Bird Strike Committee Canada
Meeting 28, June 9th & 10th, 1998

CO-CHAIRS:
Bruce MacKinnon, Transport Canada, and
Capt. Sara Karcha, Department of National Defence.

MINUTES PREPARED BY:
Phillip Scott, Transport Canada.

NEXT MEETING:
October 22nd and 23rd, 1998, Québec City, Québec, Canada.

ATTENDEE LIST

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Minutes of the 28th meeting of Bird Strike Committee Canada

June 9th and 10th, 1998
Valhalla Inn
Thunder Bay, Ontario

DAY 1

1. Opening and Welcome

Bruce MacKinnon, Wildlife Control Specialist for Transport Canada, Aerodrome Safety Branch, welcomed everyone to Thunder Bay, and introduced co-chair ***Capt. Sara Karcha*** from DND, and co-op student ***Phillip Scott***. The official welcome was provided by ***Scott McFadden***, General Manager for the Thunder Bay Airport Authority. This particular meeting is being held in Thunder Bay due in part to some recent bird hazard concerns, and a recent incident involving the emergency landing of a DC-9 due to a bird strike. Along with regular committee business, it is hoped that a discussion of Thunder Bay Airport's wildlife control issues may provide assistance in developing an effective plan of action.

2. Keynote Address

Dr. Richard Dolbeer, USDA Wildlife Services, presented a study of reproductive and lethal control programs and their effects on certain species populations, entitled *Population Dynamics: The Foundation of Wildlife Damage Management for the 21st Century*. The study used population modeling as a means of justifying wildlife control activities. (Please see appendix 3.)

3. BSC North America

Bruce MacKinnon proposed the idea of a Bird Strike Committee meeting which combines the agendas of BSCC and BSCUSA into a BSC North America conference. The proposal suggested that in addition to each committee's separate meetings, the combined meeting's location alternate between host countries as a shared yearly meeting.

The group discussed some issues associated with the proposal, which included:

- increased participation from private wildlife control companies and others from the aviation industry;
- potential for corporate sponsorship;
- administrative issues related to publishing minutes, costs, numbers of participants.

4. Bird Strike Summary Reports

The Bird Strike Summary Reports from several organizations were briefly discussed, as well as reports of some more notable recent bird strikes. (For 1996 ICAO stats. please see appendix 4. For 1997 DND stats, please see appendix 5.)

5. Evaluation Of The Efficacy Of Various Techniques And Equipment For Airport Bird Control

Ross Harris, on behalf of Rolph Davis, presented a report on the draft document produced by LGL ltd. He noted that it is difficult to compare products due to the dynamic nature of each airport and the varied application of a number of control products. He explained that the report relies on literature reviews, a compilation of existing test results, and even conversations with users in order to produce comprehensive evaluations based on:

- biological premise;
- habituation;
- cost and practicality.

A given technique or piece of equipment is categorized in one of three groups:

1) Not Recommended
2) Okay, But...
3) Component of an Effective Airport Bird Control Program

In conclusion he emphasized that "it is always important to have skilled operators".

(Please see appendix 6.)

6. Predator Urine As A Means To Deter Deer

Dr. Richard Dolbeer presented a study undertaken to test the effectiveness of certain brands of bottled predator urine which are being marketed as a method to deter deer. The tests were run at the National Wildlife Research Center, using feeding troughs and marked control areas. Tests were also carried out on regularly used trails. The results showed that the particular products were not an effective deterrent to deer. (Please see appendix 7.)

7. Bird Balls - A Fail Proof Barrier To Exclude Waterfowl And Other Birds From Landing On Ponds

Mike Taber, from Wildlife Control Technology Inc., presented Bird Balls, an alternative method to netting for the purpose of excluding waterfowl and other birds from contained bodies of water. The drawbacks of netting were discussed in the presentation, along with a brief description of three types of exclusion methods, including:

- floating membrane;
- netting;
- Bird Balls.

Bird Balls are hollow plastic balls approximately four inches in diameter, requiring approximately 10 per ft^2, floating tightly together, creating a visual and physical barrier on the surface of the water. In contrast to netting, Bird Balls are not affect by severe and adverse weather conditions; snow and ice in particular. Some concerns raised during the presentation included the potential lack of coverage due to changing water levels and high winds. Mike explained that the balls' effectiveness is reduced under such abnormal conditions, but unlike permanent installations that when damaged, may often require a great deal of repair, this system can be easily restored as the balls will not be destroyed due to high winds. Another concern raised was the potential eutrophication of a body of water covered by Bird Balls. (Please see appendix 8.)

8. Bird Flight Forecast Model And Information System

Harlan Shannon presented this bird strike reduction method, as a study of bird flight processes based on aerodynamic theory and meteorological trends and predictions. The study focused on pelicans to show that the birds' behaviour was largely influenced by the weather. The study revealed that soaring times and altitudes varied considerably based on the strength and location of thermals (which are affected by sun/cloud cover). This type of adaptation demonstrates that forecasting weather can help in predicting bird behaviour. (Please see appendix 9.)

9. Field Trip

I. Thunder Bay Airport Wildlife Control Program

II. Thunder Bay Municipal Landfill

III. Mission Island Conservation Area

DAY 2

10. Open Discussion - Bird Hazard Management - Thunder Bay Airport And Landfill

All - Following are some of the issues discussed from the previous day's field trip:

- gull behaviour at landfill is in the process of being documented;
- active control not occurring due to CUPE strike;
- gull flocks from the entire area tend to end up in a variety of locations/directions;
- suggested control at airport would be to train the gulls not to fly-over airport lands by creating a hostile environment;
- shooting gulls would require justification, similar to Dr. Dolbeer's study at JFK, but data does not presently exist;
- gulls are so adaptable that controlling at airport should be priority, rather than at the landfill site, since the gulls will remain attracted to the airport;
- maintaining database / daily log is key; has already been started at Thunder Bay;
- Ring Billed and Herring gulls both frequent the landfill, and have a noticeably strict feeding regimen / schedule at the site;
- shooting birds at landfill:
  - most effective - use with agony postures;
  - requires permits;
  - complements the use of shell crackers.

11. New Bird Avoidance Model

Major David Arrington explained how some of the old Bird Avoidance Models were not very easy to use, but developments in Geographic Information System technology have offered greater possibilities:

I. existing BAM (1983) - DOS based table generation
II. Spectrum BAM - GIS based
III. Dare County/Moody BAM - multimedia application

The new model uses GIS based information handling, and has been based on historical data through the preliminary development stages, taking into account breeding and migration of certain species to determine danger areas and level of risk. This information can then be used for the routing of low-level flights.

12. Software Development For Wildlife Control Management Planning And Incident Reporting

Dave Fairbairn briefly discussed this software development project, intended as a tool for wildlife control management planning. The software would be for the use of Airport Authorities, rather than private consultants who currently undertake many comprehensive wildlife control plans for airports. The project will be tested for practical use at a few airports in the near future.

13. A Techniques Guide For The Management Of Problem Urban Canada Geese

Art Smith began by explaining that there is an informational void concerning the handling of problem urban geese, on topics such as:

- regulations;
- available techniques;
- how to choose appropriate techniques;
- where to buy supplies;
- where to find additional information.

As such, he explained that he has undertaken the production of a book and video dealing with these topics in a comprehensive manner:

- regulations; management strategies;
- techniques;
  - scientifically cited
  - unbiased presentation
  - habitat modifications
  - hazing/scaring
  - birth control
  - removal
- supplies;
  - material list cross-referenced to supplier list
  - addresses, numbers, etc.

The book and the video are expected to be available in September, 1998.
(Please see appendix 11.)

14. Snow Bunting Issues - Halifax International Airport

Shawn Hicks presented a report on the wildlife control program at Halifax International Airport, based on their ongoing problem with Snow Buntings. Halifax's year round moderate climate, along with the open fields at the airport, has offered an attractive habitat for Snow Buntings. The autumn season has proven to be the busiest for these birds; in the fall of 1997, there were 15 confirmed strikes involving 31 Buntings, along with several complaints from pilots. A control program was initiated focusing on cautious snow plowing, falconry, and live trapping. Before the program, during peak season, it was estimated that there were approximately 1500 Buntings (in only a few flocks) on the airport at once. After the initiation of control activities, there were less than a hundred at any given time. Shawn also showed a video of the falconry practices at Halifax International Airport.

15. Survival, Movement, And Harvest Of Translocated Canada Geese

Art Smith explained that since urban waterfowl cannot be hunted, and removal can also result in population augmentation elsewhere, interstate translocation to State Gaming Areas should be undertaken, and carefully monitored. Tagging and translocation was carried out on juvenile geese only, the test hypothesis being that geese return to where they learn to fly, rather than where they were born. (Please see appendix 12.)

16. Update - Bird Control Program - BFI - Prairie Green Landfill

Presented by ***Stan Kruse*** and ***Rhian Christie.***

One of the critical objectives of the Prairie Green Integrated Waste Management Facility was that gulls must never be allowed to feed or loaf on any part of the landfill area. Control methods used at the site, which include pyrotechnics, 12 gauge shotguns, and natural predators, have proven to be successful. (Please see appendix 14.)

17. Chemical Immobilization Program Of White-Tailed Deer At The Minneapolis - St. Paul Int'l Airport

John Ostrom explained the need for effective deer control due to the intensity of operations at the airport, and the large number of deer in the immediate area. Although deer incursions may not necessarily be frequent, the process of subduing and removing the deer can often be very disturbing to airline passengers, airport staff, and the deer itself. Long delays are likely to occur if an errant deer cannot be quickly removed from the airfield. Chemical immobilization was chosen as a safe and effective tool, when used by properly trained staff, and has been integrated into the overall wildlife control program. (Please see appendix 15.)

18. Innovative Products For Wildlife Control

Dave Ball offered a demonstration of some products that have been selected for use in Vancouver International Airport's wildlife control program, along with a presentation of their grass management activities.

YVR has experimented with net launchers and a night vision telescope as tools for aiding in the capture of birds in the terminal itself, animals such as dogs which have escaped from the cargo areas, or even individuals in certain situations on the airfield. The net launcher proved to be successful in tests conducted at the airport, but Dave's demonstration proved that the net launcher should probably not be used in rooms with low ceilings. The night vision telescope has also been quite useful, since infra-red devices cannot be used in an environment such as an airport.

The use of Reed Canary Grass in selected locations on the airfield at YVR has proven to be very effective in eliminating small to medium size flocking birds. Although the good results may be site specific due to the species of grass and the climate, this program demonstrated that experimentation in grass height management can be undertaken quite painlessly as a complement to conventional wildlife control methods. This type of grass at YVR is cut only once in the spring, and is left to grow over 2ft until the next spring. Some potential drawbacks discussed included: line of sight for smaller aircraft; dried out grass may be a fire hazard; coyotes and other such animals can hide in the grass when being harassed. (Please see appendix 16.)

19. Initial Estimates Of The Costs Of Bird-Aircraft Strikes To Canadian Civil Aviation

Doug Meeking presented this eye-opening report that offers new estimates to the actual costs of bird-aircraft strikes for the aviation industry. Doug re-established the fact that along with the direct costs due to the physical damage caused by bird strikes, indirect costs are a major issue, and can easily exceed direct costs. In addition to these, ancillary costs (studies, testing, investigations, etc.) and catastrophic costs can add to the total.

"The total costs to Canadian civil and military aviation, exclusive of any ancillary costs, potentially significant indirect costs, or any consideration of general aviation, are estimated to be within the range of **$253.5 million** to **$618.9 million** when expressed in 1997 Canadian dollars." In the discussion that followed, many concurred that these costs are generally just accepted by airlines and the military as operating write-offs. (Please see appendix 17.)

20. Other Business - Conclusion

Bruce MacKinnon - The last business of the day was a request for any **photographs** that people may have of bird-strike related subject-matter, such as bird-strike-damaged aircraft, wildlife control operations, etc. for the Bird Hazard Handbook which is currently under production.

The next BSCC meeting will be held in Quebec City, on October 22 and 23, 1998.

> (At the time these proceedings were printed, the 1st Bird Strike USA/Canada has been planned for May 9-13, 1999 in Vancouver (Richmond), British Columbia.)

Thank You to all who attended.

BIRD STRIKE COMMITTEE CANADA
MEETING 28, June 9th and 10th, 1998

LIST OF APPENDICES

1. Organizational Letter
2. BSCC 28 Agenda
3. Population Dynamics: The Foundation of Wildlife Damage Management for the 21st Century
4. 1996 World Bird Strike Statistics (IBIS): ICAO
5. 1997 Bird Strike Statistics: Canadian Forces
6. Evaluation of the Efficacy of Various Techniques and Equipment for Airport Bird Control
7. Predator Urines As Chemical Barriers to White-Tailed Deer
8. Bird Balls - Fail Proof Barrier for Waterfowl
   - Wildlife Control Technology Inc.
9. Bird Flight Forecast and Information System
10. Selected Articles from *The Chronicle Journal* (Thunder Bay, Ontario)
    - *Birds and planes fight for space around airports*
    - *Pesky seagulls concern airline representatives*
    - *Airport hunter keeps animals away*
11. A Techniques Manual and Video for the Management of Problem Urban Canada Geese
12. Survival, Movement and Harvest of Translocated Canada Geese
13. "No Airspeed Restriction" Bird Strike Report - FAA
14. Update - Bird Control Program - BFI - Prairie Green Landfill
15. Chemical Immobilization Program for White-Tailed Deer at the Minneapolis - St. Paul Int'l Airport
16. Innovative Products for Wildlife Control
17. Initial Estimates of the Costs of Bird-Aircraft Strikes to Canadian Civil Aviation
18. Evaluation of Shooting and Falconry to Reduce Bird Strikes With Aircraft at John F. Kennedy Int'l Airport
19. Excerpt from *The Airport* by James Kaplan
20. IBSC Newsletter - April 1998
21. Selected Article from *The Plain Dealer* (Cleveland, Ohio)
    - *Aviation Experts Targeting Birds*
22. Aerodrome Safety Information Circular (1998.03.24)
23. *Honk if you like flying carp* (from *Equinox* - February/March 1998)
24. They're Back - Raptors on the Rebound

25. Selected Articles from *The Globe and Mail*
(Canadian National, daily)
- *Worst-run runways identified in report*
- *2,000 geese on city's hit list*
- *An early-morning patrol to save birds*
- *Browning-Ferris might merge with Allied Waste*
- *Bulldozer rolls over nests on Leslie Street Spit*
- *Cormorants ruffle fisherman's feathers*

26. Selected Articles from various newspapers
- *Growing bird population causing a flap*
- *Dramatic increase in bird population poses aircraft threat*
- *Airport critter patrol*
- *Smashed Tern eggs infuriate activists*

27. *Bird strikes a bigger threat than ever* (from *Flying* - June 1998)
28. ARFF Hot News
29. *For the birds - again* (from *Plane and Pilot* - May 1998)
30. Take Five... Low-Flying Exam - Transport Canada
31. *A Reminder about Bird Strikes* (from *Aviation Safety Letter* - February 1998)

APPENDIX 1

Organizational Letter

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

Your file Votre référence

Our file Notre référence

April 15, 1998

AARM 5158-36-20-51

Members/Participants
Bird Strike Committee Canada

Dear Member/Participant:

Please find enclosed the draft agenda for Bird Strike Committee Canada meeting # 28, which will be held in Thunder Bay, Ontario on Tuesday and Wednesday, June 9 and 10, 1998 at the Valhalla Inn.
The meeting will be held in the Viking Room:

Valhalla Inn
1 Valhalla Inn Road
Thunder Bay, Ontario
P7E 6J1
Phone: (807) 577-1121
Fax: (807) 475-4723

There is a block of rooms reserved for Transport Canada, at a rate of $89.00 per night, and the toll-free reservation # is 1-800-864-1121. Please quote reservation number G5899 when you book your room, and we suggest that you reserve early because the block will be released on May 8, 1998.

As you can see from the agenda, there are open blocks of time, so if you wish to present a paper or have agenda items, please contact me as soon as possible.

We look forward to seeing you in Thunder Bay, and if you have comments or questions, please feel free to contact me at (613) 990-0515 or by Fax at (613) 990-0508.

Regards,

Bruce MacKinnon
Wildlife Control Specialist

APPENDIX 2

BSCC 28 Agenda

AGENDA TIMETABLE

BIRD STRIKE COMMITTEE CANADA
28TH MEETING

THUNDER BAY, ONTARIO
Valhalla Inn

TUESDAY, JUNE 9, 1998

TIME	ITEM	SPONSOR
0830 - 0900	COFFEE AND MUFFINS	ALL
0900 - 0905	OPENING	BRUCE MACKINNON
0905 - 0910	WELCOME	SCOTT MCFADDEN
0910 - 0915	INTRODUCTION OF ATTENDEES	BRUCE MACKINNON CAPT SARA KARCHA
0915 - 0940	KEYNOTE ADDRESS - POPULATION DYNAMICS "THE FOUNDATION OF WILDLIFE DAMAGE MANAGEMENT FOR THE 21ST CENTURY"	DR. RICHARD DOLBEER
0940 - 1000	BSC NORTH AMERICA	DR. RICHARD DOLBEER BRUCE MACKINNON
1000 - 1015	BIRD STRIKE SUMMARY REPORTS	DND-FAA-AC-CAI-TC-USAF-ICAO
1015 - 1045	COFFEE BREAK	ALL
1045 - 1115	EVALUATION OF THE EFFICACY OF VARIOUS TECHNIQUES AND EQUIPMENT FOR AIRPORT BIRD CONTROL	DR. ROLPH DAVIS
1115 - 1135	PREDATOR URINE AS A MEANS TO DETER DEER	DR. RICHARD DOLBEER
1135 - 1155	BIRD BALLS - A FAIL PROOF BARRIER TO EXCLUDE WATERFOWL AND OTHER BIRDS FROM LANDING ON PONDS	MIKE TABER
1155 - 1215	BIRD FLIGHT FORECAST MODEL AND INFORMATION SYSTEM	DR. WILLIAM SEEGAR
1215 - 1330	LUNCH	ALL
1330 - 1600	FIELD TRIP 1 - THUNDER BAY MUNICIPAL LANDFILL 2 - THUNDER BAY AIRPORT WILDLIFE CONTROL PROGRAM 3 - MISSION ISLAND CONSERVATION AREA	BILL BRITT

WEDNESDAY, JUNE 10

TIME	ITEM	SPONSOR
0830 - 0900	COFFEE AND MUFFINS	ALL
0900 - 0920	OPEN DISCUSSION - BIRD HAZARD MANAGEMENT - THUNDER BAY AIRPORT AND LANDFILL	ALL
0920 - 0945	NEW BIRD AVOIDANCE MODEL	MAJOR DAVID ARRINGTON
0945 - 1005	SOFTWARE DEVELOPMENT FOR WILDLIFE CONTROL MANAGEMENT PLANNING AND INCIDENT REPORTING	DAVE FAIRBAIRN
1005 - 1030	COFFEE BREAK	ALL
1030 - 1100	A TECHNIQUES GUIDE FOR THE MANAGEMENT OF PROBLEM URBAN CANADA GEESE	ART SMITH
1100 - 1130	SNOW BUNTING ISSUES - HALIFAX INT'L AIRPORT	SHAWN HICKS
1130 - 1200	SURVIVAL, MOVEMENT, AND HARVEST OF TRANSLOCATED CANADA GEESE	ART SMITH
1200 - 1300	LUNCH	ALL
1300 - 1315	A GENERIC GUIDE TO WILDLIFE CONTROL MANAGEMENT PLANNING AT AIRPORTS	PHIL SCOTT
1315 - 1325	AERODROME STANDARDS AND REGULATIONS - WILDLIFE CONTROL - UPDATE	BRUCE MACKINNON
1325 - 1330	SPEED LIMITATIONS BELOW 10,000 FEET MSL	BRUCE MACKINNON
1330 - 1400	UPDATE - BIRD CONTROL PROGRAM - BFI - PRAIRIE GREEN LANDFILL	STAN KRUSE RHIAN CHRISTIE
1400 - 1420	CHEMICAL IMMOBILIZATION PROGRAM OF WHITE TAILED DEER AT THE MINNEAPOLIS - ST. PAUL INT'L AIRPORT	JOHN E. OSTROM
1420 - 1450	COFFEE BREAK	ALL
1450 1520	INNOVATIVE PRODUCTS FOR WILDLIFE CONTROL	DAVE BALL
1520 - 1550	INITIAL ESTIMATES OF THE COSTS OF BIRD-AIRCRAFT STRIKES TO CANADIAN CIVIL AVIATION	DOUG MEEKING
1550 - 1600	OTHER BUSINESS - CONCLUSION	ALL

MacKinnon, Bruce

From: Lowrey, Thomas
Sent: Monday, January 19, 1998 9:30 AM
To: MacKinnon, Bruce
Subject: FW:

Importance: High

Tom Lowrey

From: Lowrey, Thomas
Sent: January 19, 1998 9:22 AM
To: Lauridsen-Hoegh, Richard - AFN; 'Amyot, Katherine'; Lalonde, Monique; Bourgeois, Gilles; Marston, Elizabeth
Importance: High

<u>The Statues</u>

For decades, two heroic statues, one male and one female, faced each other in a city park, until one day an angel came down from Heaven.
"You've been such exemplary statues," he announced to them, "that I'm going to give you a special gift. I'm going to bring you both to life for thirty minutes, in which you can do anything you want."
And with a clap of his hands, the angel brought the statues to life.

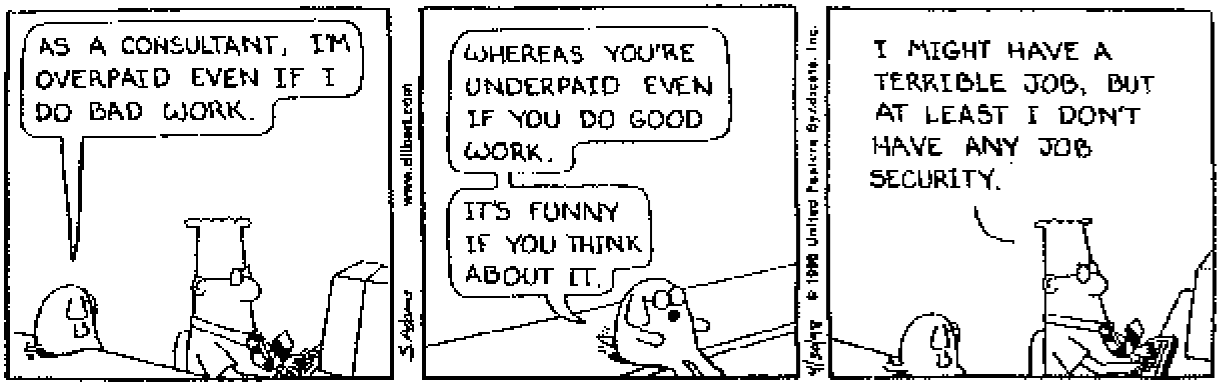
The two approached each other a bit shyly, but soon dashed for the bushes, from which shortly emerged a good deal of giggling, laughter, and shaking of branches. Fifteen minutes later, the two statues emerged from the bushes, wide grins on their faces.
"You still have fifteen more minutes," said the angel, winking knowingly.

Grinning even more widely, the female statue turned to the male statue and said, "Great! Only this time YOU hold the pigeon down and I'LL shit on its head."

Tom Lowrey

DILBERT ®

By Scott Adams



BIZARRO By Dan Piraro

BIRDS OF PRAYER

MacKinnon, Bruce

From: W. John Richardson[SMTP:wjrichar@idirect.com]
Sent: Thursday, May 07, 1998 10:24 PM
To: Rolph Davis; Bruce MacKinnon
Subject: ARFF HOT NEWS (fwd)

FYI.--WJR
---------- Forwarded message ----------
Date: Thu, 7 May 1998 11:50:05 EDT
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May 7, 1998 - Taiwan Cracks Down On Pigeon Threaty To Planes

TAIPEI, Taiwan - Taiwan is cracking down on pigeon fanciers living near airports whose birds are posing an increasing risk to air traffic.

In the past week alone, the Civil Aeronautics Administration has asked prosecutors to bring criminal charges against three people whose pigeons were sucked into commercial jet engines, an administration official said by telephone.

``It's necessary," the official said of what some had suggested was unusually harsh treatment. ``Following a spate of airline accidents, we are not taking any chances."

Under recent laws, owners of birds that fly into commercial aircraft engines or otherwise threaten the safety of passengers face hefty fines and even prison terms if convicted.

If a bird-plane collision causes deaths or injuries, owners can be imprisoned for 10 years to life. Even if no one is hurt, fines can run as high as T$1.5 million (US$45,000).

In the latest incident, two birds flew into the engine of a Far East Air Transport Corp plane as it landed at Kaohsiung in southern Taiwan.

Investigators used the mangled birds' leg tags to trace their owners and referred them to the courts for prosecution.

An airline spokeswoman said Far East had recorded 246 cases of bird-plane collisions over the years, over 50 percent of which involved domestic pigeons.

APPENDIX 3

Population Dynamics: The Foundation of Wildlife Damage Management for the 21st Century

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POPULATION DYNAMICS: THE FOUNDATION OF WILDLIFE DAMAGE MANAGEMENT FOR THE 21ST CENTURY

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ABSTRACT: To justify and defend lethal or reproductive control programs to solve vertebrate pest problems, wildlife biologists must have a sound understanding of the population status and dynamics of the problem species. Models are essential to project how populations will respond to proposed management actions, providing a scientific foundation to counter the emotional debates that often arise. Four population models (PM1-PM4) for predicting population responses are described. PM1 and PM2 explore the relative efficacy of reproductive and lethal control for vertebrate species over 10-year intervals. PM3 simulates population responses to actual management actions through 10-year intervals. PM4 simulates population changes for a species at weekly intervals over an annual cycle, exploring the immediate (≤1 year) impact of population management actions. Population simulations using PM1 and PM2 demonstrated that for most vertebrate pest species, lethal control will be more efficient than reproductive control in reducing population levels. Reproductive control is more efficient than lethal control only for some rodent and small bird species with high reproductive rates and low survival rates. A simulation (PM3) of the removal of 47,000 laughing gulls (Larus

atricilla) from the Long Island-New Jersey population accurately predicted the 33% decline of the population over 5 years. A simulation (PM4) of the annual cycle of the common grackle (Quiscalus quiscula) population in the eastern United States demonstrated why removing 4.2 million birds in 1 winter had no discernible impact on subsequent breeding populations. Understanding the population dynamics of wildlife species is the cornerstone to successful management, and population models will be essential for this task in the years to come.

KEY WORDS: black rat, fruit bat, grackle, gull, lethal control, model, population dynamics, reproductive control, vertebrate pest

INTRODUCTION

The world human population is increasing at an unprecedented rate of 90 million people/year (about 4 million/year in North America). In parallel, dramatic increases in populations of many wildlife species such as Canada geese (Branta canadensis), gulls (Larus spp.), white-tailed deer (Odocoileus virginianus), double-crested cormorants (Phalacrocorax auritus) and beaver (Castor canadensis) have occurred in North America over the past 30 years due to land-use changes and effective management programs by public and private natural resource and environmental agencies (e.g., Ankney 1996, Hatch 1995, Belant and Dolbeer 1993). These simultaneous population expansions inevitably lead to conflicts between wildlife and humans in an increasingly crowded world. Managing these conflicts is an intricate, difficult process because of 4 factors:

1) The science of wildlife management is complex, particularly understanding and predicting the behavior, population dynamics and economic/health impacts

of wildlife species;

2) Wildlife biologists study and manage sentient, adaptable and secretive organisms, requiring the development of many complex, labor-intensive tools and techniques to census, monitor, and measure;

3) The sociological aspects of wildlife management are diverse and emotional, particularly the oftentimes polarized views of society regarding the killing and management of wildlife species;

4) The regulatory aspects of wildlife management can be almost overwhelming, particularly regarding the legal status of wildlife, National Environmental Policy Act (NEPA) processes, and the registration of chemicals as management tools.

I believe that as a profession of research and management biologists, we have become so involved in techniques development, sociological issues and regulatory aspects related to wildlife management that we have lost focus on our most important mission: the science of wildlife management. Furthermore, I contend that the foundation of wildlife management is understanding the population dynamics of the species in question. Any management action we recommend should be based and clearly communicated on this foundation of population dynamics. Unfortunately, this is often not the case either because we fail to communicate our knowledge and understanding or because we do not have the level of understanding needed.

There are many situations where lethal control has been implemented to resolve human conflicts with wildlife (e.g., Dolbeer 1986, Dolbeer et al. 1993, 1997, Bedard et al. 1995). However, our urbanized public generally advocates nonlethal means of managing problem populations of wildlife (Stout et al. 1997). To this end, there has been increased interest in the development of reproductive control strategies for wildlife species (Kirkpatrick and Turner 1985). To justify lethal or reproductive control programs to state and federal regulatory agencies and the public, wildlife biologists must have a sound understanding of the population status and dynamics of the problem species. Population models are essential to document the immediate impact that lethal or reproductive control programs will have on local, regional and continental populations and to project how populations will respond to these management actions. Such models provide a scientific foundation for management actions to counter the emotional debates that often arise.

My objective is to focus on this foundation of population dynamics from which, in my opinion, our profession has drifted. I first describe 4 population models for vertebrate species developed on Excel spreadsheets. Second, I use these models to demonstrate fundamental principles of population dynamics for several species that often conflict with human activities. Finally, I give 2 examples of how these models and the underlying principles demonstrated have provided guidance and justification for management actions to reduce conflicts.

METHODS

Population Models 1 (PM1) and 2 (PM2)

PM1 explores the relative efficacy of reproductive and lethal control for vertebrate species that produce ≤1 generation per year (i.e., offspring do not reproduce until ≥1 year old). PM1 also determines reproductive and survival parameter values needed to produce a stable population and provides an estimate of the age composition. PM1 has 6 age classes (0 [year of birth], 1, 2, 3, 4, and 5+ year-old animals). Population parameters that must be entered are initial estimates of the age distribution and survival and reproductive rates by age class (Table 1, Fig. 1). PM1 is designed to simulate population levels by age class for 20 years, the first 10 in a stabilizing or "baseline" mode and the next 10 in a "treatment" mode that shows population response to various management actions. No compensatory factors (e.g., increased annual survival rates during a period of management-induced population decline) are included in PM1. PM1 simply is designed to determine parameter values for species that result in stable populations and to compare the relative efficacy of control strategies within and among species.

To simulate population responses of a species, the best available mean values from the literature or other sources are input for the population parameters. An initial age structure is also entered, arbitrarily using 200-400 individuals for age-class 0 and then reasonable approximations for the remaining age classes (e.g., 90 for age-class 1 if the mean annual survival rate of 200 age-class 0 animals is estimated to be about 0.45). If these initial parameter estimates cause the population to increase (decrease), the reproductive and/or survival rates are adjusted downward (upward) until the population stabilizes by year 10 (Table 2). Parameter values that result in a stable population should represent realistic values for a typical population of the species.

In year 11 (Baseline 1000), the stable age structure from year 10 is adjusted to sum to 1,000 individuals for age classes 0-5+ (Fig. 1). This simply provides a convenient baseline number for the stable population (1,000) to compare with population levels during the 10-year treatment period.

Table 1. Population parameters used in Models 1-4.

Population parameter	Definition
JSR[a]	Juvenile (age 0 [weaning/fledging] to age 1) survival rate.
ASR[a]	Adult (≥age 1) survival rate (annual).
ESR[a]	Egg survival rate (egg laying to fledging/weaning).
EPRA[a]	Eggs per reproducing adult/year.
FFR1...5[a]	Fraction of females reproducing in age classes 1...5.
MCF[b]	Max. compensation factor to adjust ASR, JSR and ESR; = 1/ASR.
CF[b]	Compensation factor for ASR, JSR and ESR; = MCF-((MCF-1)*FIPR).
FIPR[b]	Fraction of initial (baseline) population remaining.

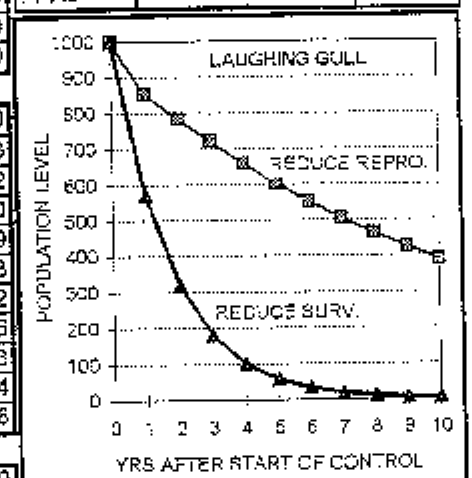
[a] Used in Population Models 1-4.

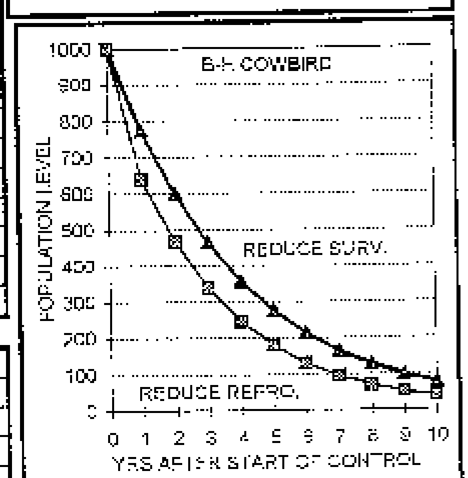
[b] Used in Population Models 3 and 4.

Fig. 1. Example of tabular and graphic output from Model 1 in which 1) parameters values were determined for laughing gulls to produce stable population (stabilizing years 1-10), and 2) population responses to 50% reductions in survival or reproduction were simulated for 10 years (Treatments 1 and 2). In addition, graphic output for same simulations with cowbirds (see Table 2 for parameter values) is presented.

SPECIES:	LAUGHING GULL						
SIMULATION:	DECREASE ADULT SURVIVAL BY 50%/DECREASE ADULT REPRODUCTION BY 50%						
PERIOD	YR	AGE 5+	AGE 4	AGE 3	AGE 2	AGE 1	AGE 0	TOTAL POP
Initial		200	60	80	110	120	360	930
Stabilizing	1	208	64	88	96	173	236	864
Stabilizing	2	218	70	77	138	113	246	862
Stabilizing	3	230	61	111	90	118	260	871
Stabilizing	4	233	88	72	95	125	255	870
Stabilizing	5	258	58	76	100	123	255	869
Stabilizing	6	252	61	80	98	123	256	870
Stabilizing	7	250	64	79	98	123	256	870
Stabilizing	8	251	63	78	98	123	256	870
Stabilizing	9	252	63	79	98	123	256	870
Stabilizing	10	251	63	79	98	123	256	870
Base1000	0	289	72	90	113	141	294	1000
Treatment 1	1	289	72	90	113	141	147	853
Treatment 1	2	289	72	90	113	71	147	782
Treatment 1	3	289	72	90	56	71	142	720
Treatment 1	4	289	72	45	56	68	128	659
Treatment 1	5	289	36	45	54	61	117	603
Treatment 1	6	260	36	44	49	56	107	552
Treatment 1	7	237	35	39	45	51	98	506
Treatment 1	8	217	31	36	41	47	90	463
Treatment 1	9	199	29	33	38	43	82	424
Treatment 1	10	182	26	30	35	40	75	386
Base1000	0	289	72	90	113	141	294	1000
Treatment 2	1	145	36	45	57	141	147	571
Treatment 2	2	72	18	23	56	71	79	319
Treatment 2	3	36	9	23	28	55	46	180
Treatment 2	4	18	9	11	15	22	26	102
Treatment 2	5	11	5	6	9	12	15	57
Treatment 2	6	6	2	4	5	7	8	32
Treatment 2	7	3	1	2	3	4	5	18
Treatment 2	8	2	1	1	2	2	3	10
Treatment 2	9	1	0	1	1	1	1	6
Treatment 2	10	1	0	0	1	1	1	3

PARA-METERS	STABLE POP.	TRT 1 POP.	TRT 2 POP.
JSR	0.48	0.48	0.48
ASR	0.8	0.8	0.4
ESR	0.551	0.275	0.551
EPRA	1.1	1.1	1.1
FFR1	0	0	0
FFR2	0.3	0.3	0.3
FFR3	1	1	1
FFR4	1	1	1
FFR5	1	1	1





JSR	=JUVENILE SURVIVAL RATE (FLEDGE/WEAN TO AGE 1).
ASR	=ADULT (≥AGE 1) SURVIVAL RATE (ANNUAL).
ESR	=EGG SURVIVAL RATE (EGG LAYING TO FLEDGE/WEAN).
EPRA	=EGGS PER REPRODUCING ADULT.
FFR1...5+	=FRACTION OF FEMALES BREEDING IN AGE CLASS 1...5+.

Table 2. Parameter values used in Population Models 1-4 that result in stable annual population levels for 11 vertebrate species that are sometimes pests.

Species[b]	Population parameter values[a]									
	JSR	ASR	ESR	EPRA	FFR1	FFR2	FFR3	FFR4	FFR5	MCF
GFBT	0.635	0.798	0.80	0.5	0	1	1	1	1	1.25
BRAT[c]	0.670	0.773	0.80	3.0	1	1	1	1	1	1.29
WTDR	0.570	0.700	0.89	0.9	0	0.8	1	1	1	1.43
COYT	0.250	0.603	0.88	2.5	0.3	1	1	1	1	1.67
BEAV	0.500	0.669	0.85	1.8	0	0.2	0.6	1	1	1.49
CAGO	0.300	0.699	0.60	3.0	0	0.3	1	1	1	1.43
DCCO	0.353	0.771	0.50	2.0	0	0.3	1	1	1	1.30
LAGU	0.480	0.800	0.55	1.1	0	0.3	1	1	1	1.25
BHCO	0.210	0.454	0.13	20.0	1	1	1	1	1	2.20
COGR	0.400	0.562	0.50	2.4	0.8	1	1	1	1	1.78
RBQU	0.223	0.500	0.80	2.8	1	1	1	1	1	2.00

[a] Estimates for parameters derived from literature (see below) or, when not available, by applying reasonable approximations that resulted in stable population.

[b] GFBT = giant fruit bat, BRAT = black rat (Dolbeer et al. 1988); WTDR = white-tailed deer (Hayne 1984); COYT = coyote (Canis latrans, Bekoff 1982); BEAV = Beaver (Hill 1982); CAGO = Canada goose (Bellrose 1976); DCCO = double-crested cormorant (Bedard et al. 1995); LAGU = laughing gull (Burger 1996); BHCO = brown-headed cowbird (Lowther 1993); COGR= common grackle (Peer and Bollinger 1997); RBQU = red-billed quelea (Jones 1989).

[c] JSR and ASR are monthly rates; EPRA/4 months; females reproduce at 4 months.

In treatment years 1-10, parameter values are adjusted to reflect the simulated management action. For example, one may want to compare the relative response of the population over 10 years to a 50% decrease in the survival rate of adult animals versus a 50% decrease in the reproductive rate. The model is first run with the survival rate reduced and then with the reproductive rate reduced (Fig. 1). These simulations provide simple but fundamental insights into the sensitivity of a species, given its population characteristics, to reproductive versus lethal control.

PM2 is a derivation of PM1 for simulating populations of rodents that produce more than 1 generation per year (e.g., commensals). PM2 has 2 age classes (immature and mature) and allows 3 generations per year.

Population Model 3 (PM3)

PM3 has the same basic structure as PM1 with the addition that the stable population in baseline year 0 can be adjusted to an actual population level (e.g., 131,000 nesting laughing gulls in New-Jersey-Long Island in 1989 [see below]) so that a real-world population can be simulated in treatment years 1-10. Then, actual numbers of animals or eggs removed by management actions are entered for each of the 10 treatment years. Finally, compensatory factors can be added to adjust reproductive and survival rates upward when populations decline below baseline (stable) levels as a result of management actions (Table 1). Thus, whereas PM1 and PM2 provide a generic comparison of population responses among species and management actions, PM3 allows simulation of a real-world situation. An added bonus is that PM3 provides an estimate of the total population (non-breeding and breeding animals) when census data are available for only the breeding population (e.g., as in most colonial waterbird populations, Belant and Dolbeer 1993).

Population Model 4 (PM4)

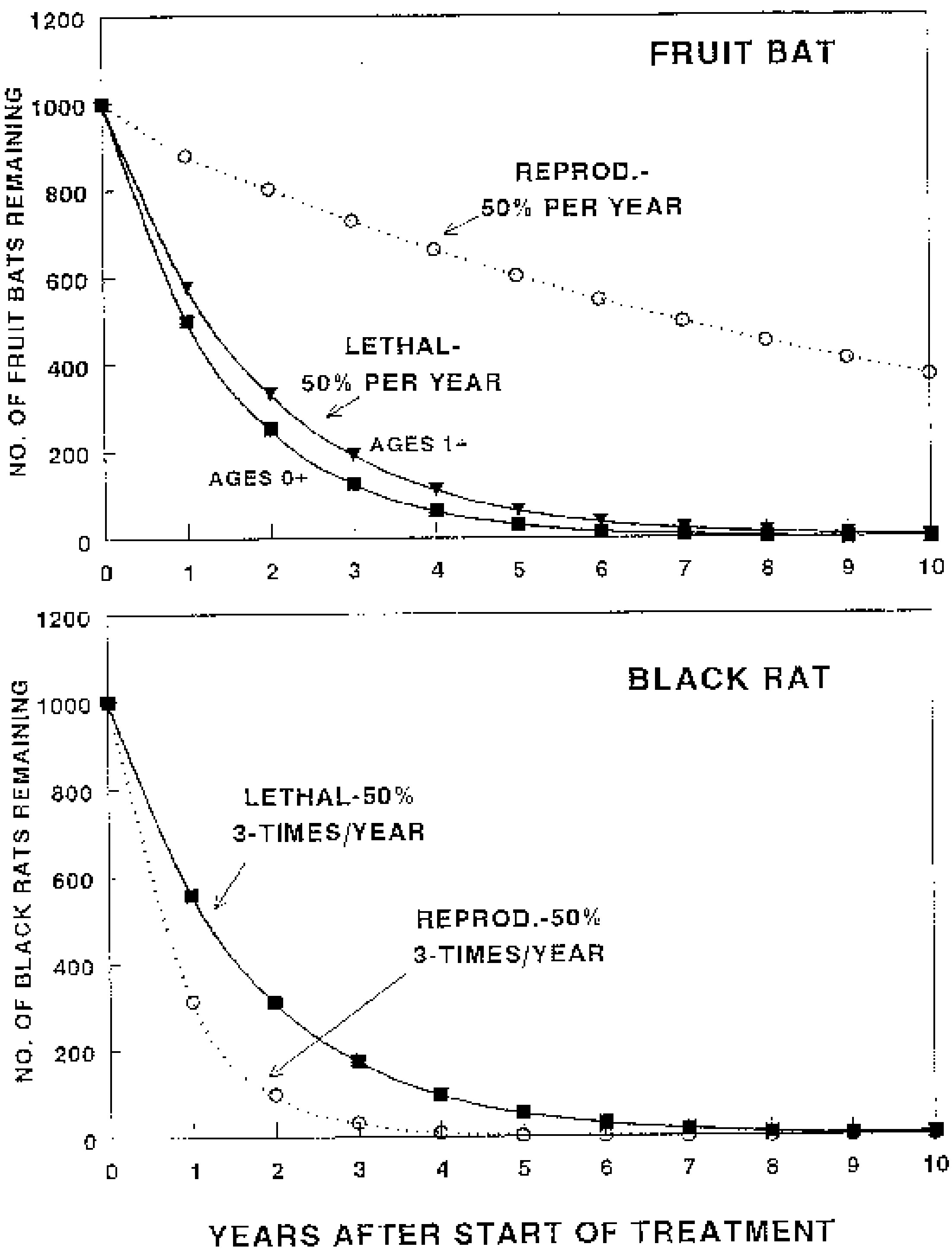
Whereas PM1-3 simulate changes in populations at yearly intervals, PM4 simulates population changes at weekly intervals over an annual cycle. PM4 explores the immediate (≤1 year) impact of population management actions. The population is initialized (week 0 = 23 Apr) using actual population estimates for the species to be simulated and stable age composition, reproductive and survival estimates determined from PM1. Also, the start and end weeks for fledging/weaning are entered so that young (age 0) enter the population during appropriate weeks. The population is then simulated for 52 weeks (1 May-1 May) and parameters adjusted if needed to produce a population that is stable. For the treatment simulation, start and end weeks for removal are entered as well as the number of animals to be removed. As with PM3, a compensatory factor for survival can be added to adjust weekly survival rates upward (downward) as the population declines below (exceeds) the baseline population for a given week.

RESULTS

Population Responses to Lethal and Reproductive Control (PM1, PM2)

The Republic of Maldives, an archipelago nation in the Indian Ocean, has 2 mammals, the endemic giant fruit bat (Pteropus giganteus) and introduced black rat (Rattus rattus) that damage agricultural crops (Dolbeer et al. 1988). These 2 species have dramatically different life histories (Table 2) which provide an excellent comparison of population response to control strategies (Fig. 2). Fruit bat populations, with low reproductive rates and high survival rates, can be reduced 4-6 times more

Fig. 2. Relative efficiency of reproductive and lethal control (yearly 50% reduction in reproductive or survival rate from values that produce stable population) for giant fruit bats (Population Model 1) and black rats (Population Model 2).



efficiently by lethal compared to reproductive control applied for 3 years (Table 3). In contrast, rat populations, with high reproductive rates, can be reduced 2-3 times more efficiently by reproductive compared to lethal control. The validity of these simulated responses was supported by management actions in the Maldives. Lethal control suppressed populations of fruit bats by 46-70% 1 year later, whereas rat populations recovered fully (Dolbeer et al. 1988).

Brown-headed cowbirds (Molothrus ater) and laughing gulls are bird species with contrasting life histories (Table 2) that demonstrate these same differences in population response to control strategies (Fig. 1). Laughing gull populations, with relatively low reproductive rates, can be reduced 4-6 times more efficiently over a 3-year period by lethal compared to reproductive control (Table 3). Cowbird populations, with high reproductive rates, are more efficiently reduced by reproductive control when control is directed only at adult (≥1 year old) animals. When control can be directed at all age classes, lethal control is 3 times more efficient than reproductive control. Red-billed quelea (Quelea quelea) populations respond in a manner similar to cowbirds.

The predicted relative efficiencies of lethal and reproductive control for various vertebrate species (Table 3) can be generalized based on adult survival rate (ASR) and age at which animals reproduce (Fig. 3). For species in which females first reproduce at 1 and 2 years, lethal control will be more efficient than reproductive control in reducing populations when the ASR is greater than about 0.56 and 0.23, respectively. For species in which females first reproduce at 3 years, lethal control always will be more efficient than reproductive control in reducing populations.

Table 3. Estimated relative efficiency of reproductive and lethal control based on numbers remaining after 3 years from an initially stable population of 1,000 individuals in which reproductive or survival rate is reduced annually by 50% (using Population Model 2 [rats] and Model 1 [all other species]).

Species	Number remaining after 3 years			Relative efficiency[a] of lethal to reproductive control (RC/LC) after 3 years	
	Reproductive control (RC)	Lethal control (LC)			
		> Age 0[b]	≥ Age 1[c]	≥Age 0[b]	≥ Age 1[c]
Fruit bat	731	125	191	5.5	3.8
Laughing gull	720	125	180	5.8	4.0
D.C. cormorant	673	125	183	5.4	3.7
White-tailed deer	639	125	212	5.1	3.0
Beaver	624	125	199	5.0	3.1
Canada goose	607	125	193	4.9	3.1
Coyote	486	125	264	3.9	1.8
Common grackle	430	125	349	3.7	1.7
Brown-headed cowbird	338	125	402	2.7	1.3
Red-billed quelea	368	125	421	2.9	0.7
Black rat	97[d] (405)[e]	307[e]	675[d]	0.3[e]	0.6[d]

[a] Efficiency ratios presented are specific to population status after 3 years and will increase during additional years of treatment.

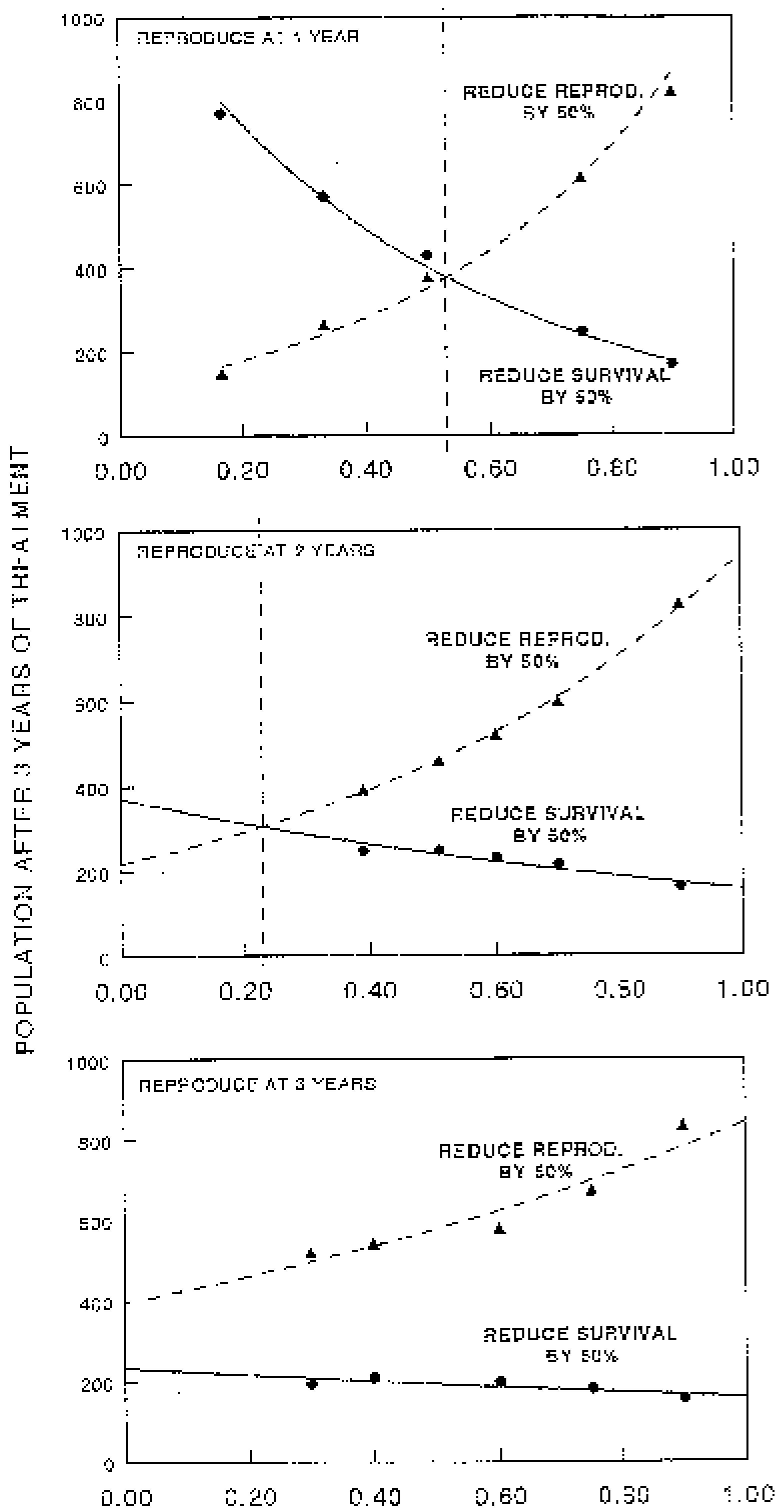
[b] Survival reduced 50% for age classes ≥ 0.

[c] Survival reduced 50% for age classes ≥ 1.

[d] Survival and reproduction of adults (≥3 months old) reduced 3 times/year.

[e] Survival and reproduction of adults (≥3 months old) reduced 1 time/year.

Fig. 3. Relative efficiency of reproductive and lethal control (yearly 50% reduction in reproductive or survival rate from values that produce stable population) in relation to mean adult annual survival rate for hypothetical vertebrate species that first reproduce at 1, 2, or 3 years (Population Model 1).



Response of Laughing Gulls to Control (PM3)

A colony of laughing gulls on Jamaica Bay Wildlife Refuge, New York, immediately adjacent to John F. Kennedy International Airport (JFKIA) increased from 15 to 7,600 nests, 1979-1990. The increase in this individual colony paralleled a general increase of the entire coastal New Jersey-Long Island (NJLI) population from about 31,000 nests in 1977 to 61,500 nests in 1989-1990 (Belant and Dolbeer 1993).

The large nesting colony next to JFKIA created a hazard for aircraft during summer because gulls frequently overflew the airport on daily foraging trips (Dolbeer et al. 1993). Because the colony was on protected National Park Service land, management options to reduce aircraft collisions with gulls (bird strikes) were limited. From 1991-1997, biologists shot 47,600 laughing gulls flying over the airport during May-August, reducing gull strikes by 66-89% (Dolbeer and Bucknall 1998).

This management action, involving the removal of a relatively large number of gulls within a major metropolitan area, received intense media and public scrutiny (USDA 1994). Therefore, it was imperative to document the impact of killing on the regional population to ensure the public that responsible management actions were being implemented (Belant and Dolbeer 1993). PM3 provided an objective means of predicting the impact of this shooting program on the NJLI population and putting the level of kill into perspective with regard to the total population.

First, PM3 estimated that in addition to the 131,000 nesting birds censused in 1989-1990, the population contained about 60,000 non-nesting adults ($\geq$1 year old, Table 4). Second, PM3 predicted a 26% decline in the NJLI nesting population from 1989-1995 whereas actual surveys estimated about a 33% decline. Finally, if an egg-

Table 4. Predicted response (Population Model 3) of laughing gull population on Long Island, New York and New Jersey to killing (actual) and egg oiling (hypothetical) in relation to field-based estimates of nesting population, 1977-1997 (numbers x 1,000).

			Predicted nesting and total population			
	Estimated	No. of	After killing[c]		After egg oiling[d]	
Year	nesting population[a]	gulls killed[b]	Nesting	Total[e]	Nesting	Total[e]
1977	61					
1985	122					
1989	131		131	190	131	190
1990			131	190	131	190
1991		14.2	121	177	131	190
1992		11.8	113	161	131	182
1993		6.5	107	151	129	176
1994		3.7	103	147	124	174
1995	88	6.2	97	140	121	173
1996		2.0	95	137	120	170
1997		3.2	93	133	118	170

[a] Based on actual nest censuses summarized by Belant and Dolbeer (1993) and Dolbeer et al. (1998).

[b] Birds shot at John F. Kennedy International Airport (93%, Dolbeer et al. 1998) and Atlantic City International Airport (7%, J. Floyd, Unpubl. data).

[c] In addition to the number of birds actually killed, I assumed 50% of shot birds resulted in nest failure.

[d] Hypothetical simulation: number of nests oiled (100% effective) equal to the number of birds killed.

[e] Total population includes nesting birds plus non-breeders (age 1-5) determined from age composition and estimated fraction of population breeding in each age class (Table 2).

oiling program had been conducted in which the number of nests oiled was equivalent to the number of gulls killed, PM3 predicted a decline of about 8% from 1989-1995. Neither the national nor northeast regional (Virginia-Maine) population of laughing gulls has declined during the years (1991-1997) of the shooting program, based on North American Breeding Bird Survey results, 1966-1996 (Burger 1996, Sauer et al. 1997).

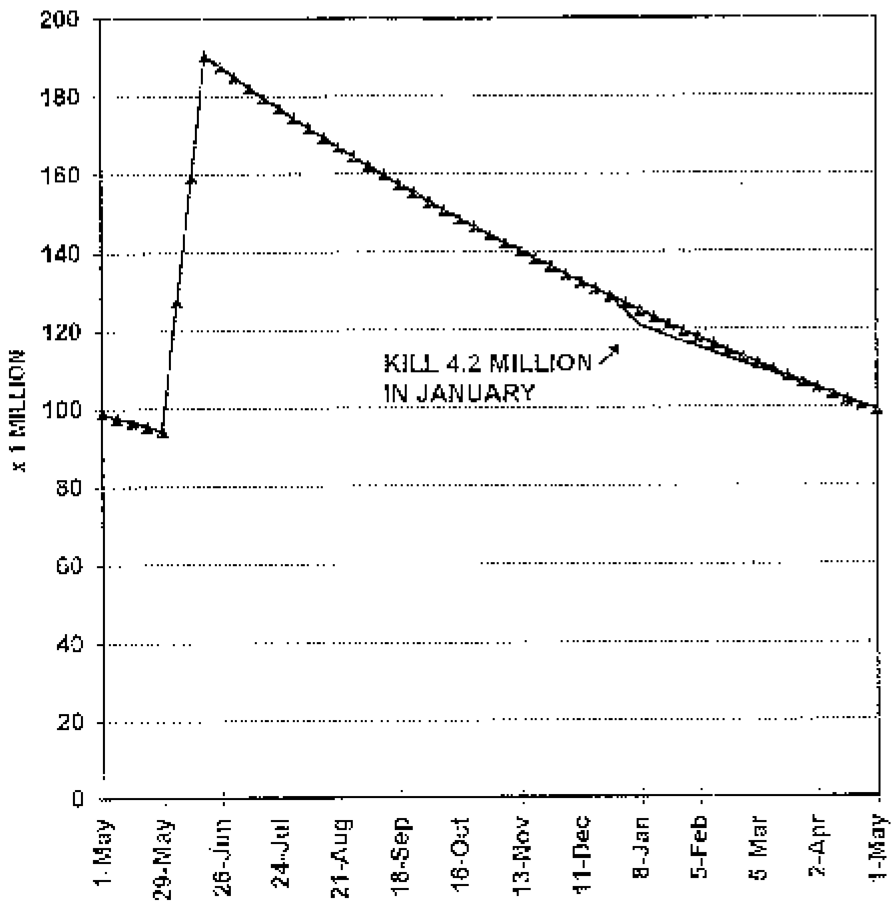
Response of Blackbirds to Control (PM4)

From 1974-1992, an estimated 38.2 million blackbirds (Icterinae) and starlings (Sturnus vulgaris) were killed in the southern United States by surfactant applications to winter roosts (Dolbeer et al. 1997). These management operations had no detectable impact on subsequent nesting population levels in the northern United States (Dolbeer et al. 1997), a finding that had been predicted (U.S. Dep. Inter. 1976) based on simulations from an earlier version of PM4 (Dolbeer et al. 1976). The greatest number of birds removed during a single winter was 4.2 million common grackles in 1977. A simulation with PM4 of the annual population cycle of common grackles in the eastern United States demonstrated the minimal impact of removing 4.2 million birds during January (Fig. 4).

