotta birds here.
0746:33	**AC:**	# we took one.
0746:36	**CP:**	What do I got?
0746:37	**FE?:**	We took two of 'em.
0746:37	**AC:**	We got two motors.
0746:37	**FE:**	Flight start.
0746:38	**CP:**	Roger that.
0746:40	**AC:**	Take me to override.
0746:41	**CP:**	Go to override on, on the ...
0746:43	**RDO-CP:**	Elmendorf tower, Yukla two seven heavy has an emergency. Lost ah number two engine, we've taken some birds.
0746:44	**St5:**	You're in override.
	St5:	There's the rudder.
0746:46	**FE:**	Got it.
0746:47	**St5:**	You're in override.
0646:48	**AC:**	Thank you.
0746:49	**FE:**	Starting dump fuel.
0746:51	**AC:**	Start dumping.
0746:52	**RDO-TWR:**	Yukla two seven heavy, roger. Say intentions.
0746:55	**CAM:**	[Stick shaker activates, continues until impact]
0746:56	**RDO-CP:**	Yukla zero two heavy's coming back around for an emergency return.
0746:58	**CP:**	Lower the nose, lower the nose, lower the nose.
0747:00	**RDO-TWR:**	Two seven heavy, roger.
0747:00	**AC:**	Goin' down.
0747:02	**CP?:**	Oh my God.
0747:02	**AC:**	Oh #.
0747:04	**CP:**	OK, give it all you got, give it all you got.

0747:06	**RDO-CP:**	Two seven heavy, emergency.
0747:09	**RDO-W1:**	Roll the crash, roll the crash.
0747:10	**CAM:**	[PA tone]
0747:11	**CP:**	Crash (landing)
0747:11	**AC:**	We're goin' in.
0747:11	**AC:**	We're going down.

RDO = Radio transmission
TWR = Tower controller
CAM = Cockpit area microphone *
AC = Aircraft commander
CVR = cockpit voice recorder
CP = Copilot
FE = Flight engineer
St5 = Instructor flight engineer
* = Unidentifiable word or words
# = Expletive
? = Unsure of origin
[ ] = Editorial insertion

Source: U.S. Air Force

the senior tower controller said he "observed geese lift off and turn right, directly into the path of the [accident] aircraft."

"Moments before the [accident] aircraft's departure, [the senior tower controller] witnessed a C-130 take off and flush a flock of geese from the infield adjacent to Runway 5," the report said. "Fortunately for that aircraft, this flock turned away from its flight path."

The report noted: "While [the senior tower controller] could have assumed that every infield goose joined the flock that the C-130 flushed and that this flock had left the area, sound judgment dictates that he should have contacted the E-3 and warned the crew. The aircraft could have held takeoff until the squadron SOF or base operations could ensure that these geese had not returned and that no more geese were in the area. I [the investigating officer] cannot imagine why [the controller] did nothing. He had more than two minutes to advise the [accident] aircraft that a flock of geese had taken wing and nearly struck the C-130."

The investigating officer commented in the report: "I believe [that the tower controller] had a duty to warn the [accident] aircraft and that his failure to do so was a contributing factor to this accident. While it would not have been standard operating procedure for a tower controller to raise the bird watch condition [BWC] to severe, he certainly could have warned the aircraft of the potential hazard."

The background and qualifications of the flight crew were reviewed. The aircraft commander, 28, had logged 1,922 total flying hours, excluding student pilot training, the report said. He had completed his initial E-3 copilot training in 1992 and upgraded to aircraft commander in 1994. The aircraft commander "had a solid flying background with no breaks in flying operational assignments since pilot training," the report said.

The aircraft commander had flown one 10-hour flight in the 30-day period preceding the accident, the report said. "He was current by all Air Force standards," the report said. "[He] had a strong flying record and was a very capable aircraft commander." There were no recurring problems in his training records, the report said.

