

BIRD STRIKE COMMITTEE CANADA
MEETING 23, NOVEMBER 29 & 30, 1995

CO-CHAIRS:

Mario Larosa, Department of National Defense and Bruce MacKinnon, Transport Canada

MINUTES PREPARED BY: Lee-Ann Locker

Transport Canada, Airports Group, Safety and Technical Services

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Minutes of the 23rd meeting of Bird Strike Committee Canada

**November 29 and 30, 1995
Citadel Inn Ottawa, Ontario, Canada**

1.0 Introduction and Welcome

Suzanne Tining, gave the official welcome, on behalf of Victor Barbeau, Assistant Deputy Minister. She stressed that this meeting should be used as an opportunity to share information and experiences in order to reduce the bird strike hazard to aircraft and airports.

2.0 Introduction of Attendees

3.0 Review of the Minutes/BSCC 22 Action Items

There were neither action items nor any comments or amendments proposed or mentioned for the BSCC 22 minutes.

4.0 Bird Strike Summary Reports

4.1 Department of National Defense (DND)

DND statistics were presented by Mario Larose. He mentioned that he will be attempting to increase DND awareness of the requirements to identify birds in bird strike incidents. Also of note, there has been a general decrease in the strike rates since 1991. A copy of the overheads can be found in **Appendix 2**.

4.2 Transport Canada (TC)

Bruce MacKinnon informed us that bird strike reporting has increased since the creation of a new bird/wildlife strike reporting form and awareness materials. To date in 1995, Winnipeg has the highest strike rate, which is likely due to land use issues pertaining to landfills in the vicinity of the of the airport. **Appendix 3** contains the tables, based on the preliminary data in 1995 that was used for this presentation.

4.3 Air Canada for ATAC

To date, eighty-two strikes have been reported to the airline this year. This information is recorded by aircraft type. Current data shows the DC 9 as the "bird favourite". The reason for this could be the frequency and type of flight that this particular aircraft is involved in. Lester B. Pearson International Airport in Toronto, leads the way in reported strikes, with 21 so far this year.

4.4 Federal Aviation Authority (FAA)

1995 data is still very preliminary, therefore, 1994 stats were highlighted. 1994 was the first year that a total data analysis was completed for all wildlife strikes in the USA from all sources, including one alligator strike. In total, there were 2295 reported, with the radome and windshield being the parts most often struck and reported. Two different sets of data analysis for the USA's bird strike situation were contributed to the meeting. These are included in **Appendix 4**.

At this point in time, discussion arose about the factors influencing reporting.

4.5 International Civil Aviation Organization (ICAO)

Alistair Pinos discussed some of the ICAO data, emphasizing international numbers of bird strikes by part of the aircraft struck and bird strike effect on flight (pp. 5 and 6 in the July 14 letter). See **Appendix 5**. A discussion emerged regarding bird strike reporting and reporting mechanisms. It was generally agreed that

sharing data is essential. The discrepancies surrounding reporting practices and the perception of time and importance involved with the report, were also broadly discussed.

5.0 Jet Engine Certification Tests

Martin Hexter, discussed the criteria pertaining to bird strikes required for jet engine certification: considerations for a large sized bird, considerations for a medium sized bird and blade containment at ingestion. A wide range of standards is investigated. For a large size bird, some of them are: a complete loss of engine power is acceptable, the engine cannot catch fire or burst, the engine cannot generate loads greater than engines can handle and the pilots must be able to shut the engine down, regardless of what happens. Certification tests are also done to simulate a flock encounter.

Following this, the video "The PW 4084" was viewed. It discussed the development process, which included consultation with industry and airlines and the many certification requirements for the Boeing 777 112 inch engine. Ease of maintenance and engine durability were just two of the tested features. Some of these parameters set new benchmarks for performance standards in the aviation industry.

6.0 Midway Island Bird Strike Issue

Richard Dolbeer presented the case of Midway Island, which is a US Naval Air Facility. The presentation began with the initial question "Can albatross and an active naval air facility co-exist on Midway Island".

Midway Island is a heavily populated habitat for two different species of albatross as well as other birds. There are over 1 million albatross nesting on the island. This situation poses an extreme bird strike hazard situation. A recent study conducted by the BASH team found that approximately 360 albatross were crossing the runway per minute during the day. In comparison, less than 6 albatross crossed the runway at night.

In the near future, perhaps as soon as next year, the Air Force is planning to hand over Midway Island, to the Fish and Wildlife Service as a bird refuge.

In response to the question asked --whether or not albatross and aircraft can co-exist-- it has been recommended that from mid-November to mid-July, flights only be scheduled at night. From mid-July to mid-November, the albatross leave the island. During this period of time, flights could resume their normal day flight patterns. Only in this way, can the two "birds" (albatross and aircraft) co-exist safely.

(Since the results have yet to be released, Richard was unable to provide a paper for the minutes of BSCC 23. An update on this project, sometime in the future would be greatly beneficial. We look forward to that.)

7.0 Landfill Issues: Winnipeg, MB and St. John's NFLD

7.1 Proposed Rosser Landfill, north of Winnipeg, MB

Rolph Davis presented a review of the landfill issues that pertain to the Winnipeg International Airport. BFI waste systems is proposing to open a landfill site, located just beyond 8 km due north of the Airport's runway 18/36. Currently, a two-phase, one year ornithological study is being conducted to determine the flight lines and behaviour patterns of gulls in that area. It began in early May of this year and will be completed next spring after spring migration. In May, there were 2000-3000 visiting gulls to the existing landfills. The slated closure of at least one of the existing landfills will definitely have some effect on the patterns and behaviour of the gulls. Currently, the proposal is in the public evaluation stage.

A copy of the "Interim Summary Report of Bird Hazard to Aircraft Safety Issues Associated with the Proposed Rosser Landfill", submitted by LGL in October 1995 is available in Appendix 6.

7.2 Robin Hood Bay Waste Disposal Site, St. John's, Nfld

The Robin Hood Bay facility, according to Rolph, is much more like an open dump than a modern landfill. This site was studied from mid-November 1994 to mid-March, 1995. The findings of that study are being published in "Gulls Associated with the St. John's Airport and the Robin Hood Bay Waste Disposal Site, Newfoundland, 1995" by LGL Ltd. This can be found in Appendix 7. A regional approach is being taken to come up with working solutions to the problem that the site and gulls pose to safety at St. John's International Airport. St. John's Airport was used as a case study in the new Transport Canada video "Not In My Backyard", which was shown later in the morning.

8.0 FAA Landfill Study

Unfortunately, Ben Castellano, could not make the meeting. Therefore, Ed Cleary took his place and discussed the FAA's landfill study. It was first commented that most of what can be said is contained in the "Federal Register" notes of May 25, 1995 that are found in Appendix 8. Until congress approves the bill, not much more can or will be discussed.

Ed did mention that public and industry response to the proposed bill seemed to be split into two "sides". The first group was formed largely by waste generators and those generally in the waste industry. They feel that the bill was too hard on the waste industry. The other side, from the aviation industry, felt that the proposed bill is too lax.

9.0 "Not in My Backyard" Landfill Awareness Video

The third video to be produced for Wildlife Control is called "Not in My Backyard". Because of the inherent bird strike hazard from birds generally and gulls specifically, landfills and airports are often incompatible land uses. This is the focus of this production.

As we know, the airport can do all in its power to reduce the hazard of wildlife strikes. However, this can be negated by the land use adjacent to its property. The video stresses the need for planning and management of land use in the vicinity of airports and raises the question "Is 8 kilometers really enough?". This refers to current guidelines found in TP 1247, "Land Use in the Vicinity of Airports". Several means of resolving existing incompatibilities are described in the video.

Copies will soon be available for distribution. Please contact Bruce MacKinnon for further details.

10.0 Ottawa-North Bay Bird Studies

Carol Potter, from Carleton University, presented the findings from a year long study at Ottawa and North Bay airports. She outlined: the bird strike statistics for both airports, the results of her survey of birds using the airfield, bird densities by habitat within 2 km of the airport, bird movements and an assessment of the bird control programs at each airport.

Interestingly, it has been found that the most hazardous birds, identified in this study as Ring-billed gull, Snow Bunting, Swallow and Rock Dove, occur in short grass and not longer grass. It is thus recommended that the grass be kept longer. According to this study, there are no large flocks of birds that regularly fly over either airport. However, in spring and autumn, Canada Geese do use the corridor of the Rideau River and feed in fields to the south of the Ottawa airport. This information raises the issue of the need for awareness of seasonal hazards that are not directly on or over the airport, but definitely in the air space that is used by aircraft. This study also confirms the hazard that outdoor food operations, like chip stands and drive-in cinemas, pose to aircraft safety. Birds were found to be concentrated in these areas and when the bird locations on the airport were plotted, it was found that the higher numbers correlated to the presence of outdoor food operations.

A copy of the presentation can be found in Appendix 9.

From this presentation, a short discussion ensued about different options for mowing. An example of mowing HOW and not WHEN was brought up. Instead of mowing at night, which is particularly tricky, one airport first mows the area furthest away from the runways or in a location that would pose the least amount of hazard. The mowing then proceeds closer to the airport. By doing this, all the birds were attracted to the furthest point, which effectively decreases the risk that is associated with day time mowing.

11.0 Bird Avoidance Model and Landfill Issues

11.1 Bird Avoidance Model

Ron Merritt of Geo-Marine Inc., shared, with the Committee, the details of the new Bird Avoidance Model System. Its foundation was one year's intensive study, using 5 band radar to study migratory bird movements. This has been down loaded into an interactive GIS mapping program, which allows the user to access general bird strike hazard information for any mapped area within a specific time range. It also gives further information about migratory bird movement, individual species and will actually show individuals and flocks on a radar screen.

11.2 Landfill Issues

Geo-Marine has been doing work on three different landfill sites --one each in Dublin, Ireland, Georgia, and Kelly AFB. At the Dublin site, the landfill management practices have been brought up to FAA/ICAO policy standards. The Georgia site is proof that "daily cover" at a landfill need not be 6-8 inches of soil. They have chosen to use a tarp-like surfacing that is put on at the end of each day and removed when the face is again operable. There are some concerns about the birds "getting smart" and finding ways to get underneath the tarp and feast on the garbage. At Kelly Airport, they have been able to control vulture populations to an ambient level.

12.0 Calgary Avifauna Study

Clark Norton introduced Howard Troughton from the University of Calgary. The overall goals and objectives of the avifauna study were: an evaluation of the Phoenix Wailer, a bird and wildlife inventory and an examination of the regional influences and adjacent land use issues.

Howard's work has evolved into creating a "risk" evaluation of each of the species at the Calgary Airport. To do this, a number of categories were considered and assessed for their contribution to bird strike hazard. These categories included: abundance (more birds equal increased possible conflict), occurrence (more frequency increases possible conflict) and increased degree of flocking (increases the possibility of conflict). To assess this, the amount of time spent in a flock and the size of the flock were the two elements considered. Bird weight was also considered, using the assumption that a larger bird increases damage. Species behaviour and habitat were also considered; particularly runway usage, habituation to control methods and evasive response to disturbances. This was the most complex category of assessment and is further outlined in the overheads used for the presentation, found in Appendix 10.

Each of these categories is weighted with a value of 10. To get a determination of the "risk ranking", the score from each of the 5 categories is added together. This sum is then used to give a "total risk calculation" for each species. Generally, the higher the number associated with the species, the higher the possible risk: the potential of that species to present a bird strike hazard.

Following this presentation, there was some discussion about this model's applicability to other airports

13.0 TC Wildlife Control Training Program Update

During the quick coffee break, Ron Merritt gave a demonstration of the Bird Avoidance model. As well, the Wildlife Control training video, "There's Something Out There" was shown. Following this, Dave Fairbairn gave a presentation on the creation of the new Wildlife Control Training Program. Originally, this course was run in a 5 day format, which included field trips. This was reduced to a very focused two day course that has a very clear purpose: to give participants sufficient information to allow them to make a contribution to the reduction of bird strike hazard at their airport.

The key to achieving this goal is giving the students as much working knowledge as possible for them to take back to their airports. A case study is used in which students create a draft Management Plan for the sample airport. The plan includes the integral components of: bird strike information, an ecological survey, risk analysis and control program. During the three courses presented since May, the case study has been the host airport. To date, the response has been quite positive.

14.0 BSCC T-shirt and Logo

Bruce MacKinnon, Hans Blokpoel and Mario Larose presented the idea of a logo to the Committee members. It was generally felt that the initial design did not give "the right message". However, it was agreed, by most present, that a logo and T-shirt is a good idea. The table was opened for suggestions. Hans Blokpoel had a "sketch" of his idea for a T-shirt. As well, the albatross photo from Midway Atoll (Stop... Aircraft have right of way...) was suggested. A possible visual with a bird and an aircraft coming towards each other, each with their brakes on, was also recommended. All members and those involved are encouraged to put their pens to paper and come up with some design. These can be submitted to Bruce MacKinnon or Mario Larose.

15.0 Electrophoresis Feather Identification Update

Henri Ouellet described the process of feather identification. Visual identification is first attempted. If necessary, the feather is then viewed with an electron microscope, where feather formation, the shape of the nodes on the feathers and the space between them are used for identification. In cases where there is insufficient information in the feather to make an identification electrophoresis is used. For this, 10 mg of feather is required. The process of electrophoresis analyses the biochemical structure of feathers, using the feather's keratin proteins.

The cost of the basic visual identification is \$300.00. The electrophoresis process requires a base funding of \$6000.00 per year to keep the technology "alive". This includes 100 hours technician time and includes the cost of material. Without this bottom line expenditure, the expertise will be lost. In 1995, the Airports group will provide part of the money required to fund this project, however, other sources of funding are required. A brainstorming session followed. One of the possibilities mentioned was to expand the database to include species from outside of North America and to then advertise world-wide. Another idea was to create an annual subscription fee to the identification service. This seemed to create some positive feedback. It was also later suggested, that the TDC consider the update of the database to offer world-wide service as one of their research and development projects.

16.0 TDC Projects

The TDC is Transport Canada's research and development agency. Trevor Smith from the Centre, extended an invitation to all attendees to submit R&D proposals that are technology based, focused on safety and security. Two previous research projects produced by the TDC were: the 1978 National Study of Bird Hazards in Canada, an anthology of 15 site visits at Canadian airports and the aircraft mounted strobe light project. The latter project was terminated, even though there was and still is conflicting information about this device's performance. Trevor commented that the centre is attempting to have the aviation industry finish up the strobe light research. As well, a handout, found in Appendix 11, gave a summary report of the research to date on the strobe light project. Again, it was stressed that any comments or recommendations for research or development would be welcomed.

17.0 JFK Gull Shooting/FAA Bird Strike Database

17.1 FAA Database

Richard Dolbeer took up the challenge of being the last speaker of a long, full day. The FAA database was first discussed. For the first time in its history, the USDA and the FAA have completed a cooperative effort on bird strike analysis. From now on, there will be an annual report produced, that is something like Canadian annual Bird Strike Summary Report. One of the main findings from this first annual report was that in terms of bird strike hazard, waterfowl are just as important and dangerous as gulls. According to the report, waterfowl are twice as likely to cause damage as gulls.

17.2 JFK Airport Gull Shooting

Shooting as an interim control measure for the Laughing Gull problem at the JFK Airport began in 1991. It has been carried out by the USDA and is funded by the Port Authority of New York and New Jersey.

To give a bit of background to the subject, the only laughing gull colony in New York state is adjacent to JFK International Airport. While establishing a new laughing gull colony is in the planning process, an interim measure to control this migratory species was and still is required to decrease the bird strike hazard at the airport. The gulls are not attracted to the airport, they only use it as a flyway. Thus a lethal control program was established in which the gulls are shot as they attempt to fly across the airport.

It seems that the birds have learned to stay away from the airport. Since 1991, there has been a decrease in bird strikes. Currently, they are down to one-fifth of the number previous to the shooting program. As well, the birds' flight lines have been altered. This would indicate that habituation to lethal control has modified bird behaviour in this particular case. Since 1991, a total of 43,000 gulls have been shot. In 1991, the population was at 15,000 gulls. Over the past 5 years, the population has fluctuated. However, the laughing gull population near JFK International Airport is 12,000. The overall decrease in the population has only been 20%. This would indicate that the shooting has not impaired the gulls ability to maintain a viable population.

The cost of this program is \$80,000 US per year. There was a very low initial start-up expenditure for the purchase of shotguns, estimated to be \$2,000 US. It is anticipated that this method of interim control has applications to urban Canada Goose populations in the vicinity of airports.

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

DAY 2

18.0 Blue Ribbon Panel and YVR SICA Issue

Bruce MacKinnon gave an overview of the issue surrounding the Vancouver International Airport (YVR) Sea Island Conservation Area (SICA) issue.

For a background on this issue, please refer to the minutes of BSCC 22. Information on the 'Blue Ribbon Panel' and CWS SICA Management Plan will be provided at BSCC 24.

19.0 SRT-SICA (Safety Review Team)

Terry Kelly spoke about system safety and safety reviews and used SICA as a case study for the System Safety Review Process.

The role of a system safety review is to give an independent assessment of the risk. Terry provided a copy of the overheads used for the presentation, found in Appendix 12. The Safety Review Team acts as a type of feedback mechanism. Ultimately, risks can be managed if there is: comprehensive planning, an interdisciplinary systems approach, continuous monitoring and updating and effective communications.

20.0 Le Bourget Falcon 20 Crash

Alistair Pinos of ICAO distributed an "ICAO ADREP INFORMATION" sheet that contained information about the crash at Le Bourget, France in January 1995. This can be found in Appendix 13. What could be told about the crash is as follows. The engine was pre-1970, a CF 700, that did not require certification for a 4 lb. bird strike. The presence of birds was not reported by any means or by any of the airport users. However, it has been confirmed that birds were seen by the crew. The engine ingestion caused an uncontained failure that punctured the fuel tank (in the old air frame construction, the fuel tank is right in line with the engine). Ten people died in the crash. To date, the crash is still being investigated.

21.0 Weitech Bird Control Unit

Peter Sanguinetti of Trillium Windmills Inc. described the Weitech Bird Control units that his company manufactures. The company offers two different systems. The small unit runs off a solar panel and costs \$590.00. The larger system runs off a windmill and costs \$2000.00. To date there are three specific bird distress calls --one each for the crow, Herring Gull and Ring-billed Gull.

Trillium Windmills Inc. also offer small rodent control units, that sonically affect the rodents. The technology also has applications to electric fencing used for wildlife control. See Appendix 14 for more details.