DISCUSSION

Population models provide an essential framework for understanding the population dynamics of wildlife species to guide the development, evaluation and defense of management decisions. First, such models provide predictions of parameter values needed to produce a stable or changing (e.g., 10% mean annual increase) population level for a species. Second, models provide estimates of population responses to various control strategies, either hypothetically (PM1, PM2) or for real-world situations (PM3, PM4). As demonstrated in this paper, these models can provide

Fig. 4. Simulated annual cycle of population of common grackles in eastern North America (Population Model 4) showing no control and the removal of 4.2 million birds in winter 1978 (Dolbeer et al. 1997).



critical perspective into the impact, or lack thereof, that a given level of reproductive or lethal control has on a population in an actual or proposed management action.

One criticism of population modeling as a management tool is that data on parameter values often are inadequate to make modeling meaningful. I contend that this argument is not true for many situations with species such as gulls, deer, waterfowl and blackbirds. Furthermore, for those situations or species with meager data, I contend this criticism provides even greater justification for modeling. Management decisions are made whether or not models are used. Models provide an objective framework whereby assumptions and parameter estimates are explicitly stated in numerical values and mathematical relationships. Subsequent simulations produce testable hypotheses that can be challenged through experimentation. Models simply make those decisions more objective and provide professional wildlife managers and the public with an improved means of arriving at, justifying, debating and evaluating decisions (Starfield 1997).

Modeling also clearly identifies parameters for which improved data are needed for a species or situation, thereby focusing research efforts so that more reliable predictions can be made and defended. For example, data for key parameters such as the fraction of females breeding in younger age classes (e.g., age classes 2-3 for double-crested cormorants; Bedard et al. 1995) are often meager, making estimates of reproductive rate uncertain. Also, estimates of the total population being managed are often lacking (e.g., Torres et al. 1996), making evaluation of management impacts difficult even if good data were available on population parameters such as survival and reproductive rates. By requiring estimates for each of the population parameters, a manager quickly prioritizes critical data gaps.

Population simulations using PM1 and PM2 demonstrated that for most vertebrate pest species, lethal control will be more efficient than reproductive control in reducing population levels. This finding conflicts with the growing public desire for nonlethal methods of solving wildlife damage problems of which reproductive control is currently fashionable, at least conceptually (Kirkpatrick and Turner 1985). Professional biologists should not allow these outside pressures to cause them to stray from the fundamental principles of wildlife management, of which population dynamics is the cornerstone.

Reproductive control may have a place in wildlife management. But I contend that efforts for reproductive control should focus on those species for which the concept is most likely to be successful, such as rodents and small birds. Furthermore, if reproductive control strategies are developed and used on long-lived species such as deer and geese, biologists need to be honest with the public about the length of time required for such strategies to reduce populations relative to lethal control.

In conclusion, as professional biologists practicing wildlife damage management, we have an obligation to be leaders in taking appropriate management actions based on the principles of wildlife science, and we betray our profession when we become followers of vacillating public opinion. We should not be afraid to recommend and implement lethal control to manage legitimate damage situations when 1) such actions are justified based on the population status and dynamics of the species, 2) alternative control methods are impractical or less efficient, and 3) outcomes can be monitored to evaluate the impact of killing on target populations and in solving problems.

Understanding the population dynamics of wildlife species is the cornerstone to successful management, and population models such as described in this paper will be essential for this task in our increasingly crowded world in the years to come.

ACKNOWLEDGMENTS

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LITERATURE CITED

ANKNEY, C. D. 1996. An embarrassment of riches: too many geese. J. Wildl. Manage. 60:217-223.

BEDARD, J., A. NADEAU, and M. LEPAGE. 1995. Double-crested cormorant culling in the St. Lawrence River estuary. Colonial Waterbirds 18 (Special Publ.):78-85.

BEKOFF, M. 1982. Coyote. Pages 447-459 in Wild mammals of North America. J. A. Chapman and G. A. Feldhamer, eds. Johns Hopkins Univ. Press, Baltimore, MD.

BELANT, J. L., and R. A. DOLBEER. 1993. Population status of nesting laughing gulls in the United States, 1977-1991. Am. Birds 47:220-224.

BELLROSE, F. C. 1976. Ducks, geese and swans of North America. Stackpole Books, Harrisburg, PA. 540pp.

BURGER, J. 1996. Laughing gull (Larus atricilla). in The Birds of North America, No. 225. A. Poole and F. Gill, eds. The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union. Washington, DC. 28pp.

DOLBEER, R. A. 1986. Current status and potential of lethal means for reducing bird damage in agriculture. ACTA XIX Congr. Intern. Ornithol., Univ. of Ottawa Press, Canada 1:474-483.

_____., J. L. BELANT, and J. L. SILLINGS. 1993. Shooting gulls reduces strikes with aircraft at John F. Kennedy International Airport. Wildl. Soc. Bull. 21:442-450.

_____. and J. L. BUCKNALL. 1998. Shooting gulls to reduce strikes with aircraft at John F. Kennedy International Airport, 1991-1997. Spec. Rep. for Port Authority of NY and NJ by U.S. Dep. Agric., National Wildl. Res. Cent., Sandusky, OH. 33pp.

_____., L. A. FIEDLER, and H. RASHEED. 1988. Management of giant fruit bat and rat populations in the Maldive Islands, Indian Ocean. Proc. Vertebr. Pest Conf. 13:112-118.

_____., C. R. INGRAM, and J. L. SEUBERT. 1976. Modeling as a management tool for assessing the impact of blackbird control measures. Proc. Vertebr. Pest Conf. 7:35-45.

_____., D. F. MOTT, and J. L. BELANT. 1997. Blackbirds and starlings killed at winter roosts from PA-14 applications: implications for regional population management. Proc. East. Wildl. Damage Manage. Conf. 7:77-86.

HATCH, J. J. 1995. Changing populations of double-crested cormorants. Colonial Waterbirds 18 (Special Publ.):8-24.

HAYNE, D. W. 1984. Population dynamics and analysis. Pages 203-210 in White-tailed deer ecology and management. L. K. Halls, ed. Stackpole Books, Harrisburg, PA.

HILL, E. P. 1982. Beaver. Pages 256-281 in Wild mammals of North America. J. A. Chapman and G. A. Feldhamer, eds. Johns Hopkins Univ. Press, Baltimore, MD.

JONES, P. J. 1989. Quelea population dynamics. Pages 198-215 in Quelea quelea Africa's bird pest. R. L. Bruggers and C. C. H. Elliott, eds. Oxford Univ. Press, NY.

KIRKPATRICK, J. F., and J. W. TURNER. 1985. Chemical fertility control and wildlife management. Bioscience 35:485-491.

LOWTHER, P. E. 1993. Brown-headed cowbird. in The Birds of North America, No. 47. A. Poole and F. Gill, eds. The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, DC. 23pp.

PEER, B. D., and E. K. BOLLINGER. 1997. Common grackle. in The Birds of North America, No. 271. A. Poole and F. Gill, eds. The Academy of Natural Sciences, Philadelphia, PA, and The American Ornithologists' Union, Washington, DC. 19pp.

SAUER, J. R., J. E. HINES, G. GOUGH, I. THOMAS, and B. G. PETERJOHN. 1997. The North American Breeding Bird Survey results and analysis. Ver. 96.4. Patuxent Wildl. Res. Center, Laurel, MD.

STARFIELD, A. M. 1997. A pragmatic approach to modeling for wildlife management. J. Wildl. Manage. 61:261-270.

STOUT, R. J., B. A. KNUTH, and P. D. CURTIS. 1997. Preferences of suburban landowners for deer management techniques: a step towards better communication. Wildl. Soc. Bull. 25:348-359.

TORRES, S. G., T. M. MANSFIELD, J. E. FOLEY, T. LUPO, and A. BRINKHAUS. 1996. Mountain lions and human activity in California: testing speculations. Wildl. Soc. Bull. 24:451-460.

U.S. DEP. AGRIC. 1994. Gull hazard reduction program at John F. Kennedy International Airport. Final Environmental Impact Statement. U.S. Dep. Agric., Animal Damage Control, Pittstown, NJ.

U.S. DEP. INTER. 1976. Use of compound PA-14 avian stressing agent for control of blackbirds and starlings at winter roosts. Final Environmental Impact Statement. U.S. Dep. Inter., Fish Wildl. Serv., Washington, DC.

APPENDIX 4

1996 World Bird Strike Statistics (IBIS): ICAO

INTERNATIONAL CIVIL AVIATION ORGANIZATION
ORGANISATION DE L'AVIATION CIVILE INTERNATIONALE
ORGANIZACIÓN DE AVIACIÓN CIVIL INTERNACIONAL
МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ГРАЖДАНСКОЙ АВИАЦИИ
منظمة الطيران المدني الدولي
国 际 民 用 航 空 组 织

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AARM

TEL.: (514) 954-8717

Ref.: AN 4/9.1.1-98/26

17 April 1998

Subject: 1996 Bird Strike Analyses (IBIS)

Action required: To note

Sir/Madam,

1. I have the honour to transmit the attached analyses of bird strike reports for the year 1996. Included are a world statistical analysis and a significant strike analysis of the bird strikes reported to ICAO for that year. These analyses are based on 5 192 reports, received from thirty-eight States on strikes occurring in 110 States and territories as shown in the attached list. Lists of bird species involved in each of the analyses are also attached.

2. In my previous State letter AN 4/9.1.1-97/79, on the subject of bird strikes, I requested your views regarding the presentation of significant bird strikes using the world statistics format, rather than the previously used case-by-case format. The majority of responses received have been in favour of the statistical presentation. Therefore, this State letter presents the significant bird strikes using the world statistics format. A description of the significant bird strike criteria may be found in the *Manual on the ICAO Bird Strike Information System (IBIS)*, Doc 9332, page 15. Upon request, States desiring more detailed information may obtain significant bird strike reports in the previously used format.

3. The IBIS programme is an important element in accident prevention and is highly supported by airlines and experts working to reduce the threat of bird strikes to aircraft. If your State is not reporting bird strikes or has discontinued doing so, I urge you to participate in IBIS. Discussion with your national airline(s) and major airport operators may be all that is required to implement an effective reporting programme. For your information, special analyses of bird strike data stored in the IBIS system may be obtained on request.

Accept, Sir/Madam, the assurances of my highest consideration.

for R.C. Costa Pereira DANB
Secretary General

Attachment: World statistics and significant strike statistics for the year 1996

ATTACHMENT to State letter AN 4/9.1.1-98/26

STATE REPORTING

AUSTRIA
BAHRAIN
BARBADOS
BELGIUM
BRUNEI DARUSSALAM
CANADA
CHILE
CYPRUS
DENMARK
FIJI
FINLAND
FRANCE
GREECE
ICELAND
IRELAND
ITALY
JAPAN
MAURITIUS
MEXICO
MOROCCO
NETHERLANDS
NORWAY
PAKISTAN
PANAMA
PAPUA NEW GUINEA
POLAND
PORTUGAL
SAUDI ARABIA
SLOVAKIA
SOUTH AFRICA
SPAIN
SWEDEN
SWITZERLAND
THAILAND
TRINIDAD AND TOBAGO
UNITED KINGDOM
UNITED STATES
UZBEKISTAN

STATE/TERRITORY OF OCCURRENCE

ALBANIA
ARGENTINA
AUSTRALIA
AUSTRIA
BAHRAIN
BANGLADESH
BARBADOS
BELARUS
BELGIUM
BERMUDA
BOTSWANA
BRAZIL
BRUNEI DARUSSALAM
BULGARIA
CAMEROON
CANADA
CHILE
CHINA
COLOMBIA
CONGO, PEOPLE'S REP.
COSTA RICA
COTE D'IVOIRE
CROATIA
CUBA
CYPRUS
CZECH REPUBLIC
DENMARK
DOMINICAN REPUBLIC
EASTONIA
EL SALVADOR
FIJI
FINLAND
FRANCE
FRENCH POLYNESIA
GAMBIA
GERMANY
GHANA
GIBRALATOR
GREECE
GUATEMALA
HAITI
HONG KONG
HUNGARY
ICELAND
INDIA
INDONESIA
IRAN
IRELAND
ISRAEL
ITALY
JAMAICA
JAPAN
KENYA
LEBANON
LITHUANIA
LUXEMBOURG
MALAYSIA
MALI
MALTA
MARIANA ISLANDS
MAURITIUS
MEXICO
MOROCCO
MYANMAR
NAMIBIA
NETHERALANDS
NEW CALEDONIA
NIGERIA
NORWAY
OMAN
PAKISTAN
PANAMA
PAPUA NEW GUINEA
PHILIPPINES
POLAND
PORTUGAL
PUERTO RICO
REPUBLIC OF KOREA
ROMANIA
RUSSIAN FEDERATION
RYUKYN ISLANDS
SAINT LUCIA
SAUDI ARABIA
SENEGAL
SEYCHELLES
SINGAPORE
SLOVAKIA
SLOVENIA
SOUTH AFRICA
SPAIN
SRI LANKA
SUDAN
SWEDEN
SWITZERLAND
SYRIAN ARAB REPUBLIC
THAILAND
TRINIDAD AND TOBAGO
TUNISIA
TURKEY
UGANDA
UKRAINE
UNITED ARAB EMIRATES
UNITED KINGDOM
UNITED REPUBLIC OF TANZANIA
UNITED STATES
UZBEKISTAN
VENEZUELA
VIET NAM
YUGOSLAVIA
ZAIRE, REPUBLIC OF

I B I S

WORLD BIRD STRIKE STATISTICS - 1996

	Total	S-Z	NE	K	C	J	N5	A-H	N	R	L	M	1	P	UNKNOWN
TOTAL	5192	702	676	258	182	173	64	61	47	44	21	17	13	0	2934
MONTH OF OCCURRENCE															
January	221	19	28	18	5	14	10	2	2	4	1	2	0	0	118
February	166	14	25	13	2	10	8	2	0	2	1	3	0	0	85
March	265	22	41	16	3	19	2	4	2	0	0	1	2	0	153
April	340	39	36	5	7	13	0	5	3	4	3	3	1	0	221
May	468	56	60	19	11	17	2	9	3	5	0	1	0	0	300
June	457	115	53	24	22	12	2	6	2	1	3	0	0	0	247
July	609	125	66	33	28	8	6	10	5	1	1	3	1	0	300
August	653	117	91	45	38	14	5	5	9	3	5	[illegible]	3	0	323
September	646	82	75	33	25	16	13	6	6	12	0	0	2	0	377
October	624	52	75	21	18	21	10	6	7	2	1	2	2	0	407
November	429	40	61	16	14	15	5	3	6	7	4	[illegible]	1	0	252
December	257	22	37	15	9	14	1	3	1	3	2	0	1	0	149
LIGHT CONDITIONS															
Dawn	182	24	41	10	10	9	1	0	0	3	1	0	0	0	83
Day	3203	584	491	203	145	80	45	52	29	8	13	12	1	0	1540
Dusk	261	33	35	10	9	26	11	1	2	3	3	1	3	0	121
Night	1120	31	86	16	8	52	6	2	16	30	4	2	9	0	856
AIRCRAFT CLASSIFICATION															
Piston over 5 700	2	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Piston under 5 700	270	31	49	26	18	30	0	3	1	0	5	4	0	0	103
Turbo Jet over 27 000	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Turbo Jet under 27 000	90	9	21	3	6	2	2	4	2	1	0	0	0	0	40
Turbo Prop over 27 000	4	0	1	1	0	0	0	0	0	0	0	0	0	0	2
Turbo Prop under 27 000	730	132	143	42	26	36	18	10	13	11	3	3	2	0	291
Turbo Fan over 27 000	3689	463	392	167	119	85	40	42	25	32	12	10	11	0	2291
Turbo Fan under 27 000	176	30	37	5	11	10	2	0	2	0	1	0	0	0	74
Helicopter	25	3	7	1	0	0	0	0	0	0	0	0	0	0	14
Other, Unkown and glider	194	32	25	6	2	8	2	2	4	0	0	0	0	0	113
FLIGHT PHASE															
Parked	5	0	1	0	0	0	0	0	1	0	0	0	0	0	3
Taxi	19	2	1	1	2	2	0	[illegible]	0	0	0	0	0	0	10
Take-off run	864	158	177	63	56	24	17	22	13	8	7	4	4	0	441
Climb	845	110	115	39	21	32	14	10	10	6	1	3	2	0	482
En route	261	9	5	9	0	8	0	[illegible]	1	0	1	1	0	0	225
Descent	98	3	6	2	1	11	0	0	0	0	0	0	0	0	73
Approach	1731	245	196	71	48	69	14	10	6	7	2	4	5	0	1052
Landing roll	819	142	143	61	45	20	18	16	14	22	0	4	2	0	321
HEIGHT AGL (FT)															
0 - 100	2782	465	485	160	152	83	51	46	37	35	16	6	10	0	1234
101 - 200	218	39	35	7	2	12	3	1	4	1	1	1	2	0	110
201 - 500	400	61	49	11	7	18	[illegible]	2	0	2	0	0	0	0	249
501 - 1000	267	30	20	18	3	21	0	1	0	0	0	1	0	0	173

The headings represent bird codes - see attached listing

IBIS

WORLD BIRD STRIKE STATISTICS - 1996

	Total	S-Z	NE	K	O	J	N5	A-I	N	R	L	M	I	P	UNKNOWN
HEIGHT AGL (FT)															
1001 - 2500	297	21	21	14	6	15	0	0	0	0	0	1	0	0	219
Over 2500	375	17	8	7	0	18	2	0	1	0	0	0	0	0	322
SPEED IAS (KT)															
0 - 80	232	37	50	33	18	14	2	5	4	4	2	2	1	0	60
81 - 100	350	56	57	31	24	8	9	6	6	8	6	7	2	0	138
101 - 150	1898	359	299	96	67	57	29	25	21	11	4	6	5	0	915
151 - 200	553	51	50	19	5	28	5	2	1	[illegible]	0	1	4	0	383
201 - 250	252	10	6	3	0	10	2	0	1	0	0	0	0	0	221
Over 250	55	1	2	1	0	1	0	1	0	0	0	0	0	0	49
PILOT WARNED															
No	3641	513	401	169	117	104	48	37	36	31	13	15	11	0	2146
Yes	777	120	171	58	47	37	11	15	8	6	3	2	2	0	297
NUMBER OF BIRDS SEEN															
1	1710	272	245	134	70	34	33	25	17	19	12	5	7	0	840
2 - 10	1060	210	228	45	46	71	13	13	16	2	3	5	3	0	405
11 - 100	54	22	15	0	0	7	0	0	4	0	0	0	0	0	6
Over 100	51	14	16	1	2	3	4	0	0	0	0	0	0	0	11
NUMBER OF BIRDS STRUCK															
1	3536	476	466	231	115	103	36	56	26	44	16	12	9	0	2046
2 - 10	936	182	166	16	50	62	25	5	12	0	5	4	2	0	295
11 - 100	5	1	1	0	0	1	0	0	1	0	0	0	0	0	1
Over 100	5	1	2	0	0	0	1	0	1	0	0	0	0	0	0
PARTS DAMAGED															
Radome	56	3	7	1	3	7	1	0	1	0	0	0	0	0	45
Windshield	40	3	1	6	1	5	0	0	0	0	1	0	0	0	23
Nose	41	1	4	2	0	7	1	2	0	0	0	0	0	0	24
Engine 1	139	9	27	8	7	12	4	3	1	1	1	0	0	0	65
Engine 2	139	9	19	19	8	12	3	3	1	3	1	1	0	0	60
Engine 3	12	0	1	2	0	0	0	0	0	0	0	0	0	0	9
Engine 4	20	0	1	1	2	0	0	0	0	0	0	1	0	0	15
Propeller	14	0	2	3	0	5	0	0	0	0	0	0	0	0	4
Wing/rotor	116	3	6	11	5	16	1	1	0	0	2	2	0	0	67
Fuselage	26	1	5	1	1	3	0	0	0	0	0	0	0	0	15
Landing gear	16	2	5	2	1	4	0	0	0	0	0	1	0	0	3
Tail	21	0	2	6	1	6	0	0	0	0	0	0	0	0	6
Lights	26	3	4	3	0	4	0	0	0	0	0	0	0	0	12
Pitot/Static head	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Hel. Transmission	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Other	36	0	7	2	2	6	0	0	0	0	0	1	0	0	19

The headings represent bird codes - see attached listing

IBIS

WORLD BIRD STRIKE STATISTICS - 1996

	Total	S-Z	NE	K	O	J	N5	A-I	N	R	L	M	1	P	UNKNOWN
PARTS STRUCK															
Radome	557	115	41	17	15	10	7	4	8	2	4	0	1	0	335
Windshield	747	110	66	22	20	15	9	4	6	5	3	0	5	0	461
Nose	754	123	90	26	30	10	6	4	7	5	0	2	3	0	440
Engine 1	306	44	44	18	14	11	8	6	8	1	2	2	0	0	148
Engine 2	237	24	34	12	7	9	3	3	5	2	1	1	1	0	136
Engine 3	57	5	6	0	1	2	0	1	0	0	0	0	0	0	42
Engine 4	34	1	4	0	0	1	0	0	1	0	0	0	0	0	27
Propeller	135	18	43	12	10	12	3	2	4	0	4	1	0	0	26
Wing rotor	604	76	105	25	28	15	12	13	13	4	3	2	2	0	305
Fuselage	641	109	79	22	14	10	9	7	6	7	2	1	5	0	370
Landing gear	280	42	55	22	18	15	5	3	5	5	1	3	0	0	106
Tail	42	5	7	3	3	7	2	0	0	1	0	0	0	0	14
Lights	17	3	4	3	1	0	1	0	2	0	0	0	0	0	3
Pitot/Static head	11	0	0	0	1	2	0	0	0	0	0	1	0	0	7
Antenna	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Tail rotor	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Other	102	16	23	5	3	5	2	1	1	1	0	1	0	0	41
AIRCRAFT DAMAGE															
None	3719	517	392	157	127	64	45	45	29	30	10	10	12	0	2281
Minor	333	11	39	33	12	41	1	3	1	1	2	3	0	0	185
Substantial	281	14	41	29	14	24	8	4	2	4	2	0	0	0	139
INJURY INDEX															
EFFECTS															
None	4018	566	498	194	116	100	53	47	38	35	15	15	13	0	2328
Aborted take-off	151	16	42	12	10	8	1	4	3	0	2	0	0	0	53
Precautionary landing	264	23	37	22	14	28	5	1	0	2	1	1	0	0	130
Engine(s) shut-down	24	0	5	2	0	1	1	0	0	0	0	0	0	0	15
Forced landing	27	6	4	0	0	2	0	0	0	0	0	0	0	0	15
Penetrated airframe	7	0	1	0	0	0	0	1	0	0	0	0	0	0	5
Vision obscured	3	0	2	0	0	0	0	0	0	0	0	0	0	0	1
Other effect	96	3	12	8	2	5	3	2	3	2	2	0	0	0	54

The headings represent bird codes - see attached listing

CODE	SCIENTIFIC NAME	ENGLISH NAME	NUMBER OF CASES*
A-I INCLUDES			
H1	GAVIIDAE	LOONS	2
H2	PELECANIDAE	PELICANS	4
H41		CORMORANTS	2
H4105	PHALA. AURITUS	DOUBLE CRESTED CORMORANT	2
H6	FREGATIDAE	FRIGATEBIRDS	1
I1		HERONS	6
I101	ARDEA CINEREA	GREY HERON	1
I102	ARDEA HERODIAS	GREAT BLUE HERON	5
I13		EGRET	19
I1301	BUBULCUS IBIS	CATTLE EGRET	4
I1302	EGRETTA ALBA	GREAT EGRET	2
I1306	EGRETTA THULA	SNOWY EGRET	2
I5	CICONIIDAE	STORKS	2
I5001	CICONIA CICONIA	WHITE STORK	1
I6102	HAGEDASHIA HAGEDASH	HADADA IBIS	8
J INCLUDES			
J	ANSERIFORMES	DUCKS, GEESE, SWANS	2
J2	ANATIDAE	DUCKS, GEESE, SWANS	9
J21		DUCKS	66
J2103	ANAS AMERICANA	AMERICAN WIGEON	1
J2109	ANAS PLATYRHYNCHOS	MALLARD	9
J2122	ANAS SUPERCILIOSA	PACIFIC BLACK DUCK	1
J22		GEESE	60
J2202	CHEN CAERULESCENS	SNOW GOOSE	3
J2204	BRANTA CANADENSIS	CANADA GOOSE	20
J2205	ANSERANAS SEMIPALMAT	MAGPIE GOOSE	1
J23		SWANS	1
K INCLUDES			
K	FALCONIFORMES	HAWKS, EAGLES, VULTURES	3
K1	CATHARTIDAE	NEW WORLD VULTURES	18
K1001	CORAGYPS ATRATUS	AMERICAN BLACK VULTURE	1
K1002	CATHARTES AURA	TURKEY VULTURE	7
K2001	PANDION HALIAETUS	OSPREY	1
K3	ACCIPITRIDAE	KITES, EAGLES, HAWKS	1
K31		KITES	31
K3102	MILVUS MIGRANS	BLACK KITE	8
K32		EAGLES	7
K3201	HAL. LEUCOCEPHALUS	BALD EAGLE	3
K3206	AQUILA CHRYSAETOS	GOLDEN EAGLE	1
K33		HAWKS	61
K3302	BUTEO JAMAICENSIS	RED-TAILED HAWK	16
K3305	BUTEO LAGOPUS	ROUGH-LEGGED HAWK	2
K3309	ACCIP. NISUS	EUROPEAN SPARROW HAWK	1
K34		BUZZARD	13
K3401	BUTEO BUTEO	COMMON BUZZARD	14
K3501	CIRCUS AERUGINOSUS	MARSH HARRIER	3
K3502	CIRCUS CYANEUS	NORTHERN HARRIER	1
K3602	GYPS FULVUS	GRIFFON VULTURE	1
K3606	NECROSYRTES MONACHUS	HOODED VULTURE	1
K4001	SAGITT. SERPENTARIUS	SECRETARY BIRD	1
K5	FALCONIDAE	FALCONS	18
K5002	FALCO PEREGRINUS	PEREGRINE FALCON	5
K5102	FALCO SPARVERIUS	AMERICAN KESTREL	12
K5103	FALCO TINNUNCULUS	EURASIAN KESTREL	28

* This column represents the number of times a species was identified, not the number of birds killed

CODE	SCIENTIFIC NAME	ENGLISH NAME	NUMBER OF CASES*
L INCLUDES			
L31		GROUSE	1
L3101	LYRURUS TETRIX	COMMON BLACK GROUSE	1
L3103	TYMPANUCHUS PHOSIANE	SHARP-TAILED GROUSE	1
L32		PTARMIGANS	3
L41		QUAILS	1
L42		PHEASANTS	7
L4201	PHASIANUS COLCHICUS	RING-NECKED PHEASANT	1
L43		PARTRIDGES	2
L4302	PERDIX PERDIX	HUNGARIAN PARTRIDGE	1
L6	MELEAGRIDIDAE	TURKEYS	3
M INCLUDES			
M4	GRUIDAE	CRANES	15
M4001	GRUS CANADENSIS	SANDHILL CRANE	2
N INCLUDES			
N	CHARADRIIFORMES	SHORE BIRDS	3
N6	SCOLOPACIDAE	SANDPIPERS	12
N6009	GALLINAGO GALLINAGO	COMMON SNIPE	5
N6010	SCOLOPAX RUSTICOLA	EURAS. WOODCOCK	2
N6013	CALIDRIS ALPINA	DUNLIN	4
N6026	GALLINAGO HARDWICKII	JAPANESE SNIPE	1
N61		CURLEW	2
N9002	BUR. OEDICNEMUS	EURAS. STONE CURLEW	1
NA2		PRATINCOLES	14
NA201	GLAREOLA MALDIVARUM	ORIENTAL PRATINCOLE	1
N5 INCLUDES			
N5	CHARADRIIDAE	PLOVERS, LAPWINGS	1
N51		PLOVERS	16
N5104	PLUVIALIS DOMINICA	LESSER GOLDEN PLOVER	2
N5111	CHARA. VOCIFERUS	KILLDEER	11
N52		LAPWINGS	12
N5201	VANELLUS VANELLUS	COMMON LAPWING	22
NE INCLUDES			
NE	LARIDAE	GULLS, TERNS	2
NE1		GULLS	586
NE101	LARUS ARGENTATUS	HERRING GULL	16
NE102	LARUS CANUS	COMMON GULL	3
NE104	LARUS DELAWARENSIS	RING-BILLED GULL	13
NE106	LARUS MARINUS	G. BLACK BACKED GULL	3
NE112	LARUS PIPIXCAN	FRANKLIN'S GULL	1
NE114	LARUS ATRICILLA	LAUGHING GULL	3
NE136	LARUS RIDIBUNDUS	BLACK-HEADED GULL	41
NE2		TERNS	2
NE202	STERNA ALBIFRONS	LITTLE TERN	3
NE214	STERNA PARADISAEA	ARCTIC TERN	3
O INCLUDES			
O2	COLUMBIDAE	PIGEONS, DOVES	1
O21		PIGEONS	33
O2109	COLUMBA PALUMBUS	COMMON WOOD-PIGEON	7

* This column represents the number of times a species was identified, not the number of birds killed

CODE	SCIENTIFIC NAME	ENGLISH NAME	NUMBER OF CASES*
O INCLUDES			
O22		DOVES	77
O2201	COLUMBA LIVIA	COMMON ROCK DOVE	49
O2205	ZENAIDURA MACROURA	AM. MOURNING DOVE	13
O2206	STREPT. ORIENTALIS	RUFOUS TURTLE DOVE	[illegible]
O2212	GEOPELIA STRIATA	BARRED GROUND DOVE	[illegible]
R INCLUDES			
R	STRIGIFORMES	OWLS	31
R11		BARN OWLS	3
R1101	TYTO ALBA	COMMON BARN OWL	7
R2001	NYCTEA SCANDIACA	SNOWY OWL	2
R22		EAGLE OWLS	1
S-Z INCLUDES			
S5204	CAPRIMUL. VOCIFERUS	WHIP-POOR-WILL	1
T1	APODIDAE	SWIFTS	15
T1005	APUS PACIFICUS	FORK-TAILED SWIFT	5
T1055	APUS APUS	COMMON SWIFT	5
W4	MEROPIDAE	BEE-EATERS	1
W4002	MEROPS APIASTER	EUROPEAN BEE-EATER	2
Y	PASSERIFORMES	PERCHING BIRDS	2
YH	ALAUDIDAE	LARKS	6
YH002	ALAUDA ARVENSIS	SKYLARK	8
YH004	EREMOPHILA ALPESTRIS	HORNED LARK	2
YI	HIRUNDINIDAE	SWALLOWS	190
YI001	PROGNE SUBIS	PURPLE MARTIN	4
YI004	HIRUNDO NEOXENA	WELCOME SWALLOW	1
YI005	HIRUNDO RUSTICA	BARN SWALLOW	5
YI008	DELICHON URBICA	HOUSE MARTIN	4
YI010	TACHYCINETA BICOLOR	TREE SWALLOW	1
YL	STURNIDAE	STARLINGS	38
YL001	STURNUS VULGARIS	EUROPEAN STARLING	63
YL1		MYNA	2
YM002	CORVUS FRUGILEGUS	ROOK	7
YM1		CROWS	37
YM104	CORV. CORONE CORNIX	HOODED CROW	4
YM201	CYANOCITTA CRISTATA	BLUE JAY	1
YM3		RAVENS	2
YM401	PICA PICA	BLACK-BILLED MAGPIE	1
YO	GRALLINIDAE	MAGPIE-LARKS	1
YR2		CHICKADEES	2
Z	PASSERIFORMES	PERCHING BIRDS	2
Z4	TROGLODYTIDAE	WRENS	2
Z52		MOCKINGBIRDS	1
Z6	TURDIDAE	THRUSHES	1
Z6006	TURDUS MERULA	COMMON BLACKBIRD	1
Z6007	TURDUS MIGRATORIUS	AMERICAN ROBIN	9
Z6008	TURDUS PHILOMELOS	COMMON SONG THRUSH	4
ZC1		WAGTAILS	2
ZC203	ANTHUS PRATENSIS	MEADOW PIPIT	2
ZT001	STURNELLA MAGNA	EASTERN MEADOWLARK	9
ZT002	STURNELLA NEGLECTA	WESTERN MEADOWLARK	4
ZT003	QUISCALUS QUISCULA	COMMON GRACKLE	3
ZT004	MOLOTHRUS ATER	BROWN-HEADED COWBIRD	1
ZT007	QUISCALUS MAJOR	BOAT TAILED GRACKLE	1
ZT1		BLACKBIRDS	57

* This column represents the number of times a species was identified, not the number of birds killed

CODE	SCIENTIFIC NAME	ENGLISH NAME	NUMBER OF CASES*
S-Z INCLUDES			
ZX000		FINCHES	2
ZX03			1
ZX1		CARDINALS	1
ZX202	PLECTRO. NIVALIS	SNOW BUNTING	27
ZX3		SPARROWS	156
ZX303	PASS. SANDWICHENSIS	SAVANNAH SPARROW	2
ZY1		MANNIKINS	2
ZY101	LONCHURA PUNCTULATA	NUTMEG MANNIKIN	2
ZY102	LONCHURA MALACCA	CHESNUT MANNIKIN	1
ZZ201	PASSER DOMESTICUS	HOUSE SPARROW	1
1 INCLUDES			
1	CHIROPTERA	BATS	13

* This column represents the number of times a species was identified, not the number of birds killed

IBIS

SIGNIFICANT BIRD STRIKE STATISTICS - 1996

	Total	NE	S-Z	J	K	O	N5	A-I	N	R	L	M	P	1	UNKNOWN
TOTAL	536	98	50	48	46	29	9	9	5	4	3	1	0	0	283
MONTH OF OCCURRENCE															
January	34	5	2	7	2	0	3	0	0	0	0	0	0	0	15
February	23	0	2	4	3	0	1	0	0	1	0	1	0	0	11
March	33	8	2	4	2	0	0	1	1	0	0	0	0	0	15
April	42	10	3	2	2	0	0	1	0	1	1	0	0	0	22
May	45	6	3	3	1	0	0	1	0	0	0	0	0	0	31
June	40	9	3	3	5	6	0	0	0	0	1	0	0	0	13
July	59	13	3	3	6	5	0	1	0	0	0	0	0	0	28
August	84	12	9	3	8	6	1	1	2	0	1	0	0	0	41
September	71	7	10	6	4	4	0	1	1	2	0	0	0	0	36
October	62	11	0	3	4	4	1	1	0	0	0	0	0	0	32
November	57	12	2	5	4	2	3	0	1	0	0	0	0	0	26
December	35	5	5	5	5	2	0	2	0	0	0	0	0	0	11
LIGHT CONDITIONS															
Dawn	21	7	1	4	1	0	0	0	0	0	0	0	0	0	8
Day	383	75	42	21	38	25	6	7	4	2	3	1	0	0	157
Dusk	27	5	3	8	1	1	1	1	0	1	0	0	0	0	6
Night	91	8	1	13	3	0	0	1	1	1	0	0	0	0	63
AIRCRAFT CLASSIFICATION															
Piston under 5 700	57	5	4	9	11	2	0	0	1	0	2	1	0	0	22
Turbo jet under 27 000	16	0	3	0	1	2	0	0	0	0	0	0	0	0	10
Turbo Prop over 27 000	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Turbo Prop under 27 000	83	24	2	9	5	3	1	0	1	0	0	0	0	0	38
Turbo Fan over 27 000	311	51	21	26	24	19	5	8	1	4	1	0	0	0	150
Turbo Fan under 27 000	24	7	2	1	0	3	1	0	1	0	0	0	0	0	9
Helicopter	12	4	1	0	1	0	0	0	0	0	0	0	0	0	6
Other, Unkown and glider	77	7	17	3	2	0	1	1	1	0	0	0	0	0	45
FLIGHT PHASE															
Taxi	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Take-off run	201	51	23	10	15	17	3	5	3	1	2	0	0	0	70
Climb	173	30	11	22	15	5	3	1	0	0	0	1	0	0	85
En route	58	2	2	4	7	0	0	1	0	0	1	0	0	0	41
Descent	6	1	0	4	0	0	0	0	0	0	0	0	0	0	1
Approach	66	7	6	6	6	0	2	1	1	0	0	0	0	0	37
Landing roll	21	2	2	1	1	4	0	0	1	2	0	0	0	0	8
HEIGHT AGL (FT)															
0 - 100	410	79	39	22	30	29	8	8	4	4	3	1	0	0	183
101 - 200	15	6	2	2	0	0	1	0	0	0	0	0	0	0	4
201 - 500	49	5	3	4	4	0	0	1	0	0	0	0	0	0	31
501 - 1000	44	2	4	8	7	0	0	0	0	0	0	0	0	0	23
1001 - 2500	44	5	2	6	4	0	0	0	0	0	0	0	0	0	27
Over 2500	23	0	0	6	1	0	0	0	1	0	0	0	0	0	15

The column headings represent bird codes - see attached list

IBIS

SIGNIFICANT BIRD STRIKE STATISTICS - 1996

	Total	NE	S-Z	J	K	O	N5	A-1	N	R	L	M	P	1	UNKNOWN
SPEED IAS (KT)															
0 - 80	256	33	20	15	17	13	1	1	4	3	2	1	0	0	148
81 - 100	54	9	6	3	9	5	0	2	0	0	1	0	0	0	19
101 - 150	165	42	19	9	14	11	5	4	0	1	0	0	0	0	60
151 - 200	68	13	5	16	5	0	3	1	0	0	0	0	0	0	25
201 - 250	20	1	0	4	0	0	0	0	1	0	0	0	0	0	14
Over 250	20	0	0	1	1	0	0	1	0	0	0	0	0	0	17
PILOT WARNED															
No	332	59	28	27	34	13	6	4	3	3	2	1	0	0	152
Yes	104	28	11	19	6	9	2	2	2	0	1	0	0	0	30
NUMBER OF BIRDS SEEN															
1	163	43	19	10	16	7	5	5	2	0	2	0	0	0	52
2 - 10	118	33	9	22	11	9	3	1	1	0	0	1	0	0	28
11 - 100	7	2	2	1	0	0	0	0	1	0	0	0	0	0	1
Over 100	8	2	2	2	0	0	1	0	0	0	0	0	0	0	1
NUMBER OF BIRDS STRUCK															
1	406	60	37	25	40	13	4	8	3	4	3	0	0	0	209
2 - 10	121	32	11	20	1	15	3	1	1	0	0	1	0	0	36
11 - 100	2	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Over 100	3	2	0	0	0	0	1	0	0	0	0	0	0	0	0
PARTS STRUCK															
Radome	26	4	4	5	1	0	1	1	0	0	0	0	0	0	10
Windshield	42	8	5	5	4	3	2	0	1	0	0	0	0	0	14
Nose	66	8	17	2	2	3	1	1	1	0	0	0	0	0	31
Engine 1	60	11	9	4	0	2	1	2	2	0	0	0	0	0	19
Engine 2	37	11	1	2	2	3	1	1	0	1	0	0	0	0	15
Engine 3	4	0	1	1	0	1	0	0	0	0	0	0	0	0	1
Engine 4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Propeller	24	7	0	6	2	3	0	0	2	0	1	0	0	0	4
Wing rotor	50	17	8	3	3	5	3	1	1	0	0	0	0	0	9
Fuselage	40	10	8	3	3	1	1	1	0	0	0	0	0	0	13
Landing gear	28	7	6	5	0	2	1	0	1	0	0	0	0	0	6
Tail	10	1	3	3	1	0	0	0	0	0	0	0	0	0	2
Lights	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0
Pitot/Static head	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Other	13	1	2	2	1	0	0	0	1	0	0	0	0	0	6
PARTS DAMAGED															
Radome	19	1	1	2	0	2	1	0	1	0	0	0	0	0	11
Windshield	22	0	0	3	3	0	0	0	0	0	1	0	0	0	15
Nose	10	0	0	2	1	0	1	1	0	0	0	0	0	0	5
Engine 1	109	20	8	7	6	5	4	3	0	1	1	0	0	0	54
Engine 2	101	19	6	10	14	7	3	3	1	2	0	0	0	0	36
Engine 3	9	0	0	0	2	0	0	0	0	0	0	0	0	0	7
Engine 4	13	1	0	0	1	2	0	0	0	0	0	0	0	0	9

The column headings represent bird codes - see attached list

IBIS

SIGNIFICANT BIRD STRIKE STATISTICS - 1996

	Total	NE	S-Z	J	K	O	N5	A-I	N	R	L	M	P	1	UNKNOWN
PARTS DAMAGED															
Propeller	6	2	0	2	1	0	0	0	0	0	0	0	0	0	1
Wing rotor	29	1	0	7	5	0	0	0	0	0	1	1	0	0	14
Fuselage	10	1	0	3	1	0	0	0	0	0	0	0	0	0	5
Landing gear	7	2	0	3	0	1	0	0	0	0	0	1	0	0	0
Tail	4	0	0	0	2	0	0	0	0	0	0	0	0	0	2
Lights	2	0	1	1	0	0	0	0	0	0	0	0	0	0	0
Heli. Transmission	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Other	19	3	0	3	1	1	0	0	0	0	0	1	0	0	10
AIRCRAFT DAMAGE															
None	121	27	16	9	5	11	0	1	2	0	1	0	0	0	49
Minor	36	4	0	9	6	0	0	1	0	0	0	1	0	0	15
Substantial	282	41	14	24	29	14	8	4	2	4	2	0	0	0	140
INJURY INDEX															
EFFECT ON FLIGHT															
None	40	6	1	5	8	1	0	3	0	0	0	0	0	0	19
Aborted take-off	152	42	16	8	12	10	1	4	3	0	2	0	0	0	54
Precautionary landing	264	37	23	28	22	14	6	1	0	2	1	1	0	0	130
Engine(s) shut-down	24	5	0	1	2	0	1	0	0	0	0	0	0	0	15
Forced landing	27	4	6	2	0	0	0	0	0	0	0	0	0	0	15
Penetrated airframe	7	1	0	0	0	0	0	1	0	0	0	0	0	0	5
Vision obscured	2	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Other effect	57	3	1	2	0	2	2	2	2	2	0	0	0	0	38

The column headings represent bird codes - see attached list

CODE	SCIENTIFIC NAME	ENGLISH NAME	NUMBER OF CASES*
A-I INCLUDES			
H2	PELECANIDAE	PELICANS	1
I11		HERONS	1
I1101	ARDEA CINEREA	GREY HERON	1
I1102	ARDEA HERODIAS	GREAT BLUE HERON	2
I13		EGRET	2
I1301	BUBULCUS IBIS	CATTLE EGRET	2
J INCLUDES			
J2	ANATIDAE	DUCKS, GEESE, SWANS	4
J21		DUCKS	12
J2103	ANAS AMERICANA	AMERICAN WIGEON	1
J2109	ANAS PLATYRHYNCHOS	MALLARD	3
J22		GEESE	18
J2202	CHEN CAERULESCENS	SNOW GOOSE	2
J2204	BRANTA CANADENSIS	CANADA GOOSE	7
J2205	ANSERANAS SEMIPALMAT	MAGPIE GOOSE	-
K INCLUDES			
K	FALCONIFORMES	HAWKS, EAGLES, VULTURES	1
K1	CATHARTIDAE	NEW WORLD VULTURES	6
K1002	CATHARTES AURA	TURKEY VULTURE	2
K2001	PANDION HALIAETUS	OSPREY	1
K31		KITES	5
K3102	MILVUS MIGRANS	BLACK KITE	4
K32		EAGLES	4
K3206	AQUILA CHRYSAETOS	GOLDEN EAGLE	1
K33		HAWKS	9
K3302	BUTEO JAMAICENSIS	RED-TAILED HAWK	1
K3401	BUTEO BUTEO	COMMON BUZZARD	3
K3602	GYPS FULVUS	GRIFFON VULTURE	1
K3605	NECROSYRTES MONACHUS	HOODED VULTURE	1
K5	FALCONIDAE	FALCONS	1
K5102	FALCO SPARVERIUS	AMERICAN KESTREL	2
K5103	FALCO TINNUNCULUS	EURASIAN KESTREL	3
L INCLUDES			
L3103	TYMPANUCHUS PHASIANE	SHARP-TAILED GROUSE	1
L42		PHEASANTS	1
L4201	PHASIANUS COLCHICUS	RING-NECKED PHEASANT	1
M INCLUDES			
M4001	GRUS CANADENSIS	SANDHILL CRANE	1
N INCLUDES			
N6	SCOLOPACIDAE	SANDPIPERS	3
N6010	SCOLOPAX RUSTICOLA	EURAS. WOODCOCK	1
N6013	CALIDRIS ALPINA	DUNLIN	1
N5 INCLUDES			
N51		PLOVERS	1
N5201	VANELLUS VANELLUS	COMMON LAPWING	8

* This column represents the number of times a species was identified, not the number of birds killed

CODE	SCIENTIFIC NAME	ENGLISH NAME	NUMBER OF CASES*
NE INCLUDES			
NE	LARIDAE	GULLS, TERNS	2
NE1		GULLS	53
NE101	LARUS ARGENTATUS	HERRING GULL	2
NE104	LARUS DELAWARENSIS	RING-BILLED GULL	2
NE108	LARUS MARINUS	G. BLACK-BACKED GULL	3
NE136	LARUS RIDIBUNDUS	BLACK-HEADED GULL	6
O INCLUDES			
O2	COLUMBIDAE	PIGEONS, DOVES	1
O21		PIGEONS	3
O2109	COLUMBA PALUMBUS	COMMON WOOD-PIGEON	2
O22		DOVES	10
O2201	COLUMBA LIVIA	COMMON ROCK DOVE	11
O2205	ZENAIDURA MACROURA	AM. MOURNING DOVE	2
R INCLUDES			
R11		BARN OWLS	1
R1101	TYTO ALBA	COMMON BARN OWL	3
S-Z INCLUDES			
S5204	CAPRIMUL VOCIFERUS	WHIP-POOR-WILL	1
YH	ALAUDIDAE	LARKS	1
YH004	EREMOPHILA ALPESTRIS	HORNED LARK	1
YI	HIRUNDINIDAE	SWALLOWS	7
YL	STURNIDAE	STARLINGS	5
YL001	STURNUS VULGARIS	EUROPEAN STARLING	9
YM002	CORVUS FRUGILEGUS	ROOK	[illegible]
YM1		CROWS	3
YM104	CORV CORONE CORNIX	HOODED CROW	1
YM401	PICA PICA	BLACK-BILLED MAGPIE	1
Z6007	TURDUS MIGRATORIUS	AMERICAN ROBIN	1
ZT001	STURNELLA MAGNA	EASTERN MEADOWLARK	1
ZT1		BLACKBIRDS	[illegible]
ZX000		FINCHES	[illegible]
ZX202	PLECTRO NIVALIS	SNOW BUNTING	[illegible]
ZX3		SPARROWS	9

– END –

* This column represents the number of times a species was identified, not the number of birds killed

APPENDIX 5

1997 Bird Strike Statistics: Canadian Forces

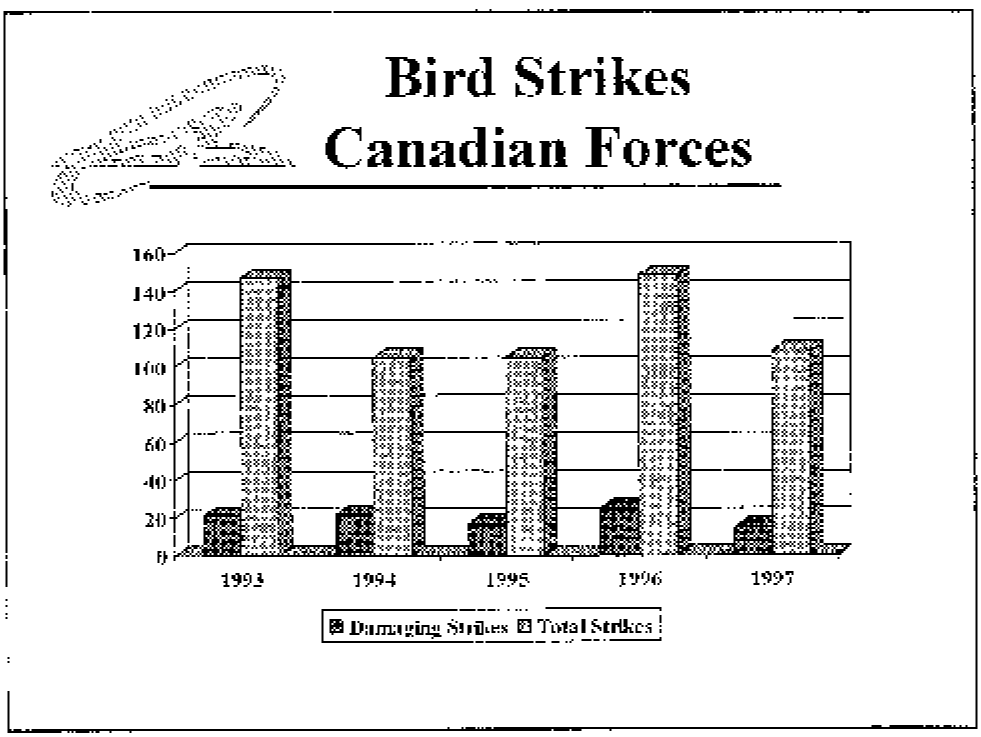
Canadian forces Bird and Mammal control Program

1. This report provides a summary of the Canadian Air Force bird strike statistics for 1997. It provides interpretation of the available statistics and some reflection on the annual Bird and Mammal Reports supplied to 1 CAD by the airfields. This report is based on bird strike data collected from the Birdstrike and Bird Sighting Reports (CF 218), and therefore reflects the nature of the information furnished as well as the interpretation by the individual who prepared this report.

1997 Bird Strikes

2. In 1997 the CF experienced 107 reported bird strikes with 15 strikes causing various degrees of damage . Although the total reported number of birdstrikes is down from the previous year (148 total, 25 damaging) there was a marked increase in the number of birdstrikes reported as occurring on or within five miles of CF airfields. In 1997 the crash of the T114 south of Moose Jaw was attributed to a birdstrike. Fortunately there was no loss of life due to the crash but the aircraft sustained CAT A damage.

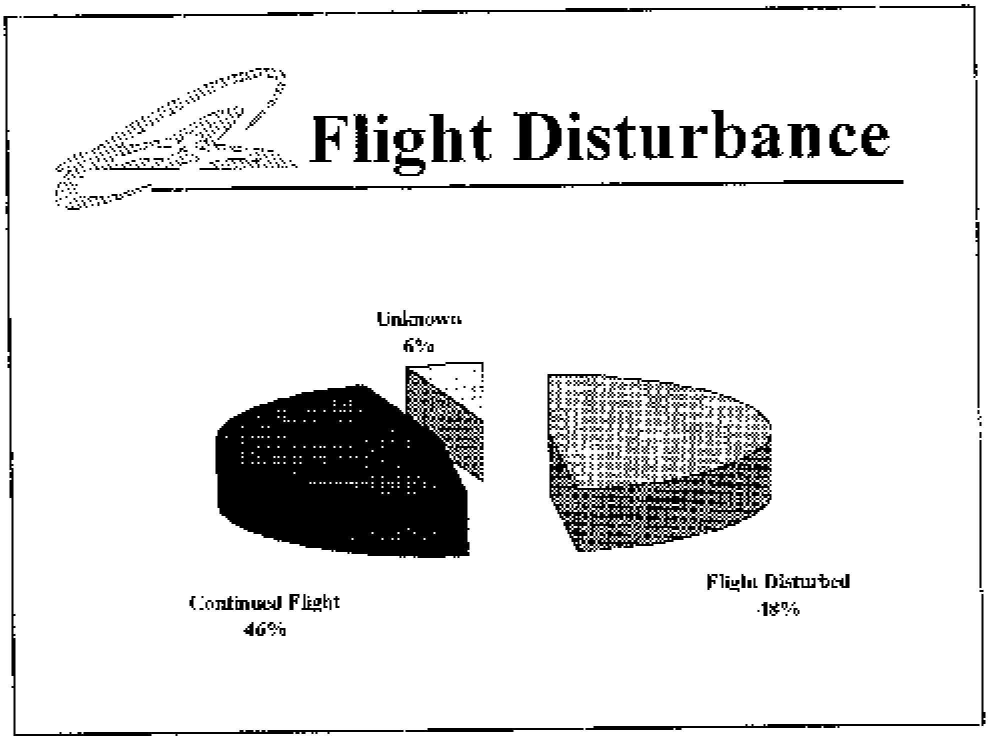
Table 1



Flight Disturbance

3. Even the smallest of birdstrikes usually results in a disturbance to flight. A disturbance to flight is defined as the pilot either aborting a take off, returning to base, or landing before the mission has been completed. 48% of the 1997 birdstrikes resulted in a disturbance to flight.

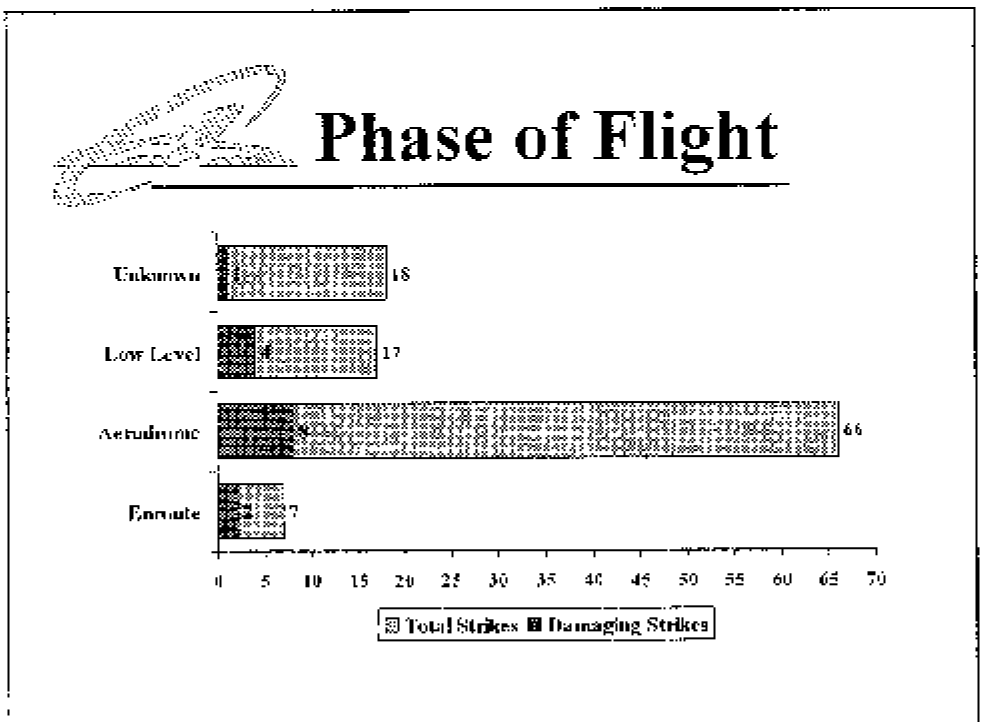
Table 2



Phase of Flight

4. The area where the greatest number of birdstrikes occur is within five miles of the airfield. This was evident in the 1997 stats as 65 of the 107 bird strikes occurred on or within five miles of the airfield. Table 3 shows 66 strikes occurring, this figure includes a bat strike in Trenton. The nature of military flying necessitates a great deal of flying activity in the vicinity of the airfield. The importance of strong wildlife control programs is imperative if these numbers are to be reduced.