The copilot, 27, had logged approximately 1,259 total flying hours, excluding student pilot training, the report said. He had completed his initial E-3 copilot training in 1992 and was certified as a mission-ready copilot in 1993. The copilot had flown three flights in the 30-day period preceding the accident and had logged 79.2 flying hours in the 90-day period preceding the accident, the report said.

There were no recurring problems noted in the copilot's training records. "He was a strong copilot who was being actively prepared for aircraft commander duties," the report said. "His training records were thorough and gave a very clear picture of a responsible and competent aviator."

The activities of the flight crew before the accident flight were reviewed. "The crew was scheduled to enter crew rest at 1800 [the day before the accident flight]," the report said. "This [schedule] provided 12 hours of nonduty time prior to a 0600 show time on [the day of the accident flight]. All evidence indicates [that] the flight crew received adequate nonduty time, and [that] crew rest was not a contributing factor in this accident," the report said.

In an aircraft simulator the investigating officer flew the profile of the accident flight, the report said. The investigator said: "I am convinced that a total power loss on no. 2 engine and a 50-[percent] to 70-percent power loss on the no. 1 engine immediately after rotation renders the E-3 incapable of controlled flight. I am convinced that the flight deck air crew accomplished their emergency procedures flawlessly in an attempt to fly this aircraft out of an unflyable scenario."

The following new procedures were ordered after the accident:

- "When workload permits, controllers will use binoculars to visually scan the runway and infield environments for concentrations of birds or bird activity prior to issuing a takeoff or landing clearance;
- "Airfield management will conduct an airfield inspection 30 minutes prior to civil twilight. This inspection should focus on the current bird activity and should help anticipate the increase in bird activity that is normally associated with the early morning period;
- "Airfield management will conduct an airfield inspection within 30 minutes of the first departure of each day;
- "The [SOF], airfield management, and ATC watch supervisor (WS) all have the authority to increase the declared BWC in the interest of flight safety. In the

absence of a Wing SOF, airfield management will have the authority to decrease the BWC;

- "In the absence of the SOF and when the tower watch supervisor and/or airfield management deems it necessary, he/she may increase the BWC. When the ATC WS upgrades the BWC, he/she will notify airfield management as to the location of the birds;

- "The SOF and the ATC WS may restrict and/or modify air traffic operations as deemed necessary for flight safety (e.g., cancellation of practice approaches, full stops only, etc.); [and,]

- "If bird dispersal is required on the airfield, the BWC will automatically be upgraded to severe during such activity."

The report noted that the new procedures required that the BWC be declared "if there are birds flying over or on the ground anywhere close to the runways (infield, edges, taxiways, ramps, etc.) ... because they need to be dispersed." Most severe bird conditions, which prohibit takeoffs and all but emergency and fuel-related diversionary landings, can be resolved within five minutes to 15 minutes.

As a result of the difficulties in reading the accident aircraft's FDR data, investigators made the following recommendations to the U.S. Air Force:

- "We recommend that the Air Force evaluate and correct the documentation pertaining to the recorded parameters on all its FDR aircraft. This is not the only case of the Air Force having [an FDR]-equipped aircraft [from which they could not] read out and evaluate the [FDR] data;

- "We recommend that all Air Force FDR-equipped aircraft have the FDR read out and the data evaluated by engineers at least once a year to locate failed sensors and other malfunctions/miscalibrations that cannot be found by the use of a built-in test;

- "The E-3 has a large amount of unused space in the data frames recorded on the FDR; however, many of the parameters are only recorded once every four seconds. We recommend that the software in the flight data acquisition unit (FDAU) be modified so that it stores the data from the four-second parameters at least once per second and the more active parameters more often than once per second. This can be done without having to add more sensors to the FDAU and would greatly improve the value of the data; [and,]

- "We also recommend that all four engine throttles be wired for recording by the FDR."♦

Editorial note: This article was adapted from *USAF [United States Air Force] Aircraft Accident Investigation Report, E-3B Aircraft #77-0354, Assigned to 3rd Wing, Elmendorf AFB, Alaska, 22 September 1995.* The report contains a 19-page summary and extensive supporting documentation, and includes diagrams and illustrations.

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