22.0 Zoning Issues

Gilles Bourgeois presented a draft copy of the updated version of TP 1247 "Guidelines for Land Use in the Vicinity of Airports" document to the Committee. He and Bruce MacKinnon have been working on an update to the document, attempting to provide more guidance for planning and land use activities near airports. Gilles invited comments or recommendations. A copy of the draft version of the new TP 1247 is in Appendix 15.

23.0 Alaska AWACS Crash News Video

In September, 1995, a USAF AWACS aircraft crashed, only seconds after takeoff, in Anchorage, Alaska. A news video was shown to give some of the details of the crash. There were multiple bird strikes to both port-side engines. Twenty-four people died in the crash.

The accident is still under investigation and a complete report will be available once the investigation is completed and reviewed by USAF authorities. A few copies of the news video are available.

In a similar incident, shared by one of our American delegates, 3 days after the AWACS incident, the aircraft carrying Newt Gingrich, Speaker of the House of Representatives of the United States, was involved in a bird strike on Mackinac Island. The aircraft ingested one or more birds. Takeoff was aborted and the aircraft slid off the runway.

24.0 USDA-ADC Wildlife Control Training Program

James E. Forbes shared some details about the new wildlife control training program in the United States. Program development was a joint process between the USAF and Animal Damage Control. The concept is to have 50 biologists trained (one for each state), who will then be the trainers for that state. The initial training program is to be held in the Spring, 1996.

25.0 Use of Benomyl for Turf Management at Airports --Update

Rob Certain gave an update of the use of Benomyl to reduce earthworm problems at the airport. The use of Benomyl at CFH Trenton was used as a case study. At Trenton, no product had been used for 8 years. Within one year the worm population was reduced by 85%, effectively managing any problem caused previously by earthworms, including bird flocking and slipperiness. Benomyl has a relatively low toxicity to birds when ingested. For more information, contact Rob Certain at (613) 945-7552.

26.0 Orders of Business

Length of BSCC Meetings

The length of BSCC meetings was brought up for discussion. A number of possibilities were suggested. One recommendation was to maintain all meetings at current two day status. Another was to extend the meeting into 3 days, making the 3rd day optional to attend. A third day could be a non-standard option that would be taken only upon consideration of the relevancy of the material and presentations, or be open to the wildlife control industry and waste disposal companies. It was also recommended that the Ottawa meeting be 3 days, while the "out" meeting only be 2 days. These recommendations will all be considered for future BSCC meetings.

Location of the Next Meeting

A number of suggestions were offered as possible locations for BSCC 24: Toronto, Vancouver, New Mexico or St. John's. Presently Dave Ball, is investigating the possibility of having the next meeting at Vancouver International Airport.

27.0 Wrap-Up and Feedback

Once all business was concluded, a round table was conducted. All attendees were asked to contribute any comments or thoughts from the last 2 days of meetings.

There was some discussion on pilot's attitudes towards altering their flight plans to avoid bird hazards.

With the round-table finished the meeting was adjourned. After lunch, there was an optional field outing to the Carp landfill site, where a falconry demonstration was given by Willred Emonds of Intercept Wildlife Control.

28.0 Action Items generated from BSCC 23

1. Funding sources for the electrophoresis project --Bruce MacKinnon
2. TDC projects related to Bird Hazards --Bruce MacKinnon to work with Trevor Smith
3. Waste Disposal Industry involvement with BSCC --Bruce MacKinnon
4. Paper from Air Canada's re: communication of bird presence --Bruce MacKinnon for John Hart.
5. Development of pilot support and guidelines for rethinking takeoff in presence of birds --John Hart.
6. BSCC Logo --Mario Larose

**BIRD STRIKE COMMITTEE CANADA
MEETING 23, NOVEMBER 29 & 30, 1995**

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2. Department of National Defense Strike Data
3. Transport Canada Preliminary Strike Data, 1995
4. FAA 1994 Wildlife/Aircraft Strike Data
5. ICAO Studies Relating to Bird Hazard Reduction
6. Bird Hazard to Aircraft Issues Associated with the Proposed Rosser Landfill, Winnipeg, Manitoba
7. Gulls Associated with the St. John's Airport and the Robin Hood Bay Waste Disposal Site, Newfoundland, 1995
8. Federal Register notes, May 25, 1995
9. Ontario Region Bird Survey
10. Calgary International Airport Bird and Wildlife Study
11. Bird Hazards to Aviation: Possible New Safety and R&D Projects
12. SICA Safety Review
13. ICAO ADREP Information: Le Bourget Falcon 20 Crash
14. Weitech Bird Control Unit
15. Update to TP 1247 "Land Use in the Vicinity of Airports"
16. USDA APHIS ADC Airport Training Program 1995
17. Gull Facts for Airport Biologists
18. At Air Travel's Hub: A day in the life of Pearson International, Canada's busiest airport.
19. Symposium: Repellents in Wildlife Management. August 8-10, 1995, Denver, CO
20. Bird Strike Committee Europe
21. Bird Strike Prevention in China
22. The Role of NIMBY Groups in 22 Sanitary Landfill Sitings in Illinois
23. Update on the Raptor Relocation Program at Pearson International Airport, 1989-1993
24. Technical and Air Safety: Close Encounters of the Bird Kind
25. Where the Birds Are
26. Aviation Safety Vortex: Issues 3/95 and 4/95
27. Transport Canada: Atlanta Georgia - Lear Transcript, November 20, 1995
28. In the News: News Clippings and Comics
29. Bird Away
30. Product Reviews, Summer 1995
31. The Contents of Chinese Volumes...from Bird Damage Control and Reduction in Aviation, China
32. John F. Kennedy International Airport Wildlife Management Plan, December 19, 1995
33. The Port Authority of NY & NJ, Report on Rare Incident: 13 Birdstrikes in One Night at Newark International Airport

APPENDIX 1

BSCC 23 Agenda

AGENDA

BIRD STRIKE COMMITTEE CANADA 23rd MEETING

CITADEL INN
OTTAWA, ONTARIO
NOVEMBER 29-30, 1995

Wednesday, November 29, 1995

Time	Subject	Sponsor
0830	Coffee and Muffins	All
	Introduction	
0900-0905	Welcome	TBA
0905-0910	Opening	Mario Larose
0910-0920	Introduction of Attendees	Mario Larose
0920-0930	Review of Minutes-BSCC 22 Action Items	Mario Larose/Bruce MacKinnon
0930-1000	Bird Strike Summary Reports	DND, TC, AC, CAI, FAA, USAF, ICAO
1000-1030	Coffee Break	All
1030-1100	Jet Engine Certification Tests and Pratt & Whitney Engine Test Video	Martin Hexter
1100-1115	Bird Strike Damage Rates for Commercial Jet Aircraft	Todd Curtis (Boeing)
1115-1130	Midway Island Bird Strike Issue	Richard Dolbeer
1130-1145	Landfill Issues Winnipeg-St. John's	Dr. Rolph Davis
1145-1200	FAA Landfill Study	Ben Castellano
1200-1300	Lunch	All
1300-1330	Ottawa-North Bay Bird Studies	Carol Potter
1330-1340	Blue Ribbon Panel and YVR SICA Issue	Bruce MacKinnon
1340-1400	SRT-SICA	Terry Kelly
1400-1440	Wildlife Control Training & Landfill Awareness Videos	Bruce MacKinnon
1440-1455	TC Wildlife Control Training Program Update	David Fairbairn
1455-1530	Coffee	All
1530-1545	BSCC T-Shirt and Logo	Hans Blokpoel/Mario Larose/Bruce MacKinnon
1545-1600	Electrophoresis Feather Identification Update	Dr. Henri Ouellet
1600-1615	Worm Control-8 Wing Troncon	Gerry Potter
1615-1630	JFK Gulf Shooting-FAA Bird Strike Database	Richard Dolbeer

Thursday, November 30, 1995

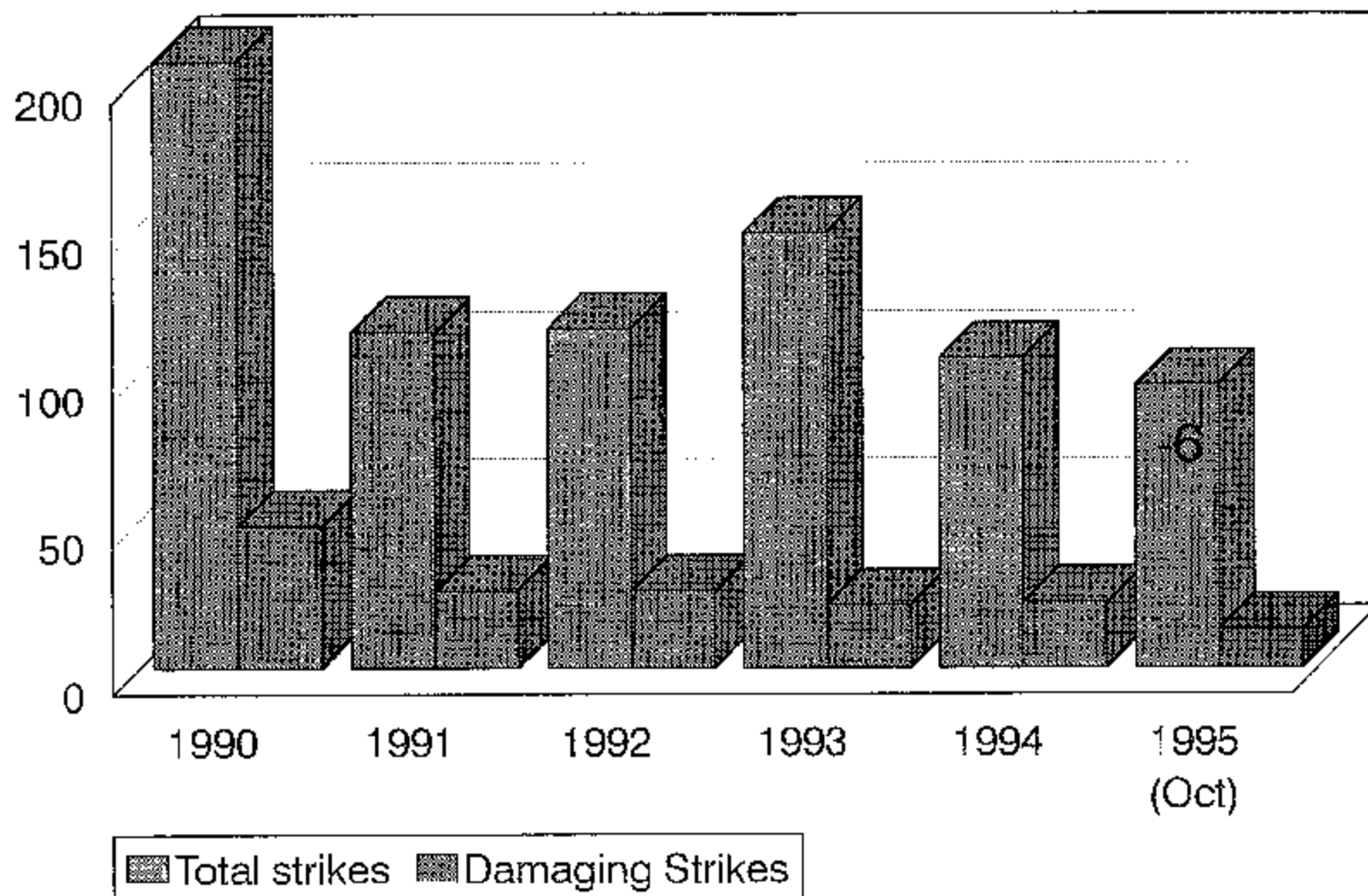
Time	Subject	Sponsor
0830-0900	Coffee and Muffins	All
0900-0930	Bird Avoidance Model and Landfill Issues	Ron Merritt
0930-1000	Calgary Avifauna Study	Clark Norton/Howard Troughton
1000-1030	Coffee Break	All
1030-1040	BSC-USA Update	Jim Forbes/Mario Larose/Bruce MacKinnon
1040-1055	Alaska AWACS Crash - News Video	Bruce MacKinnon
1055-1105	Weitech Bird Control Unit	Peter Sanguinetti
1105-1115	Le Bourget Falcon 20 Crash	Alistair Pinos
1115-1130	Zoning Issues-Airport Commercialization	Gilles Bourgeois
1130-1135	Update-Edmonton Int'l Airport Wildlife Program	Michael MacLean
1135-1145	USDA/ADC Wildlife Control Training Program	Jim Forbes
1145-1155	Other Business	All
1155-1200	Conclusion	All
1200-1300	Lunch	All
1300-1600	Field Trip	Wilfred Emonts/Mike Hendrick/Mike Walters