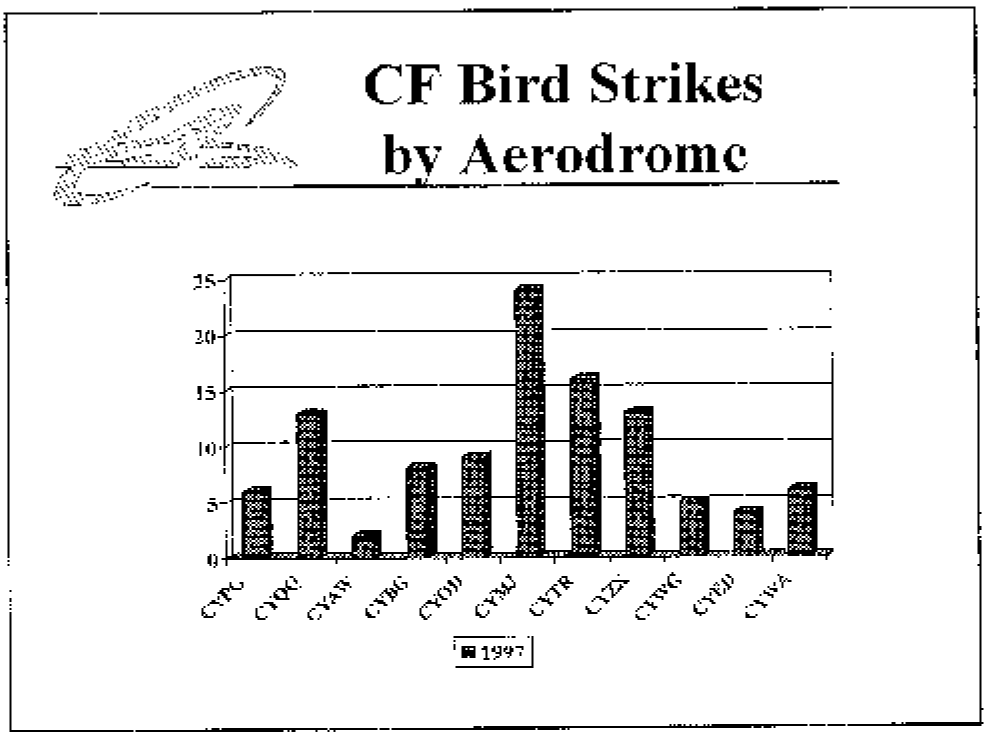
Table 3



Bird Strikes By Aerodrome

5. The reported bird strikes by aerodrome is fairly consistent with past years. The airfields recording the highest number of aircraft movements also had the greatest number of bird strikes. Some of the higher numbers may reflect excellent reporting systems rather than proportionally more strikes than other airfields.

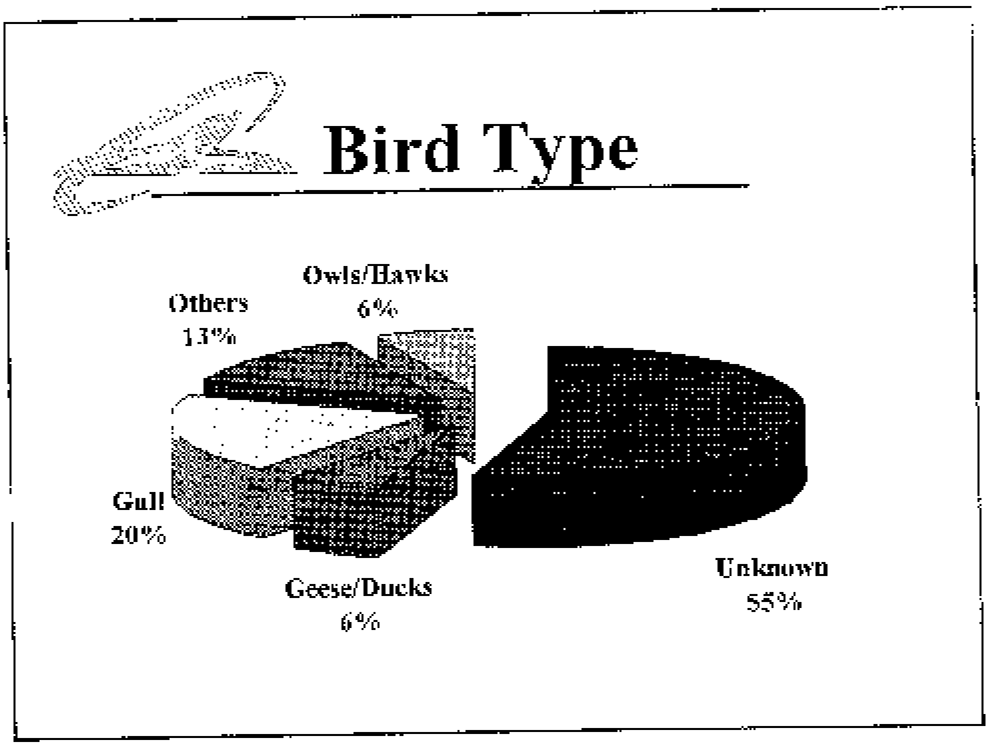
Table 4



Bird Type

6. 55% of the 1997 birdstrike reports either omitted the type of bird or listed it as unknown. Often the information is missing from the report because it could not be immediately determined from the remains, if there were any. Reporting the type of bird struck is valuable information that may help in identifying a problem species that could ultimately lead to its control. Bird identification can be made with remains evens as small as a feather. Of the reports that identified the type of bird struck the greatest number, 20%, were gulls.

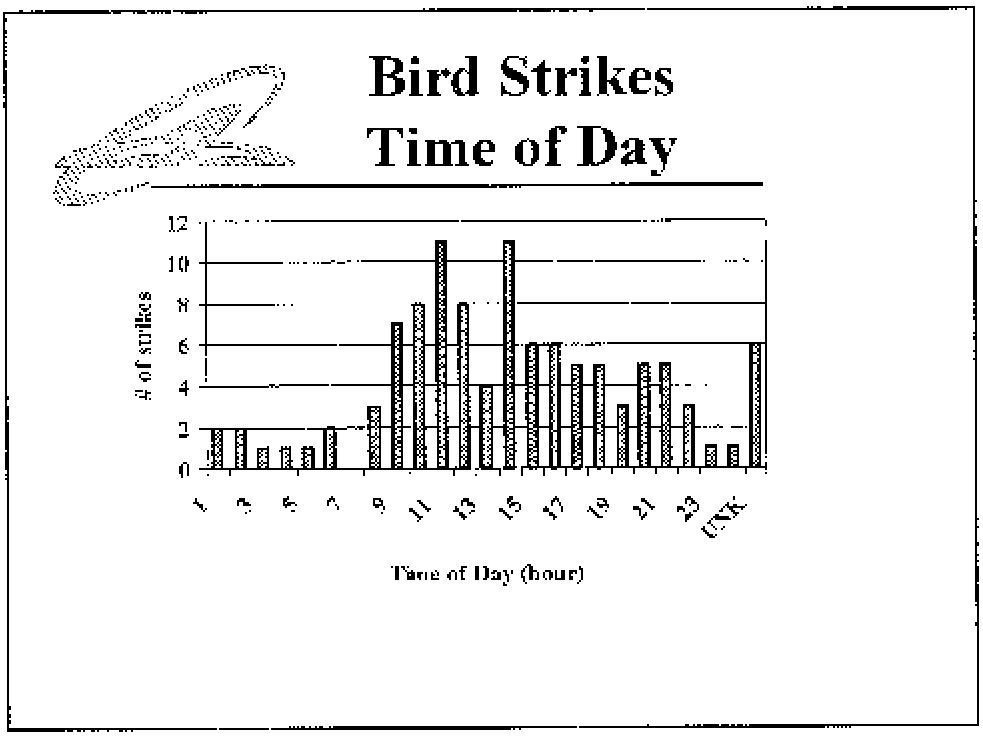
Table 5



Peak Hours

7. The peak time for bird strikes was between 10 am and 3 pm. Although it may appear that these are the times when a bird strike is most likely to occur it is also the time when most aircraft movements are recorded on CF airfields. It should be noted that bird strikes occur at all hours of the day and night and a bird strike may be especially difficult to avoid during hours of twilight and darkness.

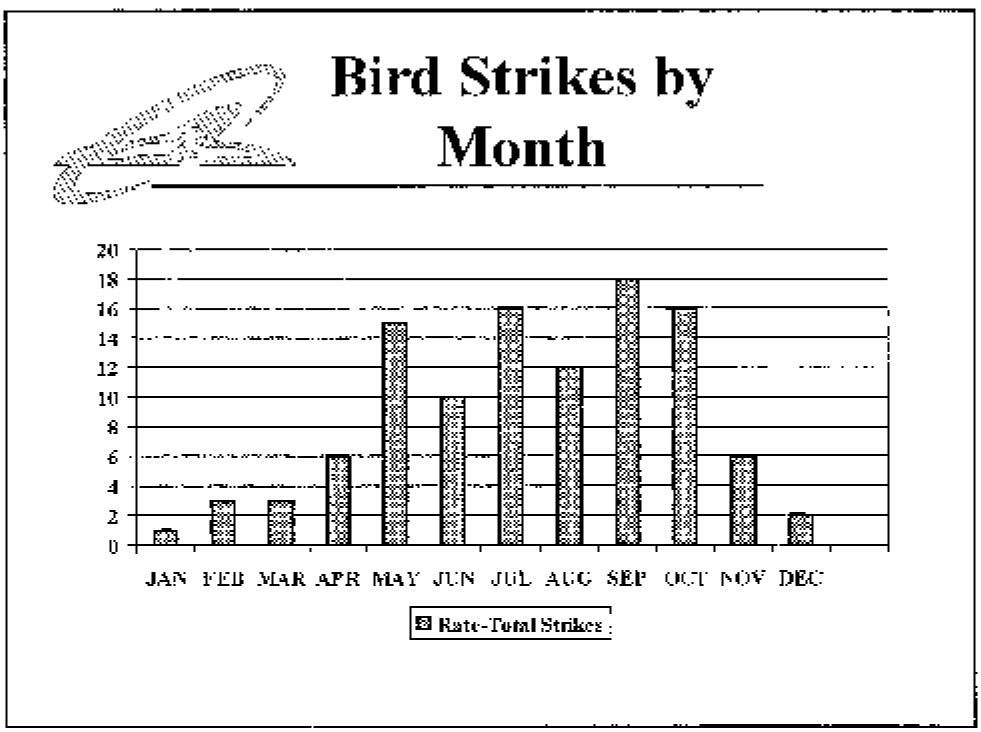
Table 6



Peak Months

8. The peak months for birdstrikes were recorded between May and October, with two of the highest months being September and October. September and October are the months of fall migration when a great number of birds, many of them juvenile, head to their wintering grounds. This is a particularly dangerous time as large flocks of birds, often triggered by weather fronts move at one time. Many of the young birds don't have the strength for long flights and the flocks will often stop over for several days to rest and feed. A hazardous situation for aircraft can occur when large birds such as geese and ducks travel back and forth, low level, between their staging grounds and their food supply, often farmers fields. The fall migration can be different for each airfield so pilots should make themselves aware of the migratory situation in their local flying area.

Table 7



Hazard Avoidance

9. The avoidance of birdstrikes can be approached through two avenues, airfield management and pilot education. The maintenance of a wildlife free environment on the airfield will reduce the number of strikes. Since all flying is not done at the controlled environment of the airfield it is important that pilots be educated in bird avoidance to enable them to assess the level of hazard they will incur during their missions.

Wing Wildlife Control Programs

10. In this time of fiscal restraint it is tempting to try to save money by reducing or eliminating funding for wildlife control programs. This is a false saving as the first significant strike can cost more than the money saved through reduction to the programs. Even the unrecorded costs of lost or delayed missions due to a birdstrike can be significant. Caution must therefore be used when diverting money from wildlife control programs. 1 CAD monitors the Wing Wildlife Control Programs and although a high standard is still being maintained at most Wings there is a noticeable trend toward reductions in funding and the replacement of trained personnel with less experienced individuals.

11. An airfield is an ideal habitat for wildlife providing food, shelter and a safe environment from predators. To deter animals and birds from frequenting, or taking up residence on an airfield requires constant vigilance. There are numerous products on the market promising to rid airfields of their wildlife hazards. Many of these products are quite technically advanced but have not been proven as effective as a wildlife control program run by educated and motivated individuals.

12. A Wildlife Control Officer (WCO) must be able to assess the attractants on the airfield and suggest modifications to the airfield environment to discourage wildlife from frequenting it. The most important service provided by the WCO is the continual harassment of itinerant, and the removal of resident wildlife. Often it is felt that the WCO need only be available during flying hours. This can be counter productive since wildlife will move in during quiet hours and be harder to remove once established.

13. Many of our airfields have professional WCO's and they provide an invaluable cost effective service. Unfortunately on a few airfields the control of wildlife is not considered a serious problem and the task has become a secondary duty. While this may be adequate on some of the smaller sites it is hard to justify on a major airfield.

14. A factor to consider when reflecting on wildlife control on airfields is liability. In this increasing litigious world an airport operator can be held accountable if it can be shown that they were negligent in removing a hazard to aviation ie. Flocks of birds. For many Wings civilian aircraft represent more than 50% of the total traffic. Therefore it is prudent to maintain a safe flying environment not only for the military traffic but also for the various civilian users of the facility.

15. The 1995 AWACS crash at Elmendorf Air Force Base, Alaska shows just how a catastrophic bird strike, resulting in the loss of 24 lives, necessitated a review of what was deemed to be a well run wildlife control program. With many of our Canadian airfields located on major migratory routes the idea that a similar bird strike could occur in Canada is not far fetched.

16. As was shown in Elmendorf, many bird populations have increased exponentially over the last few years. The Canada goose population is reported to have doubled between 1955 and 1974 and the ringed bill gull population has increased by 12% per year since the mid 1970's (figures taken from *Wildlife Control: Legal and Financial Necessities* Airport Wildlife Management, Bulletin No. 22, Spring 1998.) Both of these species frequent a number of military airfields and without action being taken the situation that occurred in Elmendorf Alaska could be repeated on a Canadian airfield.

17. These facts and figures have been presented to cause some reflection on the wild life control programs in place on CF airfields. If any further information is required please contact Capt Sara Karcha, ASR 2, at AV 257-2103.

APPENDIX 6

Evaluation of the Efficacy of Various Techniques and Equipment for Airport Bird Control

Removed
- See Birds + Aircraft file

APPENDIX 7

Predator Urines As Chemical Barriers to White-Tailed Deer

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1998. Proc. Vertebrate Pest Conference 18: In press.

PREDATOR URINES AS CHEMICAL BARRIERS TO WHITE-TAILED DEER

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ABSTRACT: We assessed whether bobcat (Lynx rufus) or coyote (Canis latrans) urine could reduce white-tailed deer (Odocoileus virginianus) use of established feeding areas or trails. A 4-week experiment evaluating deer use of 8 feeding stations, 4 each with coyote or bobcat urine was conducted at a 2,200-ha fenced facility in northern Ohio with high deer densities (38/km^2). At this same facility, we also monitored deer use of 4 trails where coyote urine was applied. For both experiments, urine was placed in holders positioned at ground level within 2 m of the area being protected . The number of deer entering feeding stations after 2 weeks exposure to predator urines was 15-24% less ($P \leq 0.05$) than the number of deer entering feeding stations during pretreatment. Deer use of trails did not decrease in response to presence of coyote urine. We conclude that predator urines used as a chemical barrier were of limited effectiveness in deterring high concentrations of white-tailed deer from areas with established sources of food and ineffective in deterring deer from trails.

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Key Words: Odocoileus virginianus, predator urines, repellents, white-tailed deer, wildlife damage management

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Deer (Odocoileus spp.) cause substantial economic loss to agricultural crops (Scott and Townsend 1985, Dudderar et al. 1990, Sayre and Decker 1990). Agricultural and wildlife agencies have ranked deer as causing more crop damage overall than any other group of wildlife (Conover and Decker 1991). Deer residing at airport facilities also pose a direct threat to aviation safety. For example, in 1993-1995, deer represented 66% of reported civilian aircraft collisions with mammals (Cleary et al. 1996).

Numerous techniques including fences, frightening devices, and repellents have been evaluated or used to reduce deer use of crops and airfields (Craven and Hygnstrom 1994, Belant et al. 1996a). Predator urines have also been evaluated as feeding repellents for mammals (Sullivan et al. 1988, Epple et al. 1993, Nolte et al. 1993, 1994), including deer (Sullivan et al. 1985, Swihart et al. 1991). However, previous studies typically have evaluated the repellency of urine applied directly on or adjacent to the food being protected. Application of urines to forage is undesirable in some situations such as livestock feed or crops for human consumption. To our knowledge, no study has evaluated the effectiveness of predator urines to reduce deer use of specific areas.

Our objective was to determine whether predator urines could be used as chemical barriers to reduce white-tailed deer use of established sources of food and trails. Our goal was to develop a technique to reduce deer depredation of agricultural crops and livestock food supplies (e.g., stacked hay or silage), and to reduce their presence near airport runways.

STUDY AREA

This study was conducted during April-June 1996 at the National Aeronautic and Space Administration Plum Brook Station (PBS), Erie County, Ohio. This 2,200-ha facility is enclosed by a 2.4-m high chain-link fence with barbed-wire outriggers. Habitat within PBS differed from the surrounding agricultural area and consisted of canopy-dogwood (Cornus spp.) (39%), grasslands (31%), open woodlands (15%), and mixed hardwood forests (11%) (Rose and Harder 1985). During this study, PBS had an estimated minimum white-tailed deer population of 825 ($\geq 38/km^2$) (P. Ruble, Ohio Div. Wildl., Unpubl. Data). The deer population was estimated from a helicopter survey which was conducted over the entire facility. Coyotes (Canis latrans) are present on PBS; bobcats (Felis rufus) are not.

METHODS

Test Materials

We obtained coyote and bobcat urine and scent darts from Johnson and Company (Bangor, Maine USA). Scent darts consisted of six foam strips attached to a 5-cm wood stake and were manufactured specifically to hold urine. Manufacturer recommended use for both urines was to saturate the foam strips of the scent darts and space them at 10- to12-ft (3.0- to 3.7-m) intervals near the area to be protected. The manufacturer recommended reapplying urine to the scent darts at 10-day intervals. The coyote urine was marketed as effective in moving deer to or away from specific areas; bobcat urine was similarly marketed for small mammals.

Feeding Experiment

We established 8 deer feeding stations located ≥ 1 km apart using whole-kernel corn placed in 2 adjacent 1.2-m long cattle feed troughs. A 1.5-m high plastic snow fence was erected on three sides of a 5- x 5-m area such that feed troughs were located inside the fenced areas about 1 m from the back. Corn was added to feed troughs as necessary to maintain a constant food supply and the amount of corn added was recorded. An infrared monitoring device (TrailMaster®, Goodson and Assoc., Inc., Lenexa, Kansas USA) was installed 60 cm above ground at each opening to record the number of deer intrusions and to avoid recording nontarget species (e.g., raccoons [Procyon lotor], fox squirrels [Sciurus niger]).

To condition deer to use feeding stations we monitored each station 5 to 7 times/week for 1 month prior to the experiment, recording the number of intrusions and providing corn as needed. The experiment consisted of a 1-week pretreatment, 2-week treatment, and 1-week posttreatment period beginning 26 April. Feeding stations were identical among periods except that urine was applied to scent darts during the treatment period.

Four sites were selected at random to receive coyote urine; the remaining 4 sites received bobcat urine. At each site, we saturated each of 2 scent darts with 6 to 8 ml of the respective urine and placed the darts 1 m in front of, and 1.5 m either side of the center of the entrance. During treatment, urine was reapplied every 7 days and whenever precipitation exceeded 5 mm within a 24-hr period.

We initially divided the daily number of intrusions recorded by the monitoring devices by 2 to determine the number of times deer entered each feeding station. We then calculated the mean daily number of intrusions/week for each station. We used analysis of variance (ANOVA) with repeated measures (weeks) (SAS Inst. Inc., 1988) on log-transformed data to compare the number of deer intrusions and amount of corn consumed among periods for each type of urine. If main effects were significant ($P < 0.05$), we used Tukey tests to determine which means differed.

Trail Experiment

We positioned a TrailMaster to record deer crossings along each of 4 trails separated by $\geq$1 km. At each trail on 16 May, we then placed a scent dart 2 m on either side of the monitoring device and < 1 m from the trail. The experimental design and statistical analyses were conducted identically to those described for the feeding experiment except that we did not divide the daily number of deer crossing by 2.

RESULTS

Feeding Experiment

The mean (± SE) daily number of deer intrusions differed among treatment periods at sites with bobcat urine ($F = 4.67$; 3,9 df; $P = 0.03$) and coyote urine ($F = 28.19$; 3,9 df; $P < 0.01$) (Fig. 1). For both urines, the number of deer intrusions was greatest during pretreatment and lowest during posttreatment. For both urines, the mean daily number of intrusions during week 2 treatment was 15-24% less than the mean daily number of intrusions during pretreatment.

Mean daily corn consumption also differed at feeding stations with bobcat urine ($F = 5.80$; 3,9 df; $P = 0.02$) and coyote urine ($F = 16.22$; 3,9 df; $P < 0.01$). For both urines, corn consumption was greatest during week 1 treatment.

Trail Experiment

The mean daily number of deer crossings increased ($F = 9.78$; 3,9 df; $P < 0.01$) during the 4-week experiment with more ($P < 0.05$) deer crossings during posttreatment (41.3 ± 5.1) than during pretreatment (4.7 ± 1.5) and treatment (7.7 ± 2.0 to 18.6 ± 8.9) (Fig. 2). The number of crossings during pretreatment and treatment was similar ($P > 0.05$).

DISCUSSION

The slight (15-24%) decline in deer use of feeding stations after 2 weeks exposure to bobcat and coyote urine suggests limited effectiveness as a chemical barrier. That deer use continued to decline during posttreatment suggests deer may have learned to avoid the feeding stations. Alternatively, the observed decline in use during April-May may be attributed to increased availability of highly nutritive grass and forbs. Also, decreased use of feeding stations could be in response to decreased movements of female deer during parturition.

Bobcat and coyote urines were marginally effective in deterring white-tailed deer from entering feeding areas and ineffective in reducing deer use of established trails. Sullivan et al. (1985) and Swihart et al. (1991) found that bobcat and coyote urines applied directly on or adjacent to food suppressed consumption by white-tailed deer and black-tailed (O. hemionus) deer. In these studies, urine applied directly on food suppressed feeding more than did urine placed adjacent to food. In our study, urine was applied about 5 m from the food. Thus, effectiveness of predator urines increases as the distance between the urine and food source decreases, and effectiveness is maximized when urine is applied directly to food.

The inability of urines to substantially reduce deer intrusions at feeding areas in our study may be related to higher deer densities than observed in other studies; however, the lack of reduction in deer use of trails was likely not. We are uncertain why deer use of trails during week 2 treatment and posttreatment increased. One possible explanation is increased movements of female deer to forage post-parturition. Also, the ineffectiveness of using predator odors such as urine to deter white-tailed deer from specific areas such as trails may not be applicable to mammals in general. For example, Sullivan et al. (1988) documented avoidance by rodents of burrows treated with predator odors. Effectiveness of repellents appears related to the relative attractiveness of the material or area being protected (see Belant et al. 1996b).

Effectiveness of predator urines may also be related to the relative threat perceived by the prey (Swihart et al. 1991). Swihart et al. (1991) suggested that white-tailed deer are more alarmed by the presence of bobcats than coyotes. Aversion to predator odors may be innate, suggesting that habituation should not occur (Muller-Schwarze 1972, 1974). However, habituation to learned avoidance of predator odors may occur if reinforcement is lacking. Bobcats have not been present in northern Ohio for > 50 years (Gottschang 1981). Thus, white-tailed deer on PBS may have overcome their innate aversive response to bobcat urine because reinforcement does not occur. We have observed coyotes chasing white-tailed deer and carcasses of deer apparently killed by coyotes on PBS; however, the relative importance of deer in the diet of coyotes on PBS is unknown.

Although direct application of predator urines to food can suppress feeding by deer (Sullivan et al. 1988; Swihart et al. 1991), predator urines were only marginally effective in excluding a high-density population of white-tailed deer from establishing feeding areas and were ineffective in reducing deer use of trails. We conclude that predator urines used as a chemical barrier would be only of limited value in deterring deer from areas containing desired food and from using airport runway areas.

ACKNOWLEDGEMENTS

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Safety and Standards, Washington, D. C., and Airports Division, Airport Technology Branch, FAA Technology Center, Atlantic City International Airport, New Jersey.

LITERATURE CITED

BELANT, J. L., T. W. SEAMANS, and C. P. DWYER. 1996a. Evaluation of propane exploders as white-tailed deer deterrents. Crop Prot. 15:575-578.

BELANT, J. L., T. W. SEAMANS, L. A. TYSON, and S. K. ICKES. 1996b. Repellency of methyl anthranilate to pre-exposed and naïve Canada geese. J. Wildl. Manage. 60:923-928.

CLEARY, E. C., S. E. WRIGHT, and R. A. DOLBEER. 1996. Wildlife strikes to civilian aircraft in the United States 1993-1995. Fed. Aviation Admin., Wildl. Aircraft Strike Database Ser. Rep. 2. 33pp.

CONOVER, M. R. and D. J. DECKER. 1991. Wildlife damage to crops: perceptions of agricultural and wildlife professionals in 1957 and 1987. Wildl. Soc. Bull 19:46-52.

CRAVEN S.R. and S. E. HYGNSTROM. 1994. Deer. Pages D25-D40 in S. E. Hygnstrom, R. M. Timm and G. E. Larson, (eds.). Prevention and control of Wildlife Damage. Univ. Nebraska Coop. Ext. Serv., Lincoln.

DUDDERAR, G. R., J. B. HAUFLER, S. R. WINTERSTEIN and P. GUNARSO. 1990. GIS: a tool for analyzing and managing deer damage to crops. Proc. East. Wildl. Damage Control Conf. 5:182-197.

EPPLE, G., J. R. MASON, D. L. NOLTE and D. L. CAMPBELL. 1993. Effects of predator odors on feeding in the mountain beaver (Aplodontia rufa). J. Mammal. 74:715-722.

GOTTSCHANG, J. L. 1981. A guide to the mammals of Ohio. Ohio State Univ. Press, Columbus. 176pp.

MULLER-SCHWARZE, D. 1972. Responses of young black-tailed deer to predator odors. J. Mammal. 53:393-394.

MULLER-SCHWARZE, D. 1974. Olfactory recognition of species, groups, individuals, and physiological states among mammals. Pages 316-326 in M. C. Birch, (ed.). Phermones. North Holland, Amsterdam.

NOLTE, D. L., J. P. FARLEY, D. L. CAMPBELL, G. M. EPPLE and J. R. MASON. 1993. Potential repellents to prevent mountain beaver damage. Drop Prot. 12:624-626.

NOLTE, D. L., J. R. MASON, G. M. EPPLE, E. ARONOV and D. L. CAMPBELL. 1994. Why are predator urines aversive to prey? J. Chem. Ecol. 20:1505-1516.

ROSE, J. and J. D. HARDER. 1985. Seasonal feeding habits of an enclosed high density white-tailed deer herd in northern Ohio. Ohio J. Sci. 85:184-190.

SAS INSTITUTE, INC. 1988. SAS/STAT user's guide. Version 6. SAS Inst., Cary, North Carolina. 1028pp.

SAYRE, R. W. and D. J. DECKER. 1990. Extent and nature of deer damage to commercial nurseries in New York. Proc. East. Wildl. Damage Control Conf. 5:162-172.

SCOTT, J. D. and T. W. TOWNSEND. 1985. Deer damage and damage control in Ohio's nurseries, orchards, and Christmas tree plantings. Proc. East. . Wildl. Damage Control Conf. 2:83-88.

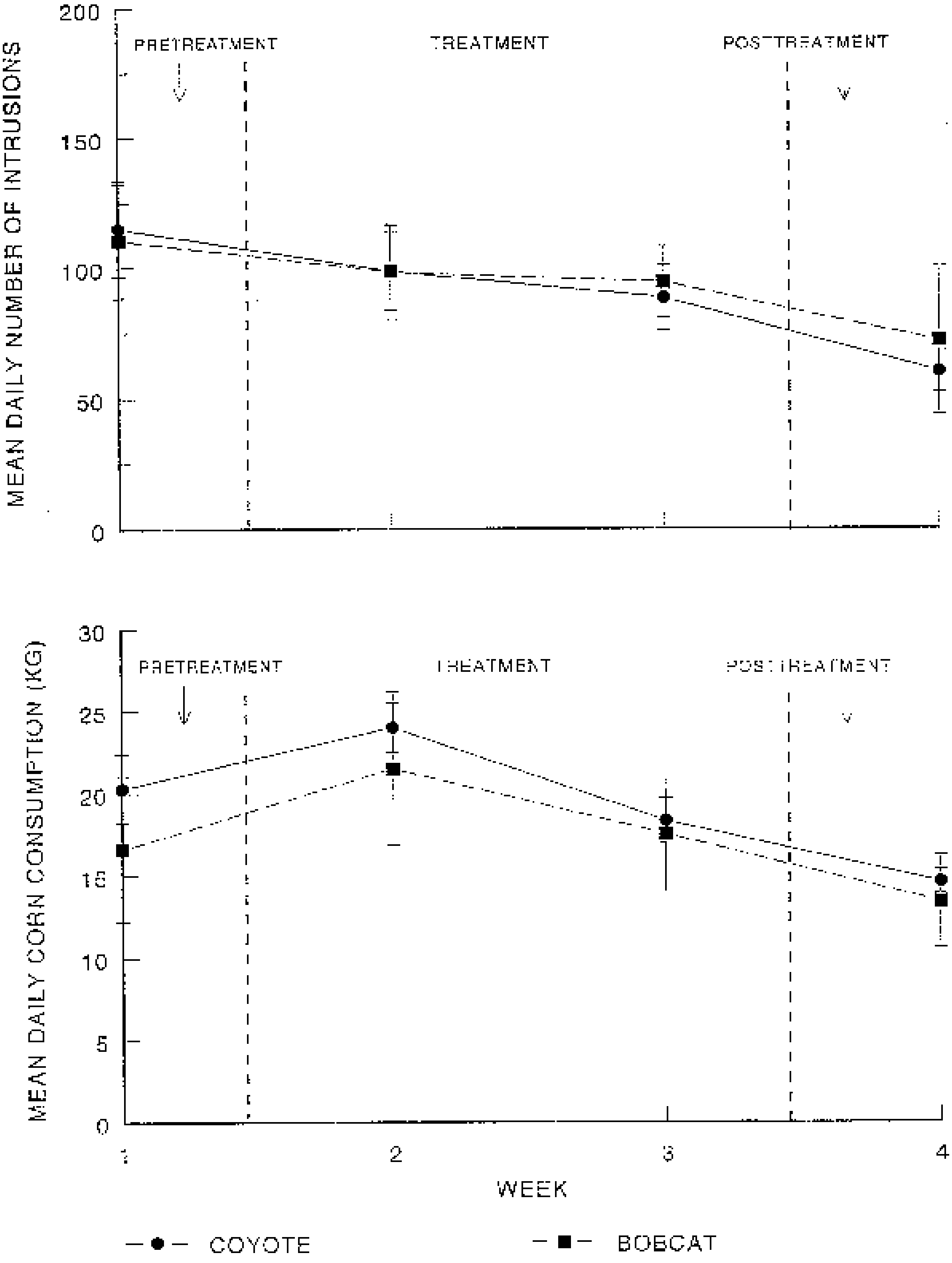
SULLIVAN, T. P., D. R. CRUMP and S. S. SULLIVAN. 1988. Use of predator odors as repellents to reduce feeding damage by herbivores. III. Montane and meadow voles (Microtus montanus and Microtus pennsylvanicus). J. Chem. Ecol. 14:363-378.

SULLIVAN, T. P., L. O. NORDSTROM and D. S. SULLIVAN. 1985. Use of predator odors as repellents to reduce feeding damage by herbivores. II. Black-tailed deer (Odocoileus hemionus columbianus). J. Chem. Ecol. 11:921-935.

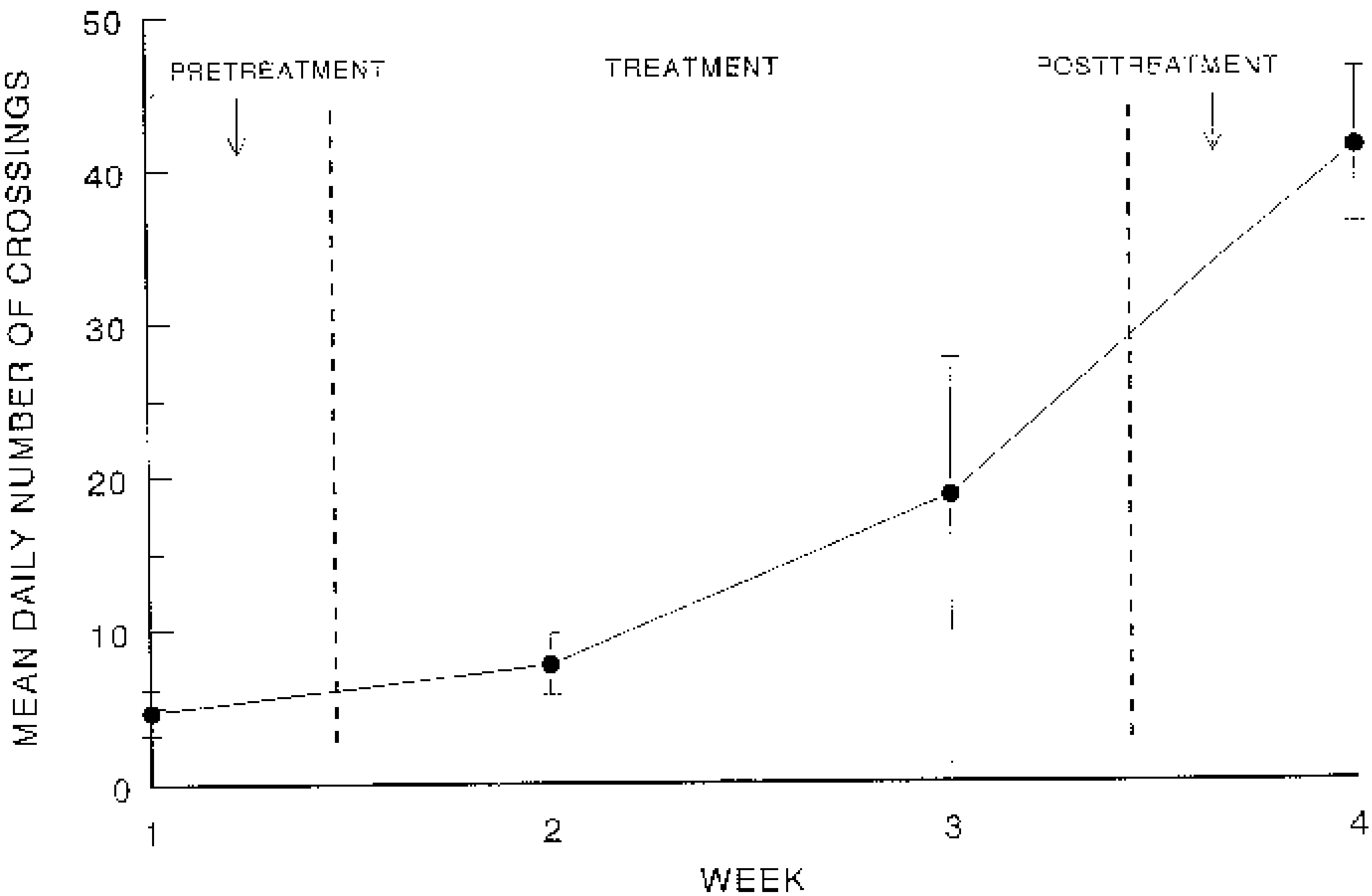
SWIHART, R. K., J. J. PIGNATELLO and M. J. I. MATTINA. 1991. Aversive responses of white-tailed deer, Odocoileus virginianus, to predator urines. J. Chem. Ecol. 17:767-777.

Fig. 1. Mean daily number of white-tailed deer intrusions and mean daily corn consumption at sites with coyote or bobcat urine by week, Plum Brook Station, Erie County, Ohio, April-May 1996. Capped vertical lines represent 1 standard error.

Fig. 2. Mean daily number of white-tailed deer crossings on trails at sites with coyote urine, Plum Brook Station, Erie County, Ohio, April-May 1996. Capped vertical lines represent 1 standard error.



MEAN DAILY NUMBER OF INTRUSIONS
200
150
100
50
0
PRETREATMENT
TREATMENT
POSTTREATMENT
MEAN DAILY CORN CONSUMPTION (KG)
30
25
20
15
10
5
0
PRETREATMENT
TREATMENT
POSTTREATMENT
1
2
3
4
WEEK
COYOTE
BOBCAT



PRETREATMENT
TREATMENT
POSTTREATMENT
MEAN DAILY NUMBER OF CROSSINGS
WEEK
0
10
20
30
40
50
1
2
3
4

APPENDIX 8

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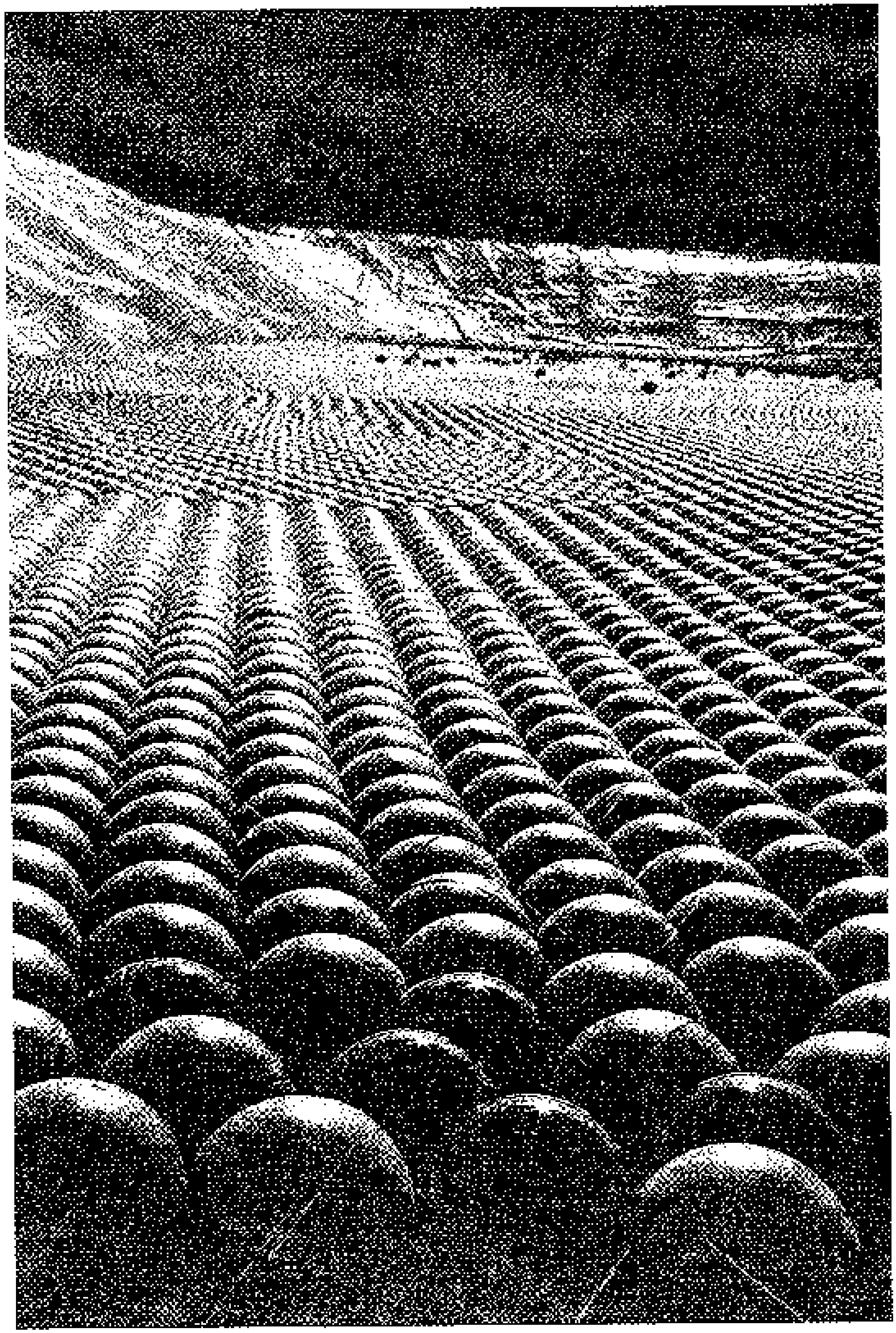

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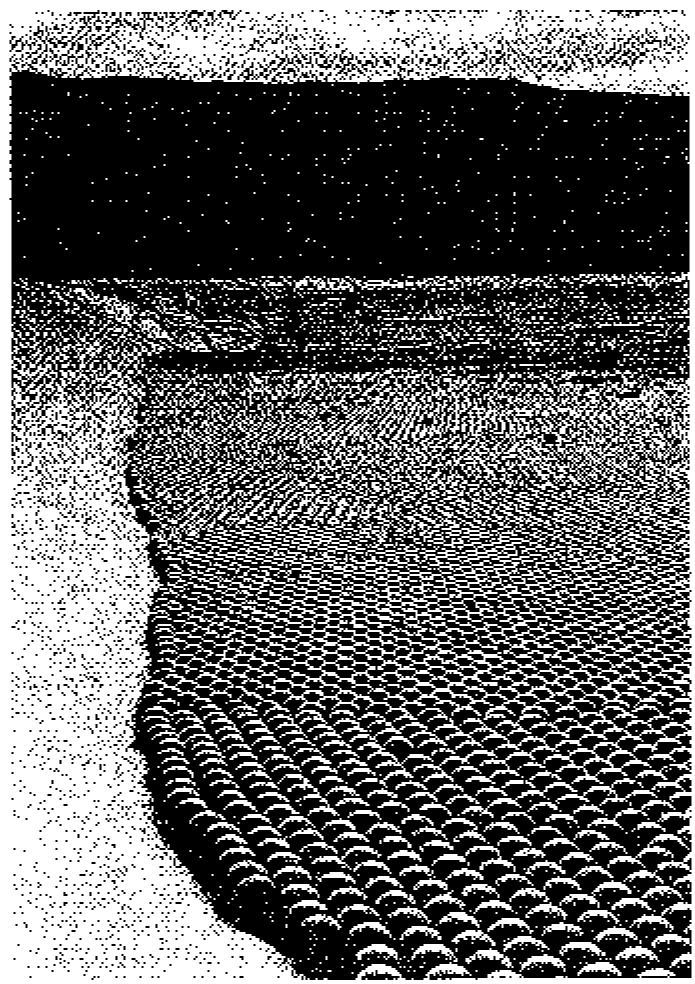

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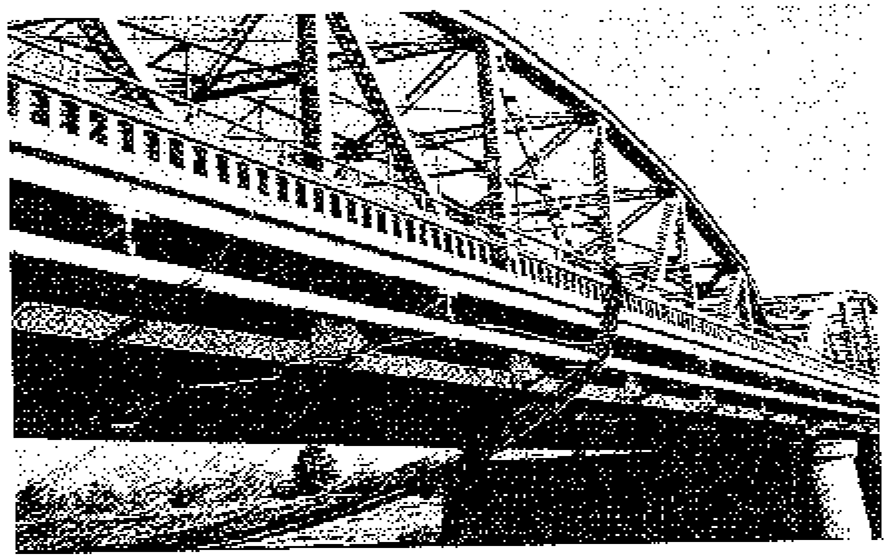

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Licenses and Permits

State of California Licenses	
◆ Agricultural Pest Control Business License	01348
◆ Structural Pest Control Business License	Branch (2) PR-88
Individual Licenses	
◆ Pest Control Advisor License	
◆ Qualified Applicator License	
◆ Qualified Applicators Certificate	
◆ Structural Pest Control Applicator	
◆ Registered Civil Engineer	C 056751
◆ Grade III Treatment Operator	20629
Restricted Materials Permit	
◆ Fresno County	10-97-10-41514
Trapping Permit	
◆ California Department of Fish and Game	D0024

Wildlife Control Technology, Inc. is a woman-owned, small business.

Aerospace/Military **California, U.S.A.**

Wildlife Control Technology developed and implemented bird air strike hazard programs for the El Toro Marine Naval Air Station and the Sacramento International Airport. The El Toro facility employed WCT to develop a training program to enable on-site personnel to conduct an establish bird air strike policy. The Sacramento terminal requested a field program to deter several different species of birds that use the facility as a roosting, feeding, nesting and loafing site. WCT works with the U.S. Navy on commorants that roost on radar equipment; and with U.S. Air Force, Lockheed, Rockwell, Northrop and McDonnell Douglas, on owls, ravens, and pigeons at facilities where contamination is a problem.

Agriculture **Canada, U.S.A., Mexico, South America**

Managing bird problems in high value cash crops is a specialty niche for Wildlife Control Technology. The dollar loss from bird damage to wine/table grapes, blueberries, figs, cherries, apples and strawberries requires control programs that limit losses to 1% or less. Our knowledge of bird behavior and management techniques has fostered a client base of over 7000 growers in the U.S. alone.

Facilities Maintenance **Western U.S.A.**

Facility engineers at new and existing facilities frequently call on Wildlife Control Technology to solve a wide variety of problems created by birds in structures. Problems range from unsanitary conditions to safety hazards, both of which escalate maintenance costs. Hospitals and food processing plants especially utilize our resources to comply with health standards. Much of this work is with bats, swallows, pigeons and gulls.

Mining/Oil **Canada, U.S.A., Mexico, South America, Asia**

Wildlife Control Technology began working with the precious metal mining and oil industries in the early 1980's. Regulatory compliance was requiring the development of techniques to exclude migratory waterfowl from the toxic solutions basins and oil pits used by these industries. These projects require extensive working knowledge of environmental conditions and materials limitations at sea level to altitudes of over 10,000 feet.

Petroleum **U.S.A., South America, Malaysia**

Wildlife Control Technology began work in the petroleum industry in the California oil fields. This has led to work in Venezuela and most recently Malaysia. It is a challenging industry because of the wide range of process liquids found in retention basins. The structures at a refinery facility are like a artificial habitat and become very attractive to birds. Each facility presents a unique set of circumstances that requires the creative use of years of field experience.

Utility **California, U.S.A.**

Electrical power generation and transmission is an industry that needs assistance when large numbers of birds roost on tower structures or on substation facilities. Wildlife Control Technology has conducted many bird hazing programs to deter birds from these structures in Central California. Migrating starlings, sometimes numbering in the thousands, and their accumulated feces on insulators during wet weather have caused power short circuits resulting in badly damaged equipment.

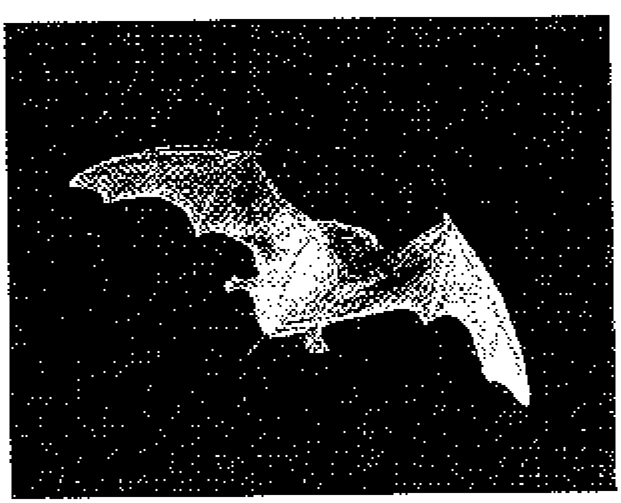
Representative Listing

Industrial

Southern Pacific Railroad	Central California Region
Certainteed	Chowchilla, CA
Foster Farms	Fresno, CA
Producers Cotton Oil Co.	Fresno, CA
Union Pacific Railroad	Lathrop, CA
Mendota Biomass	Mendota, CA
Coastal Chem Inc.	Battle Mountain, NV
Tri-State Construction	Bellvue, WA
CORP Engineers	Spokane, WA

Commercial

Kaiser Permanente Hospital	Fresno, CA
Mountain View Cemetery	Fresno, CA
Riverside Golf Course	Fresno, CA
San Joaquin Country Club	Fresno, CA
Sanwa Bank	Fresno, CA
Head Start	Hanford, CA
Monterey Plaza Hotel	Monterey, CA
Chevron Real Estate Management Co.	San Ramon, CA



Representative Listing

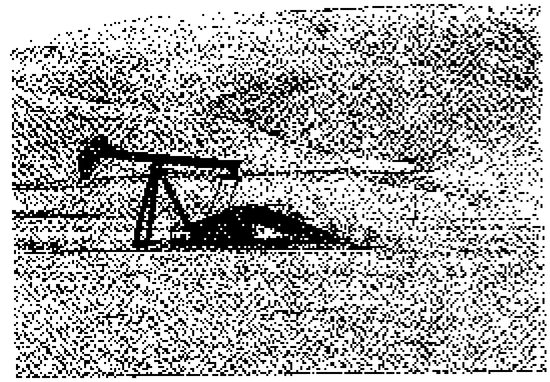
Agriculture

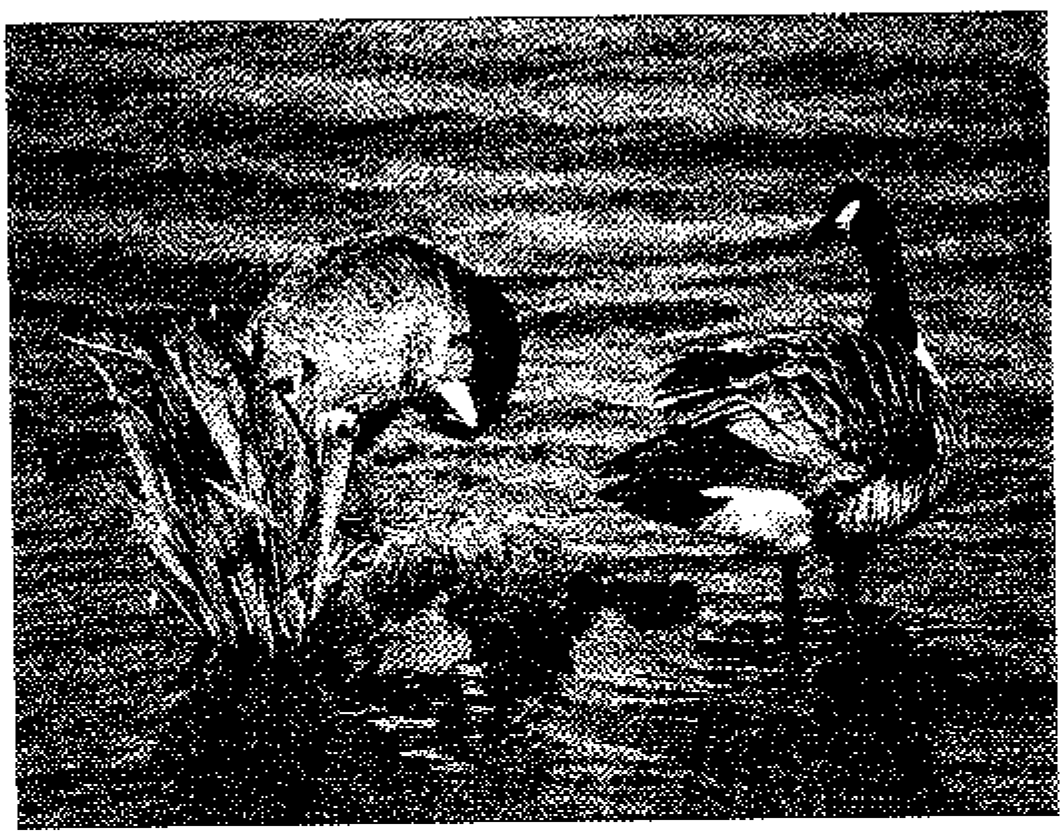
- Chateau Mantley — Payson, AZ
- Riordan Orchards — Clovis, CA
- Hailiaian Orchards — Fresno, CA
- Stevenson Orchards — Hanford, CA
- Kettleman Pistachio — Kettleman City, CA
- Gray Wolf Vineyards & Cellars — Oakhurst, CA
- Gerawan Farming — Sanger, CA
- Critchley Farming — Selma, CA
- Wildhorse Winery — Templeton, CA
- Mesa Colorado Vineyards — Palisade, CO
- Heltman Vineyards — Dixon, NM
- Whetstone Vineyards — Santa Fe, NM
- King Estate Vineyards — Eugene, OR
- Pindar Vineyards — Peconic, NY
- Big E Farms — Riverhead, NY
- Burrowing Owl Vineyards — Oliver, BC - **Canada**
- Monte Xanic Vineyards — Ensenada, Baja - **Mexico**

Representative Listing

Mining/Oil/Petroleum

Chevron Oil	Western United States
Chemgold	Yuma, AZ
Shell Oil (SWEPI)	Bakersfield, CA
Union Oil (UNOCAL)	San Luis Obispo, CA
Cripple Creek & Victor Gold	Cripple Creek, CO
Barrick Goldstrike	Carlin, NV
Kinross Candelaria Mining Co.	Hawthorne, NV
Chevron Chemical	Rock Springs, WY
Petronas Penapisan	Melaka, **Malaysia**
Lagover S.A.	Caracas, **Venezuela**

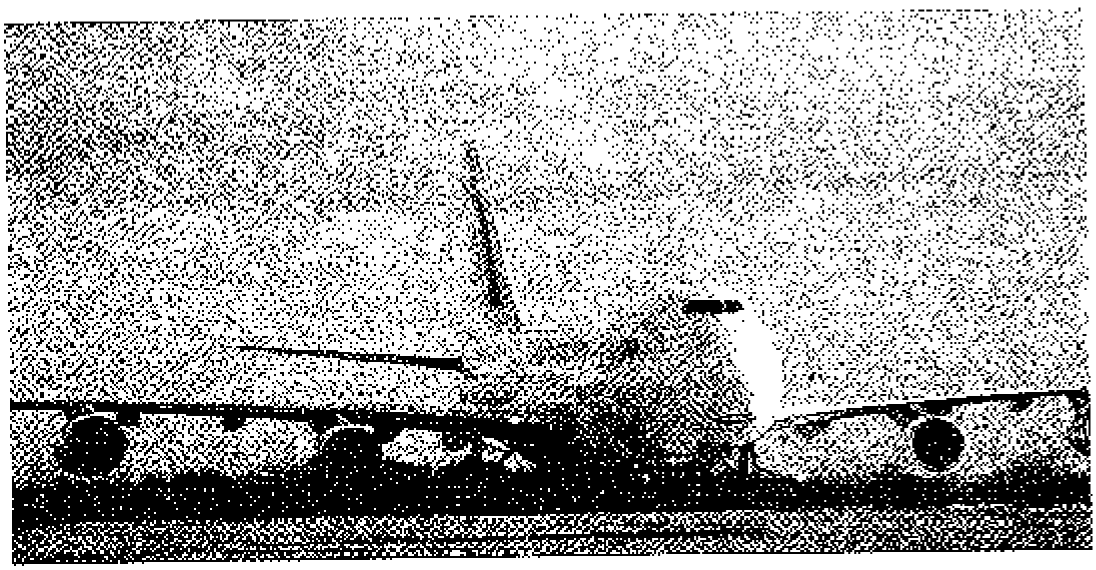




Representative Listing

Aerospace

McDonnell Douglas	Burbank, CA
Fresno Department of Airports	Fresno, CA
Lockheed	Palmdale and Burbank, CA
Rockwell	Palmdale, CA
Northrop	Palmdale, CA
Sacramento Department of Airports	Sacramento,CA



Utilities

Pacific Gas & Electric	California
Pacific Bell	California
East Bay Municipal Utility District	Central California
North Bay Regional Water District	Fairfield, CA
Fresno Metropolitan Flood Control District	Fresno, CA
Sacramento Municipal Utility District	Sacramento, CA

Representative Listing

Government

♦ U.S. Air Force	Western United States
♦ U.S. Army Corps of Engineers	Western United States
♦ U.S. Navy	Western United States
♦ California Department of Food & Agriculture	California
♦ California Department of Transportation	California
♦ California State Park Service	California
♦ Department of Water Resources	California
♦ U.S. Forest Service	California
♦ California Air National Guard	Fresno, CA
♦ CSU Fresno	Fresno, CA
♦ Fresno City College	Fresno, CA
♦ City of Hanford	Hanford, CA
♦ Merced Unified School District	Merced, CA
♦ Kings Canyon Unified School District	Reedley, CA
♦ Federal Aviation Administration	Sacramento, CA
♦ Sacramento Junior College	Sacramento, CA
♦ Sacramento Unified School District	Sacramento,CA

Representative Rodent Control Projects and References

Southern Pacific Transportation Company — *Central California*

Wildlife Control Technology, Inc., performs seasonal ground squirrel control on SPTC mainline and secondary track from Bakersfield, CA to Sacramento, CA. Work is performed from a HyRail vehicle equipped with automated bait spreaders.