APPENDIX 2

Department of National Defense Strike Data

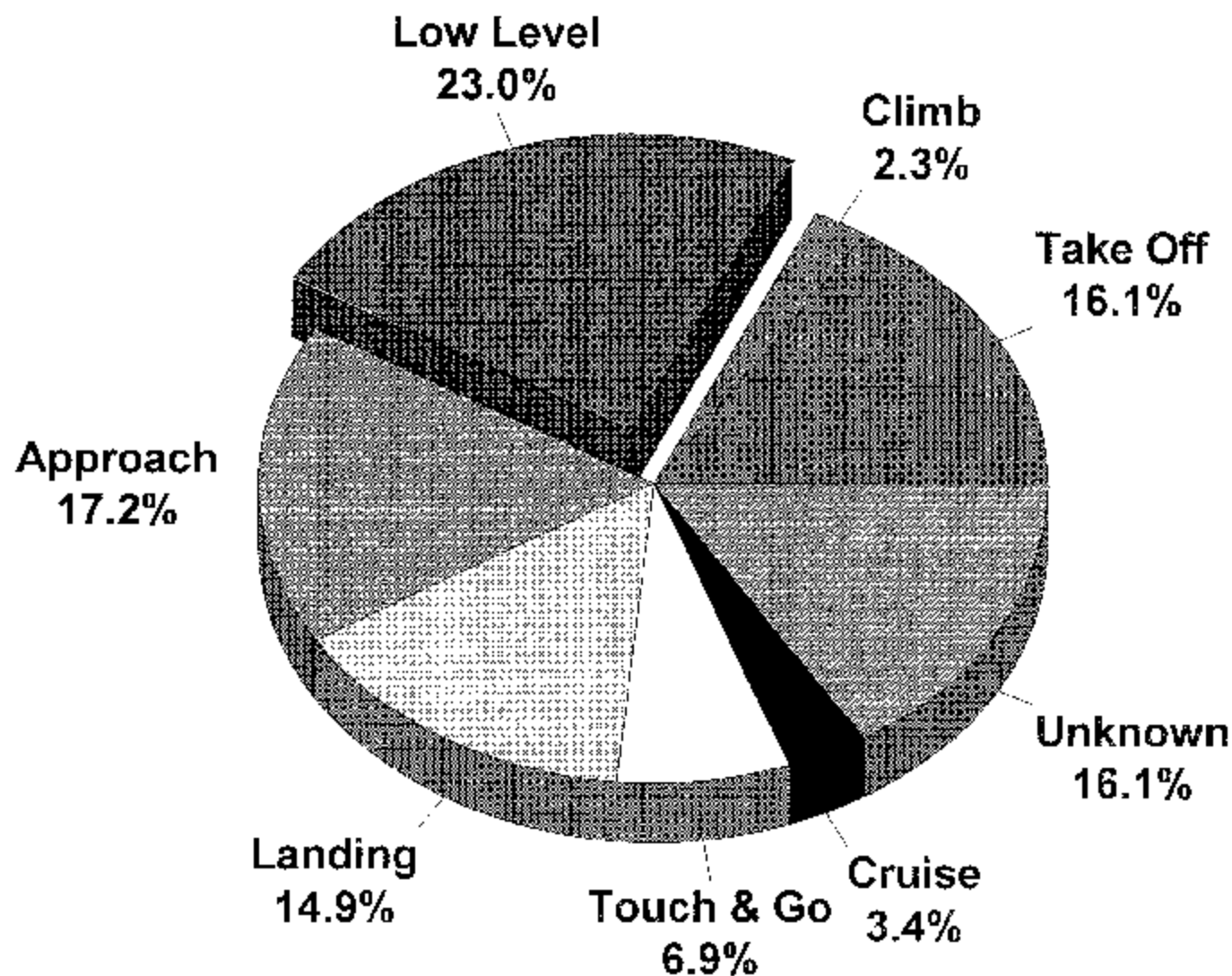


Total Strikes vs Damaging Strikes



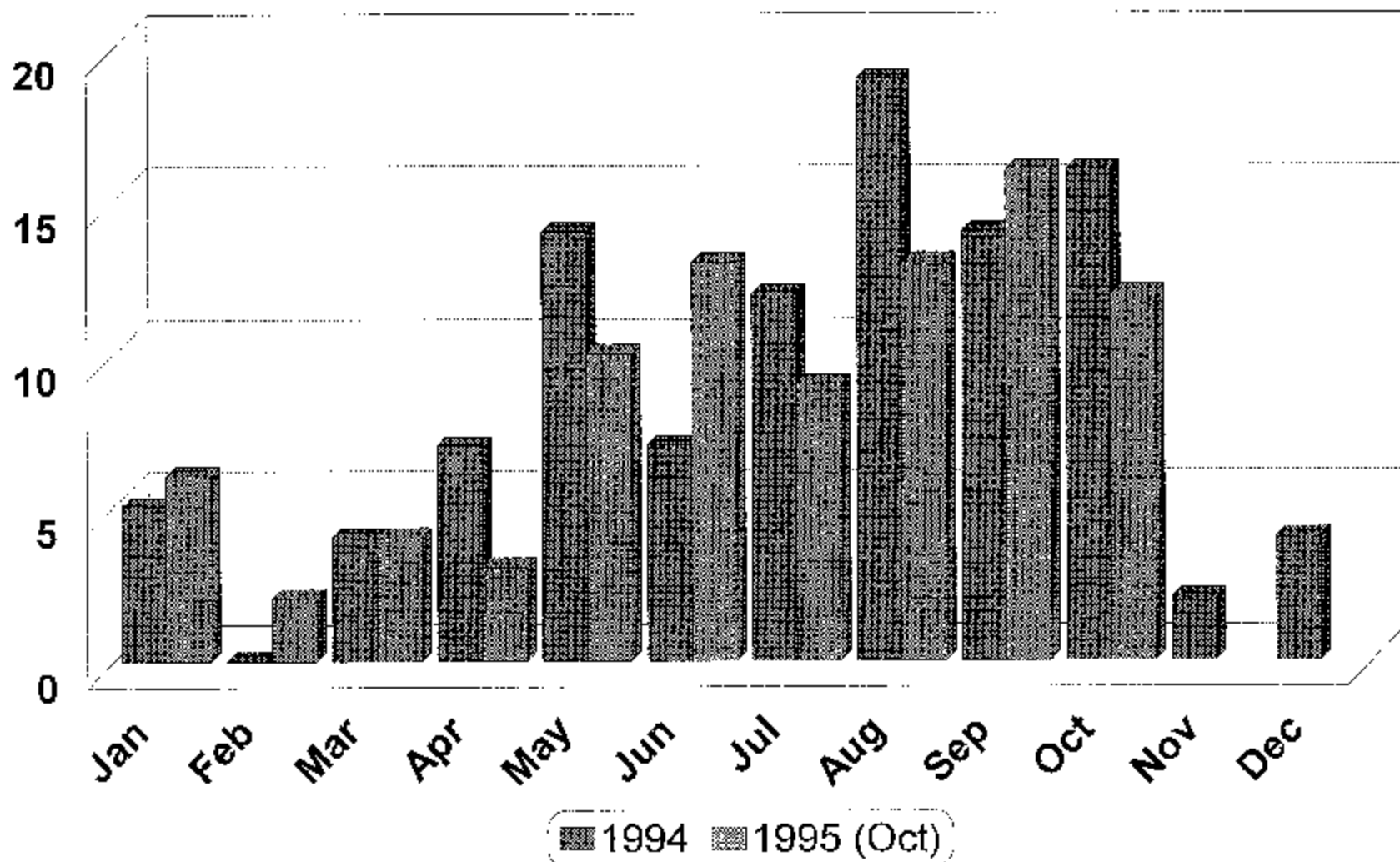


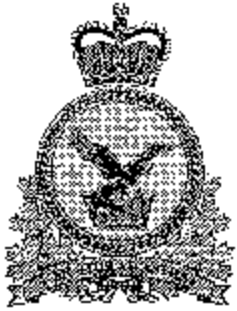
Where we hit birds - 1995



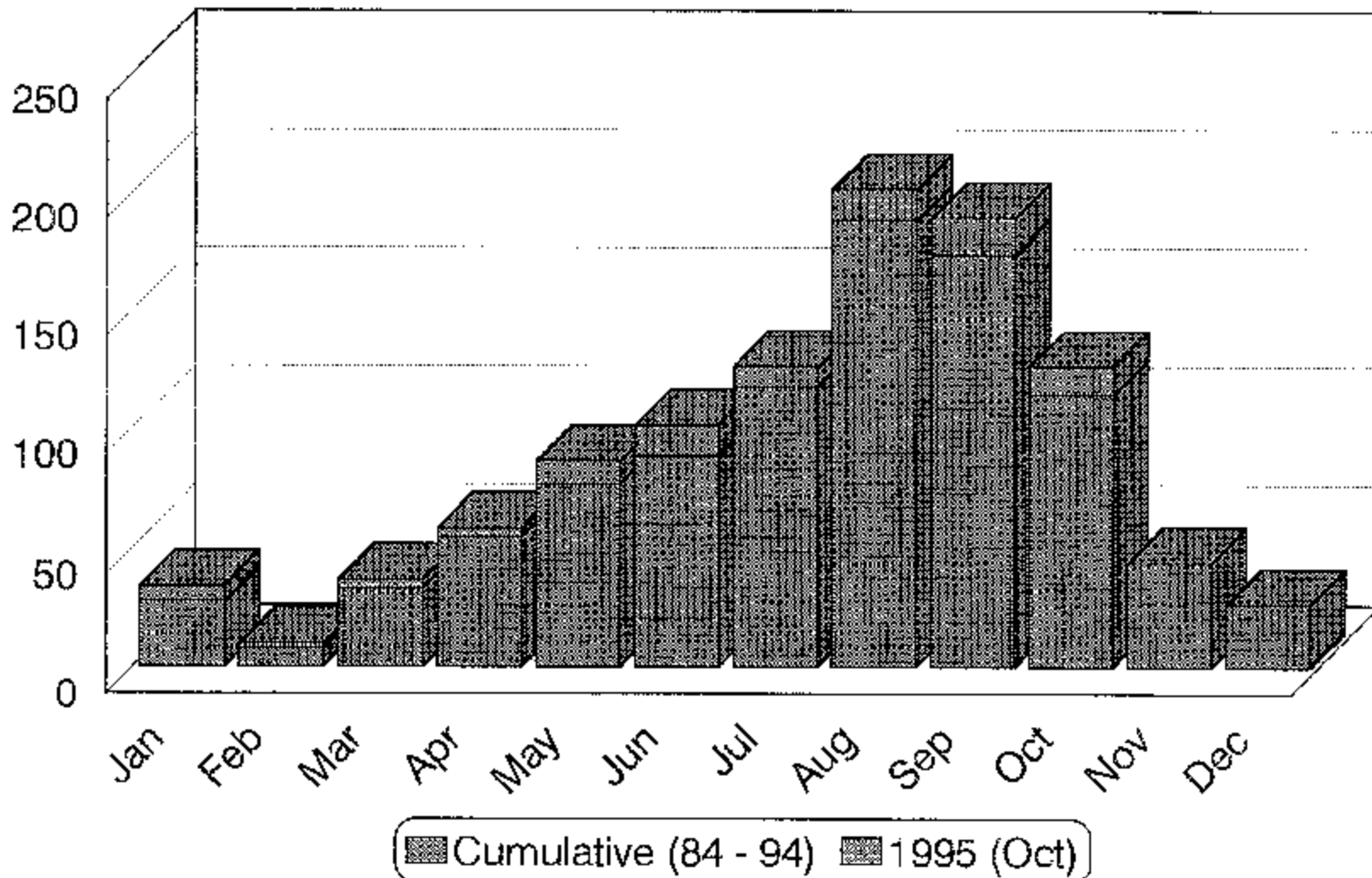


When we hit birds



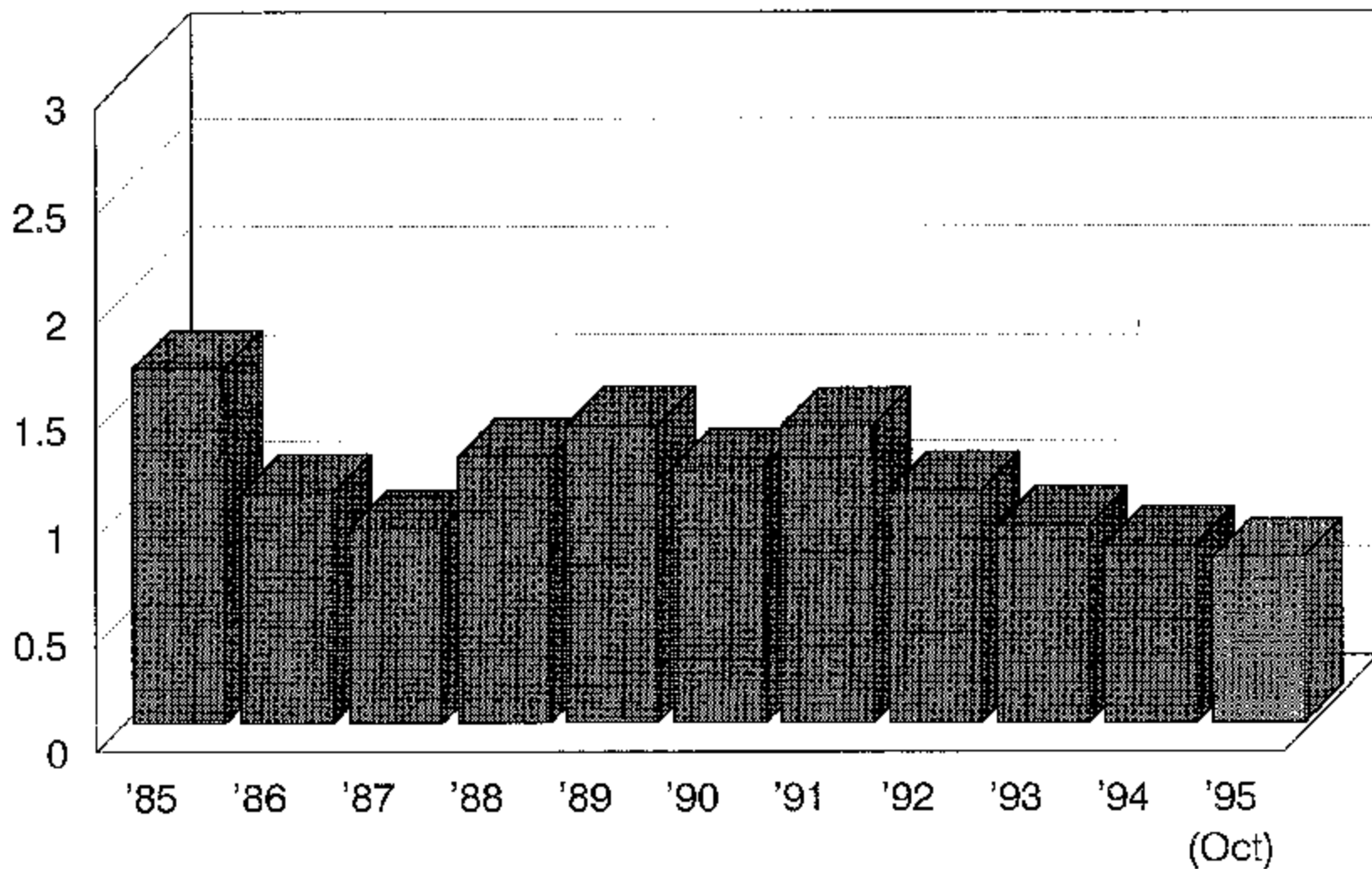


When we hit birds - Cumulative



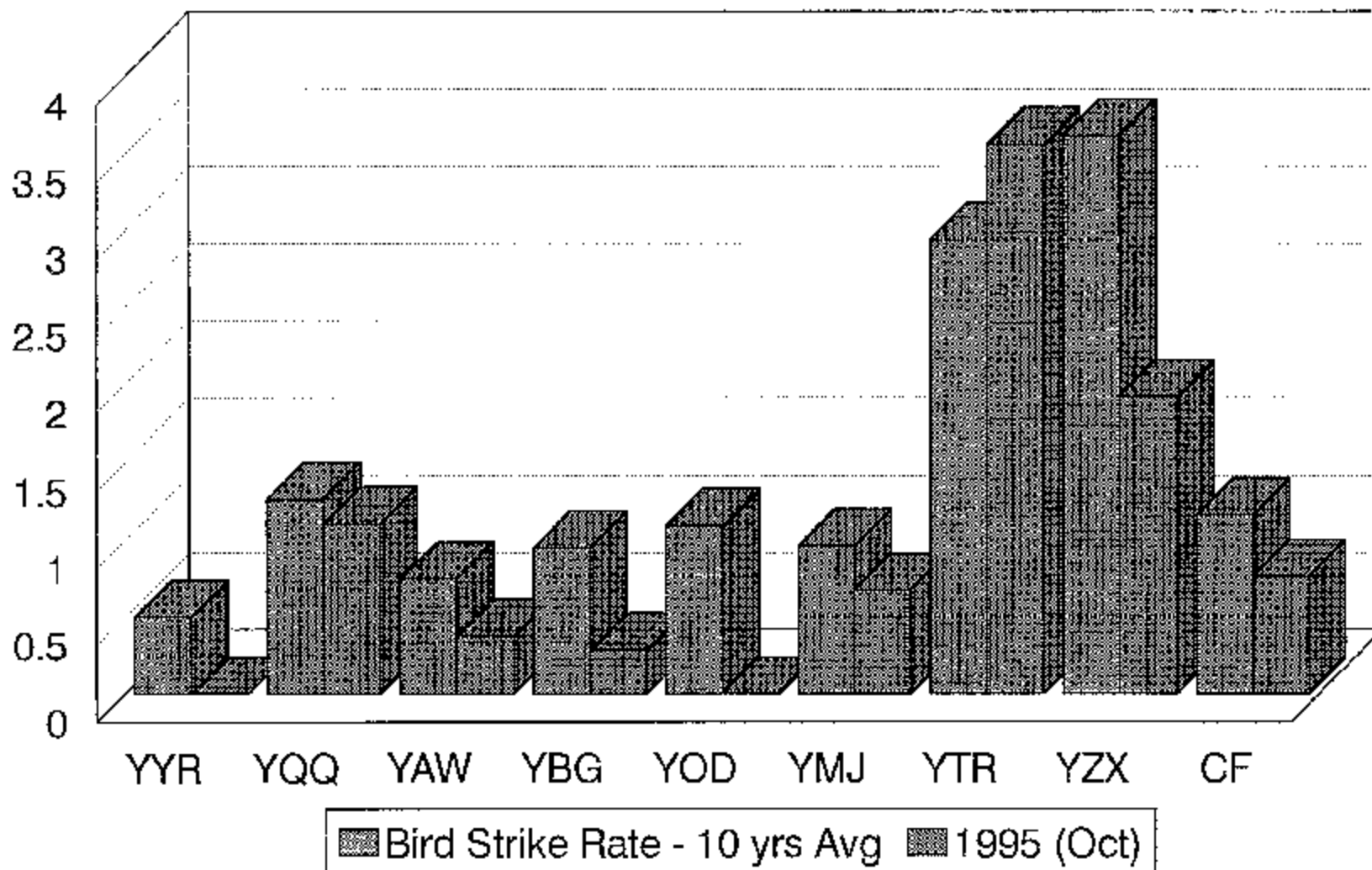


CF Bird Strike Rates



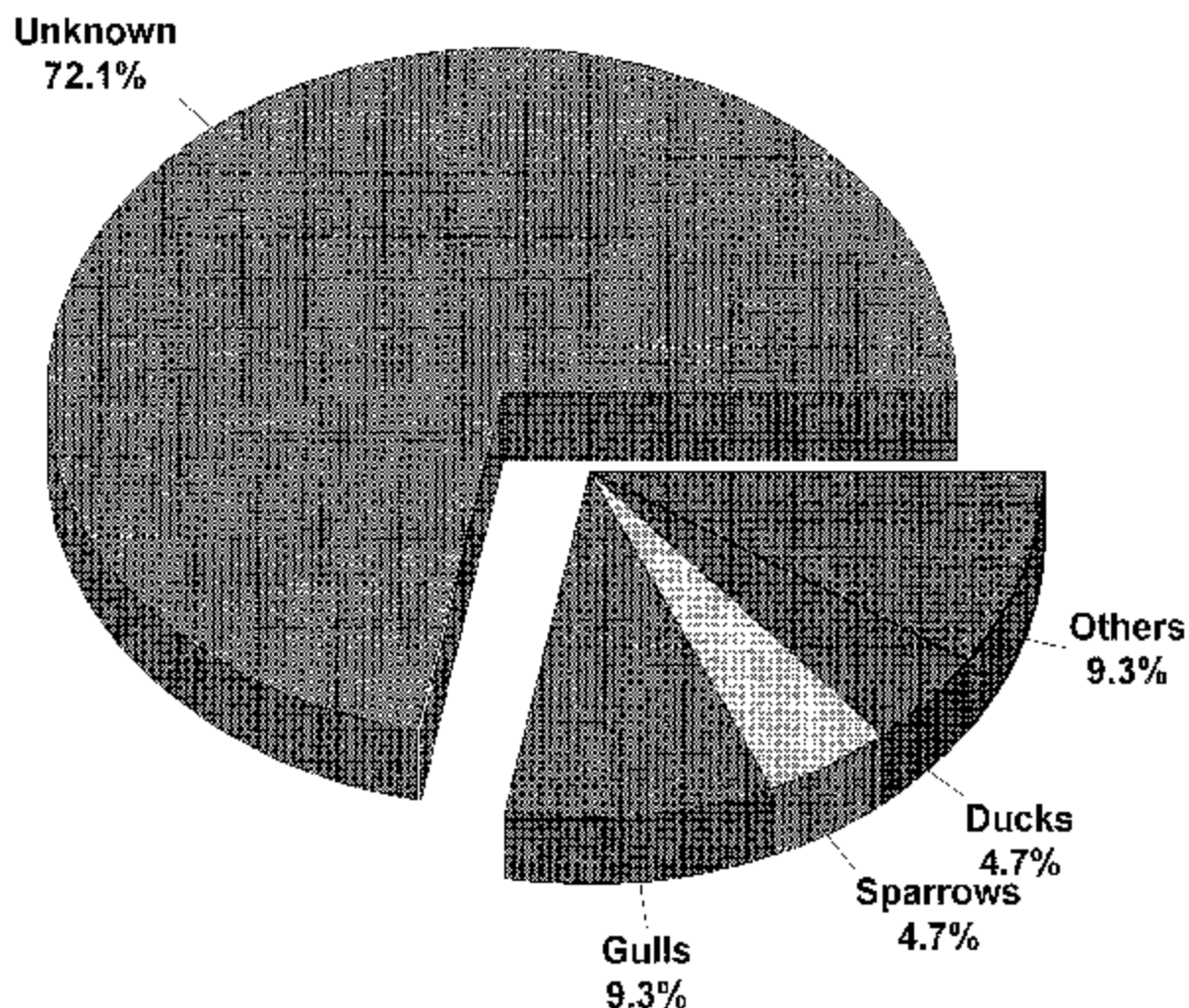


CF Bird Strikes





Species Stroke - 1995



Larks 3 Hawk 1 Starling 2 Crows 2 Swallows 2 Sandpipers 1

APPENDIX 3

Transport Canada Preliminary Strike Data, 1995

1995 Bird Strikes

Transport Canada

January 1, 1995 to November 21, 1995

AIRPORT	# STRIKES	AIRPORT	# STRIKES
Abbotsford, BC	1	Nanaimo, BC	1
Alert, NWT	1	Mirabel, QC	4
Baie-Comeau, QC	1	Moncton, NB	8
Boundary Bay, BC	5	Nanaimo, BC	1
Brochet, MB	1	Oshawa, ON	1
Buttonville, ON	2	Ottawa International, ON	33
Calgary International, AB	3	Pembroke, ON	3
Castlegar, BC	7	Peterborough, ON	1
CFB Chilliwack, BC	2	Port Hardy, BC	9
CFB Comox, BC	7	Portage la Prairie (South Port), MN	1
CFB Edmonton, AB	1	Powell River, BC	1
CFB Greenwood, NS	6	Prince Albert, SK	2
CFB Moose Jaw, SK	13	Prince George, BC	13
CFB Portage, SK	1	Prince Rupert, BC	4
CFB Saskatoon, SK	1	Quebec, QC	20
CFB Shearwater, NS	1	Rankin Inlet, NT	1
CFB Trenton, ON	11	Red Deer, AB	1
Charlottetown, PEI	3	Red Lake, ON	1
Chatham, ON	1	Regina, SK	3
Cooking Lake, AB	1	Rouyn-Noranda, QC	1
Deep River, ON	1	Saint John, NB	3
Deer Lake, NFL	2	Sandspit, BC	2
Dorval, QC	14	Saskatoon, SK	3
Downsview (Toronto), ON	1	Sault Ste Marie, ON	15
Dryden, ON	1	Sept Iles, QC	4
Edmonton International, AB	8	Slave Lake, AB	1
Edmonton Municipal, AB	3	Smiths Falls, ON	1
Flin Flon, MN	1	Springbank (Calgary), AB	2
Fort McMurray, AB	6	St. Honore, QC	5
Fort Smith, NWT	1	St. Jean, QC	2
Fort St. John, BC	1	St. John's, NFL	11
Fredricton, NB	4	Stephenville, NFL	6
Gander International, NFL	3	Stewart, BC	1
Grande Prairie, AB	7	Sudbury, ON	3
Halifax International, NS	7	Sydney, NS	4
Hamilton, ON	1	Thunder Bay, ON	19
Hay River, NWT	9	Toronto City Centre, ON	1
Hearst, ON	1	Toronto Island, ON	8
High Level, AB	1	Val D'Or, QC	4
Inukjuak, QC	1	Vancouver Harbour, BC	3
Inuvik, NWT	1	Vancouver International, BC	10
Kapuskasing, ON	1	Victoria, BC	10
Kelowna, BC	2	Wawa, ON	1
Kingston, ON	2	Welland, ON	2
Lester B. Pearson International, ON	39	White Dog Reserve Helipad, ON	1
Lethbridge, AB	2	Whitehorse, NWT	1
London, ON	4	Windsor, ON	4
Manitowaning (Manitoulin East), ON	1	Winnipeg International, MN	35
Mirabel, QC	4	Yarmouth, NS	6
Moncton, NB	8	Yellowknife, NWT	12