U.S. Army Corps of Engineers — *Central California*

Wildlife Control Technology, Inc., performs seasonal ground squirrel and gopher control at camp ground and dam sites at various USACE facilities in the central valley. Currently WCT is completing contracts at Pine Flat and Hensley Lakes. Ground Squirrel control work is performed using low profile bait stations with anti-coagulant baits. Gophers are treated below ground with anti-coagulant bait, using a hand held probe and dispenser.

Fresno Metropolitan Flood Control District — *Fresno, California*

Wildlife Control Technology, Inc., provides monthly and seasonal rodent control services on FMFCD flood control structures. Gophers, ground squirrels and meadow mice have been treated over the last seven (7) years. Wildlife Control Technology, Inc., uses both restricted and non-restricted rodenticide materials per label specifications and appropriate use conditions.

Mountain View Cemetery — *Fresno, California*

Wildlife Control Technology, Inc., provides weekly gopher control for maintenance of turf and other landscaped areas. Gophers are treated below ground with acute toxicant baits using a hand held probe and dispenser.

San Joaquin Country Club — *Fresno, California*

Wildlife Control Technology, Inc., provides weekly gopher and ground squirrel control for maintenance of greens, tee's, fairways and other landscaped areas. Ground Squirrel control work is performed using locking bait stations with anti-coagulant baits. Gophers are treated below ground with acute toxicant baits, using a hand held probe and dispenser.

SCHEDULING

Response Time and Availability
Wildlife Control Technology, Inc., maintains adequate staffing to meet the various contract completion schedules of our clients. Any work contracted to Wildlife Control Technology will receive prompt attention.

Due to the seasonal and time specific nature of nuisance wildlife control, scheduling of work will be coordinated with a client representative to insure appropriate response time and contract completion.

When the need for emergency or add-on control services arise, WCT will insure that priority response time is given where possible.

INSURANCE

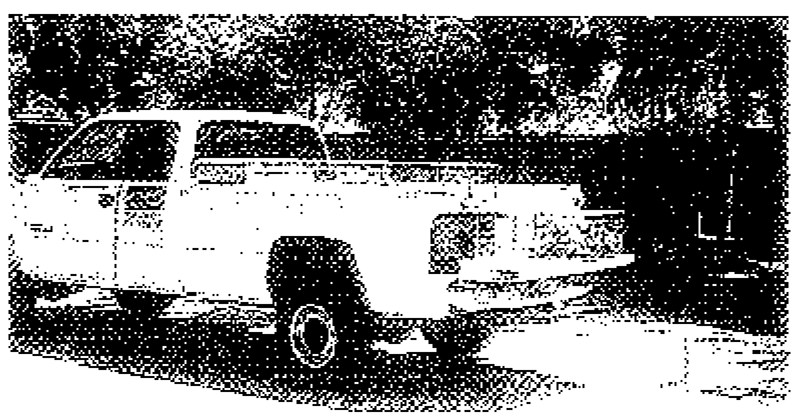
General Liability
- VanBeurden Insurance Services, Inc. Jeanette Heinrichs 209.888.2161

Vehicle
- State Farm Insurance Company Lee Enns 209.431.1691

Workers Compensation
- VanBeurden Insurance Services, Inc. Jeanette Heinrichs 209.888.2161

EQUIPMENT

Vehicles
- (3) 4x4 Service Trucks
- (3) 2x4 Service Trucks
- (1) 4x6 Polaris ATV and trailer
- (1) 24' Cargo/Job Trailer



HOW TO CONTACT US

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Mike Earls	Field Biologist
Eric Howard	Field Biologist
Clark Hardy	Field Biologist
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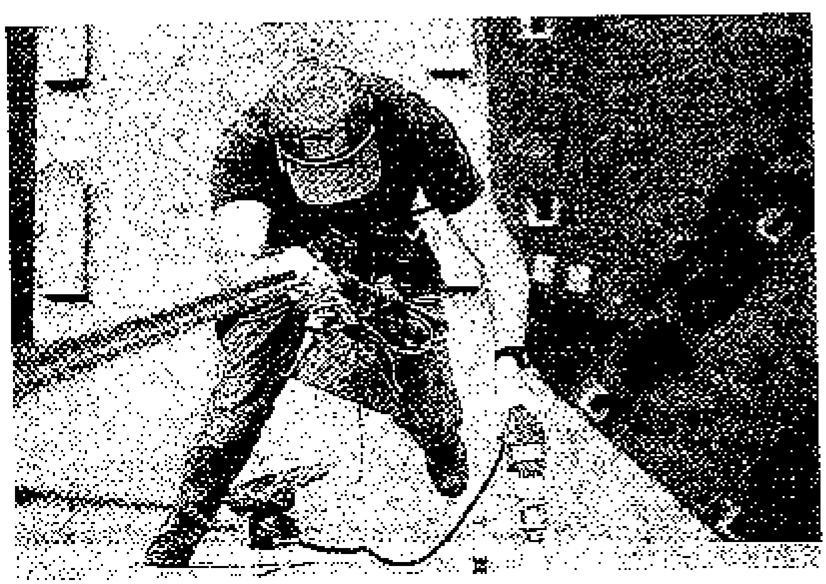
Laura Martin	Marketing Director
Sue Taber	Accounting Manager
Bettye Palmer	Executive Secretary



APPENDIX 9

Bird Flight Forecast and Information System

Bird Flight Forecast and Information System

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28th Meeting of Bird Strike Committee Canada
June 9-10, 1998
Thunder Bay, Ontario

1. Introduction

Several methods have been developed to diagnose the extent of the bird strike hazard to aircraft. Examples of these methods include the implementation of wildlife monitoring programs, bird avoidance models and radar surveillance techniques. Although these methods are effective in illustrating the current or historical avian threat to aircraft, all of these methods are incapable of predicting changes in this threat beyond the limited skill of a track-persistence forecast. This paper describes the development of a forecast model that predicts changes in the times and altitudes of avian flight based upon the physical and dynamical processes that govern this flight. The goal of this research is to develop a comprehensive bird flight forecast and information system that combines the aforementioned diagnostic and forecast techniques to reduce the bird strike hazard to aircraft.

2. Model Theory and Development

Numerous studies have examined the relationships between bird abundance, distribution and flight patterns and such variables as habitat, geography, weather and climate. For example, DeFusco (1994) correlated geographical, meteorological, and physiographical variables with the distribution and abundance of Turkey Vultures in the United States. Kerlinger (1989) has shown that the flight strategies of migrating hawks are often influenced by geographical and meteorological factors. Finally, several studies have examined the dependence of avian soaring flight on diurnal fluctuations in thermal intensity (Haugh 1972, 1974; Larkin, 1982; Pennycuick, 1989). These relationships form the backbone upon which bird abundance, distribution and flight forecast models could be developed because the variables that govern changes in these patterns are often predictable.

The bird flight forecast model (BFFM) currently under development is designed to explicitly model those processes that govern avian abundance, distribution and flight patterns. The accuracy of any forecast model is ultimately dependent upon the strength of the relationships upon which the model is developed. Establishing solid relationships requires the proper identification of those processes that govern avian abundance, distribution and flight patterns, and the gathering of data necessary to develop these relationships. We are currently exploring these relationships for several species of birds. These species include American White Pelicans, Turkey Vultures, Black Vultures, Swainson's Hawks, and Red-Tailed Hawks. Preliminary results from our study of American White Pelicans follow.

3. Preliminary Results

a. Data and Methodology

During June and July 1997, we monitored the movements in the Fallon, NV area of 10 American White Pelicans instrumented with satellite telemetry transmitters. Two two-person teams followed these pelicans during their daily flights, obtaining high-resolution altitude data (at approximately 70-second intervals) from the transmitters attached to these birds. Each team also made observations of bird behaviors and weather conditions when possible. These data are currently being analyzed in relation to the habitat, geography and weather observed in the area. This paper describes the relationship between pelican flight altitudes and changes in the weather as discovered during this field study. Preliminary results from this analysis suggest that by predicting changes in environmental factors we can predict changes in the times and altitudes of pelican flight.

b. Results

Figure 1 illustrates the temporal evolution of the flight envelope for one instrumented pelican on 7 July 1997. The morning data were gathered as the pelican completed an approximately 100-km flight from its foraging grounds to its breeding colony. After a brief stop at the breeding colony, the bird returned to its foraging grounds via the same route. This figure shows that relatively low-level flight in the morning evolves into higher-level flight during the afternoon. This increase in flight altitudes is related to an increase in thermal depth and intensity throughout the day. Figure 2 illustrates the temporal evolution of the flight envelope for the same pelican on 1 July 1997. In contrast to figure 1, the flight envelope does not continue to increase throughout this day because the sinking air associated with a high-pressure system limited thermal depth during the late morning and early afternoon. Given that the primary mode of flight for American White Pelicans is soaring flight, these results suggest that forecasts of thermal depth and intensity can be used to forecast the times and altitudes of the pelican flight envelope.

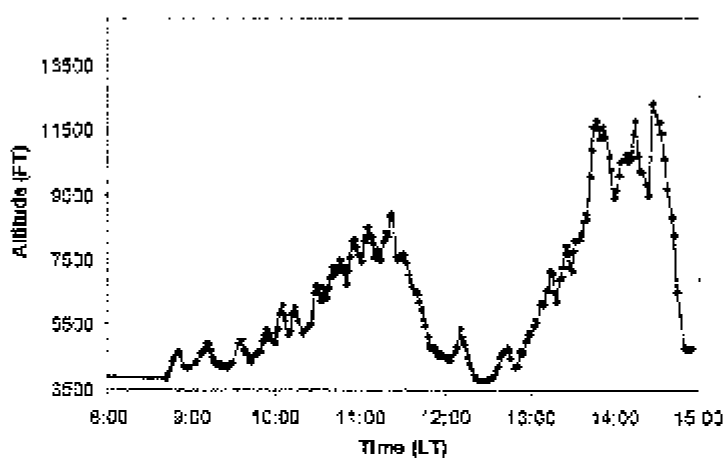

Figure 1: Flight altitudes for pelican 5720 on 7 July 1997.

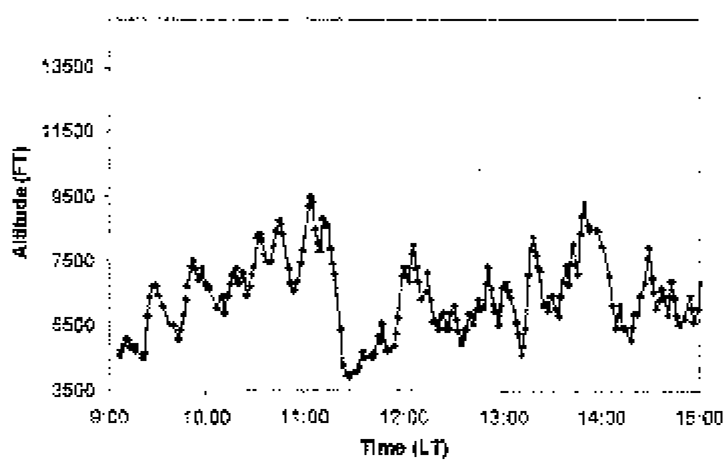

Figure 2: Flight altitudes for pelican 5720 on 1 July 1997.

Figure 3 illustrates the forecast thermal depth and observed flight altitudes for one instrumented pelican on 16 June 1997. As thermal depth increased throughout the morning the altitude of the pelican flight envelope also increased. Furthermore, the flight envelope remained in the middle of the thermal layer. A comprehensive statistical analysis of all telemetry and meteorological data is currently underway to verify the strength of these relationships.

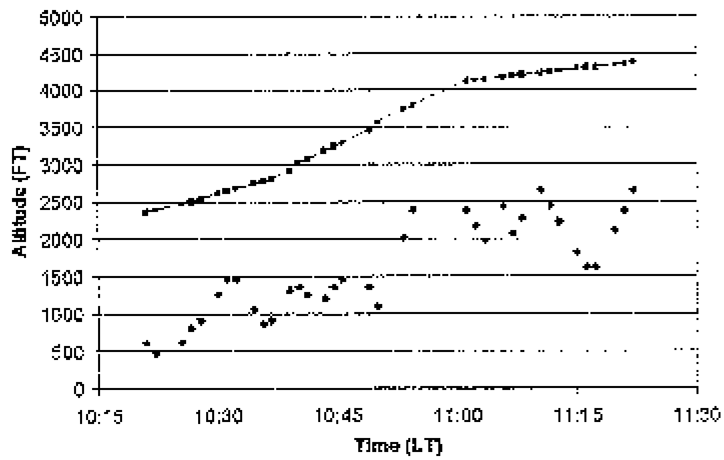

Figure 3: Flight altitudes for pelican 5722 (dots) and thermal depth (line) for 16 June 1997.

4. Discussion

The value of wildlife monitoring programs, radars, and bird avoidance models in reducing the bird strike hazard to aircraft is significant. These tools combined are capable of providing information on historical and real-time changes in bird abundance and distribution patterns. Unfortunately, these tools are either diagnostic or climatological in nature, and therefore provide little detailed information on expected changes in bird abundance and distribution patterns. Anticipating changes in these patterns prior to their occurrence is critical to reducing the bird strike hazard to aircraft. By combining wildlife monitoring programs, radars, and bird avoidance models with bird flight forecast models it is possible to develop an efficient and accurate bird flight forecast and information system. This system would provide information on past, present, and predicted bird abundance and distribution patterns, and could provide this information in a similar manner as weather information is made available to the aircraft community today.

References

Defusco, R. P., 1994: Using geographic information systems to model bird distributions and populations on a continental scale. Master's thesis. [NTIS ADA 281898]

Haugh, J. R., 1972: A study of hawk migration in eastern North America. *Search*, **2**, 1-60.

Haugh, J. R., 1974: Large aggregations of soaring birds: The influence of weather and topography. *Proceedings of the Conference on the Biological Aspects of the Bird/Aircraft Collision Problem*, Clemson, SC, Air Force Office of Scientific Research, 236-260.

Kerlinger, P., 1989: *Flight Strategies of Migrating Hawks*. University of Chicago Press, 375 pp.

Larkin, R. P., 1982: Spatial distribution of migrating birds and small-scale atmospheric motion. In *Avian navigation*, Springer-Verlag, 28-37.

Pennycuick, C. J., 1989: *Bird Flight Performance: A practical calculation manual.* Oxford University Press, Oxford.

APPENDIX 10

Selected Articles from *The Chronicle Journal* (Thunder Bay, Ontario)

Birds and planes fight for space around airports

Pesky seagulls concern airline representatives

Airport hunter keeps animals away

The Chronicle Journal
THE NEWSPAPER OF THE NORTHWEST
WEDNESDAY, JUNE 10, 1998 THUNDER BAY, ONTARIO

Birds and planes fight for space around airports

BY KIMBERLY HICKS
THE CHRONICLE-JOURNAL

Faster airplanes, busier airports and a dramatic increase in bird populations are a recipe for havoc.

Thunder Bay is host to a two-day National Bird Strike Committee conference to look at ways to combat bird congestion at airports.

"Bird problems are becoming more severe in the United States and in Canada," said Richard Dolbeer, a wildlife damage control expert from the U.S. Department of Agriculture.

The Ohio biologist said Canadian and American wildlife conservation tactics have dramatically increased bird populations. The result is more "conflicts" between airplanes and birds.

Dolbeer said bird-airplane accidents are responsible for about $500 million US in damages every year.

Last Aug. 12, seagulls got sucked into the engine of a DC-9 departing Thunder Bay Airport, forcing the aircraft to abort its flight.

Dolbeer said such accidents usually occur on a runway or during takeoff.

Fortunately, he said, birds haven't caused many in-air accidents.

Seagulls, geese, ducks, hawks and owls are the most likely species to be involved in an incident with an aircraft, he said.

The birds can break the fan blades in an engine, penetrate a windshield or break the nose of a plane.

Dolbeer said laws that protect birds make it difficult for airports to manage bird problems. He suggested that airports hire wildlife management professionals to deal with any problems.

"One thing that has to be done is make the habitat at airports less desirable and attractive to birds," he said.

Short grass alongside runways attracts birds, so he recommends grass height of 25.5 centimetres.

Landfill sites — a feasting site for gulls — should be prohibited near airports and ponds should be removed, said Dolbeer.

Techniques like shell crackers and propane cannons programmed to go off and distress calls broadcast from a loudspeaker can scare away birds.

As a last resort, birds might have to be killed, he said.

Dolbeer said new technologies are being tested to address bird congestion at airports.

THE CHRONICLE-JOURNAL Almanac Saturday, June 6, 1998

Pesky seagulls concern airline representatives

THE CHRONICLE-JOURNAL

How to keep pesky seagulls and other birds away from airports will be the focus of a two-day conference in Thunder Bay next week.

Representatives from airlines, waste management companies, Transport Canada, as well as the U.S. and Canadian military are to meet at the Valhalla Inn beginning Tuesday.

The bird problem was highlighted at Thunder Bay Airport last August when about a dozen gulls got sucked into the engine of a departing DC-9 jet, forcing it to abort its flight.

The airport is a resting spot for birds between the city dump and a nesting ground at the Mission Island conservation area.

The conference includes a keynote address Tuesday by a wildlife expert and a field trip later in the afternoon.

CANADA IN BRIEF

Airport hunter keeps animals away

EDMONTON (CP) — Ever since his boyhood on a farm where he studied and tracked wildlife, Mike Bott has hated killing animals. That's why his job today includes shooting at them on a daily basis — and missing.

Bott is the Edmonton International Airport's wildlife control officer.

As such, he patrols the 3,000-odd hectares of airport land to keep it clear of birds and animals that might get in the way of airplanes that can land as often as every two minutes.

"I don't enjoy killing things," said Bott, who is wearing his trademark blue overalls and camouflage-colored baseball hat.

"My method is scaring them."

A two-day conference is currently under way at the Valhalla Inn to discuss ways to keep birds away from airports.

THE CHRONICLE-JOURNAL Canada Tuesday, June 9, 1998

APPENDIX 11

A Techniques Manual and Video for the Management of Problem Urban Canada Geese

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University of Wisconsin
Madison, WI 53706-1598
(608) 263-5687

A TECHNIQUES MANUAL AND VIDEO FOR THE MANAGEMENT OF PROBLEM URBAN CANADA GEESE

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SCOTT R. CRAVEN, Department of Wildlife Ecology, 1630 Linden Dr., Rm #226, University of Wisconsin, Madison, Wisconsin, USA 53706-1598.

PAUL D. CURTIS, Department of Natural Resources, Room 114, Fernow Hall, Cornell University, Ithaca, New York, USA 14853-3001.

NOTE: This paper was first presented at the 18th Vertebrate Pest Conference, March 2-5, 1998, Costa Mesa, CA, USA (T.P. Salmon, Bus. Mgr., DANR: North Region, University of Calif., Davis, CA 95616-8575 http://www.davis.com/~vpc/welcome.html).

ABSTRACT: Social and management problems associated with urban Canada geese (*Branta canadensis*) are increasing in area, scope and magnitude. Although there are many articles on the management of urban Canada geese, none provide enough information for a reader to understand the impact geese have on different people, the ecology of the urban goose, evaluate the effectiveness of potential control options, choose appropriate management techniques, and then implement the chosen techniques. We present a manual and video which in combination, we

believe are not deficient in any of these areas. The video is intended to increase the awareness and knowledge of human/goose conflicts in urban and suburban environments. The manual covers the biology of Canada geese relevant to problem management in an urban setting and a comprehensive list of management techniques. Detailed instructions for implementation, permit requirements, sources of equipment and supplies, and a discussion of advantages, disadvantages, and characteristics, are included for each technique. To assist in choosing and locating appropriate techniques, quick reference summary tables are included.

KEY WORDS: birth control, Canada geese, habitat modification, hazing, removal, techniques manual, urban wildlife

INTRODUCTION

Canada geese are perhaps the most widely recognized bird in North America. Geese flying in V-formation signal changes in season and for many people have come to symbolize nature and wildlife. Canada goose numbers were once reduced to the point of near elimination in most parts of North America by unrestricted egg harvest, commercial hunting, and draining of wetland habitat. Thanks to enactment of strict harvesting regulations, creation of protective refuges, changes in crop planting and harvesting techniques, and creation of large, open grassy areas, Canada geese have rebounded and are no longer at risk. This astounding recovery is partly due to the fact that Canada geese are opportunistic and readily adapt to urban and suburban areas.

Scientists recognize several "races" or subspecies of Canada geese. The geese most commonly found in urban areas during spring and summer are called giant Canada geese (*Branta canadensis maxima*) and are the largest of the races. Giant Canada geese have undergone a phenomenal population increase from only a few thousand in 1965 in all of North America (Hanson 1965) to an estimated 1.1 million in just the central U.S in 1996 (Wood et al. 1996). This growth rate is not peculiar to North America; in Britain there has been an estimated 8% annual increase in numbers of Canada geese from 1976-1991 (Allan et al. 1995). Although a few geese may be desirable in a park, suburban pond, or backyard, such small populations increase rapidly and usually lead to problems which can be very difficult to control. Conflicts between Canada geese and humans in the urban environment have increased as goose populations have increased (Conover and Chasko 1985). Problems may be only a nuisance, such as droppings, aggressive behavior, and noise, or may represent a serious environmental threat or potential risk to human health and safety.

As a result of the increasing numbers of geese using urban areas, some major metropolitan areas in the upper Midwest and Northeast are faced with the increasing challenge of balancing Canada goose use of urban sites with human needs. As each municipality, wildlife agency, concerned citizens group or private organization has realized a human/goose conflict, they have discovered a single reference containing basic Canada goose management information is lacking. In some cases, local wildlife resources agencies have developed an informational bulletin or handout summarizing the dynamics of human/goose conflicts, outlining potential (and sometimes only favored) management techniques, and usually ending with phone numbers of the agency.

We have developed a techniques manual and video which will reduce the load on the resources of wildlife agencies to produce summary brochures or answer many questions over the phone. The combination of the video and manual will cover the problems associated with Canada geese in urban/suburban environments, Canada goose biology, state, provincial and federal regulations relevant to Canada goose management, techniques applicable to goose management in urban environments, and a wide list of suppliers.

The video is intended to increase awareness and knowledge of the human/goose problem, particularly the human dimensions components. It is 28.5 minutes long and is styled similarly to Public Broadcasting educational shows. The strength of the video is its ability to introduce the problems associated with human/goose conflicts to policy makers or general audiences. A summary of typical human/goose problems are introduced, alternative views from individuals with differing backgrounds are presented, then overviews of commonly used management techniques are shown.

The manual contains enough technical information that it may be used as a reference manual by professional wildlife biologists. However, it is written in a style that ordinary citizens can understand. The manual covers Canada goose biology as it relates to the urban/suburban environment including descriptions and general behavior, breeding behavior, nesting, molting, migration, and mortality. The Migratory Bird Treaty Act requires permits to harvest, or even handle, Canada geese. Information on US and Canadian regulations and permits concerning Canada geese is provided, including some example permit applications.

A section of the manual is devoted to the ideas of matching the ecology of the geese with various techniques and the importance of developing an integrated management strategy. This includes establishment of management goals, publicity, combining techniques for enhanced effects, and potential problems and advice for field personnel when applying certain techniques.

The largest section, and the focal point of the manual, is techniques. This section represents a sincere effort to document the state of knowledge about urban goose management practices as it existed in 1997. The primary intent is to provide a list of techniques currently in use or previously tried to alleviate human/goose conflicts in urban areas. Some techniques are highly specialized, site-specific, or may best be used in combination with other techniques. Thus, no attempt was made to rate or scale the techniques from "best" to "worst." Techniques are categorized on the basis of impact on geese (from least to greatest); prohibiting feeding, habitat modification, repellents, hazing/scaring, birth control, and removal. Within categories, groupings are based on similarity of techniques. Each technique is fully described and cited to the original studies or for further details. Each technique is also related to the part(s) of the goose ecology it affects, and strengths and weaknesses discussed. If a technique's effect may be enhanced if used in conjunction with another, the combination is noted.

Following the techniques section is a continent-wide listing of commercial suppliers of the preceding techniques. The compilation was made from a thorough literature search, however some suppliers were undoubtedly omitted. This table is provided as a convenience, and no endorsement is implied for those included nor were any suppliers intentionally omitted.

The final section consists of a summary look-up table for the techniques. Each technique is summarized by its strengths, weaknesses, qualitative cost estimates, timing and area of application, permits required for implementation, and a page number referencing its detailed description.

When these products are available, announcements will be made on The Wildlife Society (TWS) and WDAMAGE email lists and in the Probe and TWS Wildlife Damage Management Working Group newsletters.

ACKNOWLEDGEMENTS

We especially wish to thank M. R. Conover and the Berryman Institute, Utah State University for reviews and support on this project.

LITERATURE CITED

Allan, J. R., J. S. Kirby, and C. J. Feare. 1995. The biology of Canada geese *Branta canadensis* in relation to the management of feral populations. Wildlife Biology. 1:129-143.

Conover, M. R., and G. C. Chasko. 1985. Nuisance Canada goose problems in the eastern United States. Wildlife Society Bulletin. 13:228-232.

Hanson, Harold C. 1965. The giant Canada goose. Southern Illinois University Press, Carbondale. 226 pages.

Wood, John C., Donald H. Rusch, and Mike Samuel. 1996. Results of the 1996 spring giant Canada goose survey in the Mississippi Flyway. Wisconsin Cooperative Wildlife Research Unit, Unpublished Report, 8 page mimeo.

APPENDIX 12

Survival, Movement and Harvest of Translocated Canada Geese

3 June 98
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RH: Translocating Nuisance Geese · Smith et al.

SURVIVAL, MOVEMENT AND HARVEST OF TRANSLOCATED CANADA GEESE

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NOTE: This paper is being prepared for submission to The Journal of Wildlife Management.

ABSTRACT: We studied the survival, movement and harvest of intra-state translocated juvenile Canada geese (mostly *Branta canadensis maxima*) released at state wildlife areas (WAs) in Ohio

and Michigan, 1988-93. Our objectives during this study were three-fold: first was to determine if the physical stresses incurred during translocation had a detrimental effect on the geese as measured by survival; second was to measure the return rates of translocated birds to their original capture sites during the breeding season following translocation and third was to investigate the contribution translocated geese have on sport harvest at the release sites;. We also compared the performance of two survival model selection techniques, Akaiki's Information Criteria (AIC) and a modification of AIC, Quasi-likelihood AIC (QAIC).

We found that for WA release sites with both translocated and resident juvenile cohorts, first-year survival estimates should either be combined over groups or would retain estimates with confidence interval overlap suggesting no measurable adverse effect on survival brought about by translocation. There was no evidence of any return of the translocated geese to their original capture sites by the first breeding season after release, unlike resident urban or WA geese. Translocated geese also had very similar observation and recovery distributions as the resident WA group during the first hunting season after release. Comparisons of first-year survival rate estimates indicated that resident urban juvenile groups had more than double the survival probabilities than urban geese translocated to WAs and then released. Throughout all survival analyses, AIC and QAIC performed very similarily, even though there appeared to be evidence of nonindependence in the capture-recapture data structure.

We conclude that the transportation process during intra-state translocation does not appear to adversely affect juvenile Canada goose survival, and that translocation and release at state WAs is an effective management technique alleviating local nuisance problems associated with juvenile geese while concurrently providing harvest opportunities at the release sites. This technique retains the goose-resource within state boundaries, allowing recovery of the

technique retains the goose-resource within state boundaries, allowing recovery of the translocation cost through assessments and licensing fees. These results may not apply when translocating intact family units, groups of only adults or groups including nonbreeding adults and juveniles.

KEY WORDS: *Branta canadensis maxima*, giant Canada geese, harvest rate, Michigan, movement, nuisance, Ohio, resighting rate, survival rate, translocation

APPENDIX 13

"No Airspeed Restriction" Bird Strike Report - FAA

FAA/ASRS Telecon Agenda
February 19, 1998

(1) ASRS Intakes
(2) SRs Received Since the February 5 Telecon
(3) Air Traffic Incident Breakdown: (NMACs, Pilot Deviations, Operational Errors, Emergencies, etc.)
(4) Alert Bulletins (ABs) and For Your Information Notices (FYIs)
(5) ASY-1 Alert Items selected from 86 reports:

Item No: 1

Pertinent Report(s): 390448, 390515, 390699

Subject: Multiple Bird Strikes - Departing Houston (IAH), TX

9 Jan. 1998 Snow Geese

Key Points:

A. An air carrier B727-200 flight crew, departing IAH, reported multiple bird (geese) strikes.
B. The strikes occurred at 6000 feet and 280 knots speed.
C. Damage was extensive to the wings and nose area, and included loss of power to the Number One engine. Number Two and Three engines were also damaged.
D. The flight declared an emergency and returned to IAH.
E. The reporters contend that above normal speed permitted at IAH under the "No Airspeed Restriction" test program may have reduced their visual reaction time.
F. The reporters contend that above normal speed permitted at IAH under the "No Airspeed Restriction" test program may have reduced their visual reaction time.

Callback Done: Yes

Follow-Up: Recommend **For Your Information Notice** the IAH Airport Manager and IAH Air Traffic Manager, with copies to ASY-300, AFS-900 and ATX-400

#1

ACCESSION NO	: 390448; 390515; 390699;
DATE OF OCCURRENCE	: 9801
REPORTED BY	: FLC PERSONS FUNCTIONS: FLC,PIC.CAPT; FLC,FO; FLC,SO;
FLIGHT CONDITIONS	: VMC
REFERENCE FACILITY ID	: IAH
FACILITY STATE	: TX
FACILITY TYPE	: TRACON
FACILITY IDENTIFIER	: IAH
AIRCRAFT TYPE	: B727-200
ANOMALY DESCRIPTIONS	: IN-FLT ENCOUNTER/OTHER; ACFT EQUIPMENT PROBLEM/CRITICAL; OTHER
ANOMALY DETECTOR	: COCKPIT/FLC

ANOMALY RESOLUTION : OTHER

ANOMALY CONSEQUENCES : ACFT DAMAGED

NARRATIVE:

ON CLBOUT FROM IAH, PASSING 6000 FT, ACCELERATING, EXTREMELY LOUD BANG, FOLLOWED BY INTENSE VIBRATION IN AIRFRAME, AND NOISE LEVEL IN COCKPIT INCREASED TO THE POINT WHERE COM BTWN CREW MEMBERS BECAME VERY DIFFICULT. INITIALLY DID NOT KNOW WHAT HAD HAPPENED, BUT FO SAID 'BIRDS.' I DECLARED EMER, AND ASKED FOR IMMEDIATE RETURN IAH. I TOLD FO TO SLOW ACFT DOWN, AS WE WERE AT 280 KTS, PARTICIPATING IN IAH'S TEST TO ALLOW SPDS UP TO 250 KTS BELOW 10000 FT. WE TURNED TOWARD ARPT AND STARTED TRYING TO ASCERTAIN WHAT PROBS WE HAD. THE NOISE LEVEL IN COCKPIT WAS SO SEVERE COM WITH FELLOW CREW MEMBERS AND CHKLIST READING WAS NEAR IMPOSSIBLE. (I DID GET SO TO MAKE PA TO PAX.) IT BECAME APPARENT THAT WE HAD LOST ENG #1 AND ALL OF FO'S PITOT STATIC INSTS. FO CONTINUED FLYING, USING MY INSTS, AND I WORKED THE CHKLISTS WITH SO'S.

IT WAS IMPORTANT TO NOTE THAT ONE OF THE MOST IMPORTANT FACTORS THAT LED TO THE TIMELY AND SUCCESSFUL CONCLUSION TO THIS EMER WAS THAT WE HAD 2 SO'S, AS WE HAD A CHK SO GIVING IOE TO A NEW HIRE. HAVING THE 2 OF THEM TO RUN CHKLISTS AND ACCOMPLISH ALL THAT HAD TO BE DONE, PLUS KEEPING THE CABIN AWARE OF OUR SIT, ALLOWED MORE FREEDOM FOR MY COPLT AND ME TO CONCENTRATE ON GETTING THE ACFT SAFELY ON THE GND. THE MOST IMPORTANT THING TO ME WAS TO GET THE AIRPLANE IMMEDIATELY ON THE GND, AS I DID NOT KNOW IF THE REMAINING ENGS HAD INGESTED ANY BIRDS OR FOD. (I SUSPECTED FROM THE NOISE, WHICH WAS LATER CONFIRMED, THAT WE HAD LOST THE RADOME. IN FACT, #2 ENG ALSO HAD FOD DAMAGE, BUT WAS NOT FOUND UNTIL POST FLT.)

I TOOK CTL OF THE ACFT ON FINAL AFTER THE FO HAD CONFIGURED IT AND MADE THE LNDG. I MUST STRESS THAT THE ENVIRONMENT IN THE COCKPIT WAS VERY DIFFICULT, AND HAD WE ONLY BEEN 3 IN THE COCKPIT, I SERIOUSLY DOUBT WE WOULD HAVE COMPLETED ALL OF THE CHKLISTS (WHICH WE DID), AS THERE WAS NO WAY, WITH THE KNOWN AND UNKNOWN CONDITION OF THE ACFT, THAT I NEEDED MORE THAN 3 GEAR DOWN AND LOCKED TO LAND. AFTER HAVING EMER EQUIP CHK ACFT, WE TAXIED TO THE GATE. POST FLT REVEALED MOST OF THE RADOME GONE. RADAR ANTENNA GONE, #1 ENG GUTTED, #2 ENG FOD DAMAGED, SEVERE IMPACT DAMAGE TO R WING LEADING EDGE IN SEVERAL AREAS, AND GOOSE FEATHERS. IN MY OPINION, A TEST TO INCREASE SPDS ABOVE 250 KTS IN AREAS OF KNOWN BIRD ACTIVITY (ANOTHER ACR HAD SIMILAR EVENT WITHIN 30 DAYS) IS NOT SAFE.

CALLBACK CONVERSATION WITH RPTR REVEALED THE FOLLOWING: THE RPTR IS A CAPT FOR A MAJOR ACR AND HE FLIES THE B727-200. HIS ACFT SUFFERED EXTENSIVE DAMAGE DURING A NIGHT, MULTIPLE BIRD STRIKE

INCIDENT DURING A HIGH SPD DEP FROM IAH. HE SAID THAT THE GEESE STRUCK THE #1 ENG IN THE INTAKE, BREAKING SOME OF THE COMPRESSOR BLADES, AND CAUSING SUCH VIOLENT VIBRATIONS THAT THE ENG COWLING DOORS UNLATCHED, AND THEY CAME OPEN IN FLT CAUSING ADDITIONAL AERODYNAMIC PROBS. THE #2 ENG WAS ALSO SEVERELY DAMAGED AND HAD TO BE REPLACED BY MAINT. THE #3 ENG PYLON WAS STRUCK AND PENETRATED, DAMAGING SOME OF THE INTERNAL EQUIP, REQUIRING THE STRUT TO BE REPLACED. THE RADOME WAS PENETRATED AND FINALLY DEPARTED, AS DID THE RADAR ANTENNA.

ALSO, THE FORWARD PRESSURE BULKHEAD BEHIND THE RADOME WAS PERFORATED. THE LEADING EDGES OF BOTH WINGS WERE DAMAGED, WITH THE R WING'S IN BOARD KRUGER FLAP PENETRATED THROUGH AND INTO THE INTERIOR OF THE WING ITSELF. THE IN BOARD SLAT ON THE R WING WAS ALSO PERFORATED THROUGH AND INTO THE WING. HE SAID THAT THE PITOT TUBE FOR THE FO WAS TORN FROM THE ACFT, RENDERING HIS AIRSPD INDICATOR UNUSABLE. THE CAPT FEELS THAT THE FACT THAT THE ACFT WAS FAIRLY LIGHT AT THE TIME (134000 LBS), AND THAT THEY HAD AN EXTRA, HIGHLY EXPERIENCED SO ON BOARD WAS VERY HELPFUL IN RETURNING SAFELY. HE EMPHASIZED THAT HE THINKS THAT THE LOW ALT, HIGH SPD DEP TEST PROGRAM WAS NOT A GOOD IDEA, IN HIS OPINION, BECAUSE OF THE AMOUNT OF LARGE BIRDS AT THIS TIME OF YEAR NEAR IAH. HE SAID THAT HIS LANDING LIGHTS WERE ON, BUT HIS RADAR WAS OFF.

THIS WEEK, WHEN HE FLIES THE SAME FLT, HE WILL LEAVE HIS RADAR ON IN THE HOPE THAT ANY XING BIRDS WILL SENSE HIS APCHING ACFT, AND HE WILL NOT EXCEED 250 KTS TO GIVE THEM MORE AVOIDANCE TIME. THE CAPT ALSO SAID THAT HE HAS HEARD OF ANOTHER ACR HAVING MULTIPLE BIRD STRIKES DURING A HIGH SPD DEP FROM IAH RECENTLY.

SUPPLEMENTAL INFO FROM ACN 390515: ON DEP FROM IAH, PASSING APPROX 6000 FT, IN CLB AND ACCELERATING, WE HIT WHAT APPEARED TO BE A FLOCK OF LARGE WHITE BIRDS. I SAW A 'FLASH' OF WHITE OBJECTS, FOLLOWED IMMEDIATELY BY THE LOUD 'BANG' OF MULTIPLE HITS. THE ACFT BEGAN TO VIBRATE OR SHUDDER, AND THE NOISE LEVEL IN COCKPIT WAS EXTREMELY LOUD. WITH VOLUME ALL THE WAY UP, I COULD BARELY MAKE OUT RADIO XMISSIONS. AT FIRST I COULD NOT HEAR THE SO AT ALL, AND COMS WITH THE CAPT WERE DIFFICULT. A SECOND 'SHUDDER' OCCURRED, WHICH I NOW BELIEVE WAS PART OF THE RADOME AND/OR THE RADAR ANTENNA SEPARATING FROM THE ACFT. THE VIBRATION AND NOISE LEVEL IMPROVED AT THIS TIME (ALSO AS WE SLOWED THE ACFT). THE NOISE LEVEL IN THE COCKPIT MADE NORMAL CREW COORD AND CHKLIST DISCIPLINE EXTREMELY DIFFICULT. THE #1 ENG WAS RUNNING, BUT AT A REDUCED LEVEL, WITH OSCILLATING INDICATIONS. I ATTEMPTED TO ACCELERATE THE ENG, AND IT VIBRATED EXCESSIVELY.

WE DECIDED TO SHUT THE ENG DOWN (#2 AND #3 ENG INDICATIONS WERE NORMAL). I WAS STILL FLYING THE ACFT, BUT HAD NO ACCURATE AIRSPD INDICATIONS. I WAS REFERENCING THE CAPT'S AIRSPD INDICATOR ACROSS THE

COCKPIT. THE CAPT COORDINATED THE ENG SHUTDOWN PROCS WITH THE SO'S WHILE I DSNDED, SLOWED AND TURNED TOWARD IAH RWY 14L. WE WERE FORTUNATE TO HAVE A LINE CHK SO IN THE COCKPIT GIVING AN IOE TO A NEW HIRE ENGINEER. HIS ASSISTANCE BACKING UP OUR SO, MAKING PA'S TO PAX, AND SPEAKING WITH FLT ATTENDANTS WAS EXTREMELY HELPFUL.

AT THIS TIME, THE CAPT TOOK CTL OF THE ACFT (HE HAD AIRSPD INDICATOR) AND COMPLETED THE APCH AND LNDG. ON INSPECTION, #1 ENG WAS SEVERELY DAMAGED, AND THERE WAS EVIDENCE OF RADOME PIECES GOING THROUGH THE #2 ENG. 2 HOLES/IMPACTS WERE NOTED ON R WING LEADING EDGE. R SIDE OF RADOME WAS CRUSHED/MISSING, AND THE RADAR ANTENNA WAS MISSING. IAH ISSUED US A 'NO AIRSPD LIMIT' CLRNC ON CLBOUT, IN ACCORDANCE WITH A TEST PROGRAM ALLOWING SPDS ABOVE 250 KTS BELOW 10000 FT. OUR FLT PLAN INCLUDED A NOTE STATING OUR AIRLINE WOULD PARTICIPATE IN THIS PROGRAM. MY PLAN WAS TO ACCELERATE TO 300 KTS FOR THE CLBOUT (WE HAD DEPARTED LATE). I BELIEVE WE WERE AT 280 KTS WHEN WE HIT THE BIRDS. ALTHOUGH I DON'T BELIEVE THIS PROC WAS RESPONSIBLE FOR THIS INCIDENT IN ANY WAY, THE EXTRA AIRSPD CERTAINLY DID NOT HELP. THIS WAS THE FIRST AND LAST TIME I WILL ACCEPT HIGHER AIRSPDS AT LOW ALTS. SHOULD WE BE 'TESTING' HIGHER AIRSPDS IN AN AREA OF KNOWN BIRD ACTIVITY?

SUPPLEMENTAL INFO FROM ACN 390699: CHAIN OF EVENTS: NORMAL GND OPS AND TKOF FROM IAH. ALL SYS NORMAL. ACFT CLEANED UP WITH ALL GEAR AND FLAPS RETRACTED. ACCELERATED TO 250 KTS WITH NEW IAH DEP SPD PROGRAM. PASSING APPROX 7000 FT MSL, SAW APPROX 15-20 WHITE BIRDS APPEAR IMMEDIATELY IN FRONT OF ACFT AND HEARD VERY LOUD IMPACT SOUNDS. NOISE STAYED VERY LOUD, EVEN AFTER INITIAL IMPACT. (LATER DISCOVERED TO BE DUE TO SIGNIFICANT RADOME DAMAGE.) #1 ENG SUFFERED SEVERE DAMAGE. WE SHUT IT DOWN. R (FO) AIRSPD INDICATOR WAS INOP. FLT ATTENDANTS NOTIFIED US OF STRONG 'BURNT FLESH' SMELL. BECAME LESS NOTICEABLE AFTER #1 ENG AND #1 AIR CONDITIONING PACK SHUT DOWN. SO (ONE IN TRAINING, MYSELF INSTRUCTING) COMPLETED ENG FAILURE CHKLISTS, DSCNT CHKLISTS, AND APCH AND BEFORE LNDG CHKLISTS.

CAPT ASSUMED FLYING DUTIES DUE TO FO'S AIRSPD INDICATOR FAILURE. FO ASSISTED SO'S IN CHKLISTS. DECLARED EMER, SQUAWKED 7700, RECEIVED VECTORS FOR VISUAL APCH TO RWY 14L AT IAH. UNEVENTFUL LNDG. TAXIED CLR. INSPECTED BY FIRE PERSONNEL, THEY OKAYED OUR TAXI TO THE GATE. UNEVENTFUL TAXI AND SHUT DOWN. CONTRIBUTING FACTORS:

NIGHT MADE BIRDS IMPOSSIBLE TO SEE UNTIL IMMEDIATELY BEFORE IN/ALT. TEST PROGRAM TO CLB AT 300 KTS (US 250 KTS BELOW 10000 FT MSL) ALLOWED US TO BE AT 280 KTS, PROBABLY KEEPING US AT A LOWER ALT LONGER, AND MORE EXPOSED TO LOW ALT BIRD THREATS. HIGHER SPD AND PROBABLY INCREASED DAMAGE. HUMAN FACTORS: ALTHOUGH WE TOLD FLT ATTENDANTS WE'D HIT A FLOCK AND LOST AN ENG, THEY COULDN'T COM TO US LATER THAT THEY'S

INITIALLY SEEN A BRIGHT FLASH FROM #1 ENG. THE LOUD COCKPIT NOISE FROM DAMAGED RADOME PRECLUDED OUR HEARING THEIR INTERPHONE CHIME. INSTEAD OF KNOCKING ON COCKPIT DOOR, THEY ASSUMED WE KNEW ABOUT THE FLASH AND LOUD NOISE FROM #1. IN FACT, ALL WE SAW WAS FALTERING #1 INST READOUTS AND VIBRATION FROM THE #1 THROTTLE.

Form Approved
OMB No. 2120-0045

U.S. Department of Transportation
Federal Aviation Administration

BIRD STRIKE INCIDENT/INGESTION REPORT
Other Wildlife Species May Be Described Here
Operation Cost and Engine Damage Information

APR 16 1998

1. Name of Operator: DAL	2. Aircraft Make/Model: B-727-247	3. Engine Make/Model: JT 8D-15A
4. Aircraft Registration: N 2809W * SHIP # 559	5. Date of Incident (DD, MM, YY): 1-9-97 98	6. Local Time of Incident: ☐ Dawn ☐ Dusk ☐ Day ☒ Night 1925
7. Aerodrome Name: IAH	8. Runway Used: 26	9. Location if En Route (Nearest Town/Reference and State): 12-20 DME IAH 355°R
10. Height (AGL): 6000 feet	11. Speed (IAS): 280 knots (TEST PROGRAM IAH SPEEDS 280 BELOW 10K)	

12. Phase of Flight
- ☐ A. Parked
- ☐ B. Taxi
- ☐ C. Take-off
- ☒ D. Climb
- ☐ E. En Route
- ☐ F. Descent
- ☐ G. Approach
- ☐ H. Landing Roll

13. Part(s) of Aircraft Struck or Damaged

	Struck	Damaged
A. Radome	☐	☒
B. Windshield	☐	☐
C. Nose	☐	☒
D. Engine No. 1	☐	☒
E. Engine No. 2	☐	☒
F. Engine No. 3	☐	☐
G. Engine No. 4	☐	☐
H. Propeller	☐	☐
I. Wing/Rotor	☐	☒
J. Fuselage	☐	☐
K. Landing Gear	☐	☐
L. Tail	☐	☐
M. Lights	☐	☐
N. Other *(specify)*	☐	☐

14. Effect on Flight
- ☐ None
- ☐ Aborted Take-Off
- ☒ Precautionary Landing
- ☒ Engines Shut Down
- ☐ Other *(specify)*

15. Sky Condition
- ☒ No Cloud
- ☐ Some Cloud
- ☐ Overcast

16. Precipitation
- ☐ Fog
- ☐ Rain
- ☐ Snow

17. Bird Species
SUSPECT GEESE

18. Number of birds seen and/or struck

Number of Birds	Seen	Struck
1	☐	☐
2-10	☐	☐
11-100	☐	☒
more than 100	☐	☐

19. Size of Bird(s)
- ☐ Small
- ☐ Medium
- ☒ Large

20. Pilot Warned of Birds
☐ Yes ☒ No

21. Remarks *(describe damage, injuries and other pertinent information).*
ENG #1 TOTALLY DESTROYED, ENG #2 FODDED BUT RUNNING, RADOME DESTROYED, RADAR ANTENNA GONE, RT WING SEVERELY DAMAGED SEVERAL PLACES ALONG LEADING EDGE

* From JP Airline Msgs

ENGINE DAMAGE COST INFORMATION

22. Aircraft time out of service: ? hours	23. Estimated cost of repairs or replacement ($ U.S. in thousands): $ 5,000,000	24. Estimated other cost ($ U.S. thousands) (e.g. loss of revenue, fuel, hotels): $?

Reported by *(Optional)*	Title	Date
Bruce D. Harris	CAPT	1-10-97

FAA Form 5200-7 (8-95) Supersedes Previous Edition

NSN: 0052-00-851-0004

BIRD STRIKE INCIDENT/INGESTION REPORT (Continued)

SPECIAL INFORMATION ON ENGINE DAMAGE STRIKES

Reason for failure/shutdown	Engine 1	Engine 2	Engine 3	Engine 4	Comments
Unconditional Failure	☒	☐	☐	☐	#2 ENG REPORTED FODDED ON PAST FLIGHT.
Fire	☐	☐	☐	☐	
Shutdown — Vibration	☒	☐	☐	☐	
Shutdown — Temperature	☐	☐	☐	☐	
Shutdown — Fire warning	☐	☐	☐	☐	
Shutdown — Other (specify)	☐	☐	☐	☐	
Shutdown — Unknown	☐	☐	☐	☐	
	☐	☐	☐	☐	
Estimated percentage of thrust loss*	TOTAL				
Estimated number of birds ingested	2-5				

**These may be difficult to determine but even estimates are useful.*

NSN: 0052-00-651-9004

FAA Form 5200-7 (6-95) Supersedes Previous Edition

Agency Display of Estimated Burden: The FAA estimates that the average burden for this report form is 5 minutes per response. You may submit any comments concerning the accuracy of this burden estimate or any suggestions for reducing the burden to the Office of Management and Budget. You may also send comments to the Federal Aviation Administration, Program Support Branch, ARP-11, 800 Independence Avenue, SW, Washington, DC 20591, Attention: OMB number 2120-0045.

*U.S. Government Printing Office: 1995 — 623-192/83121

U.S. Department of Transportation
Federal Aviation Administration
800 Independence Ave., S.W.
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Penalty for Private Use $300

APPENDIX 14

Update - Bird Control Program - BFI - Prairie Green Landfill

BFI **Browning Ferris Industries**®

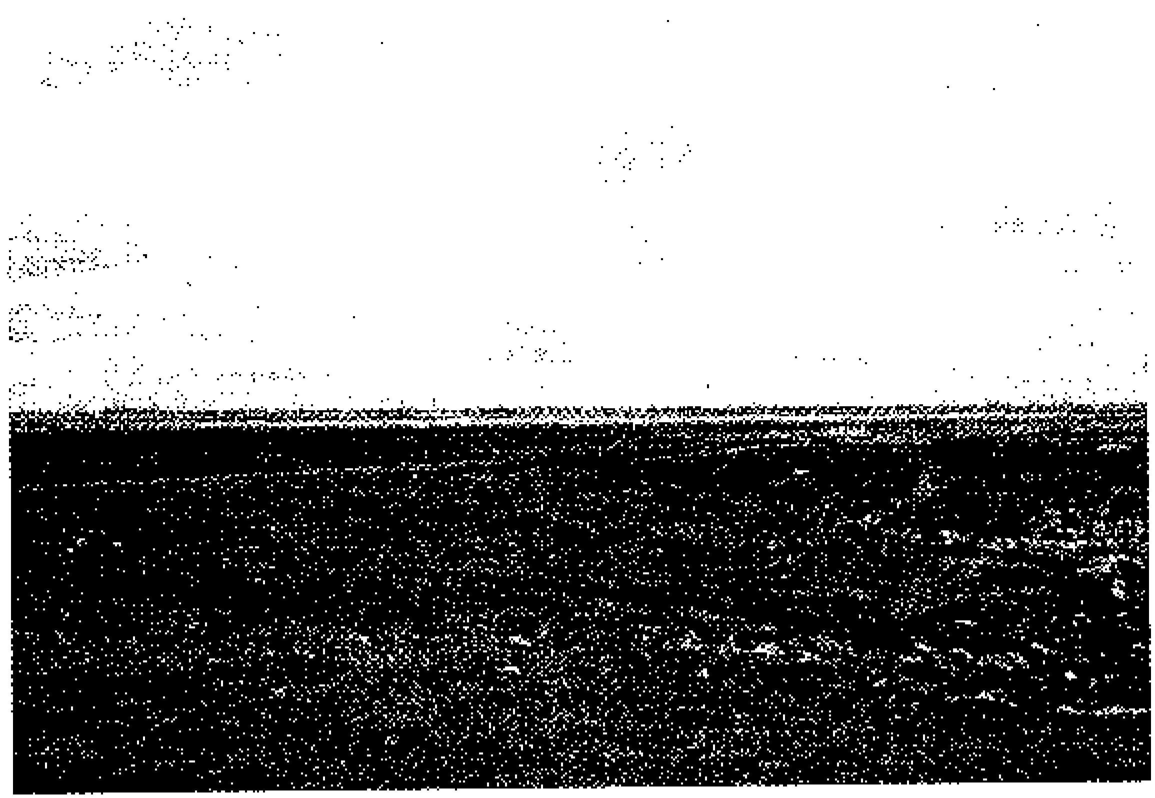
Bird Study Review 1997-98

Prairie Green Integrated Waste Management Facility

Rosser, Manitoba

Prairie Green Landfill

Prairie Green Landfill

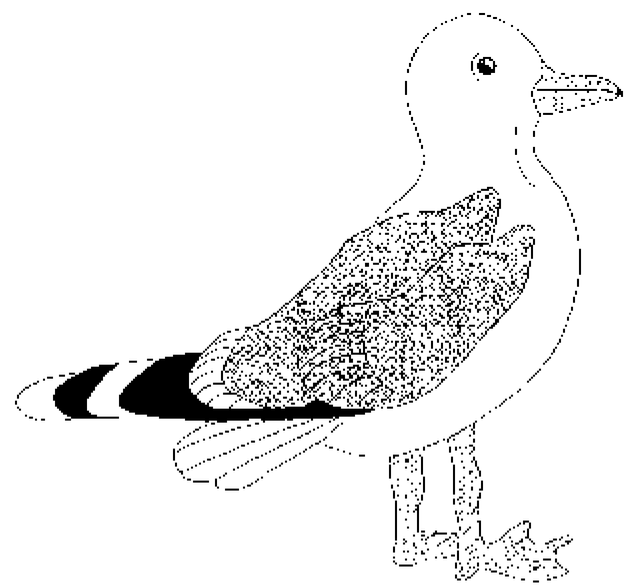


1997-98 Bird Study Goals

- Ascertain the effectiveness of BFI's bird control program
- Comparative analysis of other sites
- Follow-up of recommendations of LGL study of 1996

Critical Objective

- Gulls ***must never be allowed to feed or loaf*** **on any part of the landfill property**



BFI

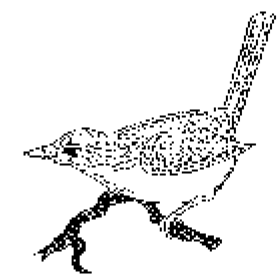
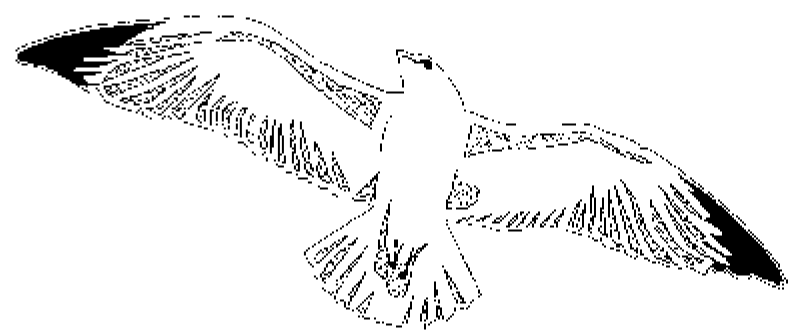
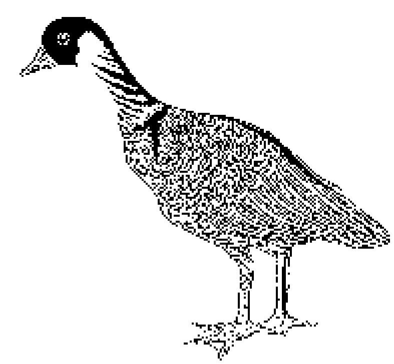
BFI Bird Control Program

- *1996 Bird Study conducted by LGL*
- *1997-98 Follow-up conducted by Dillon Consulting*
- *1998 Spring study completed*
- *Possible 1998-1999 Capital Region Bird Study program*

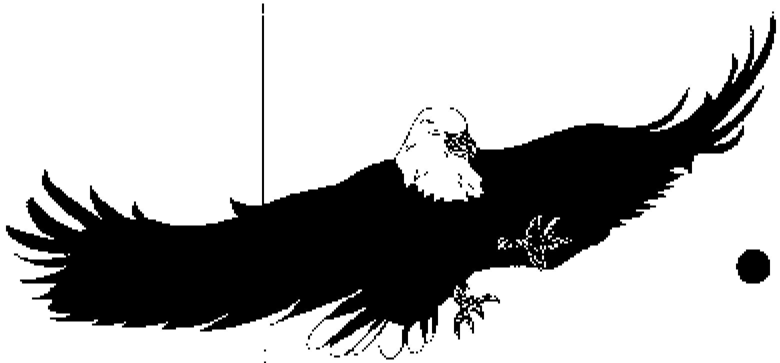
BFI

Species of Birds at Prairie Green

- Herring Gull
- Ring-billed Gull
- Franklin's Gull
- Canada Geese
- Snow Geese
- Blue-winged Teal
- Other

Control Methods



- Pyrotechnics
  - Screamers
  - Bangers
- 12 gauge Shotgun
- Natural predators

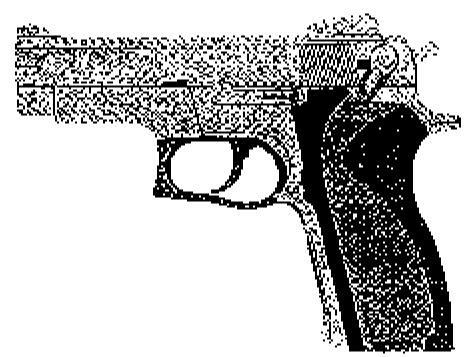
Team/Resources

- All landfill staff instructed in the use of pyrotechnics
  - every piece of heavy equipment utilizes pyrotechnics kit
  - 12 gauge rifle is only used by
    - Operations Manager
    - ESH Manager

BFI

Firearms Procedures

- Restricted to active landfill cell and adjacent property only
- Preference to use firearms only when the site is free of trucks



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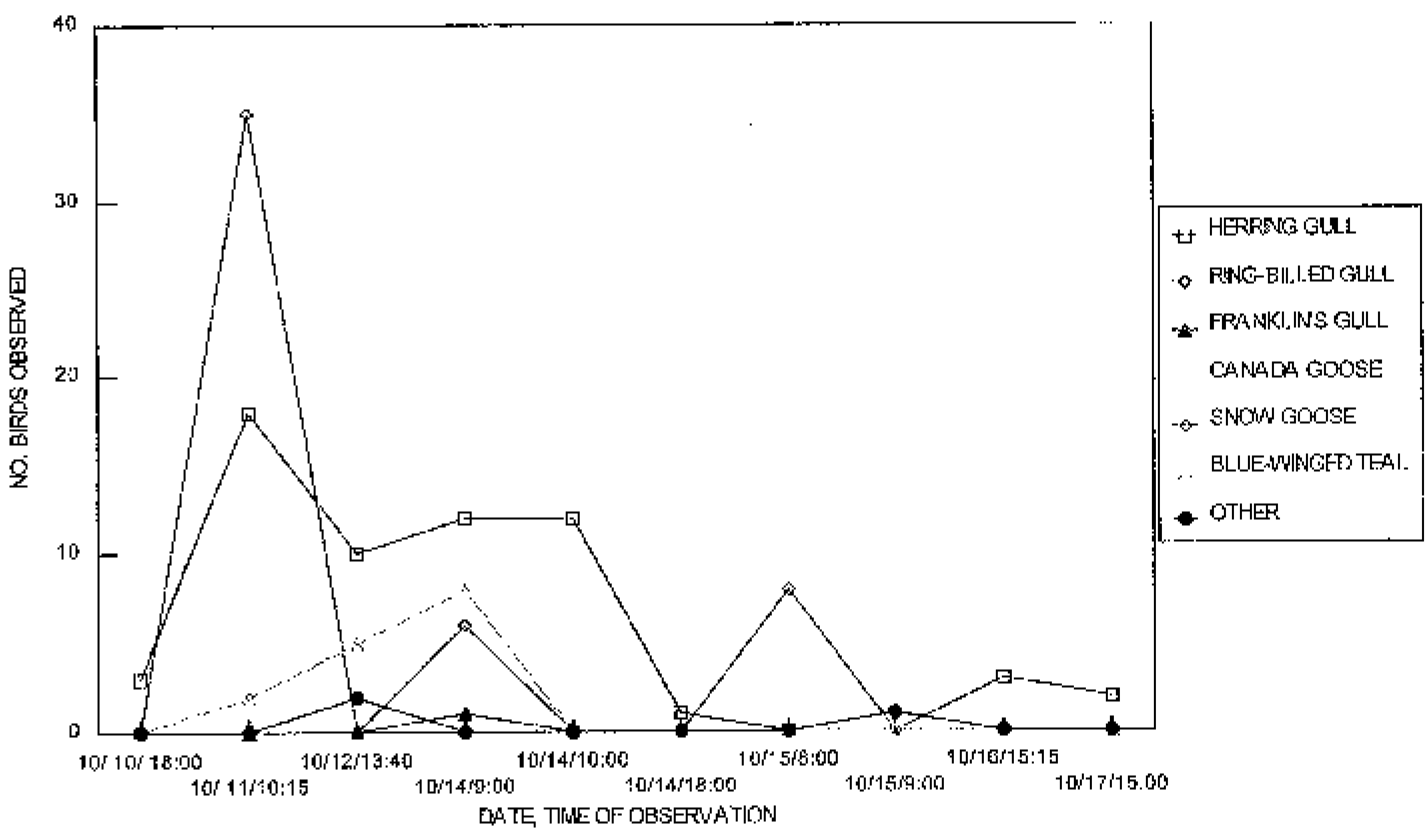
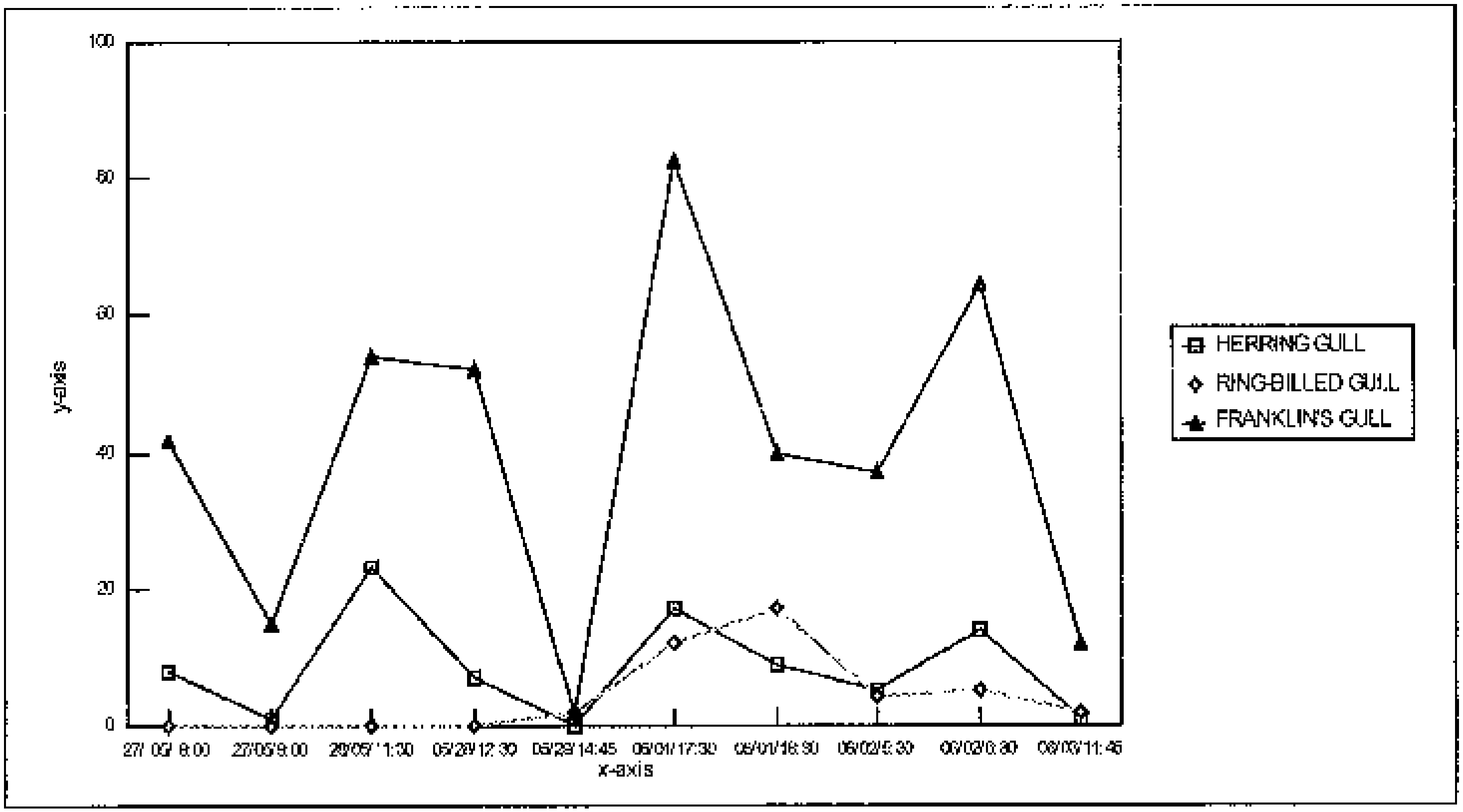
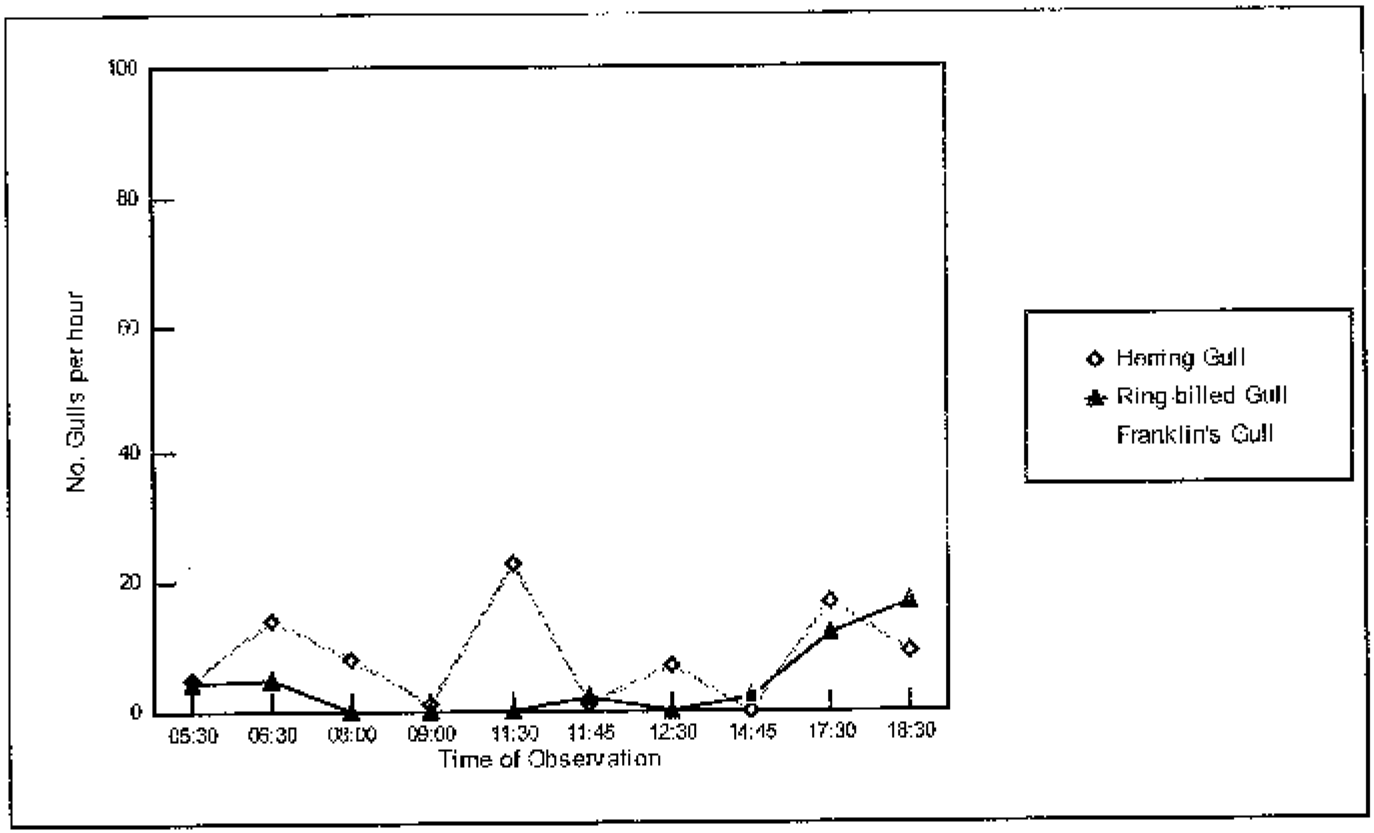
1997-Fall Monitoring Results



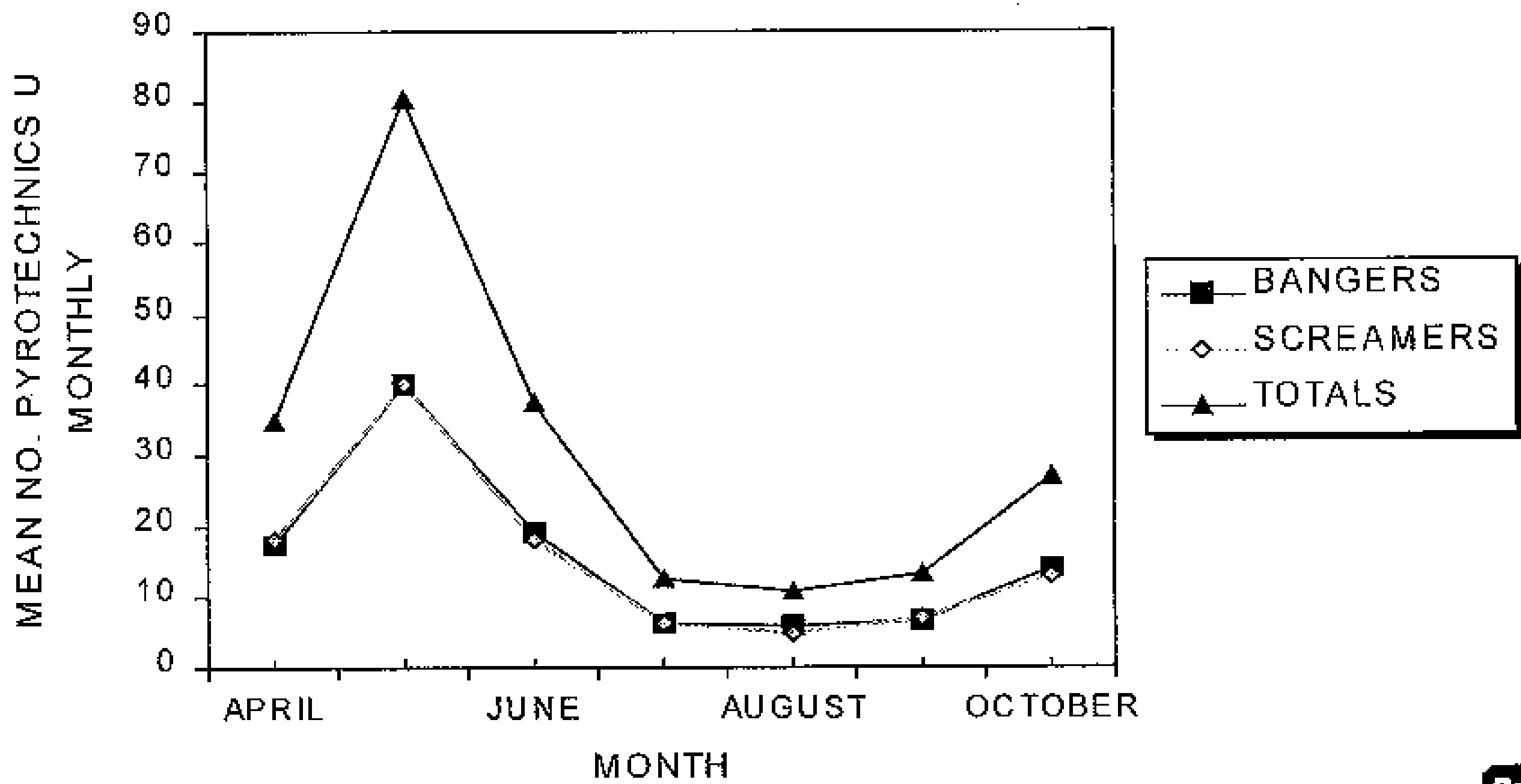
1998 Spring Monitoring Results



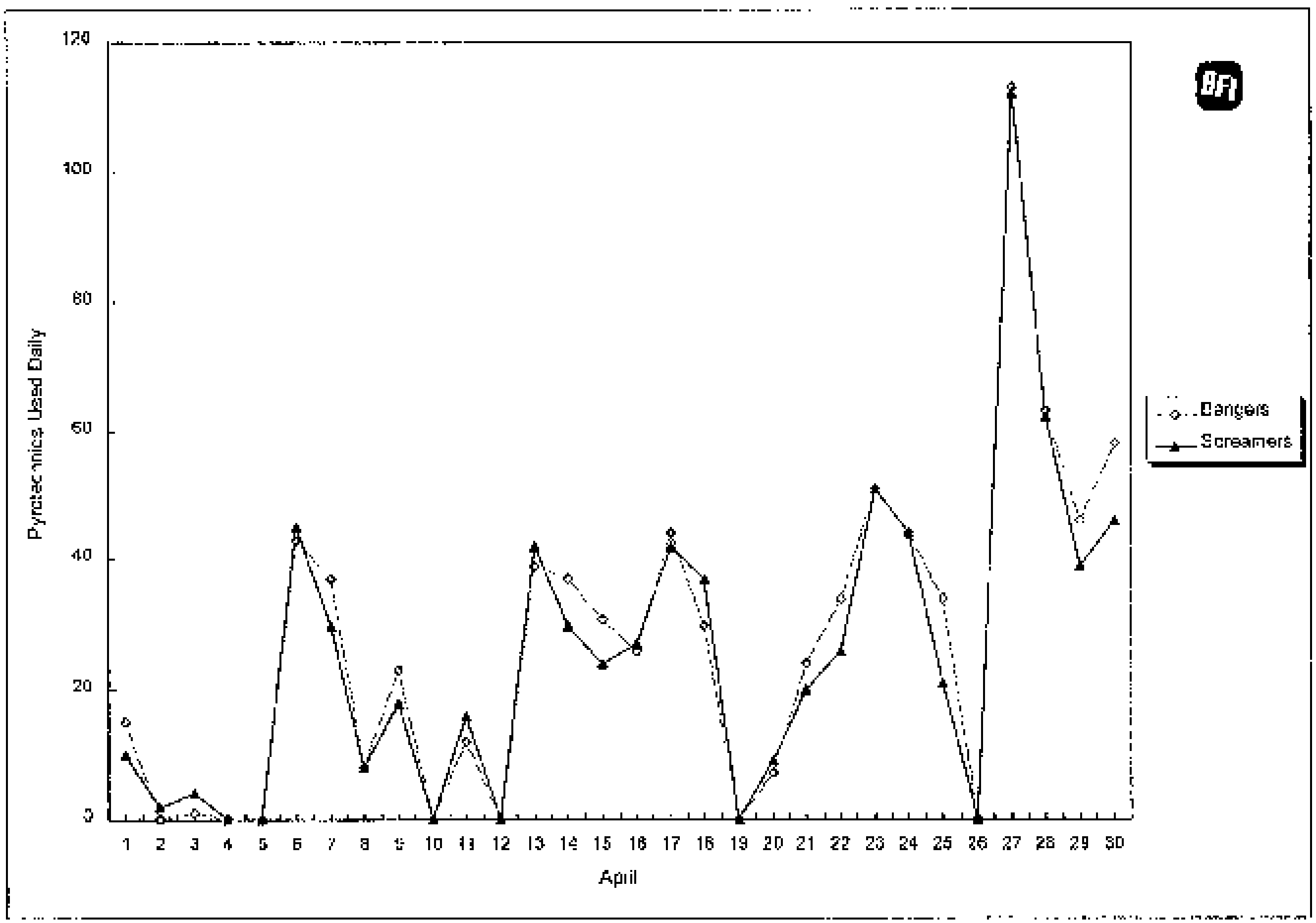
1998 Time of Day Observations



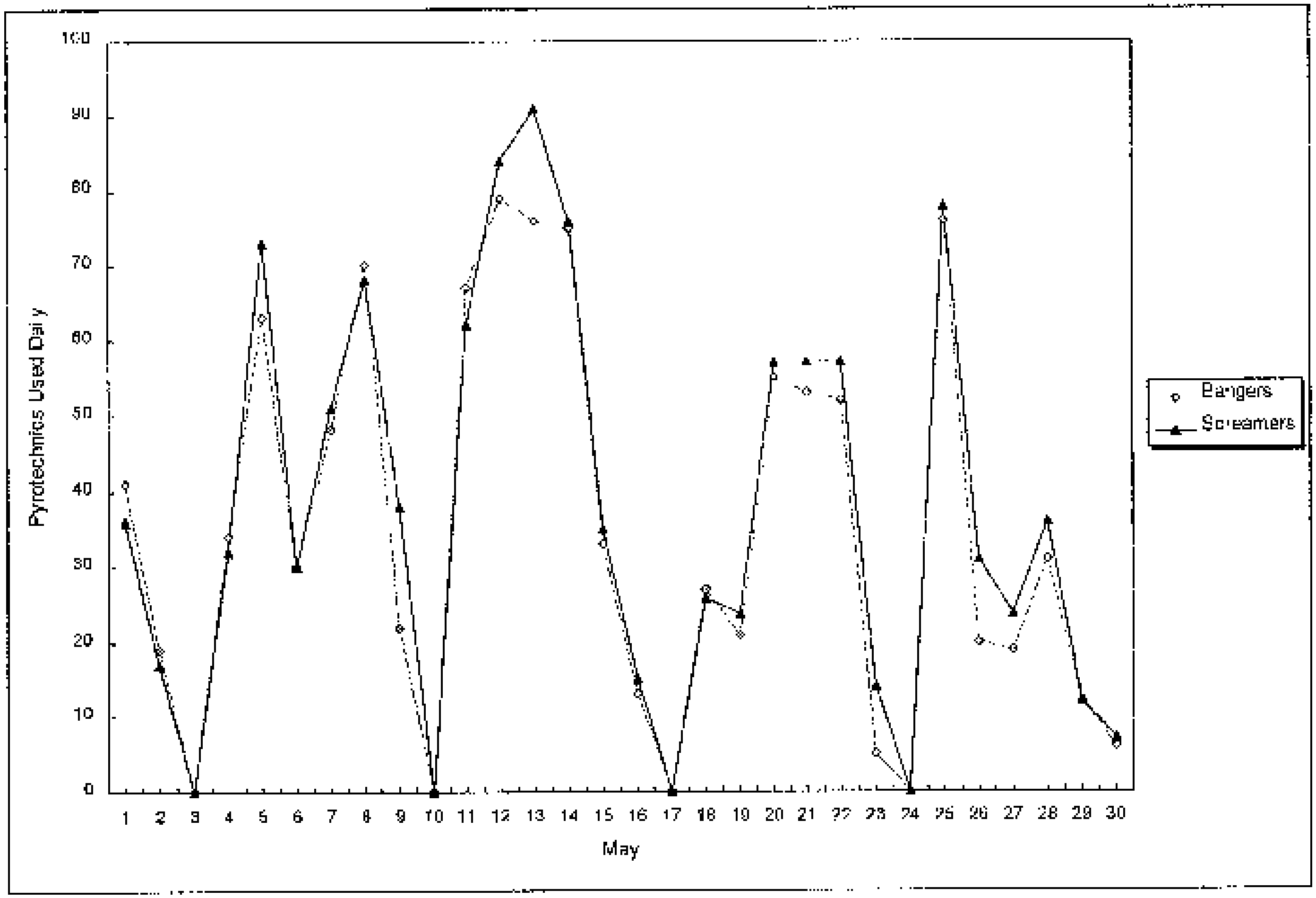
1997 Pyrotechnic Usage



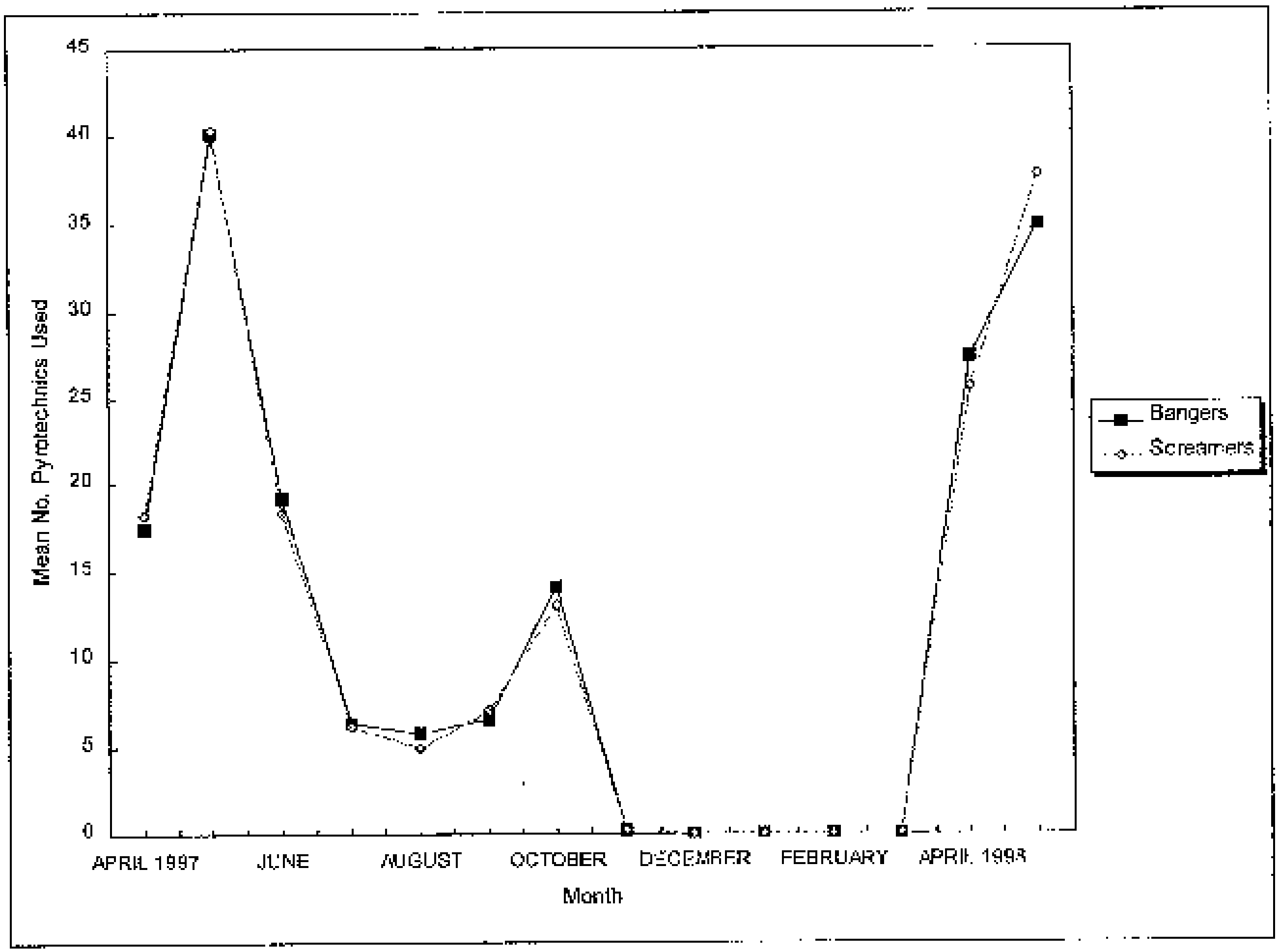
APRIL1998 - Pyrotechnics Usage



MAY 1998 - Pyrotechnic Usa



1997-98 Pyrotechnic Usage



Comparative Analysis

- Comparative analysis of BFI Landfill and:
  - Rockwood Institute, Stony Mountain
  - Winnipeg International Airport
  - City of Winnipeg Summit Road Landfill
  - Agricultural/Farm lands

Corrections Canada - Rockwood Institution

Corrections Canada

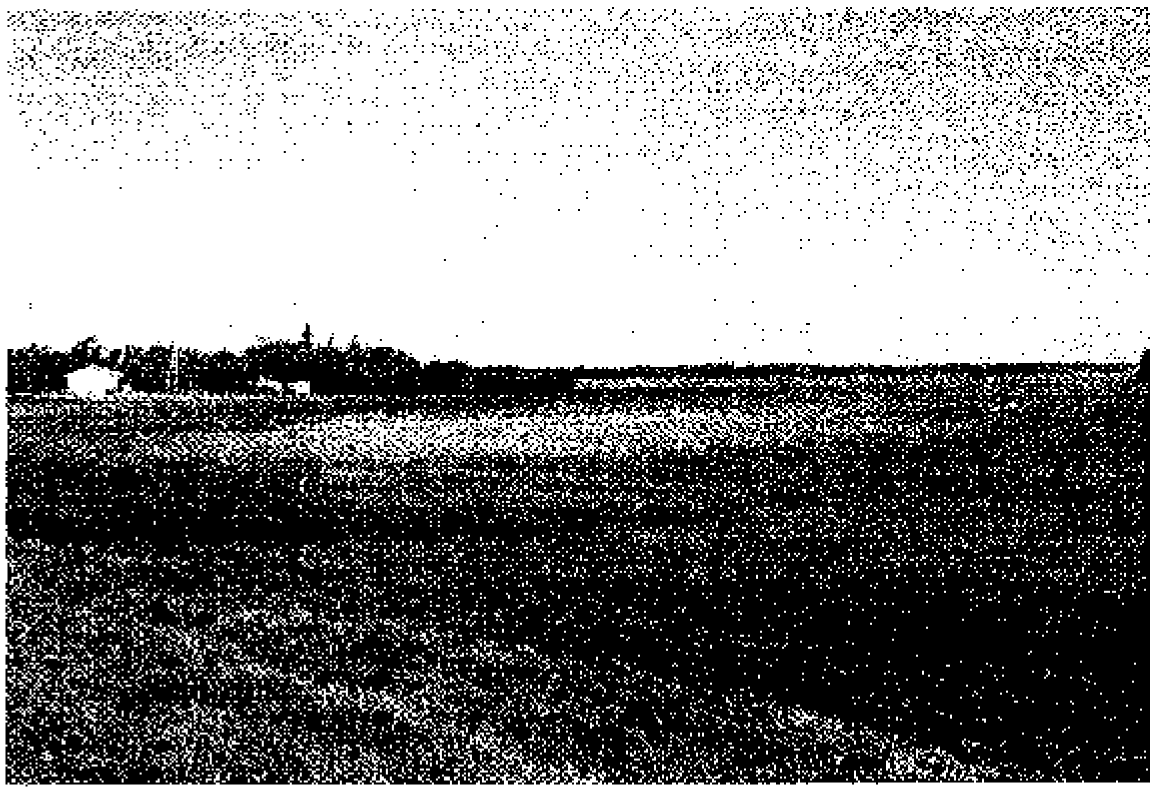
Rockwood Institute - Composting Facility

City of Winnipeg - Brady Road Landfill

City of Winnipeg - Brady Road Land

Poor Avian Management - Large Working Face
Lack of Cover M[illegible]

Agriculture Area



FARM - One Mile from [illegible]

Any Questions?

- **Stan Kruse**
  204.633.9730
  - Stan.Kruse@bfi.com
- **Rhian Christie**
  204.453.2301
  - rchristie@dillon.ca

APPENDIX 15

Chemical Immobilization Program for White-Tailed Deer at the Minneapolis - St. Paul Int'l Airport

Chemical Immobilization Program for White-tailed Deer

Minneapolis-St. Paul International Airport

MSP 1997

- 3,100 Acres
- 3 Runways
- 491, 273 Aircraft Operations
- Approximately 1, 350 operations per day
- Approximately 1 operation every minute

Background Policy

- Kill the animal only as a last resort
  -
  - Chasing deer off of AOA through open gates
  -
  - Call for MN DNR response
  -
  - Position deer and then remove with 12 gauge slug or 00 Buckshot

Incidents

- NW DC10 landing 12R - Deer on runway - Go around
- Deer chased across public highways
- Personal Injury - Intern attempted to tackle deer
- Captured deer - Died from Capture Myopathy in front of a plane full of passengers

Review of Existing Procedures and Methods

- Chasing of deer
- Response of MN DNR
- Use of 12 Gauge shotgun

New AOA Policy

- Immediately remove the animal with as little impact to operations as possible
-
- Safety of the public is the first and highest priority
-
- Safety of the operator is paramount

Research for Alternative Methods

- Capture methods - Baiting, Driving
- High powered rifle - Sniper
- Archery
- Crossbow
- Chemical Immobilization

Criteria For The Method

- It must be safe for the person(s) using it!
- It must be safe for the surrounding environment!
- It must provide minimum exposure time of the animal on the AOA!
- It must be as simple as possible!

Issues That Arose

- What are the political forces involved?
- What are the economic considerations?
- Are there any regulatory concerns?
- Are there any social problems - real or perceived?

Chemical Immobilization as the Primary Method

- What was chemical immobilization all about - Our perceptions?
-
  - Wild Kingdom - Jim Fowler and Marlin Perkins
  -
- Assistance - Wildlife Veterinarian

Legal Considerations - Drug

- Sponsorship
- Ordering and storage
- Dispensation
- Record keeping
- Investigational New Animal Drug - INAD Exemption

Criteria for Immobilizing Drug

- Must be relatively safe for humans
- Must act rapidly (<10 min)
- Effective amount must be minimal
- Must allow for beneficial use of the carcass after capture and euthanasia

Rationale for Selection of Succinylcholine

- Fast-acting
- Effective in small amounts
- Relatively safe for humans
- Not effective orally (meat can be eaten)
- Short-lived (animals not captured will recover rapidly if dosed correctly)

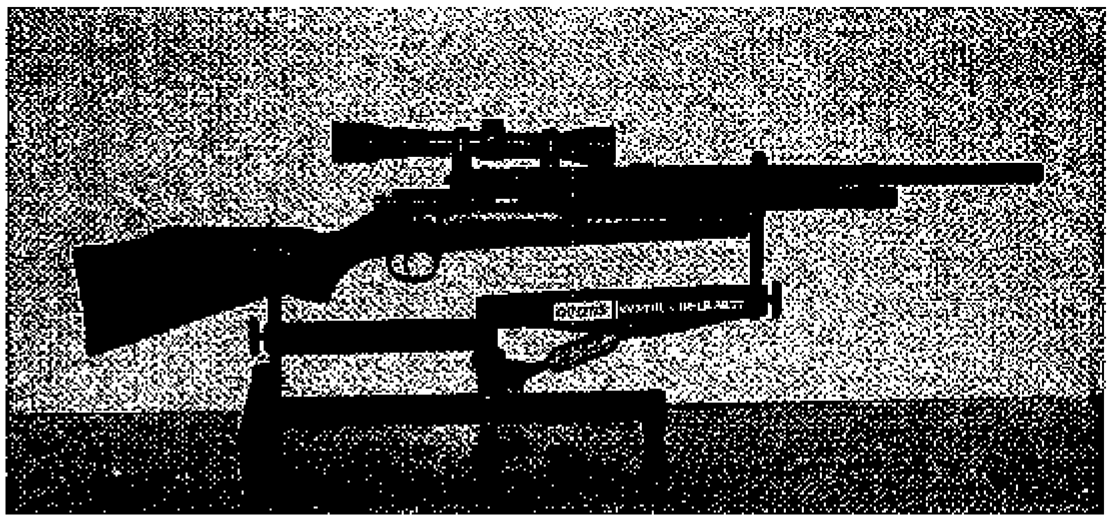
Delivery Systems

- Three types
  - .22 caliber
  - CO_2
  - Compressed air

Delivery System Considerations

- Maximum effective range
- Availability of propellant
- Temperature sensitivity
- Impact injury
- Maintenance
- Performance reliability
- Ease of use

Pneu-Dart Model 171



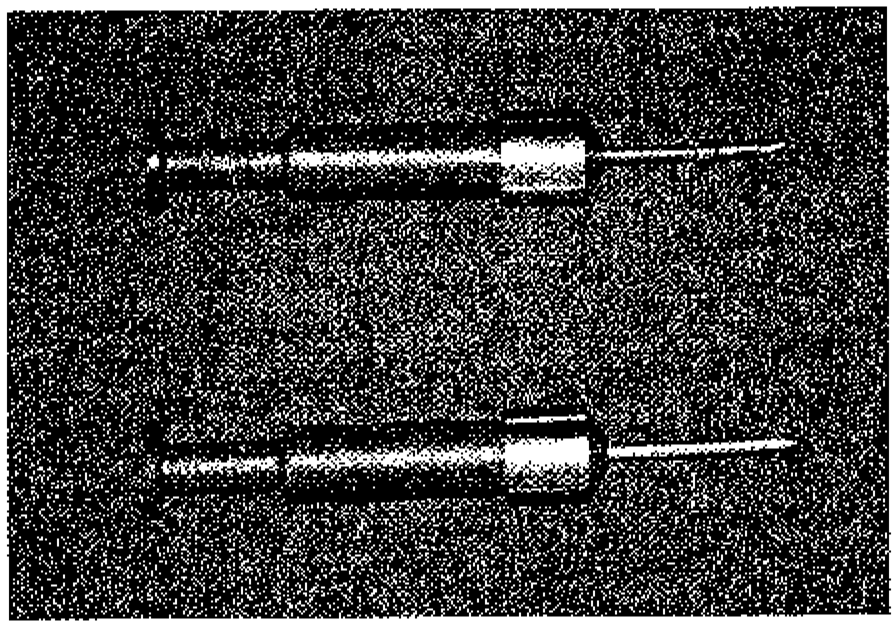
Dart Systems

- Four types of systems
  - Powder
  - Compressed air
  - Gas
  - Spring

Dart System Considerations

- Injection speed
- Weight
- Volume
- Reliability
- Contents under pressure

Pneu-Dart 1 ml Dart



Planning for the Capture Event

- TRAINING - TRAINING - TRAINING
  - Deer anatomy and physiology
  - Effects of drug on the animal
  - Drug handling
  - Equipment
  - Immobilization Event
  - Accidental human exposure
  - Basic first aid and CPR

The Capture Event

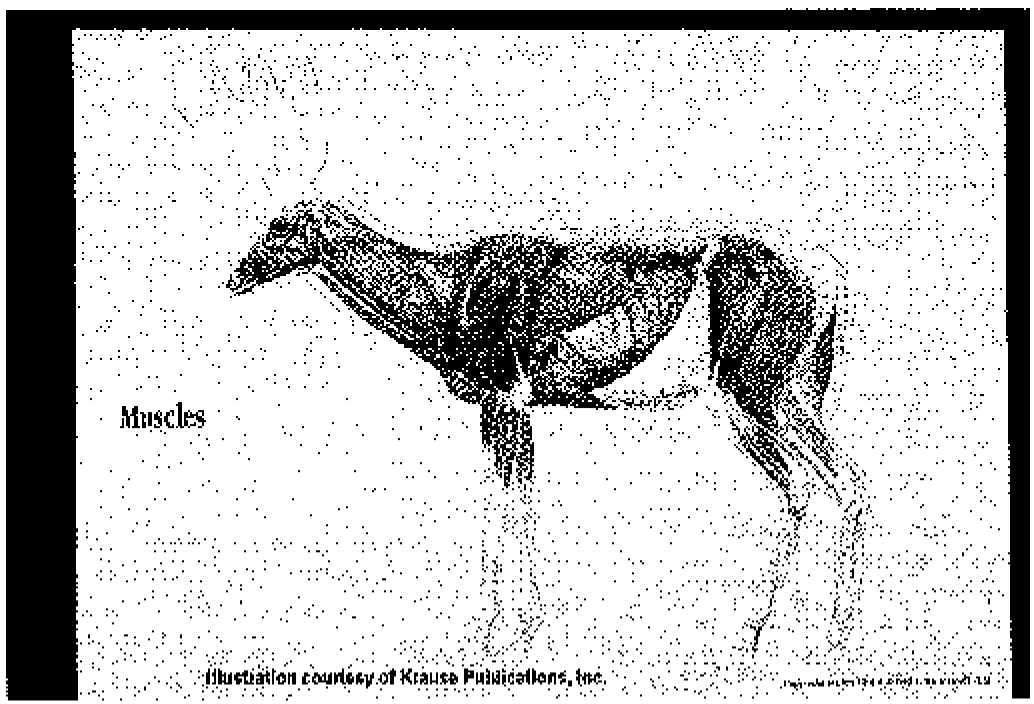
- Have everything that you need with you
- Check darts and gun before using
- Prepare darts before hand
  - Wear protective gloves and eye wear
  - Carefully withdraw drugs from vials
  - Safe handling of needles, syringes and darts

The Capture Event

- Don't load gun until ready to approach the animal
- Approach the animal in vehicle
- Estimate wind direction and speed

The Capture Event

- Administration sites



The Capture Event

- Recognizing the signs of immobilization
- Handling the immobilized deer
  - Approach from the rear
  - Don't make any loud or sharp noises
- Euthanasia
  - Quickly and humanely as possible

Conclusion

- Chemical Immobilization of White-tailed deer at MSP is a safe and effective tool because there is:
  - A NEED
  - Sufficient buy-in from all levels - Support
  - Proper funding
  - Consideration for the animals!
  - TRAINING - TRAINING - TRAINING

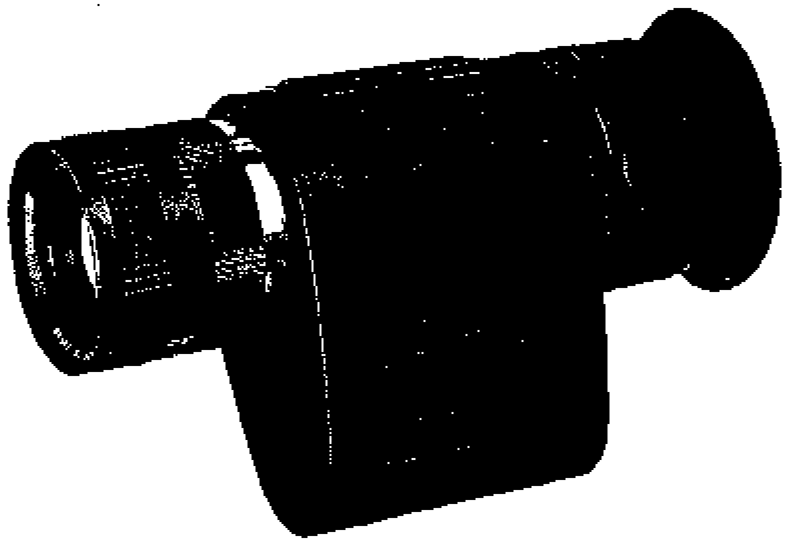
APPENDIX 16

Innovative Products for Wildlife Control

NIGHT QUEST®

190 Night Vision Viewer

The Night Quest 190 from ITT combines rugged construction with camera adaptability to create a versatile night vision viewer. Perfect for on the water, the NQ 190 works as a hand-held unit and easily attaches to a 35mm camera or camcorder. For nighttime safety, sports and fun, Night Vision viewers from ITT give you the power to see®.



Accessories Available

- 50mm lens
- Infrared Illuminator
- 180/190 DX Kit

Features

Two Operating Modes

One provides surveillance for long time use and the other shuts off to conserve battery life.

Low Battery Indicator

A flashing red light will indicate low battery charge.

Interchangeable Lens

The lens can be replaced with any interchangeable c-mount lens.

Automatic Brightness Control (ABC)

Provides constant brightness under differing light levels.

Weather Resistant

The viewer is weather resistant up to a driving rain.

NIGHT QUEST 190 Specifications	
Tube	Generation 3
Resolution	45 lp/mm
Photoresponse	No less than 1,000 μa/lm
Signal-to-Noise	16.2:1
Magnification	1X
Field of View	40°
Focal Length	25mm
Focus Range	1 ft to infinity
Battery Type/Life	"AAA" (2 required) Approx. 30 hours
Diopter Range	-6 to +2
Size	5"L X 2"W X 3.2"H
Weight	18 oz.

TUBE INFORMATION

The Generation 3 tube used in this product uses the same materials, processes and personnel that produce the high performance products available to the U.S. Armed Forces. Our guaranteed minimum performance specifications for photoresponse, signal-to-noise ratio, and resolution will provide a night vision image that is superior in clarity and resolution.

ITT NIGHT VISION™

The Power To See®

the CURRENT™ CORPORATION

THE CURRENT SALES CORPORATION
2227 ST. JOHNS STREET, PORT MOODY, B.C. V3H 2A6
TEL: (604) 937-5559 / FAX: (604) 939-9199
www.currentcorp.com

Net Launcher

Net **Launchers** are precisely machined from aluminum and incorporate an expansion chamber for a compressed gas charge which deploys the Net at more than 45 meters per second. **The Net** is made from an advanced lightweight fabric. **The Officer Hand Launcher** de-

ploys its high strength Net over the target within a distance of up to 5 or 8m, depending on choice of Cannons. Once covered by the Net, the target's struggle to free himself will typically result in further entanglement. During the struggle, the Officer gains a significant advantage which is used to subdue and handcuff target. The **Stationary Automatic Launcher** is mounted near building entry points and secured areas. Designed to work with existing alarm systems, the SAL is activated by an intruder alert signal and launches when the target moves within range. The self-contained **Portable Automatic Launcher** provides temporary perimeter security where multiple exit points exist. **Shoulder Launchers** provide military and tactical teams with a high coverage Net that fires 15m or more into and above a crowd. Once movement is restricted, the user can selectively determine sources of disturbance.

Models Available

Officer Hand Launcher
Law Enforcement & Security Forces
5 x 5 Net / 2.5m Expansion window
2.5m target range / muffled report

ERT/Military Hand Launcher
Emergency Response Teams and Military
3 x 5 Net / 1.2m Expansion window
2-8m target range / standard report
Optimized for close quarter applications

Stationary Automatic Launcher
Commercial and High level Security
5 x 5 Net / 2.5m Expansion window
4 meter target range
Optional chemical dispersion
Autonomous or complimentary use

Shoulder Launcher
7 x 7m to 10 x 10m Net
2-8 meter target range
15m target range / custom range on request

Non-lethal defense is a top priority with law enforcement and military agencies around the world. CETEC Net Launchers provide these agencies with a cost-effective approach to aid in the arrest of targets with a minimum of injury. Any device that fires a projectile can cause harm to soft tissue.

Officer Hand Net Launcher Packages :

Trial Package: $733
1 Launcher
3 Net Cannons
6 Cartridge

Basic Package: $1465
2 Launchers
6 Net Cannons
12 Cartridges

Standard Package: $4400
6 Launchers
18 Net Cannons
36 Cartridges

Complete Package: $8250
12 Launchers
36 Net Cannons
72 Cartridges

Manufactured by Cetec GmbH Leipzig of Germany

The Curran Corporation

2221 St. Johns Street
Port Moody, B.C., Canada
V3H 2A8

Phone: 604-937-3379
Fax: 604-939-0136
Email: [illegible]@currantcorp.com

GETEC GmbH Leipzig develops, produces and distributes non-lethal security and defense systems based on the high speed deployment of lightweight Nets against select targets.

GETEC systems include Hand Launchers for law enforcement and personal security use, Shoulder Launchers for military applications and emergency response, and Stationary Launchers for perimeter security and business applications.

Major components include Net Cannons, reusable Launching Systems, and optional chemical dispersion.

Net Cannons are precisely machined from aluminum and incorporate an expansion chamber for a compressed gas charge which deploys the Net at more than 45 meters per second.

The Net is made from an advanced lightweight fabric with a tensile strength of 150 Newton.

The **Officer Hand Launcher** deploys its high strength Net over the target within a distance of up to 5 or 8 m, depending on choice of Cannons. Once covered by the Net, the target's struggle to free himself will typically result in further entanglement. During the struggle, the Officer gains a significant advantage which is used to subdue and handcuff the target.

The Stationary Automatic Launcher is mounted near building entry points and secured areas. Designed to work with existing alarm systems, the SAL is activated by an intruder alert signal and launches when the target moves within range.

The self-contained **Portable Automatic Launcher** provides temporary perimeter security where multiple exit points exist.

Shoulder Launchers provide military and tactical teams with a high coverage Net that fires 15 m or more into and above a crowd. Once movement is restricted, the user can selectively determine sources of disturbance.

GETEC GmbH Leipzig is applying patented Net Launching technology to a variety of new applications scheduled for release through 1998 and 1999.

Non-lethal defense is a top priority with law enforcement and military agencies around the world. GETEC Net Launchers provide these agencies with a cost-effective approach to aid in the arrest of targets with a minimum of injury.

Any device that fires a projectile can cause harm to soft tissue. GETEC Net Launchers should only be used by qualified personnel professionally trained in the use of firearms.

GETEC Net Launchers are available in North America through a network of dealers listed on www.getec.com and through the offices listed below. Our fax-back service at 604.331.8796 will send selected documents to your fax number.

Officer Hand Launcher OHL5

- Law Enforcement and Security Forces
- 5 x 5 m Net - 70 x 70 mm mesh
- 2.5 m expansion window
- 2 to 5 m target range
- muffled report
- general security applications

Officer Hand Launcher OHL8/ERT

- Emergency Response Teams and Military
- 3 x 5 m Net - 70 x 70 mm mesh
- 1.2 m expansion window
- 2 to 8 m target range
- standard report
- optimized for close quarter applications

Stationary Automatic Launcher SAL

- Commercial and High Level Security
- 5 x 5 m Net - 70 x 70 mm mesh
- 2.5 m target expansion window
- 4 m target range
- optional chemical dispersion
- autonomous or complimentary use

Shoulder Launcher SL

- Emergency Response Teams and Military
- 7 x 7 m to 10 x 10 m Net - 70 x 70 mm mesh
- 15 m target range: custom range on request
- vehicle mounted systems on request
- ideal for gang fights and riots

Launcher Accessories

- Training Net Cannons: lower price and test strength with similar launch characteristics
- 9 mm Gas Cartridges: box of 50
- Mounting Kits: fit standard issue flashlights
- Custom SAL camouflage systems

Future GETEC Net Launchers

- Animal Control Launcher
- Personal Hand Launcher
- Long Range Ballistic Net Launcher
- Vehicle Mounted Net Launcher

Getec America Corporation

1420 Fifth Avenue
Suite 2200, Seattle
Washington 98101
206.224.7607 bus
206.224.2880 fax

In Canada:
1238 Melville Street
Suite 2101, Vancouver
British Columbia v6e4n2
604.331.8795 bus
604.331.8794 fax

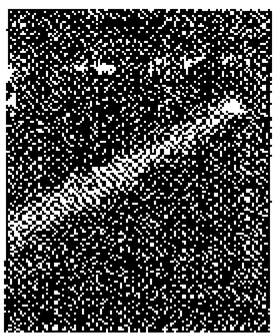
Internet:
home: www.getec.com
email: getec@getec.com

Faxback:
604.331.8796

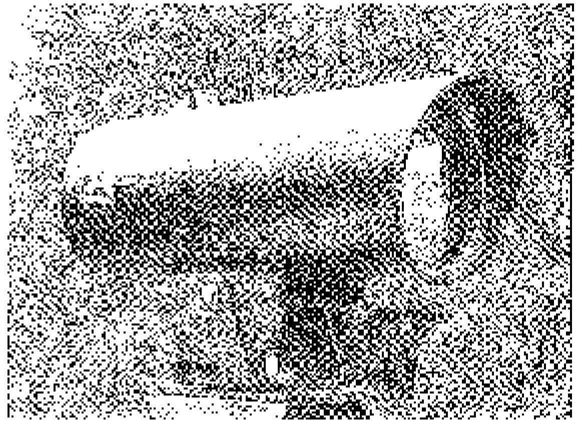
EHX

Searchlight

The EHX Searchlight is a six million candlepower searchlight in a weatherproof aluminum housing. It will illuminate targets up to two kilometers away using a short-arc 75 watt xenon lamp.



The beam can be focused to any angle between 2 and 40 degrees for use as a spotlight or a floodlight. The housing is pressurized to prevent damage to the light caused by dust, water or harmful gases. The standard model comes in a black anodized finish. Optional colors are White/Red/Blue/Green.



Models Available

All models Include 25 foot Remote control handle and Power cable

EMX125
EHX System c/w Heavy duty manual position control.

EMX225
EHX System c/w Mechanical lever control.

EMX325
EHX System c/w Electrical remote control pan & tilt

Heavy Duty Manual Positioner
Also available with Electrical remote control pan & tilt or Mechanical lever control

Infrared Filters Available

Semi-Covert Infrared Filter:
Has sharp cut-off at 715 nm. Slightly visible to the naked eye and has a range of 2000 meters with Generation 3 night vision equipment and infrared sensitive cameras.

Covert Infrared Filter:
Has sharp cut off at 850 nm. It has a range of 1200 meters and is compatible with Generation 3 night vision equipment and infrared sensitive cameras.

Specifications:

Nominal Power Consumption:
5.7 amps at 12 VDC
.6 amps at 120 VAC *
*(with EHX Power Supply)

Input Power:
12 Volts DC nominal
13.5 Volts DC maximum

Brightness:
4.2 & 6 Million Candlepower
(Programmable)

Environment:
-4 to 104 F (-20 to 40 C)

Weight: Light, 16.2 lbs. (7.4 kg.)
Shipping, 21 lbs. (9.5kg)

Dimensions:
18 long x 6.6" wide x 7.5" high.
(457 x 168 x 191mm)

The Current Corporation

2297 St. Johns Street
Port Moody, B.C., Canada
V3H 2A6

Phone: 604-937-6559
Fax: 604-939-2199
Email:

APPENDIX 17

Initial Estimates of the Costs of Bird-Aircraft Strikes to Canadian Civil Aviation

INITIAL ESTIMATES OF THE COSTS OF BIRD-AIRCRAFT STRIKES TO CANADIAN CIVIL AVIATION

1. METHODOLOGY

The primary sources of information for assessing costs of bird strike damage are available from published sources, Transport Canada and other regulatory agencies, aviation industry associations, proceedings from meetings of Bird Strike Committee Canada, Bird Strike Committee USA and Bird Strike Committee Europe, as well as solicited information from airline operators such as United Airlines, Lufthansa Airlines and Air Canada, aircraft manufacturer, and repair firms such as Boeing, and other companies providing services to the aviation industry. Also, to develop the most recent data, a number of Canadian as well as internationally recognized experts in bird strike hazards and related costs have reviewed this report and provided additional information from published, unpublished or otherwise obscure sources in order that this report can stand as a comprehensive and current summary of the state of knowledge on the subject of bird strikes to aircraft.

The challenge in developing meaningful estimates of costs related to bird strike damage to aircraft relates to the reality that the database is derived from a variety of sources that have recorded incidents for a variety of purposes, to an inconsistent level of detail, format and priority. There also is the potential for discrepancies between the primary data collected and the summary reports provided by airlines, military sources, airport operators, aircraft repair and maintenance firms and air industry regulators. As detailed in Section 2, above, the reporting rate for bird strike incidents is believed to be only 15-30% of the actual rate and the frequency of damaging strikes is also under reported, but probably to a lesser extent.

Much of the cost information presented in this report is comparative in nature. In order to facilitate direct comparisons between sources, the author has converted all references, unless otherwise indicated, to 1997 Canadian dollars, using Canadian Consumer Price Index data from the Statistics Canada website, an exchange rate of 1.30 Canadian dollars per 1.0 U.S. dollars (USD), 0.80 Canadian dollars per German Mark (DEM) and 2.25 Canadian dollars per British Pound Sterling. These exchange rates were selected to provide a reasonable approximation of average exchange rates over the past two decades.

In the competitive environment of commercial travel, an airline might be unwilling to publicize its bird strike rate if such information would lead to the public perception that the airline was in any way less safe to fly with than a competitor. However, experience in the U.S. to date indicates that airlines have not been exposed to public criticism as a result of a serious bird strike incident. Similarly, an airport operator might not willingly divulge bird strike information if such data could lead to the imposition of an expensive wildlife control program, invite future legal liabilities for an aircraft damage incident allegedly due to inadequate bird control measures or the public perception that the airport was not operated in a manner that protected public safety. Regardless, in the event of a serious U.S. incident, lawsuits naming the airport operators would likely follow and the media and public would focus on any obvious bird management problem that the operators were not actively trying to eliminate. As a co-operative service to civil aviation authorities and in the interests of public safety, both the Canadian and U.S. military divulge the incidence rates and costs of bird strikes on military tactical, training and transport aircraft. The USAF provides such information through a variety of it's websites, in the interests of reducing bird hazards to it's own operating units and the general public.

Data from the variety of sources may understate costs and not be directly comparable, for developing averages or trends. Many sources of data are unclear as to whether the cost of a repair includes parts only, parts and labour, or parts, labour and associated costs such as sending a repair crew with parts to a location away from a main repair depot to restore an aircraft to service. The costs associated with loss-of-use are rarely considered, but could be substantial for a large commercial aircraft. Lehmkuhl (1996) made the point that, with an insurance deductible typically in the range of 1.0-1.2 million USD per claim, the cost of repairs is likely to be under-reported, with only costs in excess of the deductibles being reported to insurers. Curtis 1998 (pers. com.) advised that generally, insurance on the hull excludes engines. Also, deductibles on the hull depend on the aircraft size, and will range from about US $500,000 to about US $1 million. Thus, it is rare that hull damage from a bird strike would lead to an insurance claim. The review of available information for this report also demonstrated that peripheral costs related to search and rescue, aircraft salvage, crash site cleanup, subsequent investigations and on-the-ground property damage or personal injuries are rarely, if ever, included. Such peripheral costs would rarely apply to bird strike incidents, except for major accidents involving large transport-type aircraft.

Mean costs and cost trends may also be exaggerated because the majority of bird strike reports are provided by commercial pilots, scheduled airlines and the military. These entities tend to operate larger, more expensive aircraft than the larger number of owners of typically smaller, private and executive general aviation aircraft, so any attempt to derive average cost data for aircraft damage will be skewed towards the more expensive repairs to large, multi-engined aircraft. With the inconsistent reporting rate for bird strikes and strike damage, it is next to impossible to estimate a correction factor for such a bias. While some evidence suggests that small, executive jets suffer a disproportionately large rate of damaging bird strike incidents, probably because of the high frequency of shorter flights and use of small airports, the majority of available data comes from the airline industry and military sectors, which account for a majority of the costs associated with bird strike damage to aircraft

By way of demonstrating some of the issues identified above, and to put Canadian carriers' costs into perspective with some of the costs documented or calculated in the following sections of this report, data from ten recent bird strike incidents in Canada, and one from the U.S., are presented in Table 1.