1995 Strike Rates
26 Major Airports in Canada

AIRPORT	STRIKE RATE
Winnipeg International (35)	2.8
Ottawa International (32)	2.5
Prince George (13)	2.7
St. John's (11)	2.6
Yellowknife (12)	2.2
Thunder Bay (12)	2.0
Quebec (18)	1.7
Lester B. Pearson International (39)	1.6
Edmonton International (7)	1.4
Fredricton (4)	1.3
Moncton (8)	1.3
Gander International (4)	1.0
Boval (14)	0.8
Victoria (10)	0.8
Mirabel (3)	0.7
Halifax International (6)	0.6
Regina (3)	0.6
Sudbury (3)	0.6
Kelowna (2)	0.5
London (4)	0.5
Saskatoon (3)	0.5
Vancouver International (10)	0.4
Calgary International (3)	0.2
Whitehorse (1)	0.2
Charlottetown (3)	N/A
Saint John (3)	N/A

Please note:

- strike rates calculated using "Preliminary Monthly Aircraft Movements" reports, 1995
- (x) refers to the number of bird strikes on site
- shaded areas indicate sites with greater than 100 000 movements

APPENDIX 4

FAA 1994 Wildlife/Aircraft Strike Data

TABLE 1 - FAA 1994 WILDLIFE / AIRCRAFT STRIKE DATA

There were 2,293 reported wildlife aircraft strikes in calendar year 1994. These airports reported 5 or more wildlife aircraft strikes during that period (FAA unpublished data).

Airport ID and name		No. reported strikes	Airport ID and name		No. reported strikes
KORD	CHICAGO O'HARE INTL	92	KEKE	GENERAL MITCHELL INTL	10
KDFW	DALLAS FORT WORTH	72	KFAH	HOUSTON INTL	10
	Ed Koubly	71	KAGS	MAKAMAZOO COUNTY	10
KSMF	SACRAMENTO METRO	46	FLH	FT. LAUDERDALE	10
KCCA	WASHINGTON NATIONAL	44	KOMU	MORRISTOWN MUNI AIRP	10
KCLT	CLAYTON/DALLAS INTL	42	KSAV	SAVANNAH INTL	10
KSFO	SAN FRANCISCO INTL	42	KILN	AIRBORNE AIRMARK AIR	9
KCVG	GREATER CINCINNATI	41	KAGC	ALBANY COUNTY AIRP	9
KPHL	PHILADELPHIA INTL	36	KATL	BRATTLE INTL	9
KMEM	NASHVILLE METRO/INTL	34	KIND	INDIANAPOLIS INTL	9
KMEM	BERMINGHAM INTL	33	KCMH	PORT COLUMBUS INTL	9
KLGA	LAGUARDIA NY	29	KHRL	K.O. GRANDE VALLEY INTL	9
KMSY	NEW ORLEANS INTL	19	KFD	THEODORE F. BRANN ST	9
KBMT	BALTIMORE WASH INTL	28	KBD	BURKE LAKE/ROCK	9
KORF	NORFOLK INTL	28	KMFI	MANCHESTER AIRPORT	9
KBIT	GREATER PITTSBURGH	27	KIAS	NIAGARA FALLS INTL	8
KATL	ATLANTA INTL	26	KSYR	SYRACUSE HANCOCK INT	8
KSLC	SALT LAKE CITY INTL	24	KTPA	TAMPA INTL	8
KACY	ATLANTIC CITY INTL	23	KONC	WILL ROGERS WORLD AB	8
KBOB	LOGAN INTL	23	KALB	ALBANY COUNTY	7
KCLE	CLEVELAND HOPKINS IN	22	KMG	DANNIELLY FIELD	7
KMIA	MIAMI INTL	22	KBUF	GREATER BUFFALO INTL	7
KOMA	EMPIRE AIRFIELD	21	KISV	HUNTSVILLE INTL	7
KHOU	HOUSTON-HOBBY	21	KMLP	MELBOURNE REGIONAL	7
KDFW	NEWARK INTERNATIONAL	21	KMSF	MTWILKINSON ST PAUL	7
KJFK	SAN JOSE INTL	21	KILG	NEW CASTLE COUNTY	7
KTEE	TETERBORO AIRPORT	21	KPHI	NEWPORT NEWS	7
KRON	DEKALA-PERCHOTRE GA	20	KNO	KNOX CANNON INTL	7
KMKE	GRANT COUNTY ARPT	19	KORN	NEAGER ARPT	7
KLAX	LOS ANGELES INTL	19	KGR	BANGOR INTL	6
KRDU	RALPH/FAIRBANK INTL	19	KMOB	BATES FIELD AIRPORT	6
KDFW	STANDIFORD	19	KDUK	BURBANK-GLendale-PAS	6
KIAD	DULLES INTL	18	KCHS	CHARLESTON AFB/INTL	6
KMCI	KANSAS CITY INTL	18	KTYO	CHERRY CAPITAL ARPT	6
KFTL	FORT LAUDERDALE INTL	17	KELF	EL PASO	6
KRST	ROCHESTER NY	17	KGPT	GULFPORT BILLOXI REGI	6
KPNS	PENSACOLA REG	16	KTN	MERSTE COUNTY	6
KSTL	LAWRENCE-ST LOUIS INTL	15	KPSI	PA M BEACH INTL	6
KPOK	PORTLAND INTL-ORIGON	15	KPRK	BRANCAIR	6
KDUS	ROBERT MUELLER MUNI	15	KICT	NICHITA MID-CON. INEN	6
KSLA	SEATTLE TACOMA INTL	15	KLVK	CINCINNATI MUNI ARPT	6
KDBR	DANBURY MUNI ARPT	14	KDHS	DOHRN	6
KDEN	DENVER STAPELTON INT	14	KDAY	LAYETTVILLE MUNI	6
KOAK	METRO OAKLAND INTL	14	KROC	GREATER ROCHESTER IN	6
KONT	ONTARIO INTL	14	KMOT	MARLBOROUGH INTL	6
KRIC	RICHMOND INTL	14	KJAX	JACKSONVILLE INTL	6
KDAL	DALLAS LOVE FLD	13	KMYK	KEY WEST INTL ARPT	6
KJFK	JOHN F. KENNEDY INTL	13	KETK	OAKLAND PONTIAC ARPT	6
KLNK	LINCOLN MUNI	12	KOBT	SEA LOCK	6
KSAT	SAN ANTONIO INTL	12	KPTD	PANAMA CITY/BAY COON	6
KPRI	PRIT INTL	12	KMLI	QUAD CITY ARPT	6
KISP	LONG ISLAND/MAD ARPT	12	KEDG	READING REGIONAL	6
KSLA	SANTA BARBARA MUNI	12	KSTI	SITKA ARPT	6
KMDW	CHICAGO MIDWAY	11	KPIE	ST. PETERSBURG-CLEAR	6
KLIT	LITTLE ROCK, ADAMS FLD	11	KSTW	STEWART INTL AIRPORT	6
KMCO	ORLANDO INTL	11	KTVL	TOLEDO EXPRESS ARPT	6
KDSM	DES MOINES INTL	10	KAV	WILKES-BARR/SCRANTO	6
KEGM	EDWIN A. LINK FLD	10			

TOTAL

1,772

TABLE 2 - FAA 1994 WILDLIFE / AIRCRAFT STRIKE DATA

Of the 2,293 reported wildlife aircraft strikes occurring in calendar year 1994, 1,751 reported the part of the aircraft involved (excluding engines) (FAA unpublished data).

<u>Aircraft part</u>	<u>No. strikes</u>	<u>Aircraft part</u>	<u>No. strikes</u>
Raydome		Fuselage	
struck	231	struck	239
damaged	44	damaged	16
Windshield		Landing gear	
struck	412	struck	153
damaged	40	damaged	31
Nose		Tail	
struck	281	struck	31
damaged	22	damaged	16
Propeller		Lights	
struck	101	struck	19
damaged	18	damaged	17
Wing/rotor		Total reported	
struck	284	struck	1,751
damaged	102	damaged	306

TABLE 3 - FAA 1994 WILDLIFE / AIRCRAFT STRIKE DATA

Aircraft engines reported as being struck by wildlife in calendar year 1994 (FAA unpublished data).

<u>Engine number</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>Total</u>
No. struck	192	96	12	5	305
No. damaged	80	42	7	1	130

TABLE 4 - FAA 1994 WILDLIFE / AIRCRAFT STRIKE DATA

Airlines with the best records for reporting wildlife aircraft strikes for calendar year 1994 (FAA unpublished data).

Air Carrier	Number of strikes reported
American Airlines (+AA Eagle 84)	424
US Air (+USA Express 19)	269
Privately Owned	188
Business	179
Southwest Air	134
Delta	119
United Airlines (-UAL Express 17)	109
Continental Airlines (+CNT Express 20)	73
Airborne Express	50
Northwest Airlines	47
Transworld Airlines (+TWA Express 14)	39
total	1,631

TABLE 5 - FAA 1994 WILDLIFE / AIRCRAFT STRIKE DATA

Identified wildlife groups most commonly involved in the 2,295 reported wildlife aircraft strikes during calendar year 1994 (FAA unpublished data). The species involved was identified in 1,204 of the reports. The Group Hazard Value is taken from DeHaven et. al, 1985.

Wildlife Groups	No. reported strikes	% reported strikes	Group Hazard Value
Gulls	327	27%	1.00
Terns	6	<1%	
Waterfowl	146	12%	0.30
Ducks	(66)	(5%)	
Geese/swans	(80)	(7%)	
Doves	135	11%	0.15
Mourning doves	(89)	(7%)	
Rock doves	(46)	(4%)	
Blackbirds	131	11%	0.15
Blackbirds	(71)	(6%)	
Starlings	(60)	(5%)	
Raptors	107	9%	0.25
Hawks	(84)	(7%)	
Owls	(15)	(1%)	
Eagles	(8)	(1%)	
Sparrows	90	8%	not rated
Covirids	37	3%	not rated
Crows	(35)	(3%)	
Ravens	(2)	(<1%)	
Shorebirds	33	3%	0.10
Pelicans	(4)	(<1%)	
Plovers	(4)	(<1%)	
Killdeer	(17)	(1%)	
Sandpipers	(8)	(1%)	
Vulture	25	2%	0.15
Waders	23	2%	0.10
Egrets	(14)	(1%)	
Herons	(7)	(<1%)	
Cranes	(1)	(<1%)	
Grebes	(1)	(<1%)	
Swallows	25	2%	0.05
Subtotal - birds	1,085	90%	
Ungulates	56	5%	not rated
Deer	(55)	(5%)	
Elk	(1)	(<1%)	
Canids	12	1%	not rated
Coyotes	(9)	(1%)	
Dog	(1)	(<1%)	
Fox	(1)	(<1%)	
Raccoon	(1)	(<1%)	
Subtotal - mammals	68	6%	
Reptiles	1	<1%	not rated
Alligator	(1)	(<1%)	
Total	1,154	93%	

TABLE 6 - FAA 1994 WILDLIFE / AIRCRAFT STRIKE DATE

Aircraft types most commonly reported as being involved in wildlife aircraft strikes in calendar year 1995 (FAA unpublished data).

<u>Aircraft type</u>	<u>No. strikes</u>	<u>Aircraft type</u>	<u>No. strikes</u>
A-320	20	BE-19	34
ART-42	41	C-152	24
B-727	93	C-172	43
B-727-100	4	DC-9	167
B-727-200	35	DHC8-DASE 8	36
B-737	130	EMB-120	46
B-737-200	106	FK-100	100
B-737-300	132	LEARJET-35	17
B-737-400	34	MD-80	144
B-737-500	21	MD-82	31
B-747	41	MD-83	11
B-747-200	13	MD-88	34
B-747-400	11	SAAB-100	58
B-757	54	SPORT-360	30
B-757-200	19	SW-3 MERLIN	17
B-767	14		
B-767-200	4		
B-767-300	5		
BA-31 JETSTER	82		
		TOTAL	1,665

TABLE 7 - FAA 1994 WILDLIFE / AIRCRAFT STRIKE DATA

There were 2,295 reported wildlife aircraft strikes in calendar year 1994. Of those, 2,000 reported the altitude (AGL) and state where the strike occurred. Wildlife aircraft strikes occurring outside of the 50 United States are not reported in this table.

State	Altitude AGL					
	Ground level	1 to 500 ft	501 to 1,000 ft	1,001 to 2,000 ft	2,001 to 3,000 ft	>3,001 ft
AK	6	6	0	4	0	0
AL	22	23	5	5	0	3
AR	6	4	0	0	2	0
AZ	4	2	1	1	0	2
CA	73	68	16	18	7	11
CO	14	3	0	2	0	1
CT	15	14	1	1	0	0
DC	9	31	7	8	2	2
DE	3	2	1	1	0	1
FL	67	58	14	11	4	2
GA	31	22	3	5	3	1
HI	13	0	1	0	0	0
IA	3	8	0	2	3	3
ID	1	2	0	0	0	1
IL	39	37	10	10	3	6
IN	4	8	5	2	0	0
KS	3	2	1	1	0	1
KY	30	20	3	6	3	1
LA	19	18	5	1	1	1
MA	12	9	1	3	0	0
MD	19	14	1	1	0	1
ME	5	1	0	0	2	0
MI	26	14	1	1	0	0
MN	10	9	1	5	2	2
MO	8	9	4	8	2	3
MS	5	7	1	0	1	2
MT	0	1	1	0	0	1
NC	21	33	3	3	1	7
NE	1	6	0	0	0	0
NE	10	16	0	5	2	3
NJ	8	3	0	1	1	0
NC	31	17	1	2	0	3
NM	0	0	0	0	0	3
NV	5	2	0	0	0	1
NY	59	30	7	7	4	3
OH	33	15	2	3	1	3
OK	2	2	2	2	2	0
OR	8	5	2	1	1	0
PA	53	32	6	9	2	6
RI	6	3	0	0	0	0
SC	5	6	1	1	1	0
SD	0	0	0	1	1	2
TN	9	25	4	4	1	2
TX	58	50	12	12	4	27
UT	10	3	5	0	1	3
VA	30	17	4	2	0	2
VT	2	0	0	0	0	0
WA	10	12	4	8	1	0
WI	8	6	0	0	0	1
WV	9	4	0	1	0	1
WY	2	0	0	0	0	0
Total	838	692	135	161	61	113