Table 1
A Summary Of Costs Related To Recent Bird-Aircraft Strike Incidents In Canada

Date	Location	Airline	Aircraft	Bird Species	Description of Incident and Damage	Estimated Costs
Jul-97		Air Atlantic				
Jul-97	Edmonton, AB	WestJet	Boeing 737	not known	Bird strike occurred while plane was taking off, at about 80 knots. The #1 engine was lost. Internal damage to the engine. More than 2 hours in delays.	> $600 000
Jul-97	Nanaimo, BC	Central Mountain Air	BEECHCRAFT 1900	2 to 10 geese	On departure from runway at about 600 ft the aircraft was struck on the nose, denting skin. Tail section and windshield also struck, but not damaged. Landed without incident.	Direct Costs: > $ 20 000
Jul-97	Fort Severn, ON	Bearskin Airlines	BEECHCRAFT	Gull	Damage to left wing and landing light. Aircraft out of service for 3 weeks.	$ 100 000
Jun-97	Vancouver, BC	Greyhound Airlines			Dent in leading edge of wing.	
Aug-97	Thunder Bay, ON	Air Canada	DC-9	Gulls	During take off the plane was struck by numerous gulls. Plane returned to airport after vibrations forced a shut-down of the left engine. Damage to left engine fan stages 1 and 2, numerous torn blades, blade and stator damage in core gas path, core damage to engine.	Direct Costs: $717 000
Aug-97	Charlottetown, PEI	Air Atlantic	DeHavilland Dash 8	Duck	Damage to leading edges of wings.	Direct Costs: $10 000
Nov-97	Santa Ana, CA	Northwest Airlines	A320 Airbus	maybe pelican, large bird, not goose	Damage to the #2 engine included engine core, reverser and cowling.	$ 2 000 000
Oct-97	Vancouver, BC	Canadian Airlines Int.	DC-10	snow goose	On approach into airport. Damage to #1 engine, 1 ft x 1.5 ft wrinkle dent on engine nose cowling. Aircraft landed without incident.	Direct Costs: $1 000
Mar-98	Vancouver, BC	Canadian Airlines Int.	747	Waterfowl	Damage to #2 engine included bent blades, tears and shingled mid-span beyond limits. Engine replaced. Engine failure may have been due to a previous, unknown bird strike.	$ 500 000

When compared to the accident rates and related cost database for automobiles, data on the various costs related to bird-aircraft collisions are few. Thorpe (1997c) detailed 55 serious incidents due to bird strikes, during the period 1912-1995, where the aircraft was destroyed and/or one or more fatalities may have occurred. Of these, 4 occurred in Canada and 27 in the U.S.. Compared to the frequency of vehicle damage, injuries and death on roads of the world, the frequency of aircraft incidents due to bird strikes is extremely low and provides a small sample size from which to derive conventional statistical summaries such as average costs. Furthermore, because aircraft and aviation operations are much more expensive than cars, trucks and their operation, there is a very wide range of potential costs such that mean values from a relatively small number of samples cannot be expected to reflect meaningful averages. A specific example would involve an "engine repair" that could range from the cost of a few minutes of a technician's time to dress a few slightly damaged turbofan blades so the aircraft can continue its flight without delay, to the other extreme where an aircraft is grounded for several days or weeks while the damaged engine is replaced at a repair depot and at a cost of several millions of dollars. For example – an engine is damaged by a bird strike and must be repaired before returning to service. If the aircraft was from a large airline and happened to be at one of their maintenance bases, the repair or even an engine replacement might be accomplished quickly and the aircraft returned to service within a day or so. If the same damage were to occur at a more remote location, costs would likely escalate sharply since the resources to deal with the situation may have to be flown in or contracted out, and the crew and passengers from the disabled aircraft may have to be accommodated at local hotels or provided with alternate transportation. Garber (1996) reported that the cost of damage to two engines of a Concorde that ingested Canada geese was US $6 million, whereas the minor repair by the technician would not likely accrue any reportable costs and any replacement of parts at a later date would be recorded as regular maintenance.

Although the first documented crash and fatality due to a bird strike was in 1912, this review and assessment will concentrate on records since 1990 but will make reference to earlier data to put current information into perspective for long-term trends and comparative purposes. Aircraft costs and insurance settlements for personal injuries and accidental deaths have escalated sharply since 1990 but older data are still valuable to this study because many of the aircraft in service before 1990 are still in operation and the types of damage they might have sustained could recur. Aircraft repair costs and insurance may have changed significantly but the aircraft have not; therefore, information from past incidents can help predict future costs. Cost data from earlier years has been extrapolated to 1997 Canadian dollars where possible.

2. COST ESTIMATES

Costs related to bird–aircraft collisions can accrue in several ways and are organised into five categories to facilitate presentation and discussion in subsequent sections of this report. *Direct costs* include the costs incurred by the aircraft owner/operator for repair or replacement of a damaged aircraft or aircraft parts as a result of a bird strike. For the purpose of this study, *indirect costs* include those "hidden costs" (Robinson 1996) incurred by the aircraft owner/operator. *Ancillary costs* are those incurred by the airport owners/operators regulatory authorities or emergency response agencies to deal with the bird strike hazard threat in Canada. *Catastrophic costs* would involve the destruction of an aircraft, with or without fatalities. Finally, for the purpose of this review, *total costs* are intended to represent estimates that would include all of the above components except catastrophic costs because the latter are not regular, recurring costs of operations.

2.1 Direct Costs

Direct costs include the costs incurred by the aircraft owner/operator for repair or replacement of a damaged aircraft or aircraft parts as a result of a bird strike. Thus direct costs include those for both parts and labour but are not intended to include replacement of an aircraft as would happen with a catastrophic accident - see Section 3.2.4. Lehmkuhl (1996) provides data from Lufthansa Airlines, that represents more than 50% of the civil aviation activity in Germany. He stated that the 1990-1994 annual "total costs of hull damage", which we interpret to include engines but not any secondary costs ranged from $666,000-$2,945,000 (DEM 867,908-3,421,880) when selected extreme events were deleted (these were crashes that he apparently believed would skew the cost data significantly higher). About 80% of the events cost less than $8,650 (DEM 10,000) whereas on an annual basis, 0-3% of the incidents cost more than $430,000 (DEM 500,00); a very high percentage of bird strike incident costs are less than insurance deductibles and therefore would not result in insurance claims but would be borne entirely by the aircraft owner. Furthermore, the same data showed an average cost per 10,000 movements ranging from $16,500-$44,300 (DEM 19,259-51,440) during the same period. Because these data were collected to comply with an aviation regulation, they would seem to be at least as credible as any other data collected elsewhere and dependent on voluntary submissions.

The FAA summarises bird strike incident data for the U.S. civil aviation industry. Cleary *et al.* (1996, 1997) reported that, of the 6,519 bird strikes reported to the FAA during 1993-1995, there were 1,507 (23%) reports indicating that the strike damaged the aircraft and/or had a negative effect on the flight, i.e. precautionary landing, aborted take-off, fuel dump, etc. The 979 (15%) damaging bird strikes were estimated to have incurred more than $35.5 million (US $26 million) of aircraft damage and related costs that included 30,000 hours of aircraft down time. The report apparently did not identify the number of bird strikes for which there was an estimate of the time out of service. The available data do not permit differentiating between the proportions of direct *versus* indirect costs and have been developed from the 25% of damaging incidents for which cost data were reported. Cleary also proposed that, because of the low reporting rates and other undefined factors, the actual losses due to all wildlife are probably closer to 374,000 hours per year of aircraft down time and US $155 million per year of monetary losses. Given that he reported 97% of all wildlife strike damage (but only 44% of aircraft down time) was due to bird strikes, the above figures translate to about 363,000 hours of aircraft down time and $203 million (US $148 million) for damages from bird strikes alone during the three years of record. Based on an estimated overall reporting rate of 20% in the U.S., he estimated the annual cost of bird strikes would approximate $336 million (US $245 million) in monetary costs and 280,000 hours of aircraft down time.

By way of comparison, Wong (Larose and MacKinnon 1996) extrapolated an estimate of annual costs of bird strike damage to U.S. civil aviation of $154 million (US $117 million) per year, based solely on United Airlines records of FOD costs. Conover *et al.* (1995) estimated the costs of wildlife strikes to the USAF of more than $147 million (112 million USD) so total costs almost certainly exceed $264 million (US $200 million) per year.

In a discussion of engine maintenance costs due to erosive sand particles passing through turbofan engines, Air Algeria (El Hadi *et al.* 1996) estimated the costs of an unscheduled removal and repair of a Pratt & Whitney JT8D engine was in the order of $675,000-$1,000,000 (US $500,000-$750,000).

Pratt & Whitney, GE Aircraft Engines and Rolls Royce have indicated that the cost of a new turbofan engine for the B747, B777 generation of aircraft can range from $6.6-$13.25 million (US $5-10 million) (Air Transport World 1996).

2.2 Indirect Costs

The extent of such costs can be determined by such factors as the extent of aircraft damage, operator's fleet size, type of operation (cargo or passenger) and proximity to a repair facility. Factors contributing to the hidden costs could include costs of re-routing passengers, costs of passenger and crew accommodation and meals during delays, replacement of on-board food during a delay, costs of jettisoned or wasted fuel, costs of substituting an aircraft or parts, contractual penalties for late deliveries, loss of income from an aircraft undergoing unscheduled maintenance, repairs or inspections, costs for air traffic control, crew relocation or replacement and aircraft storage associated with delayed take-offs or landings. Also included could be losses of bookings and costs to restore public confidence after an incident, the "ripple effects" of any of the foregoing factors that could increase costs or reduce revenues and any hidden costs in hull insurance rates that might have been inflated because of previous bird strike damage claims". Although there are few references providing the documented costs from specific incidents, some examples are to be found in the literature, Lehmkuhl (1996) noted that "... in addition to the costs of hull damages the costs of consequential damage have also an important influence on the cost situation of airlines. Although it is possible to buy insurance ... I do not know of any airline having done so. As airlines have (in general) no coverage for such costs; no permanent data collection is done in respect to such costs." Lehmkuhl offered some additional observations related to costs of consequential damage; they depend on the extent of damage, the distance between the place of the incident and where a repair can be done, the size of the airline fleet and whether cargo or passengers are being carried. He also estimated that the cost of a block hour for an aircraft could range from $8,000–$20,000 (DEM 10,000-25,000) per hour; hotel accommodation can be $160 (DEM 200) per passenger per night and replacement engines can cost as much as $6.5 million (DEM 8,000,000). Finally, he speculated that, in the absence of hard statistics, it seems realistic to assume that consequential damage costs are "considerably" higher than those for hull damage.

2.3 Ancillary Costs

Ancillary costs are those incurred by the airport owner/operator regulatory authorities or emergency response agencies to deal with the bird strike hazard threat in Canada. Delays in airport operations due to disabled aircraft, emergency responses for damaged aircraft and bird-repelling activities can cost operators significant time and money each year. Transport Canada and the various airport operators co-operate to develop and implement bird hazard management programs such as is done for Vancouver International Airport and Lester B. Pearson Airport at Toronto in order to reduce chances of incurring larger ancillary costs related to a bird strike accident. Transport Canada and DND collect records and prepare annual summaries of bird strike incidents, but without cost data. Both agencies co-chair Bird

Strike Committee Canada and has staff dedicated to management of the bird strike threat. Emergency response agencies train for aircraft crash search and rescue response, although not necessarily related to a bird strike. Neither Transport Canada nor DND have published information related to the costs of preparing the annual summaries, maintaining staff committed to addressing the bird strike hazard, maintaining participation in Bird Strike Committee Canada and attending meetings of the counterpart committees in the U.S. and Europe or the U.K.; although such a figure could be estimated from general labour, travel and overhead costs for the Government of Canada. It would be difficult, if not meaningless to arbitrarily apportion the annual costs of emergency crash response and Search and Rescue (SAR) training for bird strike incidents as a fraction of all emergency response and SAR training; it would be much more appropriate and relevant to review actual emergency response and SAR records from recent, specific incidents considered representative of the types of situations that might occur in Canada as a result of bird strikes.

Ball (1996) noted that the Vancouver International Airport 1997 Wildlife Control Program would operate on a 24-and-7 basis and require eleven Wildlife officers. Cost was estimated at more than $200,000 for labour and $60,000 for equipment, exclusive of new test equipment or vehicles. Ball (pers. comm.) indicated 1997 costs were approximately $500,000 for the comprehensive bird management program.

Garber (1996) has reported extensively on the ongoing wildlife management programs at John F. Kennedy and La Guardia Airports near New York City to reduce risks from gulls, geese, raptors, pigeons and shorebirds. The Port Authority of New York and New Jersey has a wildlife management staff of 30 and an annual budget of DEM $1,000,000 to try to manage one of the highest rates of bird strikes in the U.S.

Regrettably, the apparently successful USAF Bird Avoidance Model (BAM) program costs have not been published in the literature reviewed for this report.

Order of magnitude costs estimated for airport delays during 1988 at Chicago O'Hare Airport (Chicago Delay Task Force 1991) were extrapolated to Toronto's Lester B. Pearson Airport. Bird hazards were not specifically cited as delay factors, but these costs can reasonably be applied toward cost estimates of delays to a large Canadian airport's operations due to bird hazards. Direct operating costs (aircraft fuel and oil, crew salaries and other direct costs) were added to indirect costs such as passenger delay time costs and missed connection costs. A Canadian operator's cost estimates for delays to various types of large aircraft and Transport Canada's estimates for costs per unit of time for various types of aircraft in holding situations were all factored into the estimated total cost of delays for a 1996 typical planning day at LBPA of $154 million per year and as much as $228 million per year based on an annual; peak planning day ratio of 320.

2.4 Catastrophic Costs

A catastrophic incident involves the destruction of an aircraft, with or without fatalities. Given the small database (55 incidents and 190 fatalities, 1912-1995 worldwide, according to Thorpe, 1996) for accidents known to have been caused by bird strikes, a more meaningful assessment can be developed around estimates of potential costs related to an incident as might be done by the insurance industry such that the total cost would be the cost of the aircraft plus a cost per fatality or injury based on recent litigated/negotiated industry settlements. Robinson (1996) identified that in the worldwide civil aviation fleet, there were at least in excess of 1,000 aircraft in service, or on order to airlines, valued at US $100 million or more and several valued at more than US $200 million. Currently, there are more than 1,200 aircraft insured for $100 million or more (Robinson pers. comm.). Furthermore, of the estimated worldwide fleet of 270,000 general aviation aircraft (those not including large commercial aircraft, 63% are based in the U.S. and only 5.5% are based in Canada; this places a large percentage of the world's smaller aircraft in North America. Although the potential for a major legal liability is much less than for civil aviation, it should not be disregarded. Recent court settlements in the U.S. have established a value of about 2.5 million dollars for an insurance settlement for an accidental death (Garber 1996, Robinson 1996). For example, the hypothetical cost for a total loss of a fairly new B747 with 300 passengers plus the crew would be upwards of 150 million dollars for the aircraft (less than US $100 million for older B747s) and in the vicinity of 2.5 million dollars per passenger fatality (US laws related to workplace injuries and fatalities would reduce this for flight and cabin crews) for a total nearing 900 million dollars. Obviously, actual costs would relate to the model and vintage of the aircraft as well as the total of passengers and crew aboard. Thus, the potential direct-cost exposure for a catastrophic accident can readily be estimated by assuming the passenger and crew capacity as well as the replacement cost of the aircraft. The estimate might also include a provision for substantial third party liability losses for crash site damage in addition to the aircraft and passengers, on the assumption that the crash is most likely to occur near an airport and could involve a residential, commercial or industrial area. Obviously, crashes due to bird strikes will occur almost every year and costs can be assigned for each specific incident, based on costs assigned when the type of aircraft and the numbers of injuries and fatalities are known. If an assessment of general costs and an order of magnitude total cost is sufficient detail, then a better procedure might be to go to the larger database for aircraft crashes from all causes and extrapolate costs from that larger data pool to the smaller number of incidents due to bird strikes. Similarly, where data on additional costs such as search and rescue, salvage and accident investigations were available, this could be added to provide a cumulative total. With the steadily increasing costs of large civilian transport aircraft and increasing seating capacity of such aircraft, the potential for a major accident, huge legal liabilities and costs, is of increasing concern to airlines, airport operators, air transport regulators and the aviation insurance industry.

With specific reference to Canada, the four incidents recorded by Thorpe (1996) showed one helicopter and three small, conventional aircraft involving seven injured and seven fatalities (1971, 1981, 1994 and 1994); only one of these (1981) happened at or near an airport. Thus, this small sample gives no indication of the potential liabilities and costs that would accrue to an incident involving a large commercial carrier, so if the costs of an accident are to be used to justify intensive bird hazard management programs at Canadian airports, then the approach of using documented Canadian accidents would provide less convincing justification than would a projection of potential costs associated with the loss of a single, large, commercial carrier. Ideally, such a projection could be linked to an estimate of the probability of such an occurrence in Canada (over the next decade, for example) to justify the creation and implementation of a bird hazard management program, prioritized for the major airports in Canada on the basis of air traffic volumes, type of air traffic and bird hazard records. Such a projection of potential costs or estimation of the probability of a catastrophic incident is beyond the scope of this review.

2.5 Total Costs

For the purpose of this review, total costs are intended to represent estimates that would include all of the above components. The challenge in presenting this information from literature sources is to clearly understand which components are actually factored into an author's estimate. Too often an estimate of "total cost" is stated without a clear statement of what costs are included.

Transport Canada (Kieran *et al.* 1981) undertook to calculate the costs of aircraft accidents in Canada using an "accounting approach", as often used in the automobile industry, that assigned estimated costs to various accident loss components such as fatalities and injuries, hull damage, search and rescue, investigations by government and non-government agencies, insurance administration, financial impact on the operator and property damage. The first three factors were found to account for about 90% of the costs. Data from 1976-1979 were used. In 1980 dollars, the cost of a single fatality was estimated at $298,000, far below the more recent estimate of $2.5 million, even when 1980 dollars are escalated to 1997 equivalent. Finally, total annual costs were estimated to range from $210-$285 million ($103-$138 million in 1980 Canadian dollars).

Wong (1996) advised that one-third of the FOD to United Airlines aircraft was due to bird strikes and FOD in the U.S. is estimated to cost "FOD committee members" (term not defined), including airlines and airports, approximately $423 million (US $320 million) a year. Wong also stressed that not all FOD incidents are reported but reporting is more likely when the aircraft is delayed or damaged. If it can be assumed that United Airlines experience is representative, then bird strike damage in the U.S. amounts to a minimum of about $141 million (US $107 million). Given that replacement of a single turbofan engine could exceed $3.25 million (Garber 1996c) and Wong also advised that, of the 177 bird strikes to United Airlines aircraft in 1995, cost of the 31 damaging strikes was at least $660,000 to repair aircraft and engines, Wong's estimate for all FOD seems low and probably did not include indirect or ancillary costs.

Donoghue (1996) stated that MacKinnon reported on a conservative Canadian study that concluded bird strikes in North America annually incur costs of approximately $508 million; given that about 12% of aircraft in North America are Canadian, the Canadian costs would approach $42.25 million (Canadian dollars assumed). This value seems unrealistically low for Canada, especially in light of the Transport Canada (1981) estimates of $211-$284 million ($103-$138 million, in 1980 dollars) per year.

The USAF (1993) reported an annual total of 3,000-3,500 bird strikes per year at an annual cost of more than $89 million (US $65 million) and seven fatalities between 1987 and 1992. It was not likely that the costs included secondary costs and/or a provision for the "costs" of the fatalities so these cost estimates are most certainly understated, at least by civil aviation standards.

Cleary *et al.* (1997) summarised reported monetary costs of bird strikes to U.S. civil aviation totalling $49,972,000 (US $38,439,270) for the period 1992-1996 and averaging $9,994,000 (US $7,687,855). These estimates apparently included only reported costs of aircraft damage and reflect only direct costs. Given the above values for comparison, and the $5 million dollar cost of a single turbofan engine replacement, this estimate seems unrealistically low by at least one order of magnitude.

Individual incident reports offer a glimpse of the range of costs that can be incurred, but only if the various costs from a large number of bird strike damage incidents of all sizes are thoroughly itemised, will the industry costs become clear. This would be an arduous and costly undertaking.

Data from the past three years suggest that, in Canada, civil aviation experiences about 2,250 (750 X 3) bird strikes and Canadian Forces may experience upwards of 125 for a Canadian total of about 2,400 incidents. The adjustment factor of 3 for civilian incidents is intended to account for the estimated under-reporting rate. Similar estimates for the U.S. would be about 16,700 ([2,200 X 6] plus 3,500), which seems reasonable in terms of order-of-magnitude, given that Canadian civil aviation accounts for about 8% of the aircraft registered in the U.S. but the U.S. military aircraft vastly outnumber the Canadian counterpart. Any such estimate is necessarily crude and inherently vulnerable to criticism because of the acknowledged, but unsubstantiated, reporting biases.

In terms of bracketing a range of "total cost" for the U.S., based on primarily United Airlines, Lufthansa and FAA data, Cleary's 1997 estimate of US $245 million and Wong's estimate of US $117 million for direct costs provide a starting range. If we then consider Cleary's estimate of 280,000 aircraft hours lost to delays of various sorts and apply the range of values of US $6000-$15,400 per hour for aircraft downtime as estimated by Lehmkuhl, then we can add a range of US $1,723-$4,307 million for indirect costs, to the above values for a range of $1.840-$4.552 *billion* USD representing the total of direct and indirect costs to civil aviation in the U.S. in a recent year, without factoring in any costs as calculated for delays at airports such as O'Hare. The addition of US $112 million for total, undefined USAF costs (assuming a 100% reporting rate and all costs direct and indirect costs accounted for) is probably low but not unreasonable by comparison, for our purpose. Thus the estimated range of direct plus indirect costs to U.S. civil aviation is US $1.840-$4.552 *billion*; to that range add estimated USAF direct costs of $112 million for a total range of US $1.952–$4.531 *billion*. This total must be viewed as a minimum, based on the premise that ancillary and other potentially significant indirect costs, have not been included, nor have the costs to general aviation.

To translate the above costs proportionately to Canada's situation, while accounting for the dollar exchange rate difference, the U.S. civil costs can be factored down in proportion (2,250/16,700) to the probable numbers of total bird strikes, as estimated above. Thus the annual sum of direct and indirect costs to civil aviation for bird strikes in Canada are estimated to be in the range of $247,900,000 to $613,290,000 for the estimated 2,250 incidents in a recent year. If the same approach is taken for Canadian military costs, then an estimate of $5,600,000 is derived for the estimated 125 annual bird strikes. The latter figure assumes a 100% military reporting rate so, in reality, must be considered a minimum value. Thus, total costs to Canadian civil and military aviation, exclusive of any ancillary costs, potentially significant indirect costs or any consideration of general aviation, are estimated to be within the range of $253,500,000 to $618,900,000 when expressed in 1997 Canadian dollars.

APPENDIX 18

Evaluation of Shooting and Falconry to Reduce Bird Strikes With Aircraft at John F. Kennedy Int'l Airport

DRAFT

5/28/98

INTERNATIONAL BIRD STRIKE COMMITTEE

IBSC 24/WP__
Slovakia, 14-18 September 1998

EVALUATION OF SHOOTING AND FALCONRY TO REDUCE BIRD STRIKES WITH AIRCRAFT AT JOHN F. KENNEDY INTERNATIONAL AIRPORT

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Summary

The collision of birds with aircraft is a serious problem at John F. Kennedy International Airport (JFKIA), New York. Gulls (*Larus* spp.), primarily laughing gulls (*L. articilla*), accounted for 84% of bird strikes (an aircraft striking ≥1 bird) from 1988-1990, averaging 260 strikes/year. Laughing gulls are present from May-September in association with a 7,600-nest colony (1990) in Jamaica Bay adjacent to JFKIA. A program to reduce gull collisions with aircraft was undertaken from May-August 1991-1997 in which 2-5 people stationed on airport boundaries used shotguns to shoot gulls flying over the airport. In 6,369 person-hours of shooting, 52,235 gulls were killed, comprised of 47,601 laughing gulls and 4,634 other gulls. In 1996 and 1997, experimental falconry programs were implemented to complement the shooting program. In 1996, the falconry and shooting programs were conducted simultaneously from 21 June-9 August, after which shooting stopped but falconry continued until 20 October. In 1997, falconry began 1 August (when the shooting program ended) and continued to 25 November. A comparison of mean strike rates for all birds and for gulls only during 1988-1990 (no shooting or falconry), 1991-1995 (shooting but no falconry) and 1996-1997 (shooting and falconry) indicated shooting reduced ($P < 0.01$) strikes but that falconry did not ($P \geq 0.24$). The falconry program will continue at JFKIA in 1998-2001 which should provide a more complete assessment of efficacy. Falconry can have a role in integrated bird management programs for airports but data for 1996-1997 at JFKIA did not indicate falconry reduced strikes.

Key Words: Bird Strike, Falconry, Gull, Shooting

I. INTRODUCTION

The collision of birds with aircraft is a serious problem at John F. Kennedy International Airport (JFKIA), New York. Port Authority of New York and New Jersey (PANYNJ) personnel reported 80-315 aircraft struck by birds/year at JFKIA from 1979-1997 (Dolbeer and Bucknall 1998). These strikes have caused millions of dollars in damage to aircraft as well as a significant threat to human safety. From 1988-1990, laughing gulls were the species most frequently struck by aircraft at JFKIA, averaging 157 aircraft incidents (52%) involving 170 birds (47%)/year. Other gulls (herring [*L. argentatus*], great black-backed [*L. marinus*] and ring-billed [*L. delawarensis*]), which are present year-round, comprised 34% of the aircraft strikes and another 52 species of birds comprised the remaining 14%. There is a nesting colony of laughing gulls adjacent to JFKIA in Jamaica Bay Wildlife Refuge, a protected area administered by the U.S. National Park Service. This colony increased from 15 nesting pairs in 1979 to 7,629 pairs in 1990. Almost all laughing gull strikes have occurred from May-September with most in June and July during chick rearing (Dolbeer et al. 1989). Many laughing gulls fly from the colony over the airport to off-airport feeding areas throughout metropolitan New York City (Griffin and Hoopes 1991). Strikes with other gull species occur throughout the year.

As one approach to solving the problem, U.S. Department of Agriculture (USDA) biologists, under a cooperative agreement with the PANYNJ, initiated an experimental management program at JFKIA in 1991 to reduce strikes by gulls, primarily laughing gulls. From 20 May-8 August 1991, biologists used shotguns to shoot gulls attempting to fly over the airport. Hypotheses tested were that shooting would not only directly reduce the population of gulls flying over the runways but also enhance ongoing bird-frightening programs at JFKIA by conditioning gulls to avoid the airport. Because strikes by gulls were significantly reduced at JFKIA in 1991 (Dolbeer et al 1993), the shooting program was continued during late May-early August in 1992-1997. In 1994, an Environmental Impact Statement (EIS) was finalized that addressed the management of gulls to reduce air traffic hazards at JFKIA (U. S. Department of Agriculture 1994). The EIS recommended that the shooting program be continued as part of an integrated management program until other actions are taken that would result in relocation of the gull colony.

In 1996-1997, the PANYNJ implemented experimental falconry programs to complement the shooting program. In 1996, the falconry program (Bird Control International, Inc., Georgetown, Ontario, Canada) and USDA shooting program were conducted simultaneously from 21 June-9 August, after which the shooting program was discontinued but falconry was continued until 20 October (Table 1). In 1997, the falconry program (T.C. Management, Inc., Goshen, New York, USA) began 1 August (when the shooting program ended) and continued to 25 November.

Operations personnel at JFKIA have maintained detailed, consistent records of bird strikes at the airport since the 1970s (Burger 1985, Dolbeer and Bucknall 1994). The database includes both strikes reported by pilots and unreported strikes (bird carcasses found on active runways in a condition indicating an interaction with aircraft). This database allows evaluation of a bird-strike reduction program by comparing strike rates for within-year time intervals when the program was in place with strike rates for the same time intervals in years without the program. Having shooting and falconry programs conducted during overlapping and non-overlapping times in a 2-year period, combined with a long-term database on bird strikes, provided a unique opportunity to compare the effectiveness of these 2 programs.

2. METHODS

2.1 Shooting

Shooting was with 12-gauge shotguns using #4 steel shot on 31-62 days annually from 15 May-17 August 1991-1997. Two to 5 shooters were stationed along the southern airport boundaries where gulls often crossed the airport. Shooting typically was conducted from 0530-1400 or from 1200-2030. Shooters stood or sat in the open and wore blaze orange vests. Shooting was directed away from the airport and only at flying gulls that came within shooting range (about 40 m).

All shooters were subpermitees under federal and New York state permits issued to the USDA or PANYNJ. Shooters retrieved all shot gulls when possible and recorded gulls killed but not retrieved. In 6,369 person-hours of shooting in 1991-1997, 52,285 gulls were killed, comprised of 47,601 laughing, 3,403 herring, 670 great black-backed, and 561 ring-billed gulls (Table 1). Dolbeer et al. (1993) and Dolbeer and Bucknall (1994, 1998) provide additional details about the shooting program.

2.2 Falconry

In both 1996 (21 June-20 October) and 1997 (1 August-25 November), falconers generally flew their birds (primarily peregrine falcons [*Falco peregrinus*], peregrine-gyrfalcon [*F. rusticolus*] hybrid, and Harris' hawks [*Parabuteo unicinctus*]) daily on the airport. Typically, the falconers used "lure flights" in which the falcon did not attack and kill target birds but simulated hunting by chasing a lure swung from a leash by the falconer. In addition, the falconers used pyrotechnics, amplified distress calls and occasional shotgun shooting with live ammunition to disperse birds. Watermann (1997) and T. C. Management (1998) provide additional details about the 1996 and 1997 falconry programs, respectively.

2.3 Evaluation of shooting and falconry

To evaluate the shooting and falconry programs, I made 3 comparisons of strike rates among years using chi-square statistics for proportional data (Fleiss 1973:14-22). First, I compared strike rates for 21 June-20 October 1988-1996. In 1988-1990 (baseline years), there was no shooting or falconry. In 1991-1995, there was shooting from 21 June to 4-17 August but no falconry. In 1996, there was shooting from 19 June-9 August and falconry from 21 June-20 October. Second, I compared strike rates from 16 August-20 October 1988-1997 when there was no shooting in any year but there was falconry in 1996-1997. Third, I compared strike rates from 21 October-30 November 1988-1997 when there was no shooting in any year but there was falconry in 1997. In making comparisons among years, I used number of strikes instead of number of strikes/10,000 aircraft movements because aircraft movements at JFK (355,000 in 1996) have increased by only about 3% per year, 1988-1996 (U. S. Department of Agriculture 1994; Lampl 1998).

To determine if the falconry program reduced the number of gulls shot in 1996, when shooting and falconry were conducted simultaneously, I used 1-way analysis of variance to compare the mean number of gulls shot/person-hour of shooting, 1991-1997 and tukey tests to determine which means were different ($P \leq 0.05$) (Statistix 1994).

3. RESULTS

3.1 Bird Strikes: 21 June-20 October 1988-1996

In 1991-1995, when shooting but no falconry was done, there were mean reductions of

68% (X^2 = 60.26, 1 df, $P < 0.01$) and 78% (X^2 = 74.79, 1 df, $P < 0.01$) in strikes for all birds and gulls only, respectively, compared to annual means for 1988-1990 (Fig. 1). For 1996, when shooting and falconry were done, the numbers of strikes for all birds (71) and gulls only (25) were comparable (X^2 = 1.82, 1 df, P =0.17 [all birds]; X^2 = 1.43, 1 df, P = 0.24 [gulls only]) to mean numbers recorded in 1991-1995 ($\bar{x}$ = 55.8 and 34.2, respectively) when shooting only was done. When only pilot-reported strikes are considered (Fig. 2), there is also no indication that strikes in 1996 for all birds (15) or gulls (2) were lower than in the previous 5 years ($\bar{x}$ = 9.2 and 2.8, respectively). In fact, strikes by non-gulls in 1996 were the highest of any year, 1988-1996.

The number of gulls shot/person-hour during the shooting program differed ($P < 0.01$) among years, 1991-1997 (Table 1). The number killed/person-hour in 1996, when falconry and shooting were done simultaneously, was the lowest for the 7 years but was not different ($P >$ 0.05) than means in 1993-1995 and 1997.

3.2 Bird Strikes: 16 August-20 October 1988-1997

During this 2-month period following the shooting program in 1991-1995, there were mean reductions of 48% (X^2 = 7.75, 1 df, $P < 0.01$) and 68% (X^2 = 14.53, 1 df, $P < 0.01$) in strikes for all birds and for gulls only compared to the means for 1988-1990 (Fig. 3). For 1996-1997, when falconry was carried out following the shooting program, there was a mean increase of 100% (X^2 = 9.00, 1 df, $P < 0.01$) in strikes for all birds ($\bar{x}$ = 54.0) compared to the mean for 1991-1995 ($\bar{x}$ = 27.0). There was no difference (X^2 = 1.10, 1 df, P = 0.71) in the mean number of strikes by gulls in 1996-1997 ($\bar{x}$ = 8.5) compared to the mean for 1991-1995 ($\bar{x}$ = 13.4). When only pilot-reported strikes are considered (Fig. 2), there also was no indication that strikes in 1996-1997 for all birds ($\bar{x}$ = 13.0) or for gulls only ($\bar{x}$ = 1.0) were lower than in 1991-1995

($\bar{x}$ = 6.0 and 1.4, respectively). In fact, pilot-reported strikes in 1996-1997 were the highest in any year, 1988-1997.

3.3 Bird Strikes: 21 October-25 November 1997

During 1997, the only year falconry was conducted during this time period, the numbers of strikes by all birds (8) and gulls only (5) were not different (X^2 = 0.91, 1 df, P = 0.30; X^2 = 0.00, 1 df, P = 0.99) than the mean numbers of strikes by the respective groups in 1991-1996 ($\bar{x}$ = 12.3 and 4.9) (Fig. 4). In 1997, pilot-reported strikes for all birds (1) and gulls only (0) were within the range of values (0-5) for 1991-1996.

4. DISCUSSION

Shooting gulls at JFKIA has reduced gull strikes, based on a comparison of strikes in 1988-1990 (preshooting) and 1991-1997 (shooting) (Dolbeer et al. 1993, Dolbeer and Bucknall 1994, 1998). However, this shooting program has resulted in the killing of 52,235 gulls. In an effort to develop alternative, nonlethal methods to reduce strikes, the PANYNJ implemented falconry at JFKIA in 1996-1997. As noted by Blokpoel (1976), falconry on airports has attracted public interest because it uses a medieval sport to protect modern jet aircraft. Falconry, as practiced at JFKIA, is also attractive to the general public in that it is a biological control procedure in which birds are usually only dispersed and not killed.

The analysis of strike data, however, did not support the hypothesis that falconry reduced bird strikes at JFKIA below baseline levels in years immediately prior to falconry. Falconry may have resulted in fewer gulls shot in 1996 although the kill/person-hour was not statistically different than in 1993-1995 and 1997.

Reviews of airport falconry programs by Blokpoel (1976), Chamorro and Clavero (1994) and Hahn (1996) indicated that falconry sometimes can reduce bird strikes but that success is contingent on many factors. Chamorro and Clavero (1994), in discussing falconry on Spanish airports, concluded that "falconry is a very cost-effective [$460,000/year/airport] method for the control of birds in airdromes, but not all the airfields are suitable for falcons." Hahn (1996), after a study of falconry at a military airfield and waste disposal site in Germany, concluded that "we cannot recommend falconry because the success by using falconry for bird control is correlated to a lot of different factors and the effort is not proportional to the success."

Most evaluations of airport falconry programs have presented general observations of effectiveness without detailed, objective analyses of strike rates or bird responses (see Hahn [1996] as an exception). More objective, quantitative analyses are needed so that the effectiveness of falconry under various circumstances, in comparison to other management actions, can be determined. The PANYNJ plans to continue in 1998-2001, as part of their integrated bird management plan, the falconry program begun in 1996-1997. This should provide an ideal opportunity for a more detailed, 5-year evaluation of falconry.

In conclusion, the shooting program at JFKIA in 1991-1997 was designed to deal with a specific problem of gulls from a large, nearby nesting colony in a protected wildlife refuge flying over the airport to dispersed feeding sites beyond the airport. Aside from this specialized shooting program, the PANYNJ should continue developing an aggressive, integrated bird management program on the airport, including habitat management and the use of bird frightening techniques, to prevent gulls and other bird species from using the airport for feeding and loafing (U. S. Department of Agriculture 1994). Falconry can have a role in this integrated bird management program, but data for 1996-1997 at JFKIA did not indicate falconry reduced strikes.

5. ACKNOWLEDGMENTS

I thank S. Chevalier, J. K. Gartner, A. J. Graser, L. Rider and C. Zeilfelder of the PANYNJ for their support, assistance and willingness to try innovative approaches to reducing bird strikes at JFKIA, as well as for their commitment to maintaining a long-term database of bird strikes. I gratefully acknowledge the dedication and professionalism of the USDA employees in the shooting program, especially the efforts of J. L. Bucknall. I also recognize the dedication and professionalism of the falconers, especially T. J. V. Cullen, III of T. C. Management, Inc. and M. Givlin and U. Watermann of Bird Control International, Inc.

6. REFERENCES

Blokpoel, H. (1976) Bird hazards to aircraft. Books Canada Limited, London, U.K. 236pp.

Burger, J. (1985) Factors affecting bird strikes on aircraft at a coastal airport. Biol. Conserv. 33:1-28.

Chamorro, M., & Clavero, J. (1994) Falconry for bird control on airdromes. Bird Strike Committee Europe 22:397-407.

Dolbeer, R. A., Belant, J. L., & Sillings, J. L. (1993) Shooting gulls reduces strikes with aircraft at John F. Kennedy International Airport. Wildl. Soc. Bull. 21:442-450.

Dolbeer, R. A., & Bucknall, J. L. (1994) Shooting gulls reduces strikes with aircraft at John F. Kennedy International Airport, 1991-1993. Bird Strike Committee Europe 22:375-396.

Dolbeer, R. A., & Bucknall, J. L. (1998) Shooting gulls to reduce strikes with aircraft at John F. Kennedy International Airport, 1991-1997. Special Report for the Port Authority of New York and New Jersey *by* U.S. Department of Agriculture, National Wildlife Research Center, Sandusky, Ohio, USA, 31pp.

Fleiss, J. L. (1973) Statistical methods for rates and proportions, Second edition. John Wiley and Sons, New York, New York, USA. 321pp.

Griffin, C. R., & Hoopes, E. M. (1991) Birds and the potential for bird-strikes at John F. Kennedy International Airport. Final Report submitted to U.S. National Park Service Cooperative Research Unit, Natural Resources Science Department, University of Rhode Island, Kingston, Rhode Island, USA, 102pp.

Hahn, E. (1996) Falconry and bird control of a military airfield and a waste disposal site. Bird Strike Committee Europe 23: 347-352.

Lampl, R. (Editor). (1998) The aviation and aerospace almanac 1998. Aviation Week Group Newsletters, McGraw-Hill. Washington, DC, USA, 1,022pp.

Statistix. (1994) User's manual, version 4.1. Analytical software, Tallahassee, Florida, USA.

T. C. Management. (1998) Summary report--JFK falconry program 1997. Report prepared for Port Authority of New York and New Jersey *by* T. C. Management, Inc., Goshen, New York, USA

U.S. Department of Agriculture. (1994) Gull hazard reduction program at John F. Kennedy International Airport. Final Environmental Impact Statement. U.S. Department of Agriculture, Animal Damage Control Program, Pittstown, New Jersey, USA.

Watermann, U. (1997) Experimental falconry program to reduce the gull strike hazard to aircraft at John F. Kennedy International Airport, New York, New York. Report prepared for Port Authority of New York and New Jersey *by* Bird Control International Inc., Georgetown, Ontario, Canada.

Table 1. Dates of shooting and falconry, person-hours expended in shooting, and gulls killed by shooting at John F. Kennedy International Airport, 1991-1997.

Year	Dates of shooting	Dates of falconry	Person-hours shooting	No. of gulls killed by shooting			Gulls killed/person-hour[b]
				Laughing	Other[a]	Total	
1991	20 May-8 Aug		896	14,191	695	14,886	17.6A
1992	15 May-4 Aug		1,310	11,847	1,619	13,466	10.0B
1993	25 May-9 Aug		1,195	6,496	844	7,340	6.1C
1994	21 Jun-5 Aug		717	3,688	293	3,981	5.4C
1995	20 Jun-17 Aug		861	6,167	592	6,759	7.3BC
1996	19 Jun-9 Aug	21 Jun-20 Oct	657	1,970	293	2,263	3.5C
1997	12 Jun-1 Aug	1 Aug-25 Nov	733	3,242	298	3,540	5.3C
Total			6,369	47,601	3,403	52,235	8.2

[a] Herring, great black-backed, and ring-billed gulls.

[b] Mean number of gulls killed/person-hour is different among years ($F = 47.2$; 6, 1192 df; $P < 0.01$); yearly means with different letters are different ($P < 0.05$).

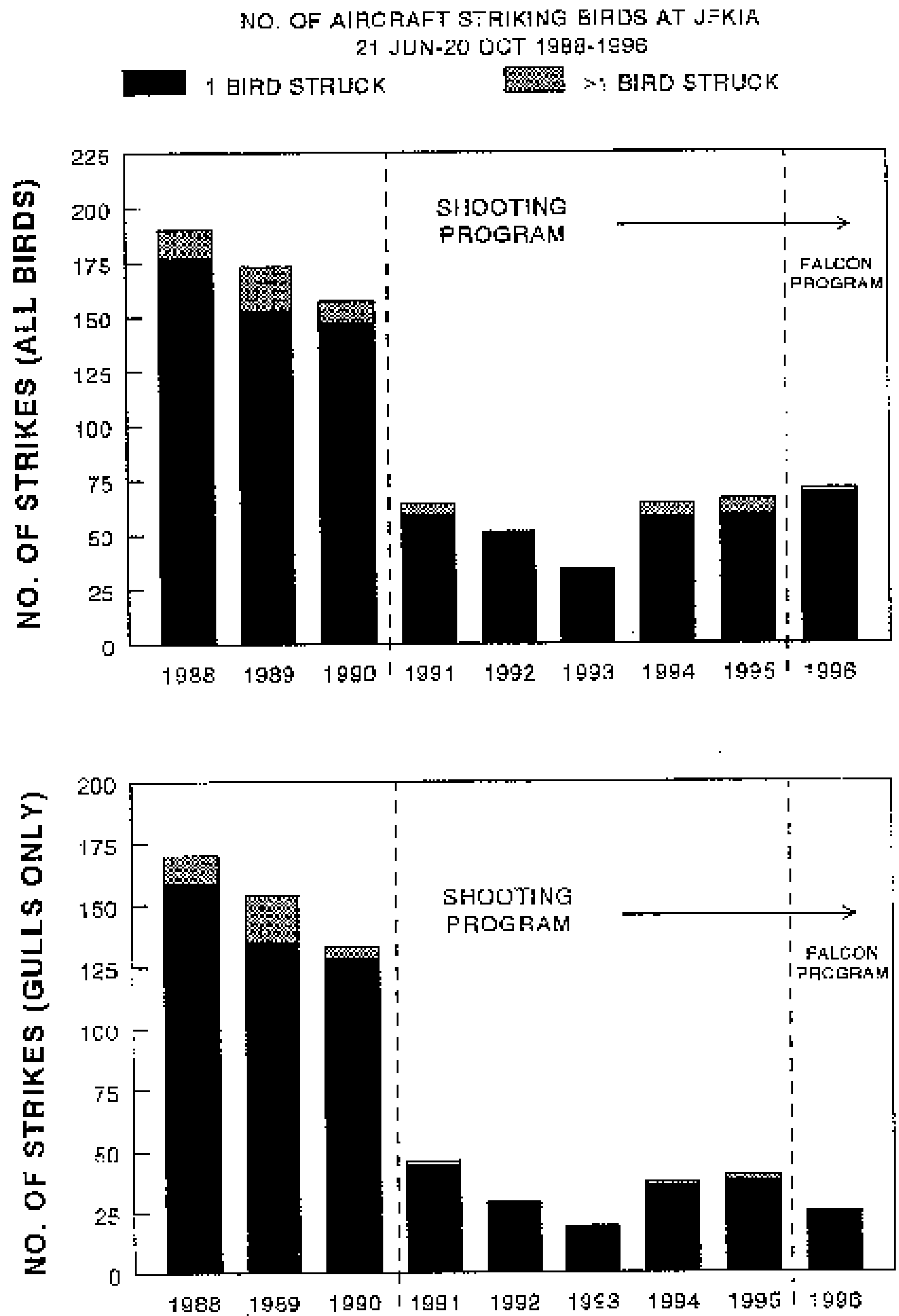

Figure 1. Number of aircraft striking birds (top graph) and gulls only (bottom graph) at John F. Kennedy International Airport, 21 June-20 October 1988-1996. During 1988-1990, there was no shooting or falconry; during 1991-1996, there was shooting from late May-early August; during 1996, there was a falconry program from 21 June-20 October.

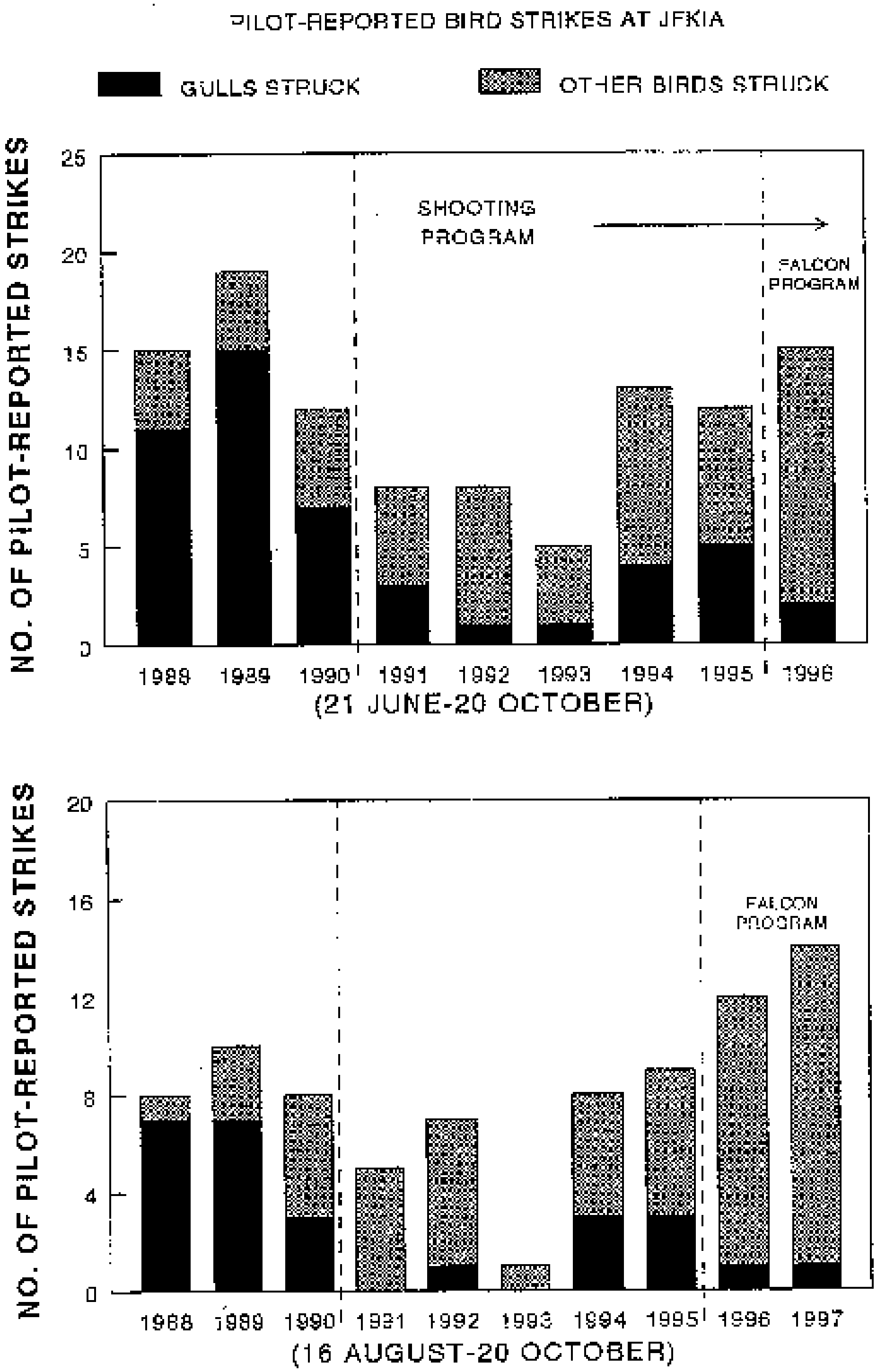

Figure 2. Number of pilot-reported strikes by gulls and other birds at John F. Kennedy International Airport, 21 June-20 October 1988-1996 (top graph) and 16 August-20 October 1988-1997 (bottom graph). During 1988-1990, there was no shooting or falconry; during 1991-1997, there was shooting from late May-early August; during 1996 and 1997, there were falconry programs from 21 June-20 October and 1 August-25 November, respectively.

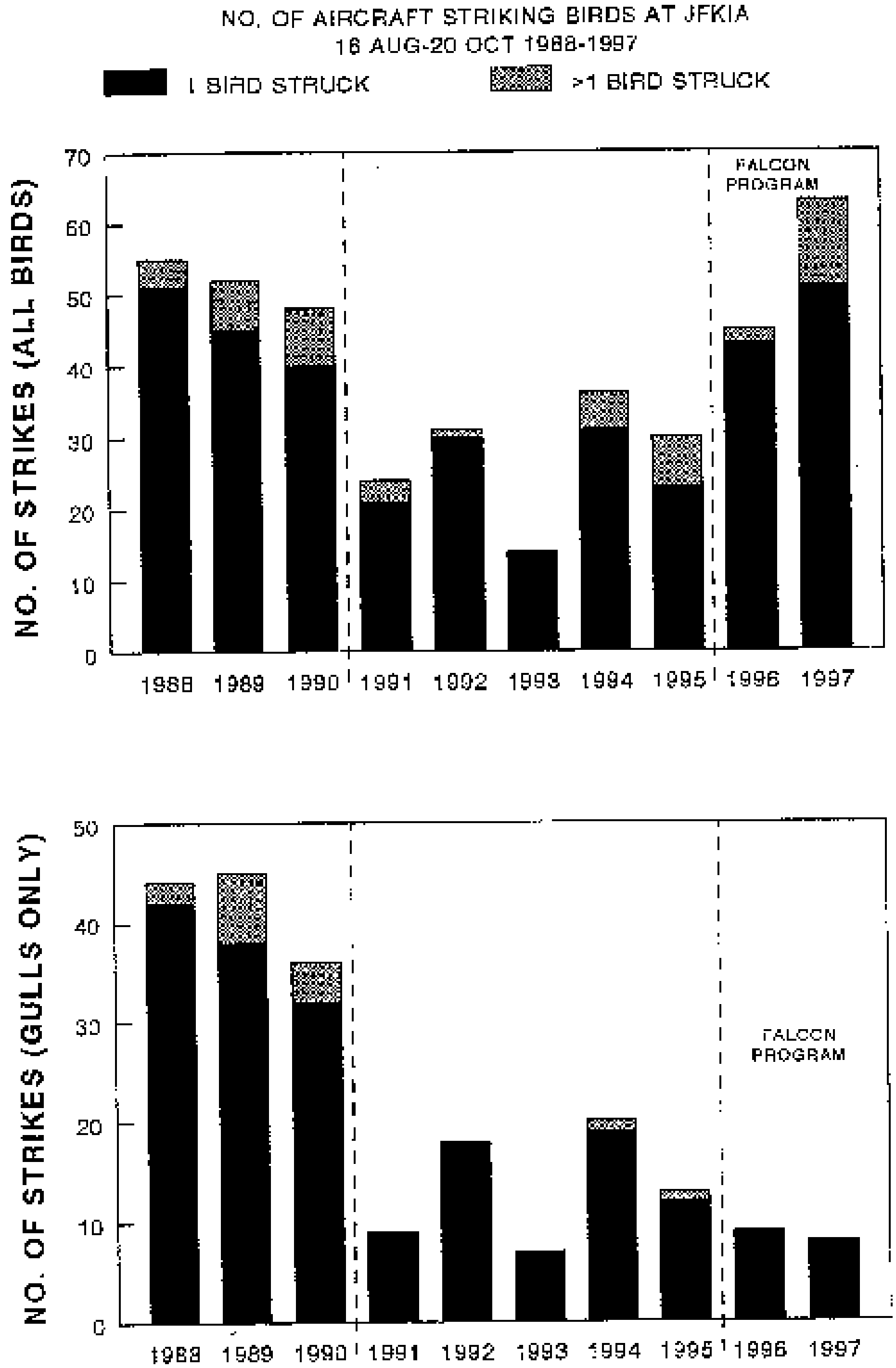

Figure 3. Number of aircraft striking birds (top graph) and gulls only (bottom graph) at John F. Kennedy International Airport, 16 August-20 October 1988-1997. During 1988-1990, there was no shooting or falconry; during 1991-1997, there was shooting from late May-early August; during 1996 and 1997, there were falconry programs from 21 June-20 October and 1 August-25 November, respectively.

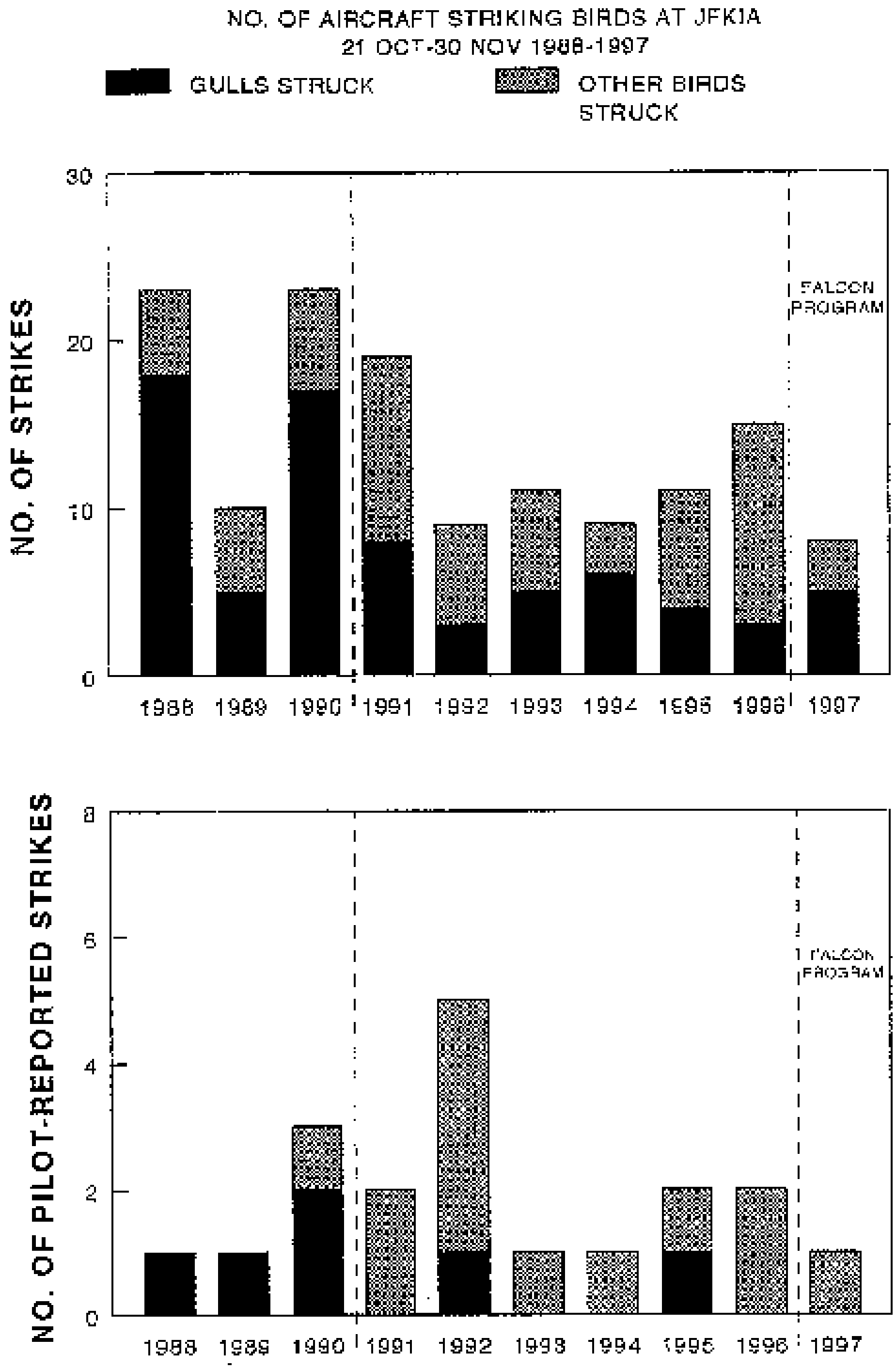

Figure 4. Number aircraft striking gulls and other birds (top graph) and number of pilot-reported strikes (bottom graph) at John F. Kennedy International Airport, 21 October-30 November 1988-1997. During 1988-1990, there was no shooting or falconry; during 1991-1997, there was shooting from late May-early August; during 1996 and 1997, there were falconry programs from 21 June-20 October and 1 August-25 November, respectively.

APPENDIX 19

Excerpt from *The Airport* by James Kaplan

The Airport

Terminal Nights and Runway Days at John F. Kennedy International

James Kaplan

William Morrow and Company, Inc.
New York

1994

Advance Praise for *The Airport*

"A splendid book . . . James Kaplan is one of those rare travelers who had the wisdom to miss a million flights at JFK and to explore from the ground the daily miracle of this great international modern airport. The cast of characters he encountered in and around the airport, and the misadventures that often go undiscovered until too late, make *The Airport* a book of discovery about a place some frustrated travelers think they know too well."

—Gay Talese

"Jim Kaplan is like the smartest kid on the field trip. He turns over the rock and discovers a teeming universe. *The Airport* is a fascinating exploration of the flying business—good guys, bad guys, wise guys, and the way you can study all of human nature through one trip to the airport. It's first-class travel."

—Diane Sawyer

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ISBN 0-688-09247-0

"The radios," I say.

"Oh . . . OK."

"Why—were you worried?"

"No, I was wondering if there was—well, frankly, I didn't know *what* you were lookin' at. I just noticed that you were."

"I was just noticing that this particular truck has two radios. And I remember the other truck we used to ride around in had three."

"Well, this one here is not in the Bird Control Unit—it doesn't have the tape player, which is probably what you saw in the other. Essentially, the other trucks have—as this one does—ground control radio, all-facility radio, which is our own company frequency, and then the tape player."

A white jumbo is coming out of the sky from the northeast. "Now, here comes a 747," I say. "That's a 400, right?"

"That's correct. Japan Air. See the tiplets, or wing tips, or whatever?"

"Yeah. Now, is he going to land on Two Two Right?"

"No, he's landing on Two Two Left. Parallel." Sammy's voice takes on a weary, pedagogical singsong. "This is the departure runway, and the other one is the landing runway."

I look at a wind sock. "And I see that he's landing into a headwind."

"Yeah."

"Which is nice."

"Well," Sammy says. "That's why they're using the Two Two."

"Beautiful plane."

"Sure is." We drive across the foot of the runway. "All right now," he says. "You've already seen this—" He points over toward the blast fence, where I can see a chartreuse Port Authority pumper truck and several police trainees in fire-fighting suits standing around The Fuselage.

"Right. They're about to light up," I say.

"Anyway," Sammy says, "at the end of the 1990 season, the Park Service came up with a proposal for what would be necessary for any further egg oiling in '91, or thereafter. The bottom line of which was one point eight *million* dollars. Which the Port Authority would have to pay for them to do this additional study, a much more elaborate study than was ever done before.

"Well, we balked at that. We don't *want* any further study. The problem has been identified; it has been studied to death already."

"Why did they want to study it further?"

"Well—foot draggin'. Taking advantage of the Port Authority's generosity and all that. And delaying any control action out at the colony. That was the bottom line, too."

"Like filibustering."

"Exactly. There you go. So as a result of that—"

"I'm sorry," I say. I point to an orange-and-white corrugated-metal shed. "What's this thing here?"

"This is the middle marker for runway Three One Right," Sammy says. "Part of the ILS system. And this instrument right here, on top of this tower, is what gives you the wind shear out at this location." He's shown me this before. I look at the detector for a moment, and think once more of Flight 66, and how this small thing might have prevented it. The cops light The Fuselage. There is the familiar—but never less than startling—billow, then column of red flame, the cloud of thick black smoke.

"There's wind-measuring equipment scattered around at various portions of the airport, to give the tower people a wind indication out near the approach ends of the runways," Sammy says. "To determine not only the wind at the center portion of the runway, where there's *always* been an anemometer, but to give you the actual wind direction and velocity nearer the ends of the runways."

"Because that's where the problem happened with Flight 66."

"That's exactly it, right. Same thing with the transmissometers that give you the visibility out at the ends of the runways. Rather than the one observation point over on the top of the IAB, where it *used* to be. Again, an Eastern Airlines airplane crashed, and killed a bunch of people, because of a three-mile visibility that was being given, measured down there—"

"When was that?" I ask.

"Probably in the sixties. It was a prop job—it was probably a DC-4, or whatever."

Lou Abelson, I remember. *The pea-soup fog.* "So," I say. "They were registering three-mile visibility down at the IAB, whereas—"

"At the end of the runway here it was, uh—"

"Socked."

"Exactly." He peers up through the windshield. "Lemme zap across this runway here—now I've got an airplane comin' in; I want to just beat him across."

We cut south across 31 Right. I look back and see an American DC-10 descending toward 22 Left through the black smoke from The Fuselage. "Of course, those airlines *love* it when the cops light that Fuselage," I say.

"Well, I'll tell you. These guys have to contact the tower and get permission to torch up, for that very reason." He clears his throat. "Now, OK. We hired an adviser—a Ph.D. research biologist in Department of Agriculture—to work with, or against, as the case may be, the National Park Service scientists for the northeast region. His name is Dr. Dolbeer. Richard Dolbeer. Now, when he saw this proposal for spending one point eight million dollars for another *study,* he came up with the concept of using our own depredation permit, to exercise a form of control on the laughing gulls without having to even *deal* with the Park Service—other than letting them know, hey, this is what we're gonna do.

"We did have to go through a certain amount of environmental review, and advising various different agencies that we were gonna be doing this," Sammy says. "Then we went ahead and did it. It started in May through to around August the ninth—roughly a twelve-week period. During that period we killed fourteen thousand eight hundred eighty laughing gulls. I say 'we'; I mean the professional shooters. ADC—animal damage control—people. This was Dr. Dolbeer's recommendation."

"How'd they do it?"

"With shotguns, live ammunition. And the cost of that entire project was—I can't say with complete certainly, but say for instance, somewhere around the area of—well, let's say for instance forty thousand dollars. As opposed to one point eight million."

"But I mean, how do they go about it?" I ask. "Are the gulls easy to kill? I mean, don't they fly away when anybody comes up with a gun?"

"Laughing gulls have not been in the area long enough and have not been shot at long enough to be shy," he says. "This is why there were so many bird strikes in the previous years. They aren't even shy of *airplanes.*"

Now we're driving south on Zulu Bravo, in between and parallel to the two 4-22 runways. "Anyway," Sammy says. "We had a lot of opposition."

"Animal-rights people?"

"Yup. But we succeeded."

"What's that I'm looking at right there?" I ask. Sammy stops the truck. "I've never seen that before," I say. "That thing that looks like a bowling pin sticking up? Is that new?" A giant bowling pin is precisely what the white-orange-and-blue structure looks like—a bowling pin or some kind of stylized fifties burger drive in.

"Oh, OK. Yeah, that's new. Well, there was one here before—it had to be relocated to accommodate the extension of this taxiway. It's the VOR—the Omnirange. The airport locator beacon for Kennedy Airport. It broadcasts a system out on every cardinal point of the compass. Three hundred and sixty. Those are known as radials. You can pick up a radial that will lead you in from wherever you are, right into that station. It's an airport-locator beacon, essentially.

"There's probably about—I'm not sure if it's three or four or five thousand of 'em, but something like that—at all major airports all the way across

the country," Sammy says. "It is the basis for the instrument flying system, nationwide—and worldwide! Yes, of course. Worldwide.

"Now, there's also distance-measuring equipment associated with practically every VOR throughout the country. So that as you tune in the identifiers for this VOR, and if you have the distance-measuring equipment in your aircraft, it will give you a read-out as to how far away you are from this station. And most all commercial airliners, at the very least, have VME—visual measuring equipment. And it's broadcast out of here. Tells the aircraft how far away he is—so how much simpler can it be? You just pick up a radio from wherever you are—you follow it in!"

This is all so beautiful that it makes my chest tight. *The world's best boys' toys.* But how can I say this to Sammy? You can't tell that to another man. "Right," I say.

In comes another white jumbo, with a blue-and-yellow-orange tail. "Lufthansa—*regular* 747," I announce, proudly.

"Right," Sammy agrees.

I can't hold back any longer. "Did you do any of the shooting of the laughing gulls yourself, Sammy?"

"No. No."

"You just drove the people around?"

"Right." But he sounds defensive. "Well—I did shoot, but it was unofficial," he says. "I have a firearms permit, so I'm allowed to *do* it. I just did it to get in on the action. You know, on a Saturday or a Sunday, when I didn't have to monitor the radio, I'd bring the guys out—especially when it was only two shooters—we'd go out to one good prime location, and just—" He pauses, not filling in the terrible blank.

Silence for a moment in the truck. "Now, you're such a bird guy," I say. "I mean, you're so fond of so many different kinds of birds. It didn't bother you to—"

"Not a bit."

"Because they're such a danger?"

"Right. And I'm psyched up to that, and I tell you—I could almost say that I *hate* gulls. I like birds, but I have to exclude gulls. Because of the problems that they've given us, and me, out here. For so many years."

We head down the service road again. I think of those years, and then I think back further, to Sammy's first flights, as a kind of aeronautical prodigy, in Swanton, Vermont, at age fifteen. And then all the years of flying after that—in light airplanes and military airplanes and helicopters—until the flying came to an abrupt halt. "Do you ever miss flying, Sammy?" I ask.

"Well," he says, "as it happens, I'm back flyin' airplanes again. Cessna

APPENDIX 20

IBSC Newsletter - April 1998

ACTING CHAIRMAN'S NEWSLETTER APRIL 1998

Next meeting of IBSC, Stara Lesna, Slovakia 14th to 18th September

Reservations and registration

This is just a brief reminder about the deadlines for registration and submission of papers for the next IBSC meeting. By now you should all have received an information pack with details of the conference hotel etc. from Boris Murar. The venue certainly looks most attractive and the conference should be very enjoyable. If anyone has not received the necessary details please contact Boris directly. His address is:

Dr. Boris Murar
Military Veterinary Institute
PS - PPS 311
Stara Bastova 6
04001 Kosice
Slovakia
Tel/Fax +421 95 765 762

Boris is currently investigating the possibility of putting on extra flights between Bratislava and Poprad. You should be receiving information on this very soon.

Please remember: it is most important that you reserve your **hotel rooms** before **30th April 1998**. Details of the hotel are included in the information pack.

Deadlines for papers

Please also remember that there is a **strict deadline** for the submission of papers for inclusion in the conference proceedings. The first volume of the proceedings will be produced in time for the conference and papers for inclusion should be sent direct to me by e-mail, or on computer disc (in Word 6 readable format) or on paper by **31st. May 1998**.

Dr. John Allan (Acting Chairman)

Birdstrike Avoidance Team, CSL, Sand Hutton, York, YO41 1LZ. UK

Papers received **after 31st May** will be included in the second volume of the proceedings, providing that the abstract has reached me by 31st. May, but there will be a **US$50 charge** to cover the additional printing costs. Delegates submitting late papers will be responsible for bringing sufficient photocopies of the full paper to distribute at the meeting.

Other news

Meeting of the International Birdstrike Research Group (IBRG)

The IBRG held its annual progress meeting in the UK in early March. The group, which is a consortium of aeroengine and airframe manufacturers and regulatory authorities, is currently involved in studies of the three dimensional structure of bird flocks in relation to the numbers of birds of different weights likely to be involved in birdstrikes. Computer models have been generated using data from real bird flocks captured by stereo video imaging in order to determine the true probabilities of particular numbers of birds being ingested into large jet fans. Data were also presented on the physical properties of bird bodies in relation to the establishment of international standards for artificial birds in component testing.

For more information contact Richard Budgey on +44 (0)1904 462000 e-mail r.budgey@csl.gov.uk

Proceedings of the 26th meeting of Birdstrike Committee Canada

The proceedings of the most recent meeting of Birdstrike Committee Canada have now been published. As usual they contain a wealth of information on birdstrike issues, research progress, bird control products etc.

Contact Transport Canada on +1 613 990 3739

Forthcoming meetings

Birdstrike Committee USA

The next meeting of BSCUSA will take place at Burke Lakefront Airport, Cleveland on 16th - 18th June 1988. It's not too late to register if you want to attend.

Contact Betsy Marshall on +1 419 625 0242 e-mail nwrcsandusky@lrbcg.com

22nd International Ornithological Congress

The most important gathering of world ornithologists will take place in Durban, South Africa on 17th - 22nd August 1998. The meeting covers all aspects of ornithology, but there are working groups covering issues such as birdstrike and management of problem birds. It is combined with the Festival of Ornithology and promises to be a splendid event - get there if you can.

Details from Turners Conferences Tel +27 31 3321451
e-mail nolram@iafrica.com. Web page http://www.ioc.org.za

Items for inclusion in future newsletters

If you have any news of meetings, research progress, recent birdstrike events etc. that you would like the rest of the birdstrike world to know about please let me have details for inclusion in the newsletter. Newsletters are only produced when there is some news to pass on, so the more information that you send in the more frequent the newsletters will be. Items for inclusion (preferably as Word 6 readable computer files) should be sent to me at the address above.

In the meantime, I look forward to meeting you all in Slovakia in September.

With best wishes;

John Allan.

APPENDIX 21

Selected Article from *The Plain Dealer* (Cleveland, Ohio)

Aviation Experts Targeting Birds

SUNDAY

THE PLAIN DEALER

OHIO'S LARGEST NEWSPAPER $1.50

CLEVELAND, JUNE 2[illegible], 1998

DAVID I. ANDERSEN / PLAIN DEALER PHOTOGRAPHER

Malcolm Kelley, who works for a research laboratory at Wright-Patterson Air Force Base in Dayton, walks through a colony of gulls near Dock 20 of the Port of Cleveland, not far from Burke Lakefront Airport, during recent demonstrations of devices designed to keep birds from smashing into planes at airports.

Aviation experts targeting birds

Conference showcases techniques that reduce number of plane-fowl collisions

By BRIAN E. ALBRECHT
PLAIN DEALER REPORTER

The attack came with the blast of a propane cannon and exploding pyrotechnics, choking clouds of smoke and a screaming aerial blitzkrieg by a falcon and a radio-controlled model airplane.

Wednesday was a bad day to be a bird on the downtown Cleveland lakefront.

Aviation officials had gathered there to observe tactics for keeping birds from smashing into airplanes — tactics that involved scaring them away from airports.

The demonstration was part of the annual conference of the Bird Strike Committee USA, formed eight years ago by the Federal Aviation Administration, the Air Force, the federal Department of Agriculture and the aviation industry.

About 350 wildlife biologists, aviation engineers, government officials, pilots and military personnel gathered to discuss a problem that, according to the FAA, costs civil aviation an estimated $216 million annually in damage to planes and aircraft down time. The problem also has resulted in 300 fatalities worldwide since 1912.

At Burke Lakefront Airport and at the Port of Cleveland docks, conferees watched vendors fill the skies with fireworks and smoke, and fire propane-powered noise making cannons. The vendors also sent border collies racing through the high grass and set traps for voles and mice (that chew the wiring of runway lights and attract birds of prey).

SEE BIRDS/3-B

Tom Seamans, a wildlife biologist at the Sandusky office of the National Wildlife Research Center, shows how radio transmitters are affixed to gulls so their flight paths can be tracked. That information is used as part of bird-control efforts at airports.

Aviation experts are targeting birds

BIRDS FROM 1-B

From 1992 to 1996, 11,571 bird-aircraft collision were reported to the FAA, which estimates that only 20 percent of all such incidents are reported. States with the most reported bird strikes were California, Texas, Illinois, New York and Florida. (Ohio had 398.)

Compared to other threats that could cause the loss of a commercial jet and fatalities, the risk from bird strikes is relatively remote (akin to loss from a lightning strike) and is decreasing as improved aircraft design minimizes damage caused by birds, according to Todd Curtis, a Boeing safety engineer who studied the odds for the committee last year. "It's extremely rare, but when it happens it can cause severe damage," he said.

The first recorded bird strike fatality came in 1912, when Calbraith Perry Rodgers (who made the first transcontinental flight) flew his biplane into a flock of gulls and crashed. Perhaps the largest single loss of life, 62 deaths, occurred in 1960 when an airliner in Boston hit a flock of starlings and crashed.

In Cleveland, the leader of the Air Force Thunderbirds was killed when his jet collided with a flock of gulls at Burke after the 1981 Cleveland Air Show.

Birds have brought down light aircraft and a B1-B bomber. In 1995, an Air Force AWACS plane crashed on takeoff in Alaska when two engines failed after ingesting Canada geese. Twenty-four crewmen perished.

Bird impacts also can damage aircraft wings and flight controls, or smash into windshields — as happened in May 1997 when a DC-9 takeoff from Akron-Canton Regional Airport was aborted after blackbirds crashed into the cockpit, injuring the pilot.

Because the majority of bird-aircraft collisions occur during takeoffs and landings, much of the effort to diminish the problem is concentrated at airports.

This effort can include making the natural environment less attractive to birds by draining wetlands, removing nesting areas and relocating garbage landfills (a food source). Deterrents range from noisemakers and chemical repellents to trained falcons and hawks.

"Birds . . . are just looking for a place to eat, hang out and breed," said Ron Merritt, former head of the Air Force bird-strike program. He now runs a wildlife control consulting firm in Florida.

Merritt said the key to wildlife control is to use several different tactics at different times, because the targeted wildlife eventually will get accustomed to a single deterrent and ignore it.

It's an approach followed at Kennedy International Airport in New York, which spends more than $800,000 a year on bird and wildlife control — including use of falcons, pyrotechnics and sharpshooters — but still had 150 reported bird strikes last year.

"You need it all. There's no one element that will take care of all your bird-control problems," said Lanny Elder, Kennedy's manager of aeronautical services. "You have to experiment and try new things because Mother Nature is very, very hard to fool."

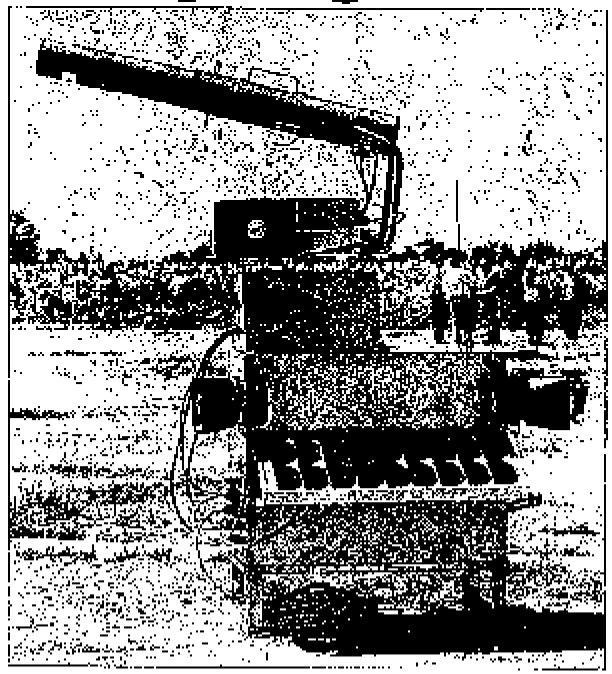
At Cleveland Hopkins International Airport, where there have been 137 reported wildlife collisions with aircraft since 1990, bird controls include pyrotechnics, propane cannons, chemical repellents, periodic patrols and varying the height of grass to discourage nesting and flocking.

Burke uses the same tactics. It has had 78 bird/wildlife strikes since 1990. Commissioner Mike Barth said a colony of about 9,000 gulls had to be chased from the airport three years ago. A decapitated coyote also was found on the runway.

Barth said that as one of the first on the scene of the Thunderbird crash, he takes the wildlife threat very seriously. "To me, wildlife management is just like snow and ice removal," he said.

Several conference participants believe greater effort and funding is needed to avert a major disaster. Gary Larson, USDA eastern regional director of wildlife services, said, "There is a great potential for disaster. I think it's only a matter of time before we lose another aircraft due to a serious bird strike."

Paul Eschenfelder, of the Air Line Pilots Association, also said the industry's good fortune in escaping bird-strike disaster could soon come to a crashing end. "There's going to come the day when we might not be as lucky, when everything is not going to go right," he said.



JAY CLENDENIN / PLAIN DEALER PHOTOGRAPHER

A propane-fueled noisemaking cannon, coupled to a machine playing tapes of bird distress calls, was demonstrated last week as one way of scaring birds from airports.

Boeing's Curtis said his study showed that during the coming decade, there is a 25 percent chance of losing a large jet transport in North America, with one or more fatalities, due to a bird strike.

The study was based on the number of jet transport losses — five, but only one involving fatalities — to bird strikes in the 300 million commercial flights since the start of the jet age.

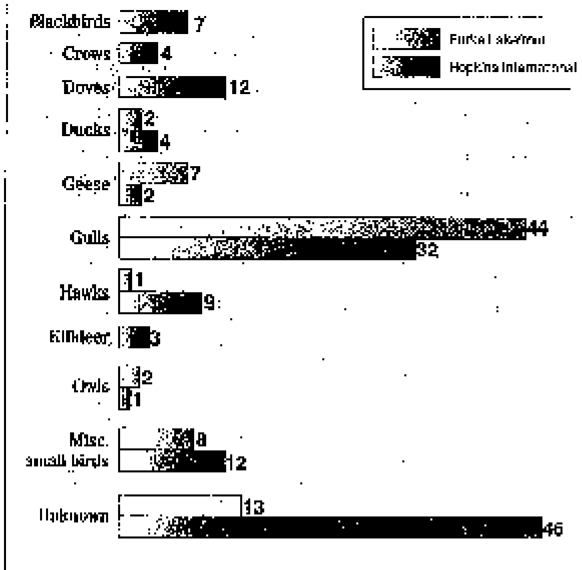
Although Roger Rozelle, director of publications for the Flight Safety Foundation said, "I don't think there's any question that bird strikes present serious problem to aviation safety," he asserted that in terms of overall threats to air travel, bird strikes represent a "very, very low risk."

"For the most part, the airports that have a bird problem are aware of the problem, and have taken measures to reduce it," he said. Also, "manufacturers work very hard to design engines capable of sustaining bird strikes without damage or loss of operations."

Mark Sullivan, spokesman for aviation engine manufacturer Pratt & Whitney, said engines must meet FAA standards for bird strikes. Engines for the Boeing 777 must be able to absorb the impact of four, 2½-pound birds (as tested by using an air cannon to fire carcasses at 180 mph into a working engine).

AIRPLANES VS. BIRDS, 1990-97

Birds being struck by aircraft at Cleveland's major airports mirror the national pattern: Gulls are far and away the most common identifiable species getting hit, though they've got a lot of company.



SOURCES: U.S. Dept. of Agriculture, National Wildlife Research Center PLAIN DEALER

"In the vast majority of [bird strike] cases, the engine design is robust enough that even if an airplane has to turn around and come back, there is no imminent threat to the passengers or crew," Sullivan said. "It's an ongoing concern of the industry that's being managed."

But several conference speakers noted that if nothing else, there are more planes and birds sharing the skies nowadays. During the past decade there has been a 58 percent increase in the number of jet aircraft, while some bird populations (notably geese and gulls) have exploded.

Plans for radar detection of flocks, linked to a system for warning pilots, were discussed at the conference. But for the immediate future, the emphasis seemed to lie with wildlife control.

Bruce MacKinnon, a wildlife specialist with Transport Canada (equivalent of the FAA), described the effectiveness of many wildlife control products as "questionable, at best."

Proven techniques have centered on alterations of habitat and killing a few birds to reinforce deterrent efforts, he said.

As conference participants walked one lakefront product test site Wednesday, gulls that had been oblivious to smoke and pyrotechnics quickly scattered, seemingly illustrating a point made by consultant Ron Merritt.

Of all the possible wildlife control tools available to airports, "the single most important thing is dedicated, trained human beings," Merritt said. "They'll find the tools that work for them."

APPENDIX 22

Aerodrome Safety Information Circular (1998.03.24)

Transport Canada Safety and Security
Civil Aviation

Transports Canada Sécurité et sûreté
Aviation civile

TP 13029

ASIC No. / Nº de CISA 98-002
Date 1998.03.24

Aerodrome Safety Information Circular

Circulaire d'information de la Sécurité des aérodromes

BIRD/WILDLIFE INCIDENT REPORTING SYSTEM

PURPOSE:

This Aerodrome Safety Information Circular is being issued in order to advise Canadian Aerodrome operators of the current situation with regards to the reporting of bird/wildlife incidents which occur in the aerodrome environment.

BACKGROUND:

Prior to the implementation of the National Airports Policy, there was a requirement that all bird/wildlife incidents which occurred at airports owned and operated by Transport Canada be reported to Transport Canada Headquarters. In addition, there remains a requirement for all facilities to report to Transport Canada's Civil Aviation Daily Occurrence Reporting System (CADORS) any incident which results in operational impacts. Furthermore, the Department of National Defence, airlines, and pilots all report bird/wildlife incidents to Transport Canada on a voluntary basis. For a number of years, the information obtained from these reporting sources has been collected and analyzed by Transport Canada, and an annual summary report of bird strikes to Canadian aircraft is produced for the industry. This report has proven to be valuable to the industry both nationally and internationally as a way to monitor trends such as bird/wildlife species involved, the numbers and locations of incidents, aircraft and engine types, and time of year or weather conditions etc. This

SYSTÈME DE RAPPORTS D'INCIDENTS LIÉS AUX OISEAUX OU À LA FAUNE

OBJET :

La présente circulaire d'information de la Sécurité des aérodromes vise à informer les exploitants d'aérodromes canadiens de la situation actuelle concernant les rapports d'incidents liés aux oiseaux ou à la faune qui surviennent aux aérodromes et dans les environs.

CONTEXTE :

Avant la mise en oeuvre de la Politique nationale des aéroports, tous les incidents liés aux oiseaux ou à la faune qui se produisaient dans les aéroports dont Transports Canada était le propriétaire et l'exploitant devaient être signalés à l'Administration centrale de ce ministère. Aujourd'hui, les installations doivent encore inscrire dans le Système de compte rendu quotidien des événements de l'aviation civile (CADORS) de Transports Canada tout incident qui entraîne des répercussions opérationnelles. En outre, le ministère de la Défense nationale, les entreprises de transport aérien et les pilotes signalent les incidents liés aux oiseaux ou à la faune à Transports Canada de façon volontaire. Depuis un certain nombre d'années, Transports Canada recueille et analyse l'information fournie par ces sources et produit un rapport sommaire annuel sur les impacts d'oiseaux avec les aéronefs canadiens pour l'industrie. Ce rapport s'est révélé un outil précieux pour l'industrie, tant à l'échelle nationale qu'internationale, car il lui permet d'établir des statistiques sur les espèces d'oiseaux et de la information can be used by the industry to initiate mitigating measures which may help to prevent damaging incidents or loss of aircraft and human life.

faune en cause, le nombre d'incidents, le lieu des incidents, les types d'aéronefs et de moteurs, le temps de l'année et les conditions météorologiques, etc. Elle peut ensuite utiliser cette information pour prendre des mesures qui contribueront à prévenir les incidents dommageables ou la perte d'aéronefs et de vies humaines.

INFORMATION:

Subsequent to the National Airports Policy, there is currently no system in place obligating the industry to report bird/wildlife incidents unless they involve the Department of National Defence, or result in operational impacts. In order to maintain the current data base of bird/wildlife incidents, Transport Canada must depend on the continued good faith and cooperation of the industry to report all incidents. In order to fulfill our goal of managing the safest aviation system in the world, it is essential that all stakeholders report every bird/wildlife incident. It is our hope that all Canadian aerodrome operators will develop and maintain a data base of incidents which occur at their sites, and provide this information to the Aerodrome Safety Branch at the end of each calendar year, or preferably throughout the year soon after each incident occurs. Incidents can be reported in the following ways:

- Transport Canada's Bird/Wildlife Strike Report form available from the address below
- Toll-free Bird Strike Reporting number: 1-888-282-BIRD (2473)
- Bird Hazard Website: (www.tc.gc.ca/aviation/wildlife.htm)
- CADORS

INFORMATION :

Depuis que la Politique nationale des aéroports est entrée en vigueur, il n'existe aucun système qui oblige l'industrie à signaler les incidents liés aux oiseaux ou à la faune, sauf si le ministère de la Défense nationale est en cause ou si l'incident a des répercussions opérationnelles. Afin de maintenir sa base de données sur les incidents liés aux oiseaux et à la faune, Transports Canada doit compter sur la bonne volonté et la collaboration de l'industrie. Pour que nous puissions atteindre notre objectif, qui est de gérer le système de transport aérien le plus sécuritaire au monde, il est essentiel que tous les intervenants signalent chaque incident lié aux oiseaux ou à la faune. Nous espérons que tous les exploitans d'aérodromes canadiens consigneront les incidents qui surviennent sur leur site dans une base de données et qu'ils communiqueront ces renseignements à la Direction de la sécurité des aérodromes à la fin de chaque année civile, ou encore mieux, après chaque incident. Les incidents peuvent être signalés des façons suivantes :

- Formulaire de rapport sur les impacts avec les oiseaux ou la faune de Transports Canada disponible à l'adresse ci-dessous
- Numéro sans frais : 1-888-282-BIRD (2473)
- Site Web sur le péril aviaire : (www.tc.gc.ca/aviation/wildlife.htm)
- CADORS

- Alternatively, each aerodrome can provide the data to Transport Canada in whatever format the facility uses to record other operational information.

It is our hope that industry cooperation in this matter will enable Transport Canada and the aviation industry to more effectively dedicate resources to those areas which require improvement. For additional information please contact:

Bruce MacKinnon
Wildlife Control Specialist
Transport Canada, Safety and Security
Aerodrome Safety Branch
330 Sparks St., Place de Ville, Tower C
Ottawa, Ontario, K1A 0N8
Phone: (613) 990-0515
Fax: (613) 990-0508

- Chaque aérodrome peut aussi envoyer ses données à Transports Canada dans le format qu'il utilise pour consigner d'autres renseignements opérationnels.

Nous espérons que la collaboration de l'industrie à cet égard permettra à Transports Canada et à l'industrie aéronautique de consacrer leurs ressources aux secteurs qui ont besoin d'être améliorés. Pour de plus amples renseignements, veuillez communiquer avec :

Bruce MacKinnon
Spécialiste du contrôle de la faune
Transports Canada, Sécurité et sûreté
Direction de la sécurité des aérodromes
330, rue Sparks, Place de Ville, Tour C
Ottawa, Ontario, K1A 0N8
Téléphone : (613) 990-0515
Télécopieur : (613) 990-0508

for Harvey Layden
Director/Le directeur
Aerodrome Safety/La sécurité des aérodromes

APPENDIX 23

Honk if you like flying carp

(from *Equinox* - February/March 1998)

HONK

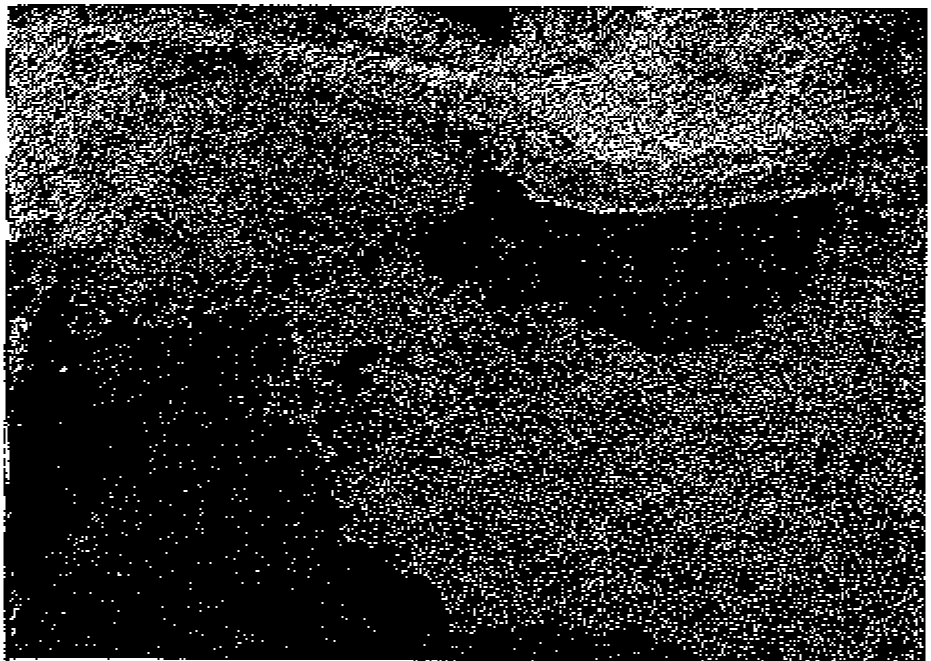
if you like flying carp

Too smart for their own good, burgeoning populations of snow geese are wreaking havoc on precious tundra habitat. It's enough to get die-hard conservationists reaching for their rifles.

Article by Ed Struzik

The late-summer morning in Churchill, Manitoba, is off to a promising start, with a clear sky unfolding from the inky cloud cover over Hudson Bay. From the air, we can see a distinctive yellow reflecting from the coats of a female polar bear and her cub marching purposefully along an esker not far from a small group of grazing caribou. But by the time the pilot gets us out to the treeless lowlands of La Pérouse Bay 30 kilometres to the east, the winds have begun to blow, raising huge swells on the sea that collapse on the mud-rock beaches. A pelting rain greets our descent, casting a pall on our work. Close to where we land, biologist Robert Rockwell of the American Museum of Natural History comes upon an emaciated snow goose gosling in a thicket of arctic willow. Barely able to raise its head, the bird appears to have just a few hours of life left. Surprised that it is even alive, Rockwell cups the gosling in the palm of his hand. "I figure it's about 500 grams," he says. The gosling should weigh at least twice that by now if it is to make it south for the winter.

John K. Ford



What nature cannot seem to do, biologists now say, humans must. Even the most conservation-minded wildlife experts are conceding that something drastic, such as the controlled slaughter of one million birds annually, must be carried out to bring back balance to the ecosystem. "It's a lot worse than what I assumed," says Gerald McKeating, the Canadian Wildlife Service director of prairie and northern regions, who is steering Canada's course on the issue, following a tour of La Pérouse Bay last summer. "It's not just the fate of the snow goose that concerns me. It's the welfare of the entire coastal ecosystem. A great variety of other birds and animals are being affected by this."

Like all troublesome phenomena in nature, this one did not happen overnight. Back in the 1960s, the traditional wintering ranges of the snow goose and other migrating birds on the Gulf of Mexico coast were being taken over by petroleum rigs and refineries, shipping canals, and suburban developments. For cranes, herons, and other birds that tend to be shy and discreet, the disappearance of the coastal salt marshes proved to be devastating. But the highly gregarious and social snow goose quickly adjusted to the problem by stopping short its migration in the interior farmlands of Louisiana and Texas, where hardwood forests had been clear-cut, wetlands drained or leveed off, and grasslands and pastures tilled to make way for new cash crops of corn, rice, soybeans, and wheat. The results were predictable, says Rockwell. "Once a goose gets a taste of rice or soy, it's not going to go back to slim pickings on the salt marshes," he says. "The snow goose hit pay dirt by stopping short its migration. It's doing so well, in fact, that we're seeing them overwinter now as far north as Iowa."

Wildlife managers inadvertently contributed to the problem. In the

Scanning the coastline for signs of life, Rockwell offers little hope for the several hundred other dwarf goslings that may still be alive. In a matter of days, or maybe a week or two, he predicts, there will be some hard frosts, and if the birds somehow manage to survive the cold, foxes, wolves, and polar bears will surely dispense with them in short order. "It's eerie," says Rockwell, who began his research studies in the area in 1969. "A decade ago, there were maybe 200 nesting snow geese in some of our study areas. Now there are none, or very few. You don't see or hear any other birds either. It's like someone came in here and napalmed the area."

Scientists call these lowlands of the sub-Arctic and Arctic the Dead Zone. On a colour-coded satellite map, they appear as a narrow ribbon of red wrapped around the 1,800-kilometre coastline of southwestern Hudson Bay and James Bay and in a small pocket of the Queen Maud Gulf Bird Sanctuary near the central Arctic coast. On the ground, the once generous land is now a baked brown, sometimes a red or green carpet of powdery peat, damp moss, or marsh ragwort with a few dried-out tufts of grass and willow. Today all that live on these patches are a few opportunistic insects and a handful of Death Valley-like plants.

The culprit is not some mysterious predator or scourge. It is the elegant white, and often blue-grey, snow goose, as well as human efforts to preserve the species, that is responsible for what scientists in Canada and the United States describe as an environmental disaster in the making. While many urbanites see geese as golf course and city park nuisances, the birds' deleterious effect on northern habitat carries with it serious ecological consequences. "I used to think that nature would take care of this over time," says Rockwell. "But what we have seen evolving here is not natural. It's nature out of control. Thirty years ago, we had perhaps a million snow geese in North America. Today there are probably six times as many. The number of snow geese in this part of the world is growing so rapidly that it is overtaking the ecosystem's ability to feed them, as well as a number of other birds and animals."

JEFF LEPORE/PHOTO RESEARCHERS, INC.

Continuing its cycle of life, a snow goose prepares its nest in the Northwest Territories, above. By adjusting the migration route, gregarious snow geese, seen on facing page resting en masse at a U.S. wildlife reserve, avoided the fate of other waterfowl.

1960s and 1970s, when it appeared that waterfowl were in desperate need of protection, refugia were established in the interior of the United States and Canada. Tougher hunting regulations were thrown in for good measure. Never high on the game list because it is difficult to shoot and has a reputation for being poor table meat, the snow goose has fallen out of favour with hunters. With more food and fewer hunters, snow geese mortality declined by 50 percent in short order. At La Pérouse Bay, all this allowed just one colony of snow geese to expand from 2,000 pairs in 1968 to 22,500 by 1990. In some cases, that amounts to 3,000 nests in just one square kilometre of tundra.

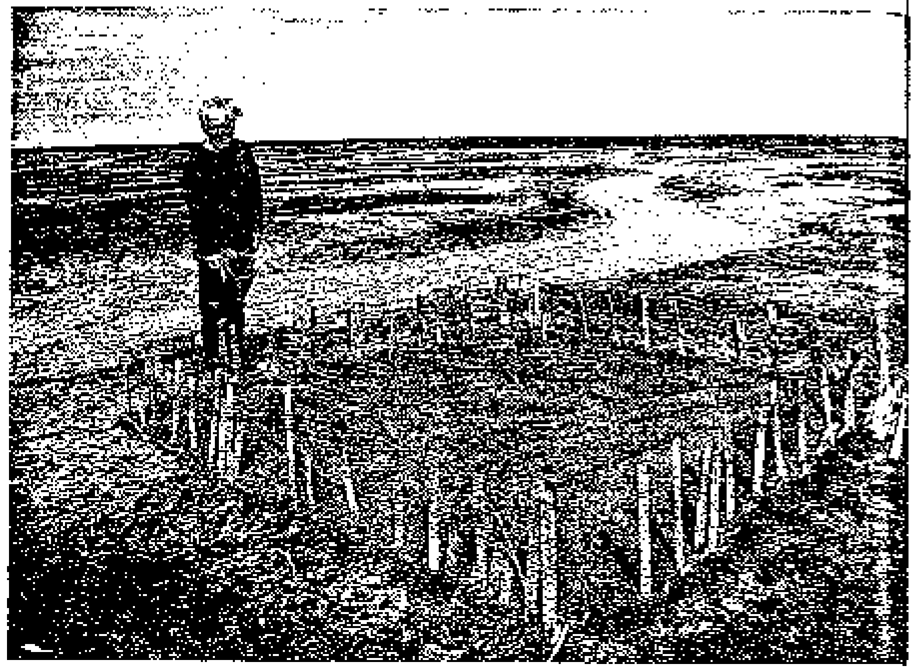
The farmers of the southern states were the first to notice the consequences. Occasionally, and then more often, hordes of geese would descend on a field of soybeans or rice and pick it clean. The birds learned they could do the same in Canada while staging at various points on their migration north. By the 1990s, the problem of geese pulling out seedlings, grazing on young plants, and removing seed heads became so serious that farmers began demanding compensation. In Quebec alone, compensation claims shot up as quickly as the goose numbers—from $466,500 in 1992 to more than $844,000 in 1996. In some parts, the noble blue goose, as the dark phase of the bird is known, was being renamed tundra maggot or flying carp.

While the southern farmer could always replant the following spring, in northern Canada, where the fattened geese migrate to breed, the consequences are vastly different. Much of the 1,800 kilometres of salt marsh along the Hudson and James bay coastlines has emerged over the past millennium as a result of isostatic uplift that has

JAMES L. AMOS/PETER ARNOLD, INC.

raised the sea bottom as much as 1.2 metres per century since the last great glacial retreat. In that time, only the thinnest of soil covering has formed, and only two plants—the stoloniferous grass and the rhizomatous sedge—have taken root in a significant way. Both are prime food sources for the snow goose.

University of Toronto botanist Robert Jefferies says the worst damage is done in the spring as snow geese follow the retreating snow line northward, feeding intensively on the exposed vegetation along the way. Most often, he explains, they pull up the shoot of a plant in its entirety, chew off the stems, which are rich in carbohydrates and nitrogen, then discard the remainder. Putting their serrated bills to good use, they seem to revel in grubbing below



the surface for roots.

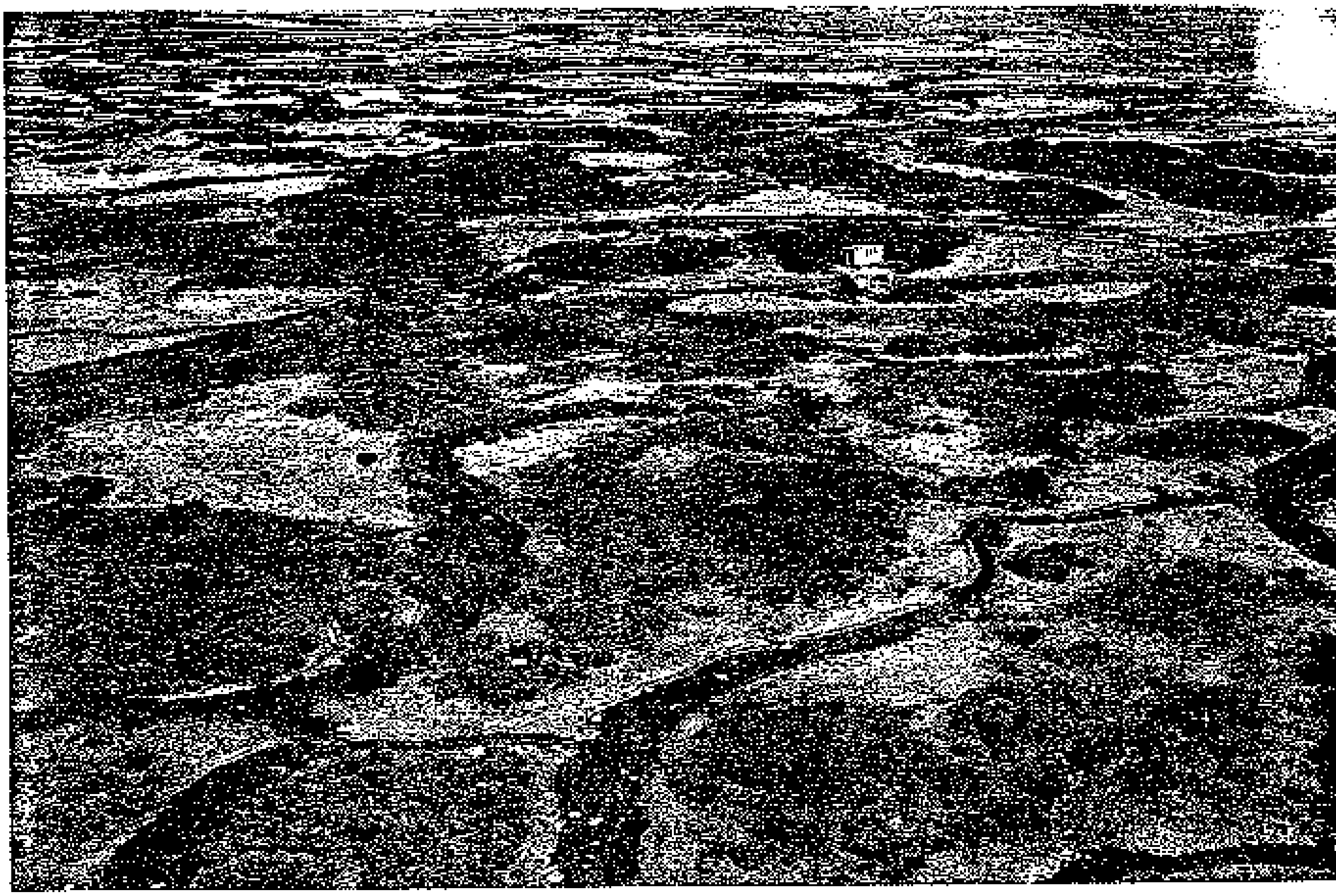
Tall, thin, and properly British, Jefferies is the antithesis of the blunt, stocky, and American Rockwell whom he has befriended and worked with at La Pérouse Bay since 1981. He points out that most arctic plants are by nature highly resilient. But even the hardiest of plants, he says, cannot withstand the constant hammering that arctic vegetation experiences year after year at La Pérouse Bay and in other areas on the Hudson and James bay coastlines.

Jefferies, who foresaw the snow goose problem many years ago, has convincing evidence. Since 1982, he, his colleagues, and students have been monitoring a number of wire-mesh vegetation enclosures designed to keep out all but curious polar bears. Today the contrast between inside and out is as striking as the difference between a well-watered lawn in suburban Phoenix and the desert surrounding it. As expected, the undisturbed vegetation within the enclosures continues to thrive while maintaining the diversity that is essential to any complex ecosystem. Outside, however, the terrain is scoured of plant life, except for species such as mare's-tail and Yukon ragwort, both of which produce noxious alkaloids and are renowned for invading disturbed areas. Considering that a single goose can clear one square metre of vegetation in under an hour, it is not difficult to imagine what tens of thousands of the birds can do. Jefferies saw for himself back in 1984, when 10,000 snow geese, many of them stalled on their northward migration by a cold front to the north, denuded six square kilometres of coastal marsh at La Pérouse Bay in just three days.

With more and more plants succumbing to feeding frenzies, ever larger tracts of thin and now unprotected arctic soil are being eroded by the movement of melting snow and rain on the coast. As on a clear-cut on a British Columbia mountainside, there is little to stop moisture in the disturbed parts from carrying away the soil and its nutrients and preventing new shoots from taking hold. In some low-lying areas, huge ponds have formed for lack of drainage. The problem is exacerbated each spring as the birds return to the ponds and resume grubbing along the edges of the water. In a particularly dry season, some of the pond water will evaporate, resulting in salt being raised to the surface: the clay lying beneath the marshes of southern Hudson Bay is a remnant of the ancient Tyrell Sea. In some cases, the salinity of the soil is three times that of seawater: too toxic to sustain the snow goose's favoured plants or the vast number of invertebrates on which the goose feeds.

The ramifications of the loss of vegetation are apparent in the work that is being done by Tanya Handa, one of Jefferies' graduate students. In a number of

(LEFT) ANDREW JANO; (RIGHT) ED STRUZIK



Undisturbed land within a wire-mesh enclosure, left, shows the richness that is nowhere to be seen on the now scoured Hudson Bay coast, above. Facing page, patches of red in a satellite image of La Pérouse Bay show vegetation loss caused by overgrazing.

enclosures, she has attempted to transplant individual shoots of goosegrass into sites that the feeding geese have denuded. Even under optimal conditions, she has been having trouble getting several plants to come back, and many of those that did recover took a great deal of time and care and, in some cases, required fertilizer and organic mulch supplements. Such evidence, Jefferies suggests, points to a decades-long process of natural recovery, if at all—in the event goose numbers return to historic levels.

While nature is usually a highly efficient, self-regulating world, the predator/prey system along the Hudson and James bay coastlines was never cut out for this kind of population explosion. Fat-starved polar bears, for example, find no value in feeding on the scrawny birds, although some seem to take pleasure in chasing goslings around for play. (Rockwell has seen juvenile bears catch a young goose, then toss it up in the air, only to resume the chase if the bird is still alive. If it is dead, they may simply walk away or take advantage of a quick meal.) The seasonal tenure of the geese is also too short to sustain a significant increase in fox and wolf populations. Their fate is determined largely by the availability of food in winter, when all the geese have gone.

From a naturalist's point of view, all that is left is to let bird numbers grow to the point where the geese eat themselves out of house and home and crash as a population. But just as snow geese were able to adapt to the dwindling salt-marsh habitats in the south, they have also been able to adjust to the changing northern conditions for which they are responsible. While one gosling may succumb to disease and starvation, for example, two or three of its brothers, sisters, and cousins will move inland with their parents—sometimes on foot—in search of new sources of food. "We know of instances where a gosling has travelled five kilometres to a new source of food within 24 hours of hatching," Jefferies says. "In other cases, we've seen goslings travel up to 60 kilometres from their hatching sites in a 30-to 45 day period. We're seeing snow geese in areas we've never seen them before."

For Rockwell, the phenomenon that is unfolding on the Hudson and James bay coastlines is akin to what can happen to humans in densely populated centres of the world. "Once the inner core starts deteriorating, the children move to the next core, and then their children move to the next core after that," he says. "What you end up with is ever-growing slums. And just as depressed human habitat produces disease and malnourishment, the same holds true for snow geese."

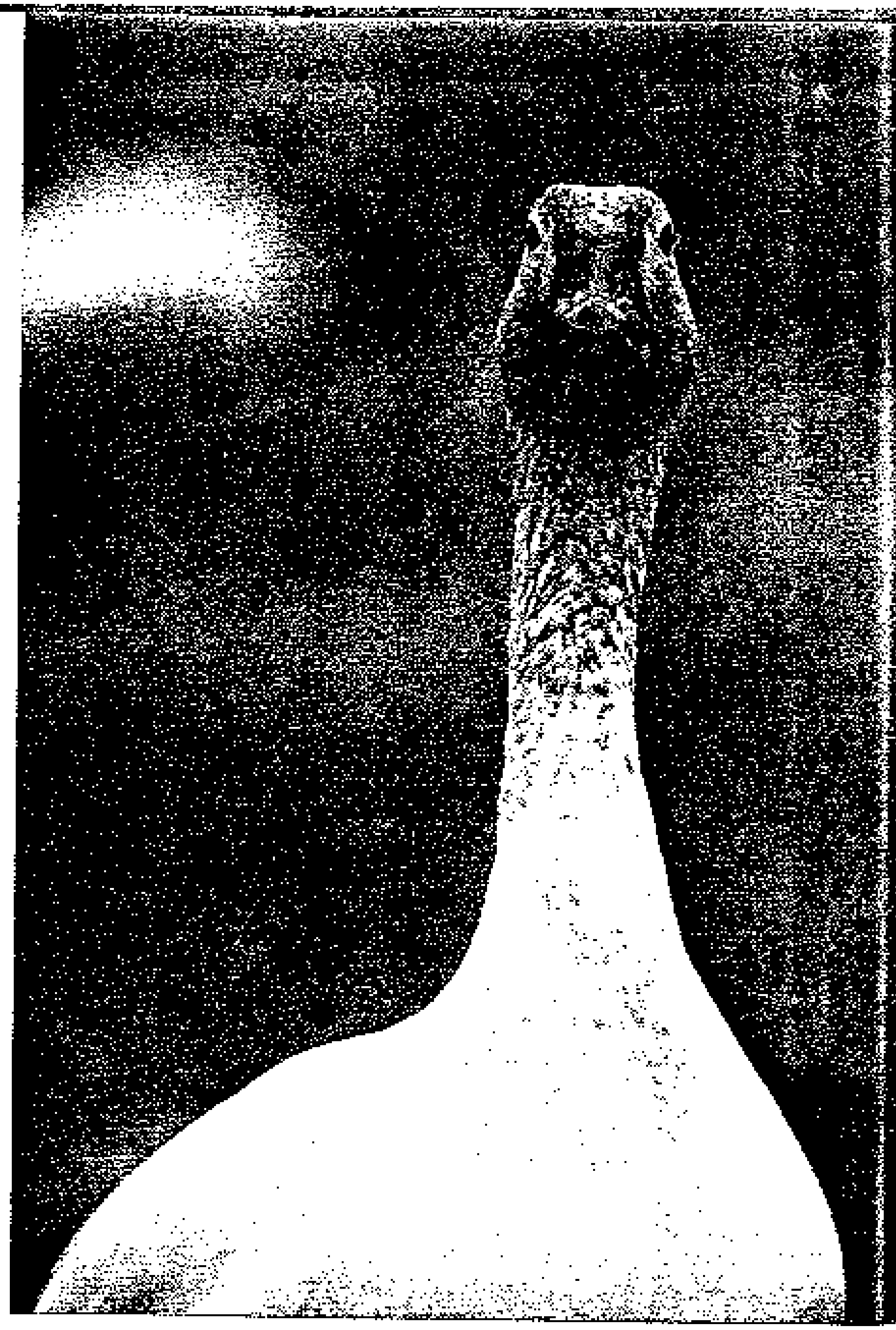
There are already indications that disease and developmental problems are afflicting the geese. In some areas, snow geese are maturing to only 90 percent of their normal size for lack of

ROBERT ROCKWELL

food, while others are experiencing deformities in their wing primaries. The incidence of renal coccidiosis is also on the rise in areas with high densities of birds and a shortage of fresh water. The affliction takes hold when an ailing bird is unable to consume enough fresh water to wash out the salt that accumulates in its kidneys. Eventually the organs shut down. Death comes slowly and painfully unless the bird is done in first by a fox or other predator.

On a hot day at La Pérouse Bay, the acrid smell of ammonia from the droppings of snow geese, which are excreted once every four minutes, is palpable. But what also comes as strikingly strange to someone familiar with such ecosystems is the absence of other forms of bird life. For example, no one has seen the once abundant yellow rail at La Pérouse Bay for years. Nesting pairs of semipalmated sandpipers and red-necked phalaropes have declined dramatically in habitats traditionally occupied by high densities of snow geese. The deterioration of the coastal landscape has biologists now focusing on various shorebirds, ducks, and passerines to see whether they have been similarly affected. Even big-game biologists in the Northwest Territories are looking at the problem, wondering whether larger species similarly dependent on coastal vegetation might be affected by what the snow goose is doing to the ecosystem.

Faced with a situation that biologists say has no parallel in nature, wildlife managers are trying to find a way to prepare the public for what they feel must be done. "We have a unique situation before us, and the ramifications are clear," says Bruce Batt, chairman of the Arctic Goose Habitat Working Group, which is monitoring the phenomenon and considering ways of dealing with it. "In the areas of La Pérouse Bay where the snow geese summer, already 35 percent of the habitat is overgrazed, 35 percent is damaged, and another 30 percent has been destroyed. And we don't see anything to suggest that things are improving."



Avian stare-down: The much-maligned snow goose, above, may be the target of renewed hunting in the U.S., facing page, and Canada, testing public attitudes.

Batt and his working group have known for some time that they have a sensitive management issue before them, and they have been reluctant to endorse formally any of the corrective measures suggested by scientists and wildlife managers. They know that liberalizing hunting laws, opening more game reserves to hunters, destroying millions of eggs annually, or even attaching a $1 million price tag to the leg of a snow goose are not measures that conservationists and animal-rights activists are willing to accept—at least not without a nasty fight. But Batt, who has been surprised by the absence of any serious public outcry, says there is no ambiguity in their ultimate goal. "The population needs to be reduced, perhaps by as much as 50 percent. We're clear on that. We'd like to see some plan in place by the fall of 1998."

While no one is denying there is a desperate need for action, the proposed

LOUISE TANGUAY

slaughter makes the Humane Society of the United States nervous. "There is no doubt in our minds that this is a serious issue," says Susan Hagood, a wildlife-issues specialist with the Humane Society who travelled to La Pérouse Bay last summer. "But we're concerned that other nonlethal options are not being considered." Egg-collection programs and the hazing of geese that stage at critical locations are two means that should be investigated, she says. Hagood also feels that control measures, if applied universally, may end up destroying thousands of geese that are not causing any problems. "It's really a southern Hudson Bay problem," she says. "There is no compelling evidence to suggest that the geese are causing problems at other nesting sites in North America."

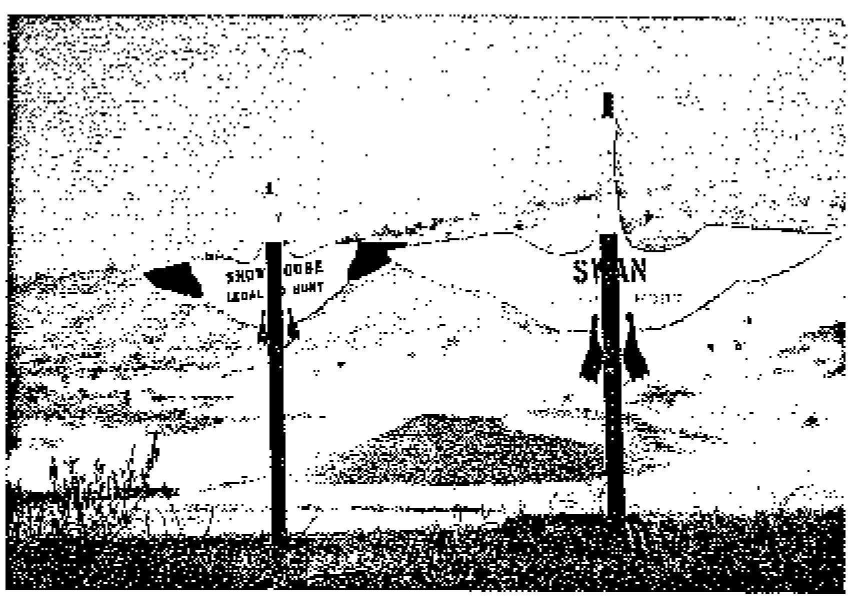
In the U.S., there is support within government circles to take extreme measures to deal with snow geese. The Canadian government, however, is not likely to be drawn into any bold corrective measures in the immediate future if Gerald McKeating of the Canadian Wildlife Service has his way. As a wetlands biologist who has worked his way up the ranks, McKeating understands the science of the issue. But as former director of the Federation of Ontario Naturalists, he is also sensitive to how the public might react to any plan that would include what may be described as a huge slaughter of elegant white birds. "Consider how valued these birds are to the thousands of people in the Alberta region who go out to marvel at the snow goose staging area every year at Beaverhill Lake or to those people in Quebec who drive to similar staging areas at Cap Tourmente," he says. "There is no way we can sell the idea of killing these birds in large numbers unless the science is absolutely clear on the issue."