Chart 1

Altitude - AGL - at Which Reported Wildlife Aircraft Strikes Occurred in 1994

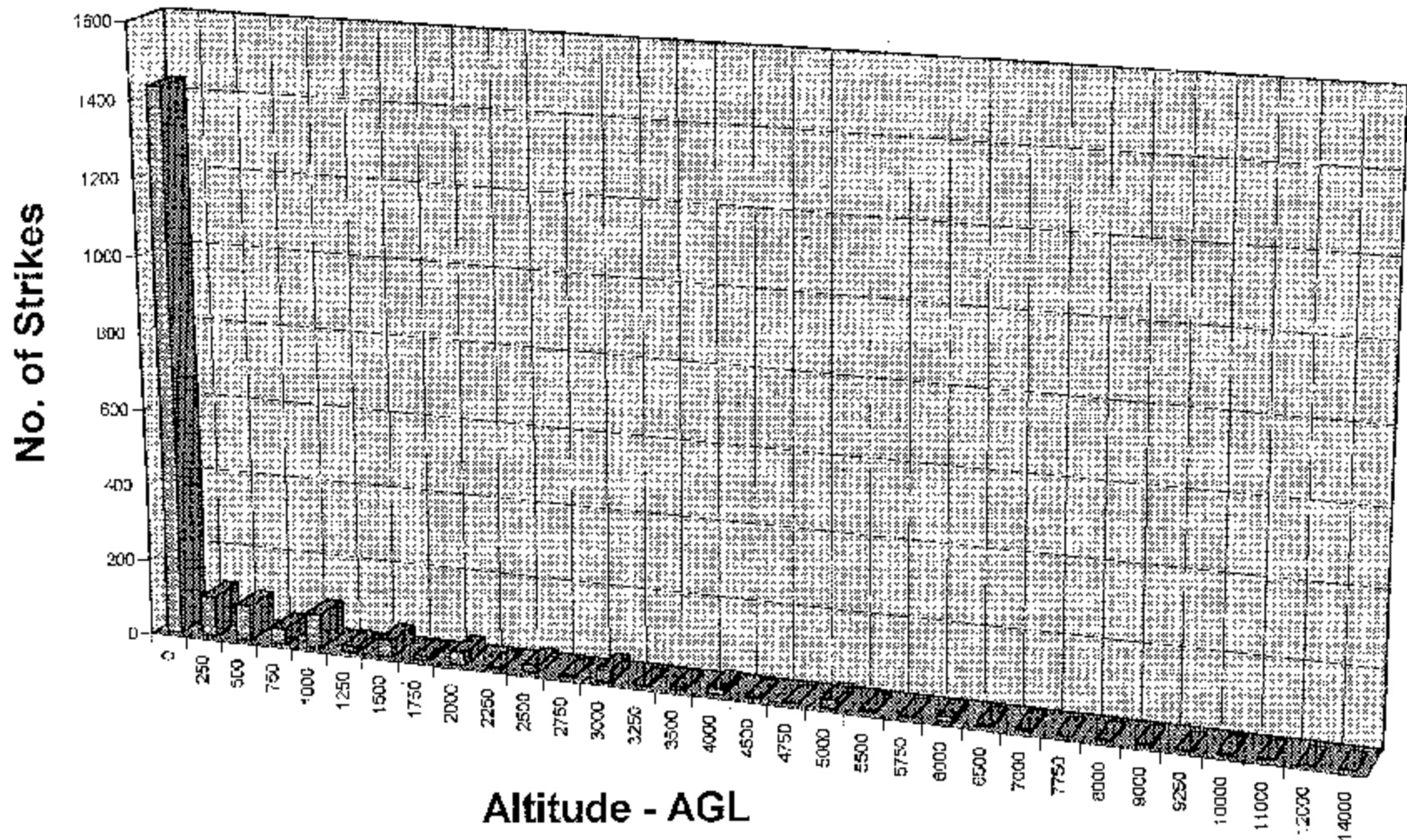


Chart 2

Reported Altitude AGL at Which Most Wildlife Aircraft Strikes Occur

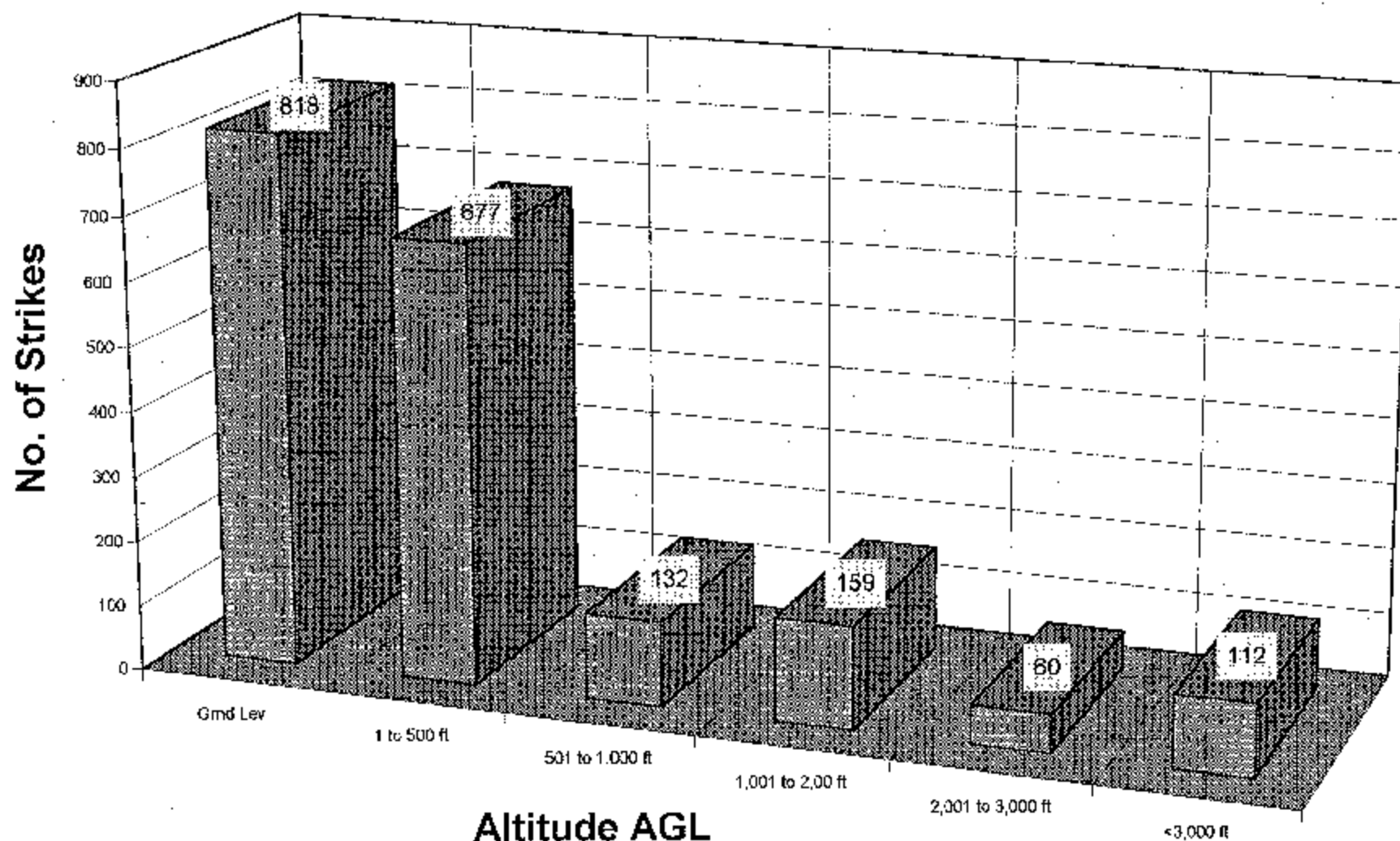


Chart 3

Time of Day When Wildlife Aircraft Strikes Occure

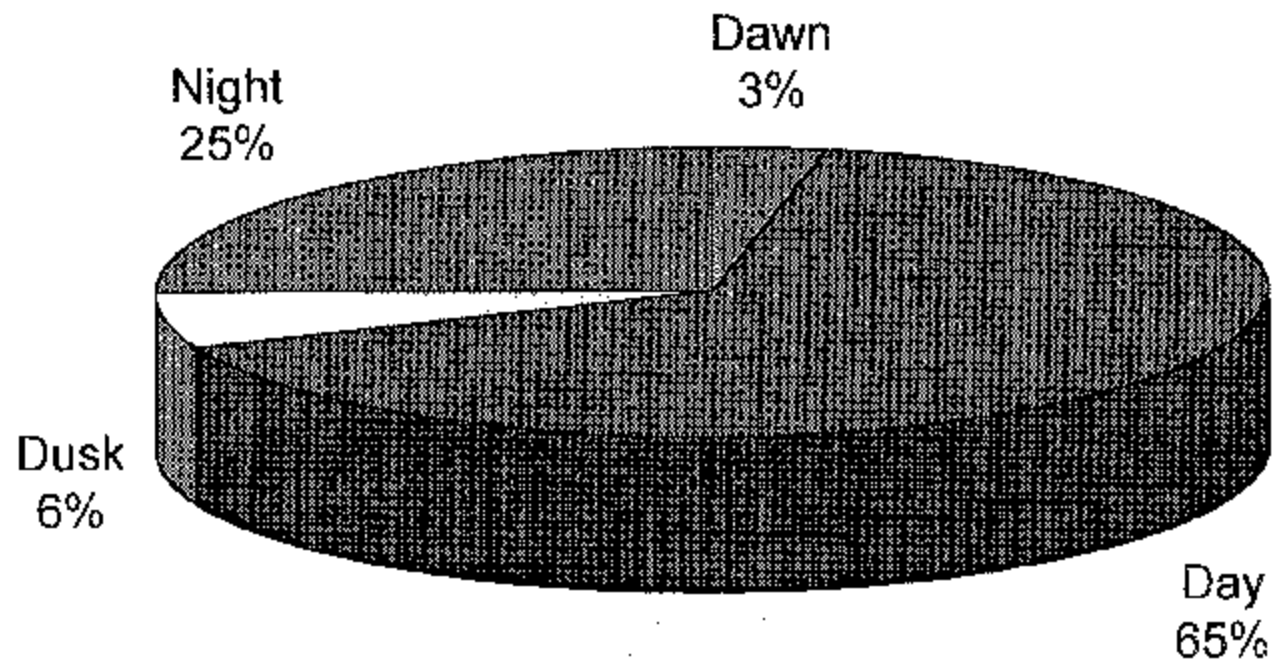


Chart 4

Reported Wildlife Aircraft Strikes by Time of Day and Month of Occurrence

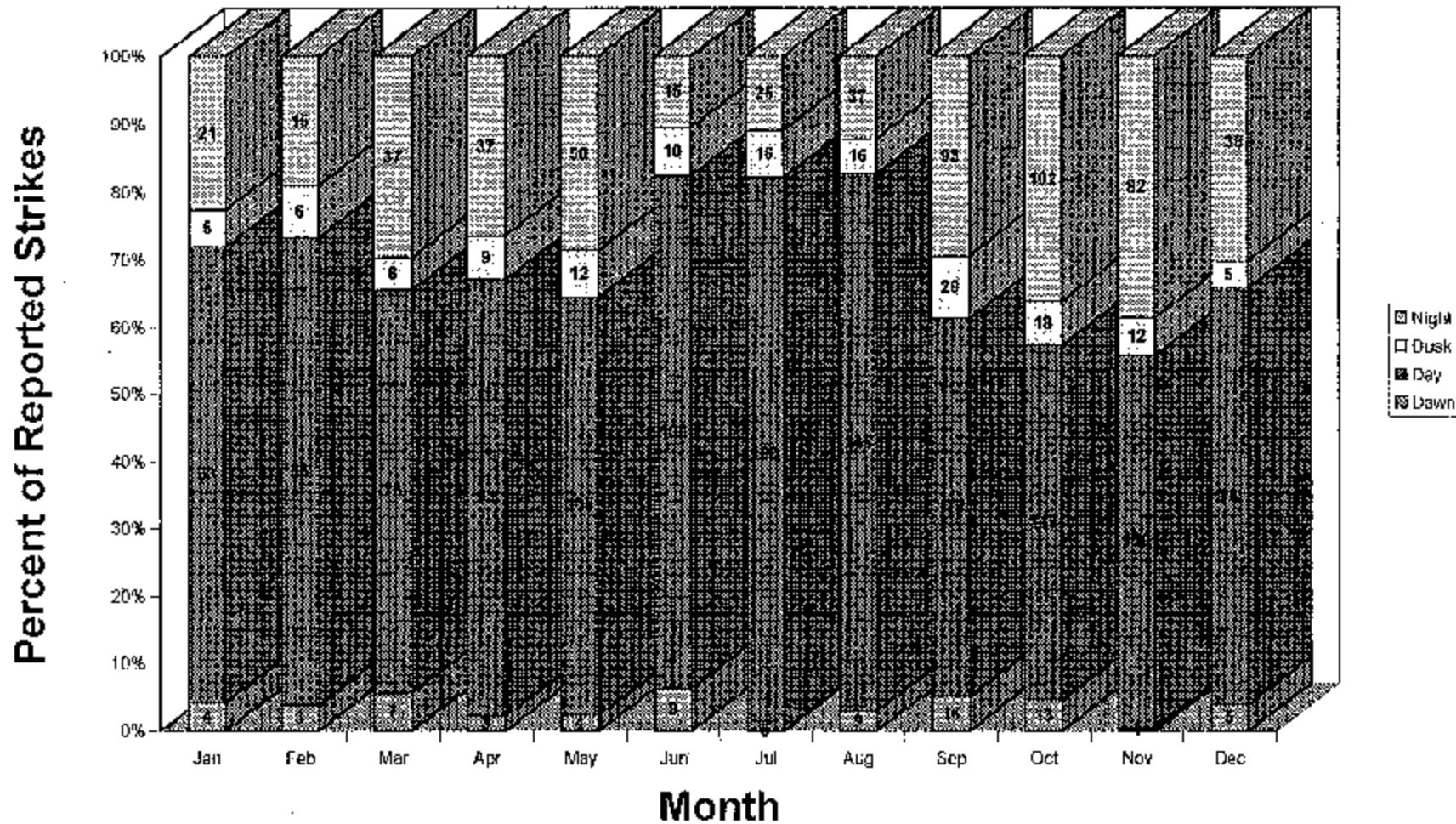


Chart 5

Wildlife Aircraft Strikes by Month of Occurrence

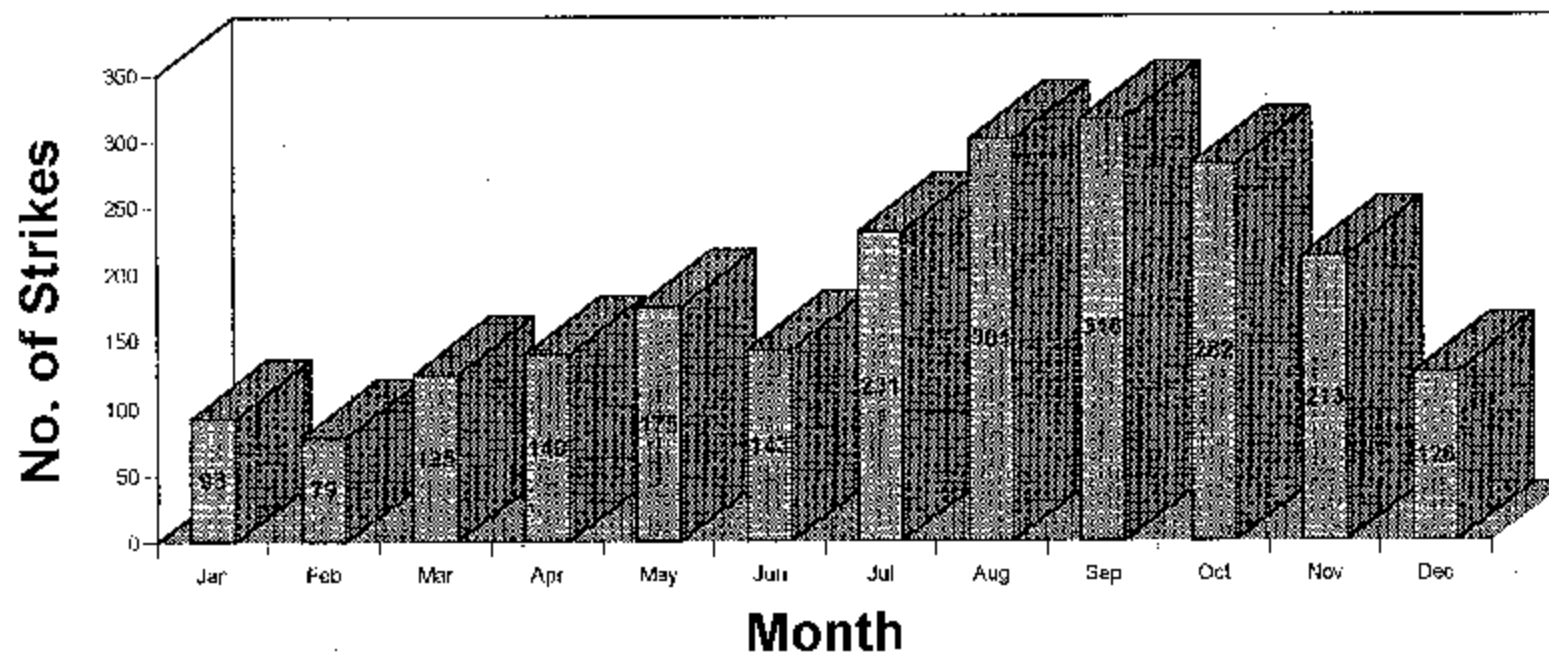


Table 1. Sources of information for reported wildlife strikes to civilian aircraft, USA, 1994.

Source	Number reported	% of total
FAA Form 5200-7	1853	84
FAA Air Carrier Incident Report	80	4
Individual Airports	33	1
FAA Prelim. Aircraft Incident Report	23	1
NASA Aviation Safety Reporting System	18	1
FAA Aircraft Accident/Incident Prelim. Notice	8	<1
Other	41	2
Multiple sources	164	7
Total	2220	100

Table 2. Number of reported wildlife strikes to civilian aircraft by type of operator, USA, 1994.

Operator	Number reported	% of total
Commercial carrier	1673	75
Business	204	9
Private	190	9
Government/Police	10	<1
Unknown	143	6
Total	2220	100

Table 3. Number of reported strikes to civilian aircraft and number of reported strikes causing damage or other costs by type of wildlife struck, USA, 1994.

Wildlife group	Wildlife type ^b	Strikes		Strikes causing damage or other costs ^a	
		No.	% of total	No.	% of total
Birds	Gulls	321	30 ^c	83	30 ^c
	Waterfowl ^d	146	13 ^e	73	27 ^e
	Blackbirds/starlings	~~2~~ 132	12 ^e	13	5 ^e
	Pigeons/doves	129	12 ^e	23	8 ^e
	Birds of prey	107	10 ^e	46	17 ^e
	Crows/ravens	35	3 ^e	11	4 ^e
	Hérons/pelicans	24	2 ^e	6	2 ^e
	Misc. known birds	193	18 ^e	18	7 ^e
	Total known birds	1087	100	273	100
	Unknown birds	1063		194	
Other	Total bird strikes	2150		467	
	Deer/elk	57	81 ^e	46	92 ^e
	Coyote/dog	9	13 ^e	3	6 ^e
	Other mammals	3	4	0	0
	Alligator	1	1	1	2
	Total other wildlife	70	99	50	100
Total		2220		517	

^a Includes aborted take-offs, fuel dumps, delays for inspections, etc.

^b Identified to species group (e.g., gull, hawk, waterfowl) but not necessarily to species.

^c Proportion of damaging strikes caused by this wildlife type was similar ($\chi^2 \leq 2.60$, 1 df, $p \geq 0.11$) to proportion of total strikes caused by this wildlife type.

^d Geese, primarily Canada geese (*Branta canadensis*), comprised 55% of waterfowl reported struck and 63% of waterfowl reported causing damage.

^e Proportion of damaging strikes caused by this wildlife type was different ($\chi^2 \geq 10.73$, 1 df, $p < 0.01$) than proportion of total strikes caused by this wildlife type.

Table 4. Number and percent of reported bird and other wildlife (primarily deer) strikes to civilian aircraft by U.S. State, 1994.