That said, McKeating and others will be talking this winter with aboriginal groups in northern Manitoba and the Northwest Territories about getting them involved in a systematic hunt that will see many more snow geese taken. Whether such a hunt will include government subsidies for ammunition, transportation, or the bartering of snow goose meat between native communities is not yet clear. In the meantime, scientists will examine more closely other factors that McKeating believes may be at play.

One of the factors is climate. Since 1961, the breeding areas of the snow goose have been experiencing warmer weather, with spring melts in southern Hudson Bay coming almost 15 days earlier than in previous decades. Although there is no clear evidence to suggest that warmer conditions have increased reproductive survival, it seems likely. But while springtime temperatures in the southern part of Hudson Bay are warmer, northern regions around Baffin Island have been shivering under a trough of cold springtime air for many years. This trough may explain why the nesting range of the snow goose has been shifting south recently. It may also account for why geese that are still nesting farther north now spend an extra couple of weeks staging in the southern Hudson Bay area before finishing the last leg of their northern flight, thereby putting additional pressure on food supplies.

Most biologists involved in the issue are aware of the scientific concerns and the potential for a public backlash if the kinds of extreme measures being considered are finally implemented. But they also warn that delaying a decision indefinitely could have catastrophic consequences for other populations.

"In 60 or 70 years, the situation may well correct itself," says Rockwell, surveying the wasteland that is now La Pérouse Bay. "The population will crash and the numbers of snow geese will return to something that is more normal. But in the intervening time, huge tracts of very productive coastal marsh in the Arctic will be lost, very likely for long periods of time and at the expense of a wide variety of birds and animals. A huge ecosystem is at stake if nothing is done about it." ■



JIM BRANDENBURG/MINDEN PICTURES

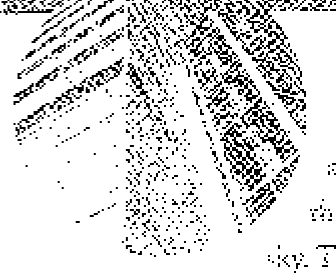
Field correspondent Ed Struzik reported in the previous issue on radars being affixed to Apollo butterflies. He resides in Edmonton.

APPENDIX 24

They're Back - Raptors on the Rebound

They're Back

Raptors on the Rebound



Gazing upward you might see a magnificent bird streaking through the downtown Toronto sky. This could be the spectacular Peregrine Falcon (*Falco peregrinus anatum*), an endangered raptor making a comeback after being nearly eliminated from much of North America due to the widespread use of insecticides such as DDT. After the banning of DDT in Canada during the early 1970s, a massive recovery program was undertaken involving breeding and releasing young Peregrines across their former nesting range. Recovery efforts by Environment Canada, the Ontario Ministry of Natural Resources, dedicated wildlife organizations and countless volunteers across the province have resulted in the return of this bird of prey to the skies of Ontario.

Peregrine Falcons are not only returning to the high cliffs of northern Ontario, but also to metropolitan areas across southern Ontario. With cliff-like building ledges on which to nest and an abundant source of food to feed their chicks, Peregrines are settling in and starting to raise their young amidst the hustle and bustle of urban environments, including the cities of London, Hamilton and Toronto. Although these concrete jungles may seem like odd places for wild raptors to call home, the tall buildings with their sheer sides are great substitutes for the high rock cliffs and canyons where Peregrines naturally breed. Their aerial acrobatics are thrilling to watch. When in an attack dive or stoop, Peregrines can reach speeds of up to 300 km/hr (186 mph) -- the fastest animal on Earth!

As Peregrine Falcon populations increase, the chances of seeing one of these impressive birds also grows. Keep your eyes to the sky in search of Ontario's newest raptors!

Peregrines are settling in and starting to raise their young amidst the hustle and bustle of urban environments.

Photo of Peregrine Falcon - John Mitchell

Environment Canada / Environnement Canada

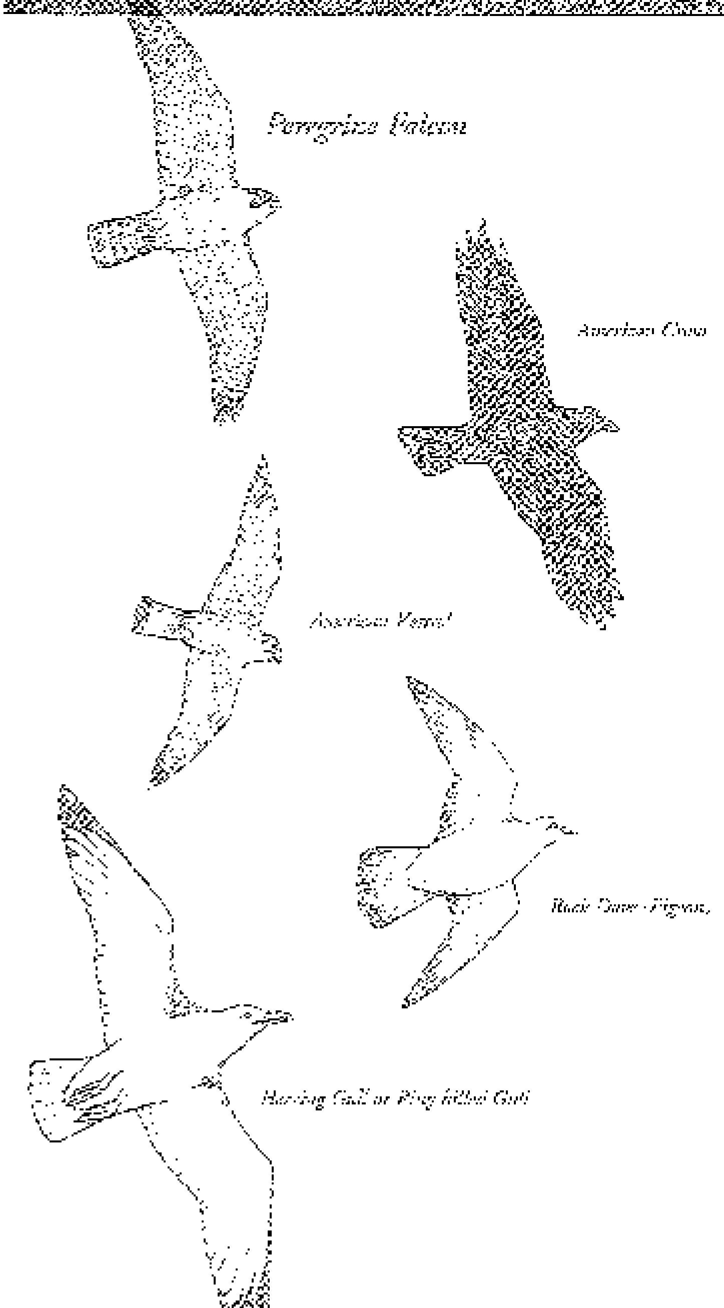
Ministry of Natural Resources / Ministère des Richesses naturelles — Ontario

Song of Hope

WWF — World Wildlife Fund / Fonds mondial pour la nature

IDENTIFICATION

You are watching a bird that [illegible] a Peregrine Falcon?



Here are some tips to help you:

Peregrine Falcon

- 38-50 cm (15-20 inch) in length
- heavy black sideburns and bluish grey back, wings and tail
- breast white or salmon with black barring
- long pointed wings, narrow tail and quick strong wing-beats

American Crow

- similar in size to a Peregrine
- completely black in colour
- fanned tail and wider wings with a more fringed appearance

American Kestrel

- a much smaller falcon, 23-30 cm (9-12 inch) in length
- back and tail are rusty in colour
- hovers while hunting with rapidly beating wings

Rock Dove (Pigeon)

- smaller than a Peregrine, 33 cm (13 inch) in length
- greyish with variations of white and brown colouring
- fan-like tail and pointed wings that are much shorter than a Peregrine's wings

Herring Gull or Ring-billed Gull

- 58-65 cm (23-26 inch) in length
- white with grey wings and black wing-tips, young birds are brown
- long pointed bill, yellow in adults and brown in young birds

For more information on Peregrine Falcons contact:

Canadian Wildlife Service
Environment Canada
4905 Dufferin St., Downsview, Ontario M3H 5T4
http://www.cciw.ca/green-lane/wildlife/

Thank you to Environment Canada's Great Lakes 2000 Cleanup Fund for supporting the recovery of raptor populations.

Visit the Peregrine Falcon web page to view live video images from the Toronto nest site!
http://www.on.doe.ca/falcon/index.html

Printed on recycled paper

APPENDIX 25

Selected Articles from *The Globe and Mail* (Canadian National, daily)

Worst-run runways identified in report

2,000 geese on city's hit list

An early-morning patrol to save birds

Browning-Ferris might merge with Allied Waste

Bulldozer rolls over nests on Leslie Street Spit

Cormorants ruffle fisherman's feathers

The Globe and Mail, Monday, June 8, 1998 A9

Worst-run runways identified in report

Canada not on list of most deficient

Associated Press

LONDON — International airline pilots have listed 150 airports with major safety problems and singled out 15 — including San Francisco and Hong Kong — that they believe are "critically deficient," the Sunday Times says.

No Canadian airports were singled out among the worst 15. The newspaper said it had been leaked a copy of a report compiled at an April meeting of the International Federation of Air Line Pilots' Associations in Montreal.

"If airports and airspaces are listed, it means they have serious deficiencies, not that they are unsafe," the Sunday Times quoted federation executive director Cathy Bill as saying.

"There are potential dangers, but there are potential dangers when you get in any plane."

Other airports in the critically deficient category were: Wellington in New Zealand; Oslo's Fornebu Airport; Suva in Fiji; Buenos Aires in Argentina; Leticia, Rio Negro and San Andres in Colombia; Maiquetia in Venezuela; Nauru, a central Pacific island; Lagos and Port Harcourt in Nigeria and Kabul in Afghanistan.

The newspaper said air crews have complained about landing at airports in popular tourist destinations, such as Greece, "to find inadequate runway lighting and no air-traffic controllers on the ground."

At Argentina's Mendoza Airport, it said, a pilot reported a horse on the runway. Another aborted a takeoff from Buenos Aires after seeing children playing in his path.

At San Francisco, planes land in pairs on parallel runways with pilots often relying largely on visual contact.

"It's been known for pilots to start aiming at the wrong runway and drift across in front of the other plane," the paper quoted an unidentified pilot as saying.

Although Hong Kong airport has had few serious accidents, it is potentially dangerous because of the proximity of the runway and parallel taxiway, which can be hazardous in crosswinds.

The Globe and Mail Thursday, May 14, 1998

2,000 geese on city's hit list

Two thousand Canada geese in Mississauga may not be as lucky as a similar flock last year, whose lives were spared when New Brunswick came to their rescue.

Mississauga Council yesterday agreed to apply to the Canadian Wildlife Service, a part of Environment Canada, for a permit to cull the geese unless another community is willing to take them.

The geese are captured while they are moulting so they cannot fly away. They are then slaughtered.

There are about 250,000 Canada geese across Southern Ontario, and the population doubles every three years. Most municipalities near harbours have learned to co-exist with their feathered neighbours, but politicians and residents of Mississauga say they have had enough of the geese ruining parks for people.

"This has been a problem for years, and for years we have been trying to deal with how to balance the millions of dollars we have spent on making the waterfront a place for people while appreciating the wildlife. But there are too many geese. It's out of control and we have to make hard decisions," Mayor Hazel McCallion said.

The city has set a June 5 deadline for the CWS to find a willing community to take the geese. New Brunswick has indicated it does not want any.

The city has not said what it will do with the carcasses.

The Animal Alliance of Canada, an advocacy group opposed to the city's plan to kill the geese, has said that it will take legal steps to challenge the CWS's authority if it grants the city a culling permit. Staff

An early-morning patrol to save birds

BY DEBBIE HONICKMAN

The Globe and Mail Thursday, May 14, 1998

REMEMBER when, in *Network*, Peter Finch throws his television out a high-rise building shouting, "I'm mad as hell and I'm not going to take it any more"? Then he urges the world to do the same. Well, what if I feel that way about the high-rise and want to throw it out the window?

You see, I'm a birder but I'm not an early birder by choice. I'd rather not walk the streets of downtown Toronto at 4 o'clock in the morning. Recently, though, I've taken to going out one day a week before dawn to stoop and scoop. It's not pet doodoo I'm after; it's the dead and the dying and the about-to-die-but-maybe-we-can-save-them.

I, and others, have been trying to rescue birds that fly into the windows of very tall buildings. The birds are migrating from their winter lands, places we like to go to, South America and Cuba and Mexico. Like us, the birds know a good season when they feel one and they are coming home, to flirt and preen and mate and sing in the North — that is, if they make it past the skyscrapers, whose brilliant lights at night are blinding and disorienting them, and causing them to fly into the windows.

My first Friday, I found 11 dead woodcocks on the pavement and road below a high-rise; this Friday, a bunch of golden-crowned kinglets and the odd junco, not to mention the white-throated sparrow I heard singing until it crashed. (It's the one you hear singing when you're sitting on the cottage porch, swatting mosquitoes at dusk. It sings "Oh Canada, Canada, Canada," unless you're from the United States, and then it sings "Sam Peabody, Peabody, Peabody.")

Of course, many of the birds that fly into the windows of high-rise apartment buildings cannot be saved because they land on terraces and balconies and ledges.

These cute little birds that crash-land on the pavement or on balconies are the very ones that eat tonnes of the black flies and mosquitoes that annoy humans so much.

A friend of mine was working late on the 53rd floor of a building near King and Bay streets, putting in far too many lawyer hours, as usual. I happened to be on the phone with him when he said: "Oh, Deb, I can hear birds flying overhead — lots of them." "Are your lights on?" I said. "Yes."

Five minutes later, I said: "Do you still hear them?" "No."

Did they make it, or, more likely, were the chirps he heard their last?

My friend told me that the building manager had circulated a memo informing tenants that all lights should be turned off from 8 o'clock until after dawn during migration season. The manager probably mentioned that this request was organization that helps rescue and rehabilitate birds that slam into buildings. The manager may even have reiterated what FLAP had explained — that turning off the lights was for the sake of migrant songbirds.

Unfortunately, the message that got passed on to my friend and the dozens of other lawyers on his floor was more or less that "the building manager wants us to turn the lights off early, but don't worry, we'll find a way around it."

No explanation for the request was given. Maybe some of those lawyers should take a weekend break to read Peter Whelan's Birds column before they head to bird country. And maybe office managers should be more informative, so that lawyers who care would turn off their lights or get proper blinds for their windows.

I don't mean to single out lawyers, but I have heard a rumour that most of the lights 150 metres above the ground are being left on by merger-and-acquisition types.

Do you see now why I feel like Peter Finch? I know it's whiny of me, but if it weren't for these high-rise lights I could sleep in until 8 a.m. And I can't sleep because I keep seeing those exquisite, delicate birds lying at the foot of buildings, with their eyes bulging and their wings damaged and their necks crooked.

If Michael and Maureen and Carolyn and other volunteers can commit far more time and energy to FLAP than I ever will, and if they can keep talking and writing to try to convince property owners and floor managers to put their lights out, and if they can be thrilled when a bird is rescued and released north of the city — if they can do all that, I guess I'll keep waking up early one day a week to try to rescue birds from the bright lights of the city.

Debbie Honickman is a family physician who spends some of her time helping to save birds, and to save forests for the birds.

The Globe and Mail Friday, June 5, 1998

Browning-Ferris might merge with Allied Waste

Idea behind $7-billion proposal is to diminish operating costs

BY JEFF BAILEY
and STEVEN LIPIN
The Wall Street Journal

Browning-Ferris Industries Inc. was approached by Allied Waste Industries Inc., a far smaller though fast-growing waste handler, with a proposed merger that would value Browning-Ferris at more than $7-billion (U.S.), according to people familiar with the proposal.

Exact terms of the bid couldn't be learned. Any merger would involve a premium over Browning-Ferris's current market capitalization of $6.7-billion.

The proposed combination, like the recent $15.8-billion merger agreement between trash haulers USA Waste Services Inc. and Waste Management Inc., is aimed at slashing operating costs at the combined companies. The USA Waste merger with Waste Management is expected by those companies to cut annual expenses by at least $800-million.

Allied, Scottsdale, Ariz., has calculated that it could slash costs in a combination with Browning-Ferris, Houston, by about $400-million a year, a person close to the proposal said. The Bass brothers' recently acquired a 1.2-per-cent stake in Browning-Ferris.

The push to cut costs comes amid a huge glut of dump space in the United States that has depressed dumping prices and reduced profits in the waste industry.

Immediately after the USA Waste merger announcement with Waste Management in March, speculation turned to Browning-Ferris, the industry's No. 2 company, and whether it would agree to join up with another hauling concern. Browning-Ferris has declined to talk about possible mergers, and a spokeswoman yesterday said the company wouldn't have any comment.

Thomas H. VanWeelden, Allied's president and chief executive officer, who has built up the company from a tiny hauling concern, couldn't be reached for comment.

Browning-Ferris shares rose 31.25 cents yesterday to $34.25 in New York Stock Exchange composite trading, while Allied Waste shares fell 6.25 cents to $26.8125 in Nasdaq Stock Market trading.

Allied, which had $875-million in revenue in 1997, is dwarfed by Browning-Ferris, which had $5.78-billion. But Allied has been growing rapidly by making acquisitions funded with its high-flying stock, while Browning-Ferris has been shedding operations and trying to cut costs.

With about 106 million shares outstanding, Allied's market capitalization is about $2.75-billion.

Among some new shareholders in Browning-Ferris is a fund controlled by Sid and Lee Bass, which has accumulated a roughly 2.2-million-share stake, public filings show. And some of these investors are known as activists and could play a role in pushing the company into a merger with Allied.

This side of the Bass family has a reputation for taking stakes in companies and pushing them to boost their stock prices. A lawyer for Bass Brothers Enterprises declined to comment on whether Trinity I Fund LP, the entity holding the stock, would push for a sale of Browning-Ferris.

Browning-Ferris shares have certainly been poor performers. In the past year, the stock is basically unchanged, despite a roughly 28-per-cent jump in the Standard & Poor's 500-stock index. For the past two years, according to Baseline, shares of Browning-Ferris are up 8.5 per cent, compared with a 81-per-cent jump in the widely followed S&P 500.

Allied shares have roughly tripled since late 1996, when the company acquired for $1.5-billion in stock and cash the North American waste business of Laidlaw Inc. That move catapulted Allied into the big leagues of its industry. And since then, it has been making dozens of smaller acquisitions.

Browning-Ferris can be expected to put up a bigger fight for its independence than did Waste Management. The merger agreement with USA Waste came after a year of management chaos at Waste Management and allowed it to call off a search for a new chief executive that had grown difficult. John E. Drury, USA Waste's CEO, will head the combined company.

The Globe and Mail Friday, June 12, 1998

Bulldozer rolls over nests on Leslie Street Spit

Group requests investigation after terns lose homes as machinery levels land, apparently without a permit

BY LILA SARICK
The Globe and Mail

TORONTO — Nests of terns were destroyed this month as bulldozers rumbled along the Leslie Street Spit, apparently without a permit from Canada's wildlife officials.

Fifty to 100 birds were flying in the air, disturbed by the bulldozer, said Verna Higgins, a bird watcher who had gone to the peninsula in Lake Ontario to look for a rare bird.

"It was clear they were very, very upset. As the bulldozer went on, they would go back down looking for where they had been nesting. The bulldozer had gone through the busiest area for the terns," said Prof. Higgins, who teaches botany at the University of Toronto and has written a book on the plant life of the Leslie Street Spit.

The peninsula, which was created by dumping earth fill from building-construction sites, has become one of the most important bird habitats in Toronto.

"In my younger days, I would have gone out and tried to talk to the operator, but I'm older and wiser now, so I didn't," Prof. Higgins said in an interview yesterday.

A formal request for an investigation into the incident has been filed with the provincial Environment Commissioner by the Sierra Legal Defence Fund on behalf of a number of naturalists groups.

The Canadian Wildlife Service issued a permit for the bulldozing on the spit starting on June 2, the day after Prof. Higgins and others witnessed the destruction of the nests, and running until the end of August.

The naturalists want to know why the federal agency issued a permit to the Toronto Harbour Commissioners, which manages the site, during the three months that the birds nest on the rocky ground.

The bulldozer was grading the area flat for a land survey that is done every year or two to check erosion of the spit, said Gary Reid, general manager of the harbour commission.

Mr. Reid said he learned of the destruction of the terns' nests only yesterday and needed to investigate further before commenting.

"The whole affair showed a callous disregard for living things, which is especially objectionable for species that is in decline like the common tern," Jerry DeMarco, lawyer for the Sierra Legal Defence Fund, said at a news conference yesterday.

However, Andrew Taylor of the Canadian Wildlife Service said the permit was issued for sites where there were either no nests or a limited number of nests.

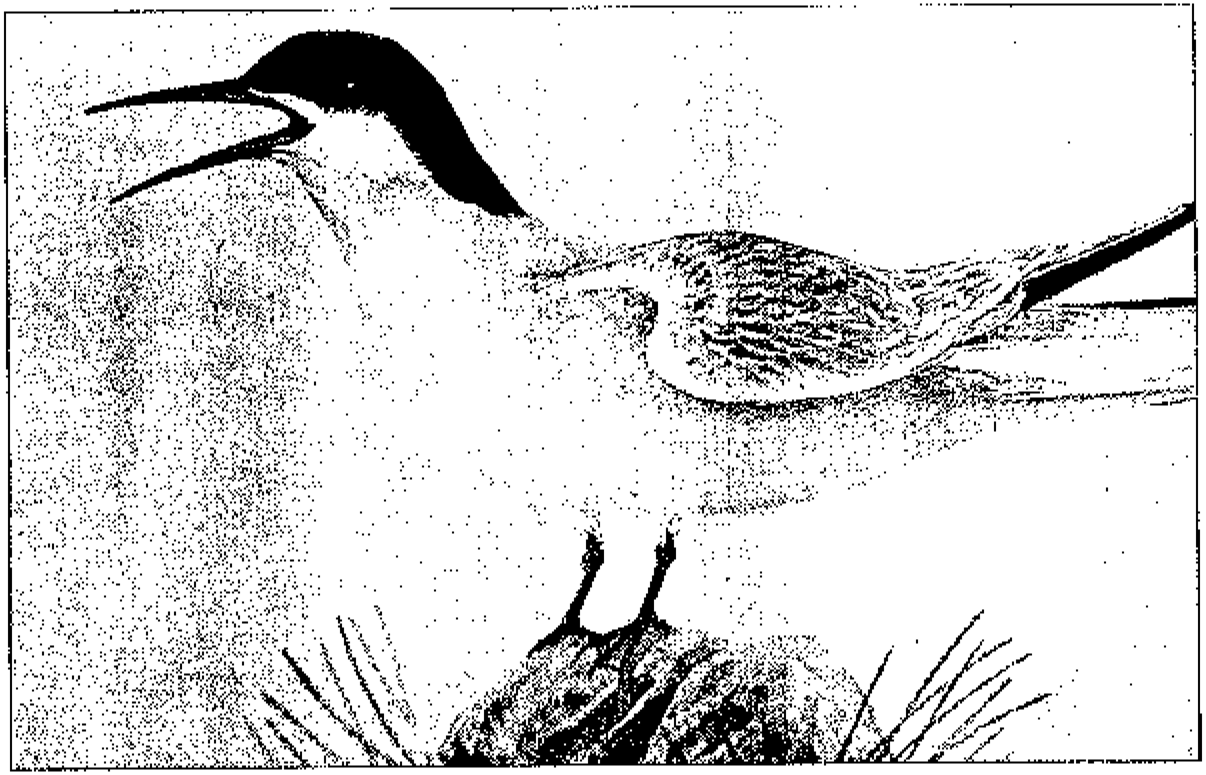
Mr. Taylor said that before the permit was issued a biologist on the site was consulted, as were conservation authorities. No environmental assessment was required, he said.

It was the first time in many years that a permit had been issued for work on the spit, he said.

Environmentalists have asked for an investigation to determine whether provincial statutes that prohibit the harassment and destruction of migratory birds and their nests were violated. The coalition, which includes the Animal Alliance of Canada, Friends of the Spit and the Ontario Field Ornithologists, is also considering filing a complaint with federal authorities, Mr. DeMarco said.

The grey-and-white common tern is smaller than a gull with a deeply forked tail, like a swallow. It flies 7,000 kilometres from its wintering spots in Central and South America to nest in the Great Lakes area. Its numbers have been declining as its habitat disappears and several U.S. states have designated the bird as endangered or threatened, according to Environment Canada.

Although the birds can nest again, it is late in the season for them and many choice nesting spots have been taken by other birds, Prof. Higgins said.

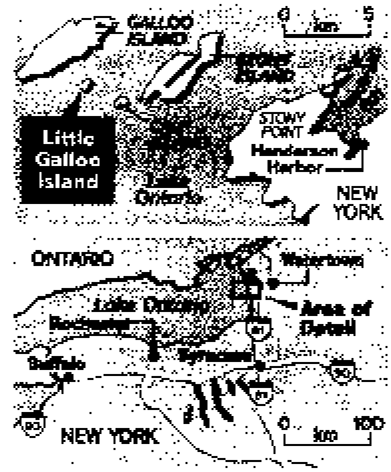


The common tern flies about 7,000 kilometres from its wintering grounds in South and Central America to nest in the Great Lakes area.

The Globe and Mail Tuesday, August, 4, 1998

Cormorants ruffle fishermen's feathers

Slaughter of fish-eating birds on Lake Ontario spurs debate over hunting of protected species



New York Times

ANDREW REVKIN
New York Times Service

In the United States, the double-crested cormorant is a protected species, its safety guarded by federal law. But on the Lake Ontario shoreline west of Watertown, N.Y., the long-necked black birds have become a pest to anglers, who say the growing colonies of cormorants are devouring smallmouth bass and, along with them, the livelihood of people who sell bait and run charter fishing trips.

Last week, wildlife officials visiting an island nesting ground discovered an unusually shocking environmental crime: more than 800 cormorants slaughtered by shotgun fire. Although they have no suspects, officials say they believe the festering conflict between conservation and commerce is responsible for what they are calling one of the worst mass killings of a federally protected bird species in recent decades.

Biologists estimate cormorants eat between 400,000 and 1.2 million smallmouth bass a year in eastern Lake Ontario. The Globe and Mail

State biologists said that when they went ashore on uninhabited Little Galloo Island on Wednesday they encountered heaps of carcasses of fledgling cormorants, piles of shotgun shells and starving chicks squawking weakly among the carnage. Clifford Schneider, who directs Lake Ontario projects for the New York state Department of Environmental Conservation, said "you see a young chick still laying there alive among all the others that had been wiped out, and you can't help but be moved emotionally."

The mass shooting appeared to be the latest of several recent instances involving once-rare species that have recovered to the point that they come into conflict with local interests. On July 23, the town of Carrollton, Texas, without a federal permit, bulldozed a rookery filled with nesting little blue herons, snowy egrets and other species protected by federal law. The count of dead birds from that incident could be more than 1,000, said Pamela McCroskery, a spokeswoman for the Texas Audubon Society.

Around eastern Lake Ontario, fish-eating cormorants have staged a dramatic recovery since the 1950s, when they were nearly wiped out by pesticides and shooting.

In Henderson and other fishing towns near Little Galloo Island, owners of charter boats and other fishing-related businesses, joined by some officials, have been pressing the government for several years to allow legalized hunting of cormorants, which they claim are responsible for a drop in populations of smallmouth bass and other popular game fish.

With the decline in the sport-fishing industry being attributed to the birds, there has been more and more talk along the shore lately of taking action, said Ron Ditch, a charter-boat owner and guide for 43 years in Henderson Harbor.

"I've been pretty instrumental in trying to do this in a proper and legal manner," Mr. Ditch said. "But everyone's been hearing rumblings forever about how people are going to go out and take care of the situation. Apparently, someone finally wouldn't be talked out of it any more."

The controversy over the cormorants has centred on Henderson Harbor, a hamlet on a peninsula several miles from Little Galloo Island. The docks are a magnet for fishermen from across the country, some of whom spend $300 (U.S.) a day to charter boats and pursue smallmouth bass, salmon and other trophy fish.

The hamlet has nine marinas and more than 60 professional captains, and for many years, fishing has been about the only source of jobs or revenue, said Grover Moore, captain of the Charter II. "When I was growing up, there were signs at both ends of the harbour that said, 'The Home of the Black Bass.' "

But black bass, including smallmouths, have been hard to come by for several years, he said, and the fishermen say the birds are the only obvious culprit.

He said anglers have shot videotape of cormorants devouring freshly stocked brown trout, in an effort to persuade state officials to press for a hunting season. "You can see them eat so many that they couldn't fly off the water," Mr. Moore said. "But nobody wants to listen to the fishermen."

Growing threats against the birds first turned to action in April, when eight cormorants were killed, federal wildlife officials said. In June, about 100 were killed. But last week's massacre, which left 840 birds dead and more than 100 others injured, transformed the local issue into an extraordinary environmental crime.

The birds can be legally hunted in only a few places where they pose a clear economic threat, such as at catfish farms in Louisiana, federal wildlife officials said. But research on their impact, if any, on the fish in Lake Ontario is still in the early stages, the officials said.

APPENDIX 26

Selected Articles from various newspapers

Growing bird population causing a flap

Dramatic increase in bird population poses aircraft threat

Airport critter patrol

Smashed Tern eggs infuriate activists

MacKinnon, Bruce

From: O'Brien, Robert
Sent: Thursday, June 25, 1998 10:37 AM
To: MacKinnon, Bruce
Subject: Growing bird population causing a flap

PUBLICATION The Calgary Herald; DATE Sat 13 Jun 1998; SECTION/CATEGORY News; BYLINE The Canadian Press;

Growing bird population causing a flap : Bird-meets-plane
accidents cause $500M damage a year

A dramatic increase in the bird population is causing havoc on runways across North America where faster airplanes and busier
airports have become the norm.

And while birds may come out on the losing side of any contest of strength with a plane, they do manage to get a few licks in before
the plane does.

Bird-meets-plane accidents cause about $500 million US worth of damage every year, a wildlife damage control expert from Ohio told
a two-day conference by the National Bird Strike Committee.

Richard Dolbeer says accidents usually occur either on the runways or during take-off and fortunately haven't caused many accidents
in the air.

But the seagulls, geese, ducks and owls that most commonly hang out at the airport can break the fan blades in a plane's engines,
go through windshields and break the noses of the plane.

A number of groups, including airline representatives, waste management companies, Transport Canada and the Canadian and U.S.
military met at the conference to discuss ways of battling bird congestion at airports.

Wildlife conservation efforts have unwittingly made the bird problem worse, said Dolbeer.

Today, for example, there are two million Canada geese, compared to 50,000 in 1965.

Dolbeer said there are a number of steps commonly used to reduce collisions.

``One thing that has to be done is make the habitat at airports less desirable and attractive to birds," he said.

Short grass alongside runways attract birds, so he recommends allowing grass to grow to 25.4 centimetres.

Landfill sites -- a natural feasting site for gulls -- should be allowed near airports but ponds and puddles within the airport should be
eliminated.

Another technique is to use noisemakers, such as shell crackers and propane cannons that go off with a bang, and distress calls
broadcast from a loudspeaker to scare off birds.

If none of this works, airports may have to resort to killing birds.

The future is more promising, said Dolbeer.

Several new technologies are being tested to address bird congestion at airports.

One is a radar detection system that will give pilots a bird forecast and the other is microwave radiation that will allow birds to sense
an airplane and get out of the way.

- The Issue: Birds at airports.

- What's New: Increase in bird population means more birds are found around the runways.

- What's Next: Two-day conference will discuss ways to battle the problem.

Robert O'Brien
Manager of Environmental Assessment
Office of Environmental Affairs
Transport Canada

phone # (613) 990-1402
Fax # (613) 957-4260
e-mail: obrienr@tc.gc.ca

MacKinnon, Bruce

From: O'Brien, Robert
Sent: Thursday, June 25, 1998 10:34 AM
To: MacKinnon, Bruce
Subject: Dramatic increase in bird population poses aircraft threat

PUBLICATION The Standard (St. Catharines - Niagara); DATE Wed 10 Jun 1998; SECTION/CATEGORY News;

Dramatic increase in bird population poses aircraft threat

THUNDER BAY, Ont. - A dramatic increase in the bird population is causing a big flap on runways across North America where
faster airplanes and busier airports have become the norm.

And while birds may come out on the losing side of any contest of strength with a plane, they do manage to get some licks in first.

Bird-meets-plane accidents cause about $500 million (U.S.) worth of damage every year, a wildlife damage control expert from Ohio
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Office of Environmental Affairs
Transport Canada

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e-mail: obrienr@tc.gc.ca

MacKinnon, Bruce

From: O'Brien, Robert
Sent: Thursday, June 25, 1998 10:34 AM
To: MacKinnon, Bruce
Subject: Airport critter patrol

PUBLICATION The Edmonton Journal; DATE Mon 08 Jun 1998; SECTION/CATEGORY News; BYLINE Lily Nguyen, Journal Staff
Writer;

Airport critter patrol keeps the fur (and feathers) from
flying; Safety on the Tarmac

Ever since his boyhood on a farm where he studied and tracked wildlife, Mike Bott has hated killing animals. That's why his job today
includes shooting at them on a daily basis -- and missing.

Bott is the Edmonton International Airport's wildlife control officer. As such, he patrols the 3,000-odd hectares of airport land to keep
it clear of birds and animals that might get in the way of airplanes that can land as often as every two minutes.

Every day beginning at 7 a.m., Bott, 51, a former heavy equipment operator, is out with his binoculars surveying the fields for hawks,
owls, gulls, geese and crows. He scans the 10 kilometres of chain-link fencing for breaks or signs of burrowing, and the coyote, deer
and moose that could take advantage of them to find out if the grass is greener on the other side.

If he finds any intruders, he drives them off with crackers fired from a six-mm pistol. The red bangers that go off with a loud, dull thud
are for animals. The green screamers that explode with a splatter followed by a sputtering whine set the birds winging away.

Bott also carries a 12-gauge shotgun that fires blanks with a timed explosion.

Propane cannons set up beside each runway emit subsonic booms at intervals of one to five minutes. They get shut off at night --
after 10 p.m. in the summer -- when most birds remain on the ground. The few who venture out are scared off by the lights of the
airplane.

"I don't enjoy killing things," said Bott, wearing his trademark blue overalls and camouflage-coloured baseball hat. 'My method is
scaring them.'

His methods are carefully timed. A screamer set off at the wrong moment can drive a flock of birds into the flight path of an airplane
instead of away from it."You've got to know when to scare them. You've got to make a fast decision," he said.

A flock of Canada geese struck at 200 km-h can do considerable damage to an aircraft. If more than five gulls -- which travel in flocks
of up to 50 -- are sucked into a plane's engine, the engine can fail, and bring down the plane. Even an animal as small as a rabbit can
interfere with the landing gear -- an animal caught under the wheels of the plane can tip the plane forward onto its belly.

At the critical stage of takeoff, all of these can be disastrous. None of them have ever happened at the Edmonton airport.

That may be thanks to Bott and the airport's environmental control program.

The name of the game is prevention, says Michael MacLean, a retired military officer who now heads the airport s environmental program.

As well as wildlife, MacLean points to the strict control exercised on the kind of crops grown on airport land, which farmers can lease up to 200 metres from the runways.

The airport can also prevent the establishment of industries that attract wildlife -- landfill sites and campgrounds are examples -- for up to a 20-km radius.

A visit to the back alleys of the MacDonald's, Wendy's, Pizza Hut and Safeway -- across Highway 2 in Leduc -- to check for open garbage is an occasional outing, though MacLean says he's had no problem with them so far.

Trees and marshlands are minimized or strategically maintained to keep wildlife away from problem areas.

"Food, shelter, water -- that's what we eliminate," said Bott.

It s a job that gets him out early in the summer and working split-shifts in the winter to accommodate seasonal patterns, but Bott says it's worth it.

"Animals are only doing what they do naturally. We're the unnatural ones. People weren't really made to fly."

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MacKinnon, Bruce

From: O'Brien, Robert
Sent: Thursday, June 25, 1998 10:37 AM
To: MacKinnon, Bruce
Subject: SMASHED TERN EGGS INFURIATE ACTIVISTS

PUBLICATION The Toronto Star; DATE Fri 12 Jun 1998; SECTION/CATEGORY NEWS; BYLINE By Brian McAndrew;

SMASHED TERN EGGS INFURIATE ACTIVISTS: Harbour commission
to probe destruction of nests on spit

More than 50 tern nests, which usually contain two or three eggs apiece, have been destroyed by bulldozers working on the rocky
peninsula jutting into Lake Ontario, angry environmentalists say.

Several hikers and cyclists saw the nests crushed on June 1, says Jerry DeMarco, a lawyer with the Sierra Legal Defence Fund, an
environmental law clinic.

The common tern population has been declining for years around the Great Lakes, although with help, it has begun to thrive around
the spit.

Most of the terns' nesting areas were lost to development and the birds were poisoned by water-borne industrial pollutants that
weakened their eggs.

ACTION DEMANDED

DeMarco, representing the Animal Alliance of Canada, Friends of the Spit and the Ontario Field Ornithologists, wants charges laid
against the Toronto Harbour Commission and the Canadian Wildlife Service.

He has also demanded an investigation by the provincial environment ministry and Environment Canada.

The defence fund has also asked Ontario environmental commissioner Eva Ligeti to order an investigation into possible violations of
the Migratory Birds Act and the Game and Fish Act.

The harbour commission allowed the bulldozing on the 13-kilometre-long spit after it was given the go-ahead by the wildlife service,
the branch of Environment Canada responsible for producing the endangered species list.

Commission general manager Gary Reid said in a prepared statement that he was ``making inquiries to determine precisely what
happened.

``Initial information indicates that our people were under the impression that they had approval to proceed with work to shore up the
spit at the water's edge."

Reid said he wants to meet with the environmentalists in order ``to clarify matters."

The wildlife service did not return calls from The Star.

DeMarco said the commission should have waited until the tern eggs hatched and the nests were abandoned before unleashing the
bull- dozers.

And he said the wildlife service should have never issued a permit for the ``collection and disposal of eggs."

MIGRATION STOP

The man-made spit is home to thousands of birds, mostly gulls, and an important stop-over site for migrating birds.

Ontario's common tern population has declined steadily over the past few decades, with just 64 colonies containing 7,000 breeding
pairs of birds on the Canadian side of the Great Lakes, according to wildlife service records.

But the birds have been making a bit of a comeback along the Toronto waterfront.

In 1990, the Toronto area conservation authority created artificial tern colonies by placing four large wooden rafts covered by sand and
gravel in the water around the spit, which is also known as Tommy Thompson Park.

The terns flocked to the rafts. Plastic snow fence submerged around the rafts became an artificial reef that attracted fish for food.

Terns can be distinguished from gulls by their forked tails, straight pointed bills, slender shape and long, narrow wings.

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APPENDIX 27

Bird strikes a bigger threat than ever

(from *Flying* - June 1998)

Flying June 1998, p36

BIRD STRIKES A BIGGER THREAT THAN EVER

According to reports from the Air Force and the U.S. Fish and Wildlife Service, the threat of bird strikes, especially that posed by large birds, may be growing worse due to successful wildlife conservation programs.

In a story in its monthly publication *Torch*, the Air Force's Air Education and Training Command reported that based on the Air Force's recent experience, the threat seems to be increasing. The most tragic bird/airplane encounter in recent years took place in 1995 when an Air Force AWACS plane crashed after running into a flock of Canada geese shortly after takeoff from Elmendorf Air Force Base in Alaska. Twenty-four crewmembers died in the crash of the military version of the Boeing 707. It wasn't an isolated incident. The Air Force says that its aircraft are involved in a staggering 2,600 bird strikes a year, resulting in an annual average of $38 million in damages. Birds don't just aim for military airplanes: ICAO pegs the number of civil aviation bird strikes between the years 1988 and 1992 at better than 25,000. The FAA says that it's aware of around 240 bird strikes a year, with damage in the millions of dollars. Because not all bird strikes are reported, the numbers are likely much higher than that.

The closer you get to the ground, the greater the chance of a bird strike. More than 80 percent of bird strikes, according to Transport Canada, are happening in the vicinity of the airport, and the U.S. Air Force says that 77 percent of its strikes take place at lower than 2,000 feet agl and that more than half of all strikes occur at 500 feet agl or lower, though there have been reports of strikes at altitudes as high as FL 370.

The Fish and Wildlife Service agrees there's a problem. According to the Service, the population of urban Canada geese has more than doubled over the past 25 years, mostly as a result of programs to conserve wetlands and other bird habitats. Other species of large bird have seen similar population increases over the past couple of decades. And many of these large-bird species are giving up migration altogether, electing instead to reside year-round at golf courses, public parks and, unfortunately, airports. Service personnel have been working with local and state authorities and airport managers to try to alleviate the problem. Geese have been successfully "controlled" by a variety of methods, including habitat modification (letting the grass grow long seems to keep the birds away), hazing, using falcons and dogs, erecting electric fencing, and lethal methods such as hunting. Capture and relocation programs, popular last decade, are not being used anymore because it's impossible to find state or local authorities that will take the captured birds.

APPENDIX 28

ARFF Hot News

ARFF HOT NEWS:

January 13, 1998 - Birds "Daily Danger" At Tel Aviv Airport - Pilot

JERUSALEM, Israel - An Israeli commercial pilot said on Tuesday planes travelling to and from Tel Aviv's Ben-Gurion airport were flying in the face of danger from birds feeding at a nearby hill of rubbish.

``It's a daily danger," El Al Israel Airlines captain Dror Harish told Army Radio. ``Before I release the brakes on take-off, I think about what would happen if a bird or several birds are sucked into an engine."

The government failed to meet a December 31 deadline for a phased closure of the Hiriya garbage dump, which has been in use for decades and now towers 80 metres (260 ft) above fields just west of Ben-Gurion airport.

``I was landing yesterday on a flight from Europe and saw birds -- quite pretty ones -- on top of me, under me, to my left and to my right. It was only by chance that they didn't hit my plane," Harish said.

He said a 1994 incident in which birds were sucked into the engine of a Boeing 747 taking off from Ben-Gurion almost ended in disaster. The plane managed to rise only 150 metres (490 ft) but managed to return to the airport and land safely.

``There are more than 100 take-offs a day from Ben-Gurion. If a plane runs into a flock of birds that shuts down two of its engines...the result will be a disaster for passengers, plane and those on the ground," Harish said.

Israel is a main migration route for birds and ``Hiriya attracts all sorts of them," Harish said. ``There are birds everywhere in the world but I've never encountered so heavy a concentration."

Government efforts to close Hiriya and find alternative sites have run into local opposition.

``Why should we be the country's garbage dump?" grumbled a municipal official in the southern city of Beersheba, one of the proposed sites, in an interview with the radio.

APPENDIX 29

For the birds - again

(from *Plane and Pilot* - May 1998)

For The **Birds—Again**

Plane and Pilot May 1998, p12

Tips for avoiding our fine-feathered friends

By Bill Cox

It's been said experience is the hardest teacher because it gives the test first and the lesson afterwards. That certainly was the case for me last year delivering a new Saratoga HP to Bendigo, Australia.

Back in the February issue, I wrote about a bird strike I suffered flying into an overnight stop in Australia last fall. In attempting to research that story, I contacted the FAA, the Department of the Interior and several other U.S. federal agencies for specifics about the risks of bird strikes on civil and military aircraft.

I was surprised at the relative lack of information on the subject. It seemed no one knew much about bird strikes. As a result, the column devolved into little more than a description of my experience and a warning to watch out for birds, especially during their spring and fall migrations.

A few weeks after the column hit print, I received a large package of videotapes and printed material from Bruce MacKinnon with the Aerodrome Safety Branch of Transport Canada in Ottawa, Ontario, Canada. MacKinnon wanted to reprint my column in Canada and thought I might be interested in the bird strike research done in his country. Turns out that Canada not only keeps track of strikes, but it has a monthly newsletter dedicated to the problem of bird and mammal hazards, *Airport Wildlife Management.*

Of course, it shouldn't take a nuclear brain surgeon to reason that Canada would have a major bird strike problem. Much of the southern portion of the country is rural, and most northern regions are relatively uninhabited wilderness. In summer, it's truly magnificent country, and birds apparently think so, too. Hundreds of species use it as a nesting ground.

The Canadian researchers suggest there are about 6000 civil bird strikes worldwide each year so, contrary to what you might think, this is no small problem. The U.S. Air Force alone records another 3000 strikes annually, partially because the Air Force mission often demands low-level, high-speed flight. More than half of all bird strikes occur below 100 feet AGL, and fully 99 percent happen below 2500 feet AGL. (Don't feel too comfortable just because you fly high, however. An airliner once ran into a vulture off the West African coast at an amazing 37,000 feet!)

In view of that, it's not surprising that 80 percent of conflicts occur during takeoffs and landings, by definition near airports where both birds and airplanes feel at home. Airports often attract birds, as runways and taxiways frequently are constructed in ideal locations, well outside major cities with a minimum of obstacles. Most airports offer all three of the primary requirements for any bird—food, water and safe haven for nesting, resting and roosting. In addition to plentiful open space and numerous lightstands, posts and other roosting spots, airports feature large expanses of grass for food and ponds of standing water, both strong attractions for migrating birds.

There have been 34 civil crashes and about 200 known deaths resulting from bird strike accidents in recorded aviation history. The first fatal aircraft accident caused by a bird strike was recorded in 1912. Fortunately, the vast majority of impacts don't result in either accidents or deaths, as birds rarely incapacitate the aircraft or crew. Such encounters are consistently expensive, however. Total damage inflicted by birds on aircraft is estimated at more than $750 million. The birds haven't enjoyed it much, either.

Pretty obviously, the two major factors in any collision are the speed of impact and the weight of the bird involved. The higher the speed and the heavier the bird, the greater the damage. Bird velocities aren't that high, rarely exceeding 50 knots (except for peregrine falcons and white-throated swifts—140 to 160 knots). Aircraft velocities below 10,000 feet can run as high as 250 knots—legally.

In tests to determine windshield flexibility, researchers air-blasted a four-pound bird at a heavily instrumented aircraft windshield at 250 knots, and the resulting impact load exceeded six *tons*. Imagine what an eight pound eagle or 15-pound vulture would do to a general aviation windshield, even at a combined closing speed of only 100 to 150 knots.

By far, the greatest threat is from seagulls. Gulls account for nearly one-third of all bird strikes and, because seagulls aren't normally seen too far from the ocean, coastal airports are the most at risk. Seagulls and landfills seem almost synonymous and, regrettably, both landfills and airports make lousy neighbors. For that reason, they're often collocated far from city centers, close enough to each other that they almost guarantee conflicts.

Put it all together and here are the traditional 10 commandments of avoiding bird strikes:

1 Always check NOTAMs and ATIS for bird advisories if your airport is on the coast or if it's migratory season.

2 Be especially wary during taxi, and note and report any bird activity on the ramp or runway. Gulls and other birds like to congregate on asphalt runways—stay alert.

3 During migratory season or any time you suspect bird activity, fly as high as practical. Only one percent of strikes occur above 2500 feet AGL.

4 Avoid flying over bird sanctuaries and landfills, and never fly low along a coast, river or estuary. Just like pilots, birds use those features for navigation.

5 Most birds fly in daylight, but don't assume you're immune at night. Ducks, geese, owls and several other types of birds often fly at night.

6 If you do spot birds in the distance, be aware that larger birds have a slower wing beat. Also, remember that birds often have natural camouflage markings that make them difficult to spot.

7 If the aircraft has windshield heat and you have any reason to be concerned about the possibility of a bird strike, turn it on. A warmer windshield will be more pliable and more liable to resist breaking.

8 Use every aircraft strobe or landing/taxi/recognition light you can find at low level in bird country, especially during sunrise and sunset departures and arrivals when neither you nor the birds can see that well.

9 Whenever possible, fly above a flock of birds rather than below. Birds tend to dive when alarmed.

10 During descents in heavy bird areas, keep speeds to a minimum. Halving the speed results in a quarter of the impact energy. P&P

P&P senior editor Bill Cox has made approximately 75 international aircraft deliveries in everything from Skyhawks to the Swearingen SJ-30 business jet, and offers aircraft delivery, aircraft positioning and international copilot service. For more information, write: Plane & Pilot, Attn: Bill Cox, 12121 Wilshire Blvd., Suite 1200, Los Angeles, CA 90025

APPENDIX 30

Take Five... Low-Flying Exam

Transport Canada

TAKE FIVE...

for safety

Five minutes reading could save your life!

Low-Flying Exam

Low flying is a killer. Before you even contemplate it, try this test. It may change your mind and save your neck.

1. How much airspeed will you lose if you slam your aircraft into a bank turn?
2. What rate and radius of turn will you get in a 45° bank turn?
3. How much space will you need to do a 180° turn?
4. How much more space will you need with a 20 kt wind behind you halfway round the turn?
5. How far away can you see a wire?
6. If you have to jerk back on the stick to miss a wire, how much space will it take to change the flight path upwards?
7. If you have to pull up quickly straight ahead, what airspeed will you have after 300 feet of climb?
8. What do you do if you run a tank dry at low altitude?
9. Will your windshield withstand hitting a 3-lb. gull?
10. Do you still want to try some low flying?

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Canada

TAKE FIVE...

for safety

Five minutes reading could save your life !

Runway Incursions

It is very difficult for pilots and controllers to see and track the many different-sized airplanes and vehicles moving on the airport surface on clear days. Add weather and/or darkness and the problem can explode.

So, start your own ground safety awareness program by noting the following suggestions (note that most of these apply in the air):

- Always communicate clearly and use the proper phraseology.
- Read back clearances with restrictions (altitude, heading, runway number, etc.). If they are not clearly understood, do not hesitate to request clarification. It is a sign of the professional pilot.
- Keep an uncluttered cockpit; avoid idle chitchat; listen to the other traffic on your frequency.
- If your aircraft is moving, keep a good lookout.
- Proceed with caution when approaching any other taxiway or runway.
- Be ready when cleared for takeoff; do not move into the active runway while trying to finish the check-list. When you hesitate in position, you destroy the timing of every controller and pilot who anticipates your action.

Transport Canada Transports Canada

Canada

APPENDIX 31

A Reminder about Bird Strikes

(from *Aviation Safety Letter* - February 1998)

A Reminder about Bird Strikes

by Bruce MacKinnon, Aerodrome Safety, Transport Canada

There are still a few skeptics within the aviation community who, like many of us, have forgotten everything that they learned in Physics 101 or don't have time to read occurrence reports. Birds *can* do a lot of harm to an aircraft. Rather than bore you with mass and velocity calculations, let's just take a look at some attention-grabbing near misses and smoking holes.

On the night of Friday, January 9, 1998, Delta Airlines Flight 1783, a B727, departed Houston International Airport and struck a flock of geese at 3000 ft. on climb-out. The No. 1 engine was destroyed, the No. 2 engine was severely damaged, the radome was torn off, and the right wing was significantly damaged.

On August 18, 1997, Air Canada Flight 502 began the takeoff roll at 07:25 local time in Thunder Bay, Ontario, with 52 passengers and 5 crew members on board. At V_r, the DC-9 struck a large flock of herring gulls and the No. 1 engine had to be shut down because of severe vibration. The crew declared an emergency and returned to Thunder Bay. Bird remains were found in the No. 2 engine, on the first officer's windshield, and on the right wing root.

Yes, But These Things Don't Happen to Turboprops!

On November 24, 1997, in Tegucigalpa, Honduras, a commuter aircraft crashed after an engine exploded following a bird strike. Seventy per cent of the aircraft was destroyed by fire, and 12 people were injured, 4 of them seriously.

On May 17, 1996, in Broome, Washington, a Dash 8 with 3 crew members and 14 passengers on board struck a wedge-tailed eagle while descending through 4800 ft. The bird punctured the wing-to-fuselage fairing and damaged the forward wing spar and electrical components, which were attached to the spar. Multiple system failures resulted, and the No. 1 engine was shut down. The crew was unable to maintain control during the landing and the aircraft left the runway.

Well, At Least We're Safe in General Aviation Aircraft!

On September 24, 1997, in Boundary Bay, British Columbia, a student pilot on his first solo flight struck a mallard duck, which penetrated the windshield of the Cessna 150. The bird continued on through the right-hand side of the passenger cabin and hit the rear wall.

On October 13, 1997, near Lethbridge, Alberta, a Cessna 172 struck a mallard duck, and the bird penetrated the windshield. The pilot suffered facial lacerations and a broken nose. He was able to land the aircraft at Brooks, Alberta.

OK, But Rarely Do Fatalities Result!

On November 15, 1997, at the Pic du Midi observatory in France, 2 adults and 2 children were killed in a light aircraft after a bird strike in the Pyrenees. Unfortunately, the 2 crew members in the rescue helicopter were also killed when they struck a wire while departing the accident scene.

In January 1994 in Le Bourget, France, all 10 people on board a Falcon 20 were killed when the crew lost control of the aircraft on final approach while attempting an emergency landing after a bird strike destroyed one engine.

On September 22, 1995, at Elmendorf Air Force Base in Alaska, 24 crew members were killed when their E-3B airborne warning and control system (AWACS) aircraft struck a large flock of Canada geese at rotation. Both the No. 1 and No. 2 engines were destroyed.

On July 14, 1996, in Eindhoven, Holland, 34 passengers and crew were killed when a C-130 Hercules struck a flock of birds on final approach and burned in the ensuing crash.

On October 22, 1997, the pilot of an F-16 flying over California manoeuvred sharply to avoid birds and collided with an AT-38B trainer. The trainer was destroyed, and both crew members died in the crash. The pilot of the F-16 was able to land his damaged aircraft safely at Edwards Air Force Base.

Yes, But Such Accidents Don't Happen All That Often!

Over 6000 bird strikes are reported annually in North America.

Canada purchased 250 CF104 fighters. During their Canadian service life, 106 were lost. Of these losses, 16 were the result of confirmed bird strikes.

The United States Air Force (USAF) has never lost an E-3 AWACS since the aircraft went into service in 1972, except for the fatal accident in Elmendorf. However, the USAF has lost 3 B-1 bombers since they went into service in 1974. One of these losses was to an American white pelican over Colorado and resulted in the death of 3 crew members. A 185,000-lb. state-of-the-art fighting machine was destroyed by a 15-lb. bird!

Since 1950, over 170 military aircraft have been lost to bird strikes in Europe and Israel.

On July 15, 1996, a North Atlantic Treaty Organization E-3 was destroyed in a runway excursion in Greece after the takeoff was rejected because of a bird strike.

The Israeli Air Force has lost a total of 22 aircraft in air-to-air combat and 8 aircraft to bird strikes. The number of aircraft lost to bird strikes is more than one third of the number lost to enemy aircraft!

But Are These Accidents Expensive?

Between 25 and 30 per cent of foreign object damage to transport aircraft is related to bird strikes. An airline loses approximately $10 000 an hour in revenue when a jet transport aircraft is taken out of service because of a bird strike. It costs $12 million for one engine on a B777, and approximately one third of bird strikes to turbofan engines cause damage. It is estimated that bird strikes cost the North American aviation industry $500 million a year in direct and indirect costs.

There Can't Be Any More?

Actually, there is; a lot more, but we think that you get the point.

But It's Not My Problem!

Well, actually, it is. If you are involved in the aviation industry, then you can do many things to prevent the types of incidents and accidents described above. Bird-strike prevention can't easily be achieved through standards and regulations, but a cooperative effort by everyone in the industry can go a long way towards saving lives and preventing unnecessary damage.

If you are an aerodrome operator, you are responsible for managing a safe facility, particularly if you invite aircraft operators to your site. You must do everything possible to deter birds from your facility and disperse them. If you are a pilot, you can contribute by reporting bird activity to airport operators, air traffic managers, and other pilots. You can also reconsider your takeoff decision if you see birds in the runway environment, avoid low-altitude flying, reduce speed at low altitudes if it is safe to do so, and wear sunglasses. If you are an air traffic controller or flight service station attendant, you can advise pilots of bird activity, offer alternate runways if necessary, and provide pilots with the option of slowing down if there is bird activity near your airport. Everyone can benefit by taking the time to learn about bird activity in the local area, and everyone can contribute by reporting bird strikes. Transport Canada has tried to make this as easy as possible. You can make a report on a self-addressed postage-paid form available at most facilities, over Transport Canada's toll-free bird-strike reporting line, or on our Bird Hazard Web Site.

Unfortunately, rapidly increasing populations of some large flocking birds that adapt well to the human landscape and increasing numbers of aircraft make it inevitable that some bird strikes will occur. However, it is *not* inevitable that damage will occur or lives be lost. Since over 80 per cent of bird-strike incidents occur within the airport environment and below 1500 ft. above ground level, there is much that can be done to prevent serious incidents and accidents. If everyone in the industry works together in a cooperative manner, it is highly probable that Canada can be spared the pain of a fatal hull-loss aircraft accident resulting from a bird strike.

For additional information on bird hazards to aircraft, please contact:

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