State	Bird strikes		Other wildlife strikes	
	Number	%	Number ^a	%
AK	17	0.8	0	0
AL	60	2.8	0	0
AR	14	0.7	2 (1)	2.9
AZ	12	0.6	2	2.9
CA	222	10.4	1	1.5
CO	21	1.0	1 (1)	1.5
CT	33	1.6	0	0
DC	63	3.0	0	0
DE	6	0.3	1	1.5
FL	168	7.9	2(1)	2.9
GA	66	3.1	1	1.5
HI	17	0.8	0	0
IA	20	0.9	0	0
ID	5	0.2	0	0
IL	124	5.8	3 (2)	4.4
IN	18	0.8	2	2.9
KS	8	0.4	0	0
KY	66	3.1	0	0
LA	48	2.3	0	0
MA	29	1.4	0	0
MD	29	1.4	2	2.9
ME	7	0.3	0	0
MI	40	1.9	8	11.8
MN	27	1.3	0	0
MO	36	1.7	3 (2)	4.4
MS	11	0.5	1 (1)	1.5
MT	2	0.1	0	0
NC	74	3.5	6	9.0
ND	8	0.4	0	0
NE	33	1.6	0	0
NH	14	0.7	2	2.9
NJ	80	3.8	6	8.8
NM	4	0.2	0	0
NV	9	0.4	0	0
NY	108	5.1	4 (2)	5.9
OH	78	3.7	0	0
OK	11	0.5	1	1.5
OR	21	1.0	0	0
PA	108	5.1	9	13.2
RI	9	0.4	0	0
SC	12	0.6	0	0

Table 4. (continued)

State	Bird strikes		Other wildlife strikes	
	Number	%	Number ^a	%
SD	4	0.2	0	0
TN	46	2.2	0	0
TX	181	8.5	2 (2)	3.0
UT	24	1.1	0	0
VA	57	2.7	0	0
VI	6	0.3	0	0
VT	2	0.1	0	0
WA	42	2.0	0	0
WI	13	0.6	3	4.4
WV	10	0.5	5	7.4
WY	2	0.1	1	1.5
Total (State known)	2125	100.0	68 (12)	100.0
State not known	25		2 (1)	
Total strikes	2150		70 (13)	

^a Numbers in parentheses refer to non-deer strikes.

Table 5. Reported time of occurrence for wildlife strikes to civilian aircraft, USA, 1994.

Time of strike	Number (%) of strikes			
	Birds		Other wildlife	Total
Dawn	71	(3)	1 (2)	72 (3)
Day	1395	(67)	7 (11)	1402 (65)
Dusk	139	(7)	5 (8)	144 (7)
Night	487	(23)	53 (80)	540 (25)
Total (time reported)	2092	(100)	66 (101)	2158 (100)
Time not reported	58		4	62
Total strikes	2150		70	2220

Table 6. Phase of flight during which wildlife strikes to civilian aircraft occurred, USA, 1994.

Phase of flight	Number (%) of strikes		
	Birds	Other wildlife	Total
Descent	68 (3)	0 (0)	68 (3)
Approach	698 (34)	0 (0)	698 (33)
Landing	413 (20)	42 (62)	455 (21)
Take-off	691 (34)	26 (38)	717 (34)
Climb	114 (6)	0 (0)	114 (5)
En route	71 (3)	0 (0)	71 (3)
Taxi	8 (<1)	0 (0)	8 (<1)
Total (phase reported)	2063 (100)	68 (100)	2131 (100)
Phase not reported	87	2	89
Total	2150	70	2220

Table 7. Number of reported bird strikes to civilian aircraft by altitude above ground level, USA, 1994.

Reported altitude (ft) at time of strike	Number (%)
0-100	1158 (63)
101-500	262 (14)
501-1000	133 (7)
1001-2000	120 (7)
2001-3000	57 (3)
3001-4000	30 (2)
4001-5000	30 (2)
5001-10000	44 (2)
10000-15000	7 (<1)
Total (altitude reported)	1841 (100)
Altitude not reported	309
Total bird strikes	2150

Table 8. Number and percent of reported bird and other wildlife strikes by type of civilian aircraft, USA, 1994.

Aircraft manufacturer	Model ^c	Reported strikes		Strikes causing damage or other costs ^a	
		Number	%	Number	%
Boeing	B-737	559	27	73	15
McDonald Douglas	DC-9/MD-80	379	19	49	10
Boeing	B-727	138	7	19	4
Fokker	F100	104	5	10	2
British Aerospace	BA 125	86	4	30	6
Boeing	B-757	73	4	11	2
Saab	340	48	2	12	3
Embraer	120 Brasilia	46	2	8	2
Cessna	170	39	2	18	4
deHavilland	DHC8 Dash 8	36	2	6	1
Beech	1900	34	2	11	2
Boeing	B-767	34	2	1	<1
Shorts	360	30	1	8	2
Piper	Cherokee	24	1	12	3
Cessna	152	24	1	4	1
Boeing	B-747	21	1	3	1
Airbus Industries	A320	20	1	4	1
All other		351	17	193	41
Total (aircraft known)		2046	100	472	100
Unknown Aircraft		174		45	
Total strikes		2220		517	

^a Includes aborted take-offs, fuel dumps, delays for engine inspections, etc.

^b Includes all series of model.

Table 9. Number of aircraft components reported damaged by wildlife strikes to civilian aircraft, USA, 1994.

Aircraft component	Number damaged (%)		Total
	Birds	Other wildlife	
Engine	118 (29)	4 (5)	122 (25)
Wing	84 (21)	11 (14)	95 (20)
Radome/nose	61 (15)	5 (6)	66 (14)
Windshield	38 (9)	1 (1)	39 (8)
Landing gear	15 (4)	17 (22)	32 (7)
Propeller	7 (2)	11 (14)	18 (4)
Lights	15 (4)	2 (3)	17 (3)
Fuselage	9 (2)	7 (9)	16 (3)
Tail	13 (3)	3 (4)	16 (3)
Other	45 (11)	17 (22)	62 (13)
Total	405 (100)	78 (100)	483 (100)

Table 10. Reported effect-on-flight caused by wildlife strikes to civilian aircraft, USA, 1994.

Effect on flight	Number (%)		Total
	Birds	Other wildlife	
None	1588 (74)	15 (21)	1603 (72)
Aborted take-off	66 (3)	10 (14)	76 (3)
Engines shut down	12 (1)	0 (0)	12 (1)
Precautionary landing	112 (5)	5 (7)	117 (5)
Other ^a	268 (13)	34 (49)	302 (14)
Not reported	104 (5)	6 (9)	110 (5)
Total	2150 (101)	70 (100)	2220 (100)

^a Normal flight and landing but subsequent miscellaneous expenses incurred such as delay to have engine inspected or parts replaced/repared.

Table 11. Bird and other wildlife strikes recorded in Federal Aviation Administration Wildlife Strike Database (FAAWS), Office of Airport Safety and Standards, Washington, DC, as percent of total strikes known to occur at John F. Kennedy International Airport (JFKIA), 1994.

Strike report obtained from:				FAAWS
JFKIA	FAAWS	Both	Total	as % of total
103	13	6	110	12

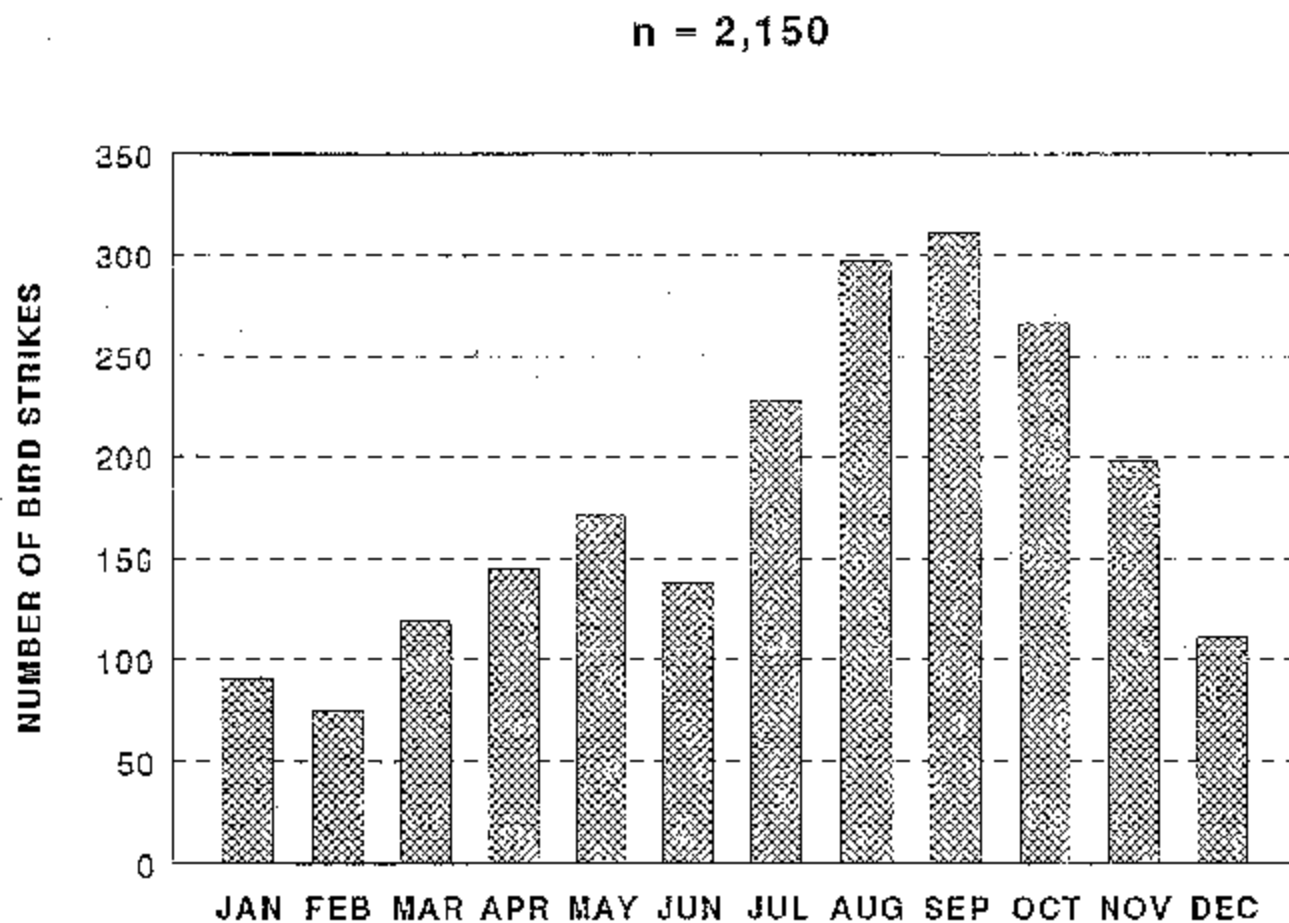


Figure 1. Number of reported bird strikes to civilian aircraft in USA by month, 1994.

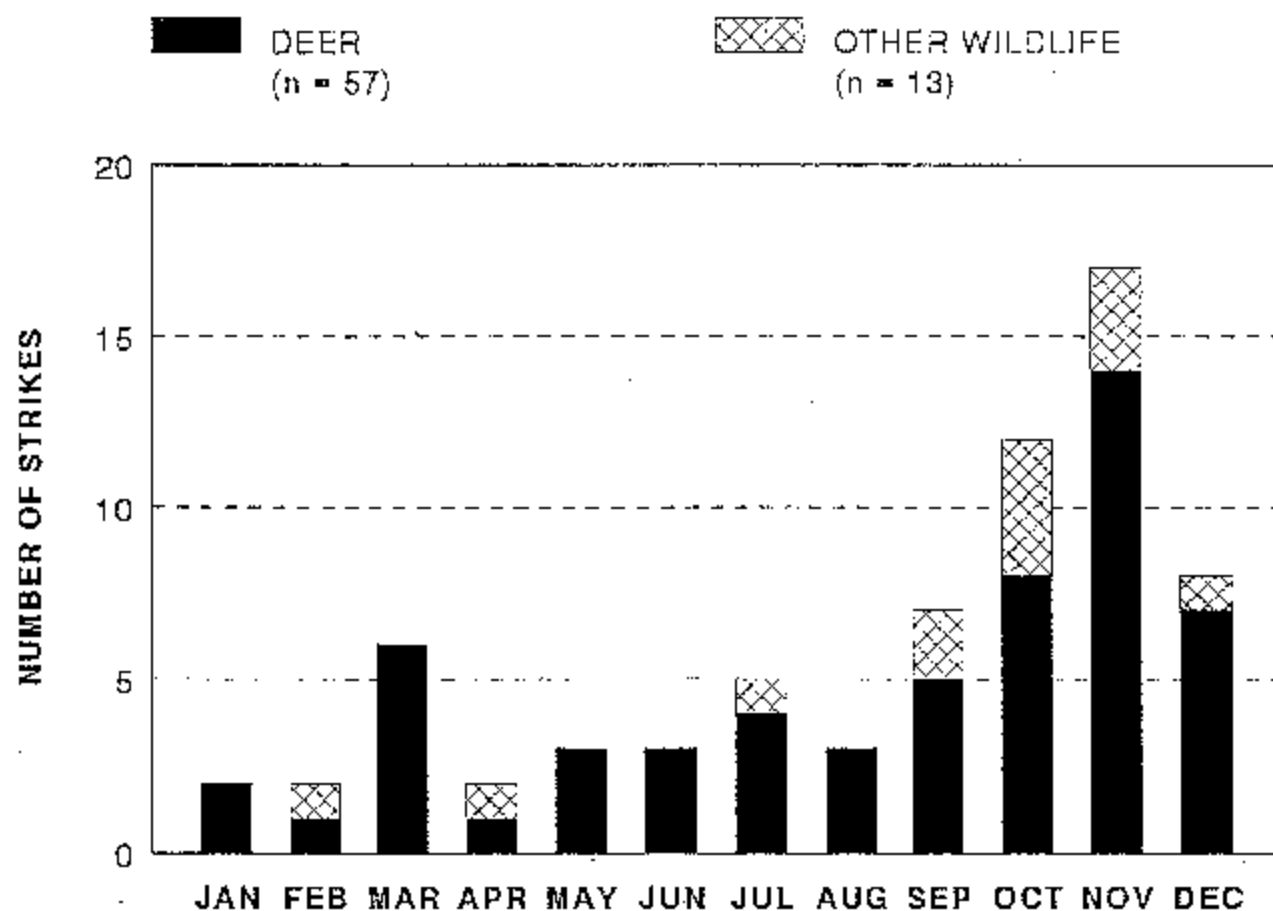


Figure 2. Number of reported strikes by wildlife other than birds to civilian aircraft in USA by month, 1994.

APPENDIX 5

ICAO Studies Relating to Bird Hazard Reduction



INTERNATIONAL CIVIL AVIATION ORGANIZATION
ORGANISATION DE L'AVIATION CIVILE INTERNATIONALE
ORGANIZACIÓN DE AVIACIÓN CIVIL INTERNACIONAL
МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ГРАЖДАНСКОЙ АВИАЦИИ
منظمة الطيران المدني الدولي

INTERNATIONAL AVIATION SQUARE, 1000 SHERBROOKE STREET WEST, MONTREAL, QUEBEC, CANADA H3A 2R2
FACSIMILE TEL.: (514) 285-1772 CABLES: CAO MONTREAL TELEEX: 05-24513 SITA: YULOCAYA

OFFICE TEL.: (514) 285-8181

Ref.: AN 4/9.1-95/52

14 July 1995

Subject: Studies relating to bird hazard reduction
Action required: To note

Sir,

I have the honour to transmit to you the attached data emanating from a statistical study of bird strikes reported to ICAO and occurring during the period 1989 to 1993. It may be recalled that annual statistics on this subject are compiled by ICAO and transmitted to States. This on-going study is being conducted to better understand the problems posed by bird strikes in the vicinity of airports. The study also provides background information for future work to be done by the Secretariat in this respect.

States are invited to make full use of the IBIS programme for general safety studies and bird strike reduction programmes. To this end, special analyses of bird strike data stored in the IBIS system may be obtained on request by writing to the Secretary General.

ICAO is now in the process of collecting data on bird strikes which occurred in 1994. If your State has not already reported such information, may I urge you to transmit it so as to reach me as soon as possible.

Accept, Sir, the assurances of my highest consideration.


Philippe Rochat
Secretary General

Enclosures:

Statistical data on the ICAO bird strike
information system (IBIS)

Table 1. Summary of Bird Strikes

SS - No. of significant strikes
 TS - No. of total strikes
 SR - No. of States reporting
 SO - No. States of occurrences

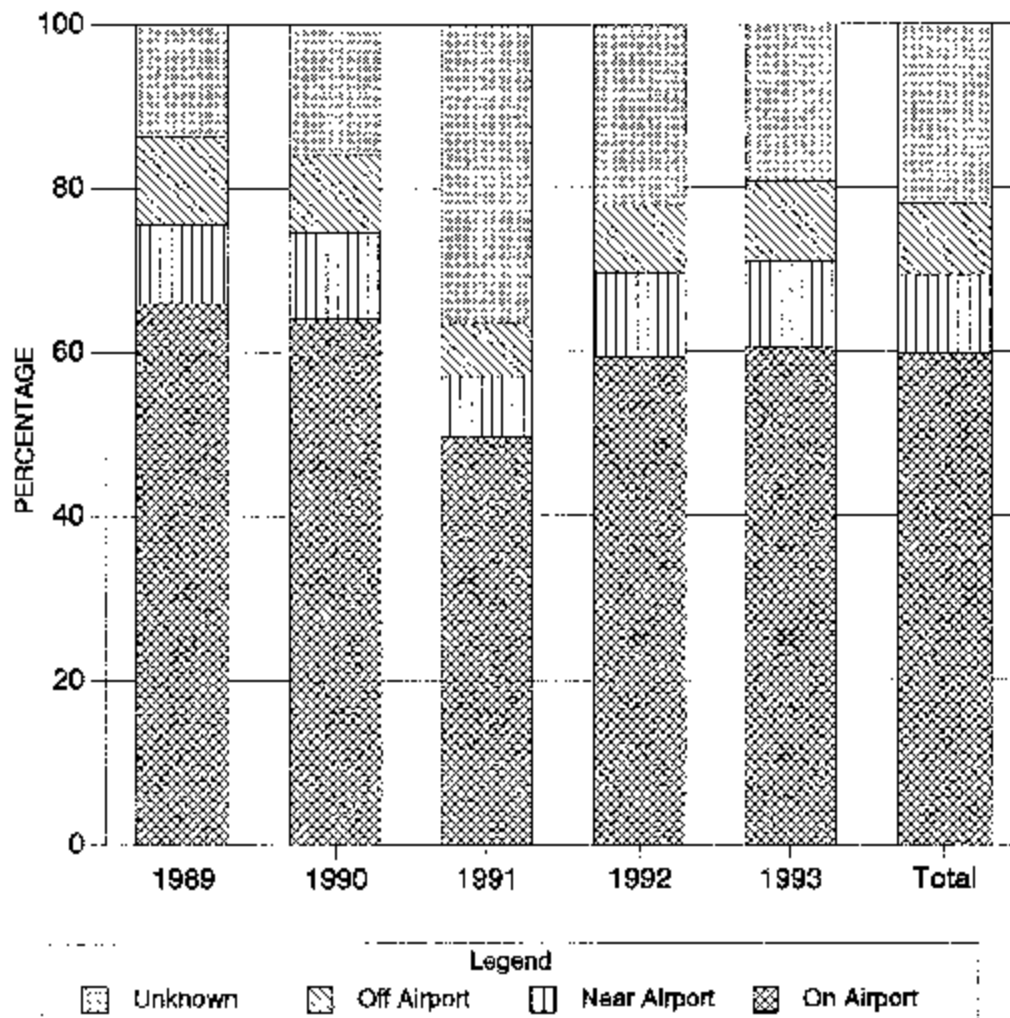
Region	Year	1989				1990				1991				1992				1993			
		SS	TS	SR	SO	SS	TS	SR	SO	SS	TS	SR	SO	SS	TS	SR	SO	SS	TS	SR	SO
1. AFI	47	51	210 (44.8%)	10	33	12	158 (3.1%)	9	29	19	168 (3.8%)	7	27	12	120 (2.1%)	6	26	9	159 (1.6%)	5	33
2. ANA	25	32	962 (20.1%)	8	34	28	610 (15.9%)	8	50	45	1 529 (25.3%)	19	19	26	939 (16.3%)	6	15	13	873 (26.5%)	7	16
3. CAR	18	3	25 (0.5%)	3	6	6	31 (0.6%)	5	7	5	26 (0.3%)	2	6	2	12 (0.2%)	2	7	1	56 (1.0%)	2	6
4. EUR	50	142	2 219 (16.5%)	14	27	119	3 161 (42.5%)	17	25	69	1 873 (36.0%)	14	23	95	1 978 (35.4%)	17	32	40	1 363 (45.7%)	13	34
5. MID	19	5	48 (0.9%)	5	9	4	58 (1.0%)	3	10	14	57 (1.1%)	6	8	8	57 (1.0%)	4	8	5	59 (1.0%)	3	7
6. NAM	5	12	1 231 (25.8%)	1	2	16	1 658 (32.7%)	1	2	3	1 589 (30.3%)	2	2	16	1 289 (41.0%)	2	2	5	458 (13.9%)	1	2
7. NAT	1		4 (0.1%)	1	1	1	5 (0.1%)	1	1	-	-	-	-	-	1 (0.0%)	1	1	0	3 (0.1%)	1	1
8. OAC	8	1	1 (0.2%)	1	5	-	2 (0.1%)	1	1	4	12 (0.3%)	1	2	-	2 (0.1%)	1	2	1	12 (0.3%)	2	2
9. SAM	15	2	26 (0.5%)	2	4	3	53 (1.1%)	4	5	1	19 (0.4%)	2	2	1	22 (0.4%)	2	4	1	97 (2.9%)	2	4
Unknown	-	5	47 (1.0%)			3	145 (2.9%)	-	-	1	112 (2.1%)	-	-	1	156 (3.0%)	-			179 (5.0%)	-	-
TOTAL	151	343	4 777 (100%)	45	164	232	5 040 (100%)	49	102	191	5 294 (100%)	44	94	156	5 586 (100%)	49	97	100	3 427 (100%)	41	105

Note. - Significant strikes are those which resulted in substantial damage to aircraft, aborted take-off, precautionary landing, etc.

Table 2. Distribution of bird strikes by location

Location	1989	1990	1991	1992	1993	Total
On Airport	3143	3173	2525	3199	2073	14113
Near Airport	467	525	376	542	354	2264
Off Airport	513	467	322	450	333	2085
Unknown	654	794	1860	1195	659	5162

Percentage Distribution



"On airport" strikes are strikes which occurred at or below (200 ft) above ground level (AGL) during approach or (500 ft) AGL during climb, or during the parked, taxi, take-off run or landing roll phases. "Near airport" strikes are strikes which occurred between (201 ft) AGL and (1 000 ft) AGL during approach or between (501 ft) AGL and (1 500 ft) AGL during climb.

Table 3. Distribution of bird strikes by phase of flight

Phase of Flight	1989	1990	1991	1992	1993	Total
Approach	1551	1730	1316	1749	1322	7668
Take-off run	1136	1132	756	1180	514	4718
Landing Roll	895	894	714	886	634	4023
Climb	739	859	558	727	441	3324
Other	179	235	59	470	107	1050

Percentage Distribution

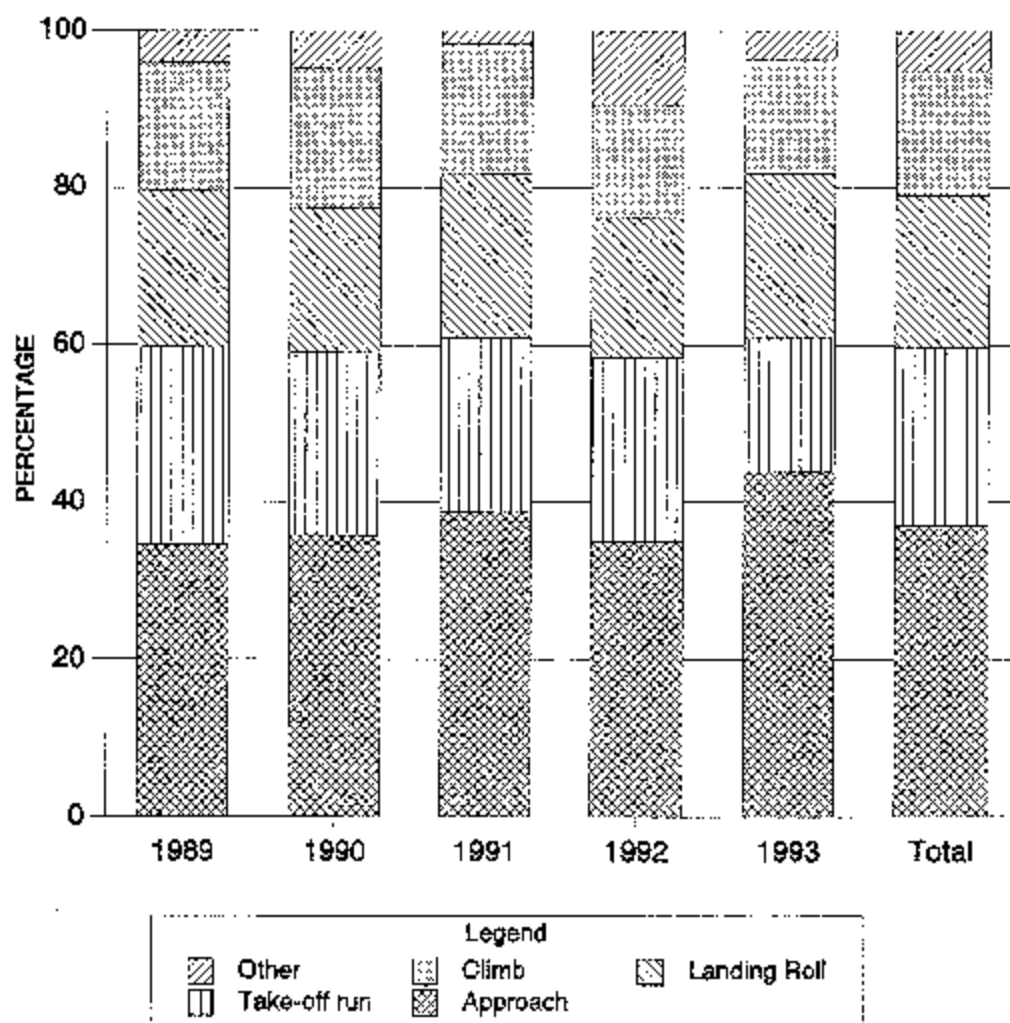


Table 4. Bird strikes by bird species

Bird Species	1989	1990	1991	1992	1993	Total
Gulls and Terns	998	861	437	869	399	3564
Perching birds	981	770	504	872	584	3711
Raptors	394	322	306	313	270	1605
Lapwings, Plovers etc.	252	217	184	150	115	918
Pigeons, Doves	109	174	124	243	116	766
Other	325	308	235	362	196	1426
Unknown	1718	2433	3377	2796	1747	12071

Percentage Distribution

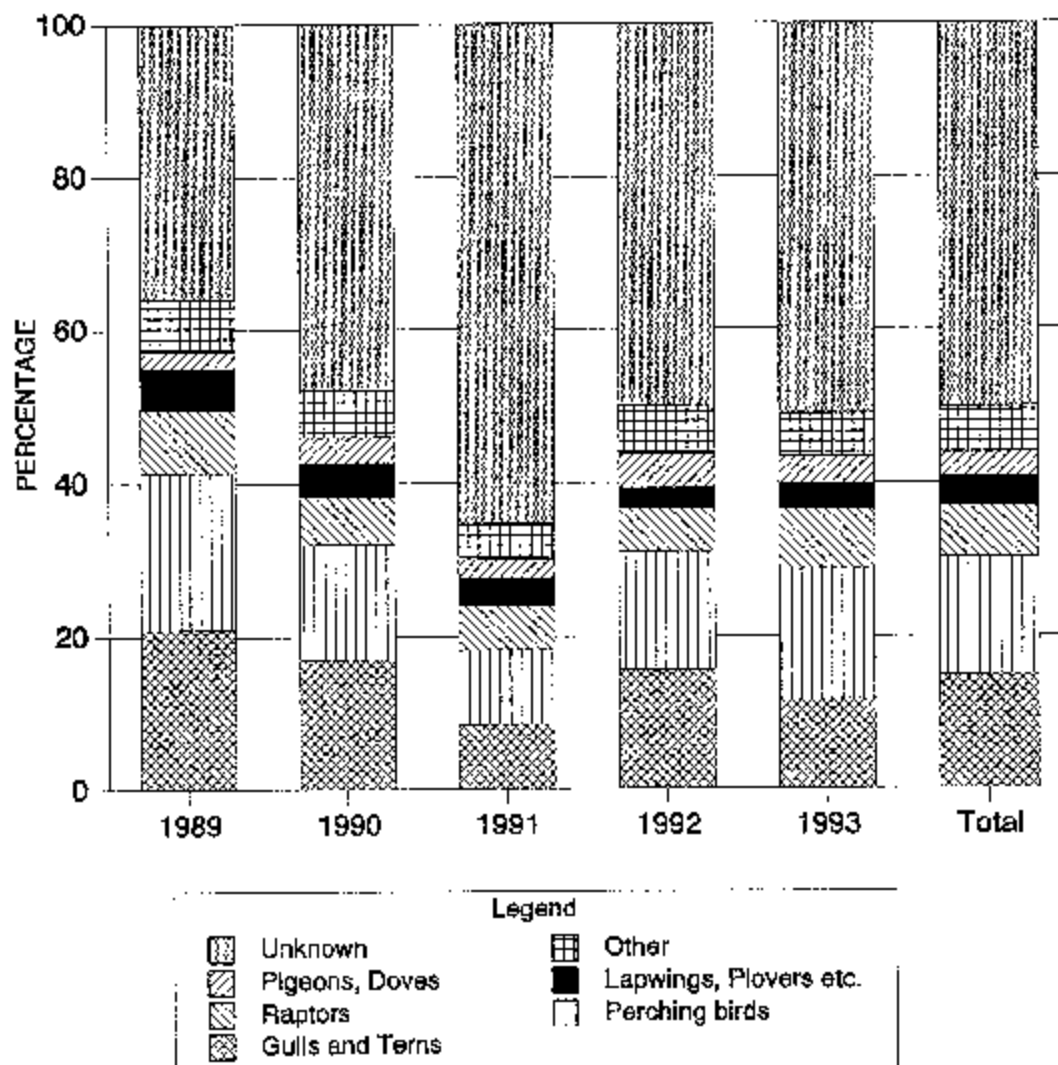


Table 5. Bird strikes by part of aircraft

Part of Aircraft	1989	1990	1991	1992	1993	Total
Nose	540	521	680	840	548	3129
Engines	861	740	853	965	771	4190
Wings	528	542	614	800	527	3011
Windshield	583	504	590	812	507	2996
Fuselage	495	461	540	629	438	2563
Radome	467	454	531	721	508	2681
Landing Gear	222	229	236	333	211	1231
Other	219	244	218	412	181	1274

Percentage Distribution

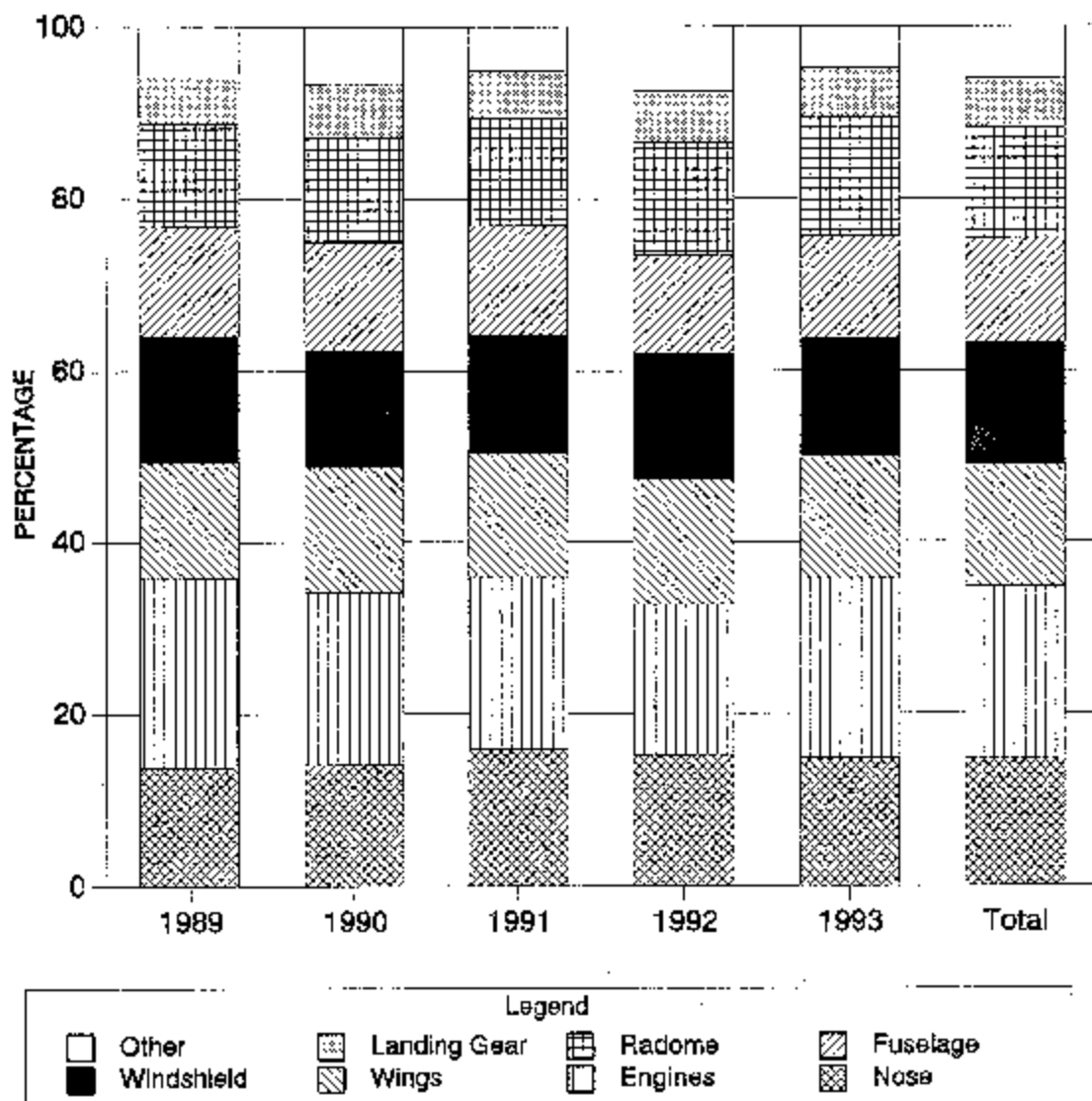


Table 6. Bird strikes by effect on flight

Effect on Flight	1989	1990	1991	1992	1993	Total
Precautionary Landing	125	173	97	216	86	697
Aborted Take-off	88	91	63	97	53	392
Engine Shut Down	26	36	28	17	9	116
Vision Obscured	8	1	10	6	4	29
Other	6	6	4	23	7	46

Percentage Distribution

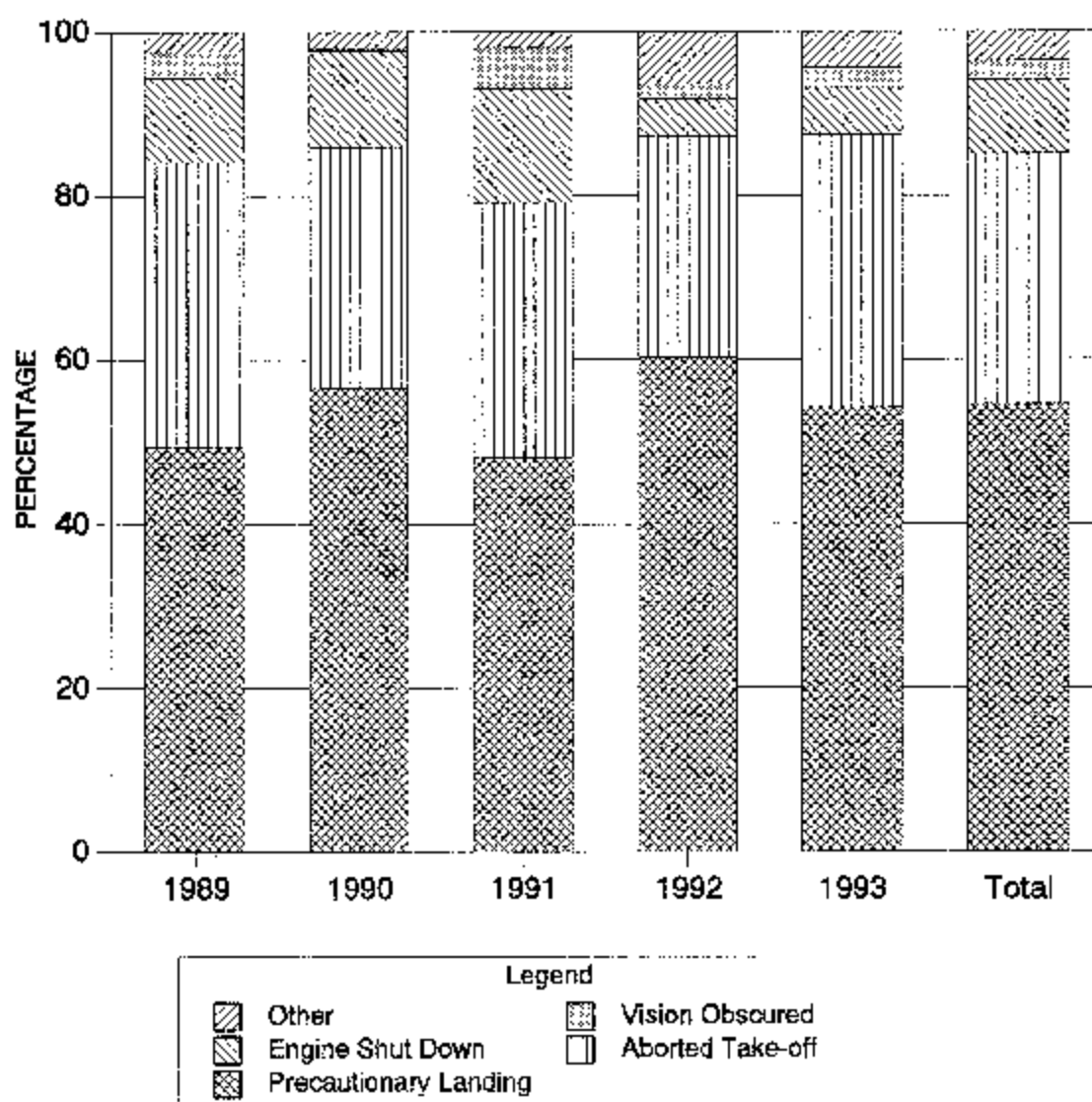
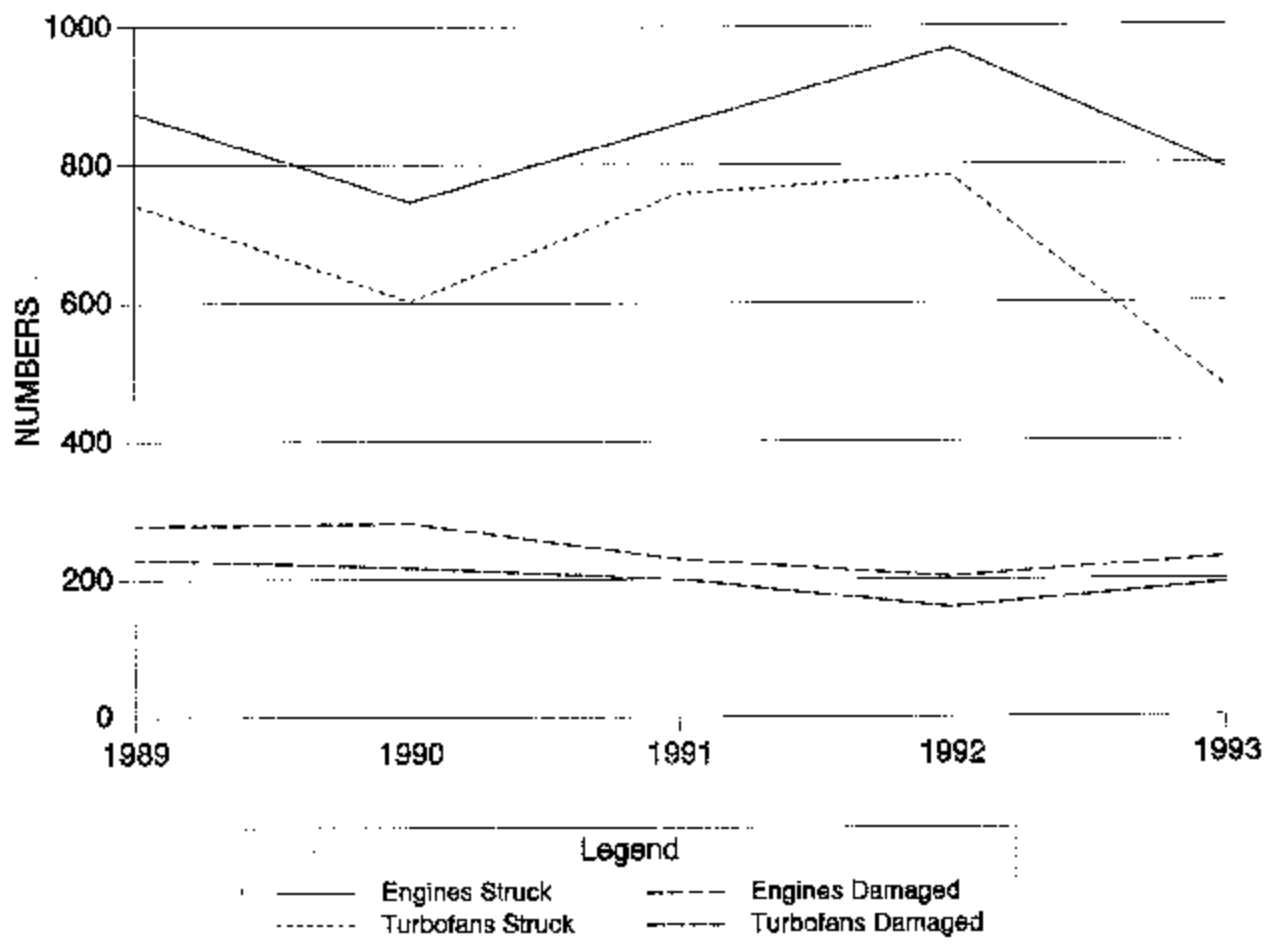


Table 7. Engine struck (S)/damaged (D) due to bird strikes

	1989	1990	1991	1992	1993
Engines Struck	874	747	859	968	794
Engines Damaged	277	281	229	204	230
Turbofans Struck	743	602	760	785	478
Turbofans Damaged	229	217	200	160	193

Percentage Distribution



APPENDIX 6

Bird Hazard to Aircraft Issues Associated with the Proposed Rosser Landfill, Winnipeg, Manitoba

**BIRD HAZARD TO AIRCRAFT SAFETY ISSUES ASSOCIATED
WITH THE PROPOSED ROSSER LANDFILL -
LATE APRIL TO EARLY SEPTEMBER 1995**

**An
Interim Summary Report**

By

**Rolph A. Davis, Ph.D.
Gary W. Miller, B.S.**

**LGL LIMITED
environmental research associates
P.O. Box 280, 22 Fisher St.
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For

**BFI Waste Systems Inc.
Central Canada Division
P.O. Box 1590, 375 Oak Point Highway
Winnipeg, Manitoba
R2R 1T9**

LGL Report No. TA2108-1

4 October 1995

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Introduction

BFI Waste Systems is proposing to construct a landfill in the Regional Municipality of Rosser, north of Winnipeg, Manitoba. The south boundary of the proposed site is slightly over 8 km directly north of the north end of Runway 18/36 at Winnipeg International Airport (WIA) (Figure 1). Because landfills attract birds, primarily gulls, and because of the location of the landfill under the Approach/Departure path for Runway 18/36, there is a concern that the landfill could create a bird hazard to the safety of aircraft using WIA. This concern has been discussed with representatives of Transport Canada in Winnipeg and Ottawa and the Canadian Airline Pilots' Association (CALPA).

In May 1995, LGL Limited was retained by BFI to evaluate the situation. A two phased approach was begun. Phase 1, conducted from late April to early June, summarized the available information on gulls in the Winnipeg area, identified data gaps, analyzed the potential for bird hazards, and determined whether additional studies were needed to fully address the safety issue. This report was released on 21 June 1995. It is entitled "Initial Evaluation of Potential Bird Hazards to Aircraft Associated with a Proposed Landfill North of Winnipeg International Airport" by Rolph A. Davis and Gary Miller. The Phase 1 report emphasized that roosting and flight patterns of gulls during the nesting season would need to be confirmed for other seasons.

Phase 2 of the study is designed to document the remainder of the annual cycle of gull behaviour in the Winnipeg area; it will continue until freeze-up forces the gulls to migrate south. It was not intended that we prepare an interim report on Phase 2. However, the timing of the CEC Hearing in mid October, and the changes in gull roosting and flight patterns that occurred when the nesting season was completed, made the preparation of an interim summary report advisable.

This interim report summarizes the main findings of the Phase 1 report and presents the main findings from the first part of the Phase 2 study.

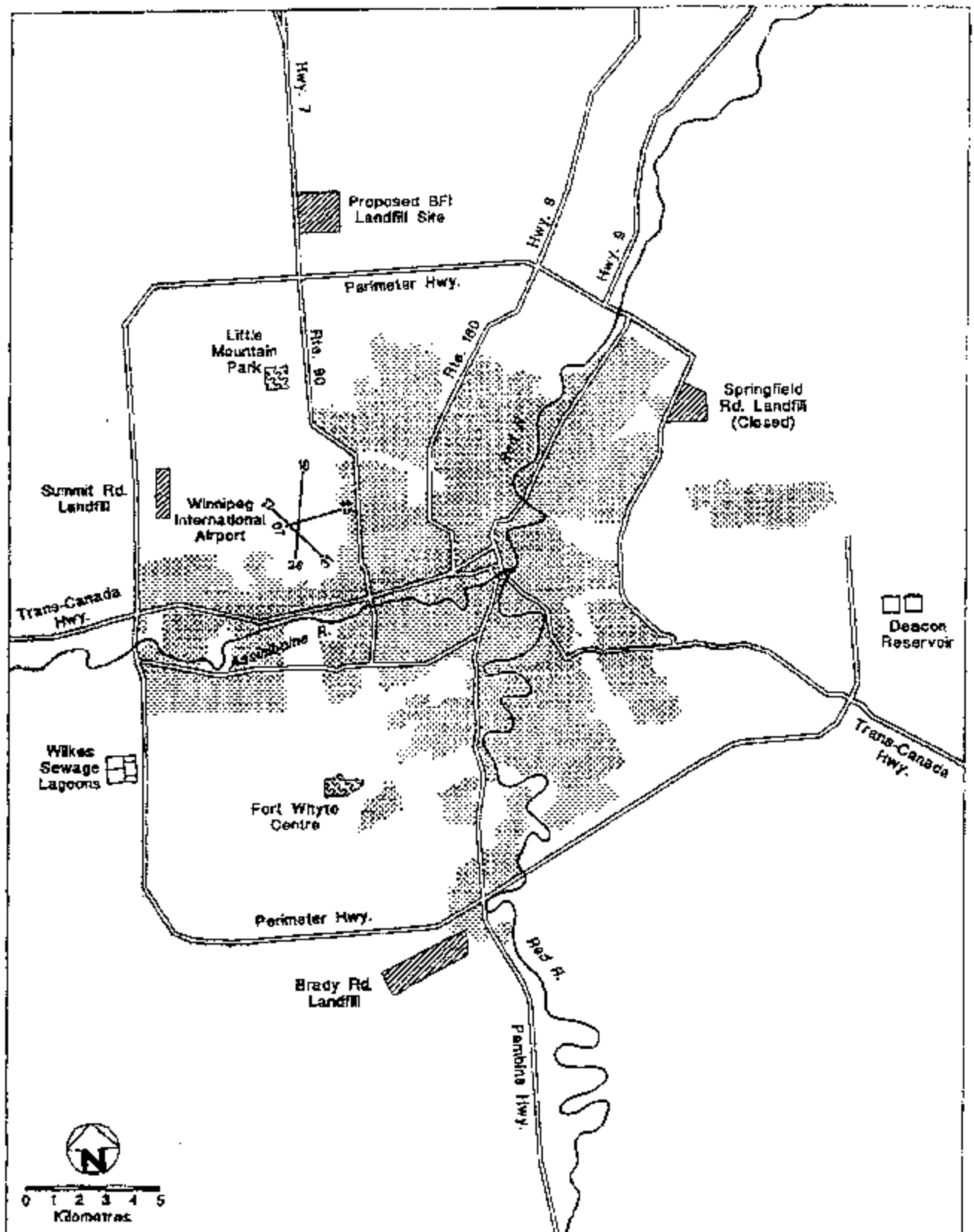


Figure 1. Location of the proposed BFI Rosser Landfill in relation to Winnipeg International Airport, existing landfills and other relevant features of the Winnipeg area.

Phase 1 Study - Late Spring/Nesting Season

The Phase 1 study extended from late April to early June 1995. Throughout this period, studies were conducted of the numbers of gulls using the existing City of Winnipeg landfills at Summit Road, west of the Winnipeg International Airport (WIA), and at Brady Road on the south side of Winnipeg. LGL's direct involvement began on 10 May. After that, the night roosts used by gulls were located and the general flight paths between these roosts and the landfills were determined.

Main Findings of Phase 1 Study

The principal findings of the Phase 1 Study are outlined below. Full details can be found in the report entitled "Initial Evaluation of Potential Bird Hazards to Aircraft Associated with a Proposed Landfill North of Winnipeg International Airport" by Rolph Davis and Gary Miller of LGL Limited, dated 21 June 1995.

1. Gulls used the existing landfills. In late April, about 2,400 gulls used the Summit Road Landfill and 4,700 used Brady Road Landfill. The daily counts in the first 20 days of May ranged between 1,500 and 2,800 at Summit Road and between 1,600 and 2,600 at Brady Road. The numbers declined dramatically in late May with only 313 at Summit Road and 135 at Brady Road. We have no observations from early June to early July but it is expected that the numbers remained low throughout the nesting season, which ended in mid to late July.
2. Most gulls that used the landfills in late April and early May were ring-billed gulls (>90%) and herring gulls (<10%). The numbers of Franklin's gulls increased at the landfills in May.
3. In May, the flight directions of gulls arriving at the landfills in the early morning indicated that gulls were arriving at Summit Road Landfill from the NE quadrant (Figure 2) and at Brady Road Landfill from the NNE quadrant.

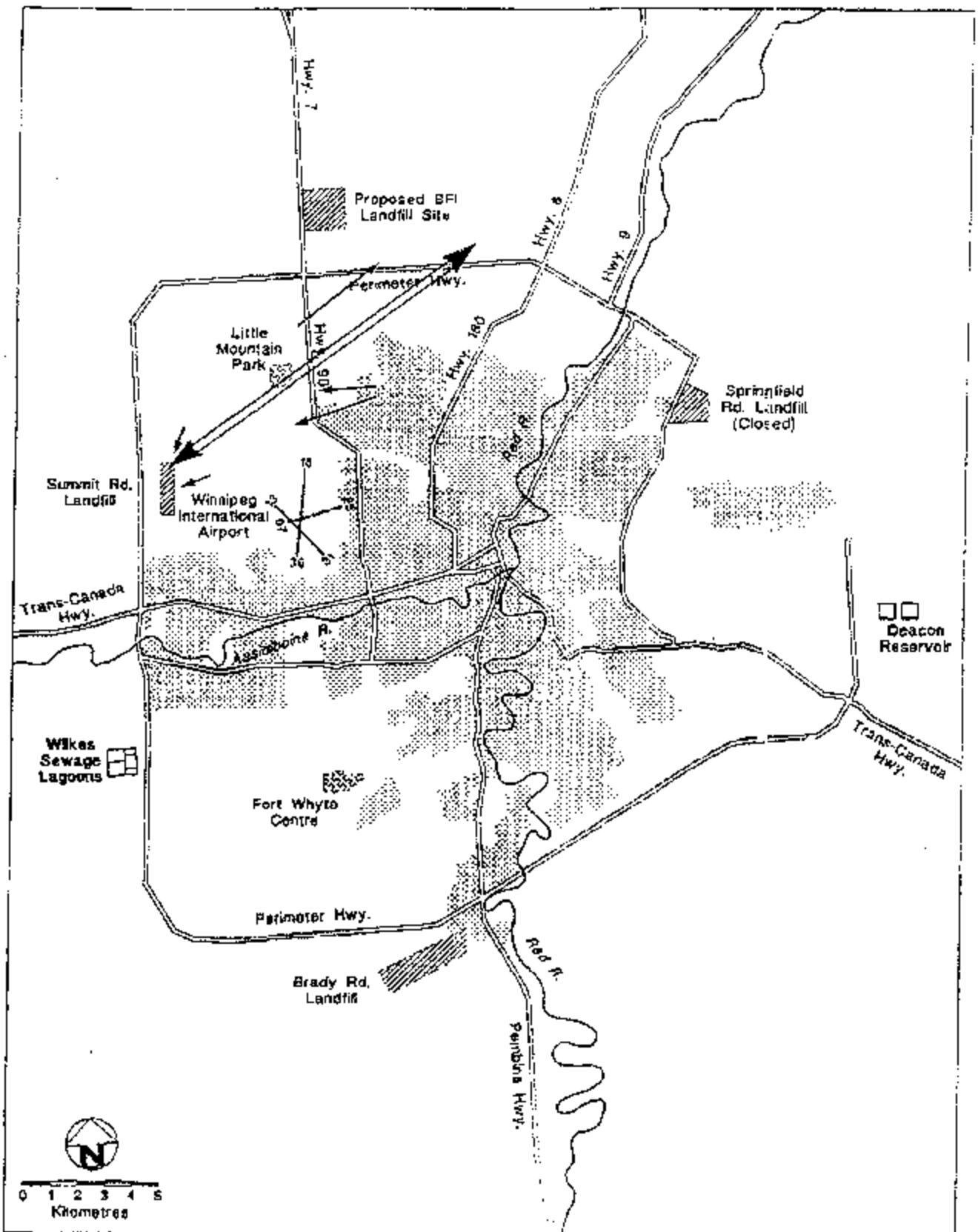


Figure 2. Approximate flight paths of gulls using the Summit Road Landfill in May 1995.

4. The main night roosts used by gulls from both landfills were either at Netley Lake or the south end of Lake Winnipeg, a straightline distance of 54 km from Summit Road Landfill and 65 km from Brady Road Landfill. Actual distances flown are probably longer since the gulls are believed to have followed the Red River for part of the way (Figure 3). This night roost was used mainly by ring-billed and herring gulls.
5. About 2,000 pairs of Franklin's gulls nest at Oak Hammock Marsh, about 31 km NNE of the Summit Road Landfill. During the nesting season, these gulls roost at night at the nesting colony.
6. A large proportion of the gulls arriving at the Summit Road Landfill in May passed through airspace used by aircraft on approach or departure from the Winnipeg Airport. As many as 20% passed directly over the airport.
7. In late May, there was no evidence that other night roosts existed in the Winnipeg area. However, there was anecdotal evidence that waterbodies in the Winnipeg area might have been used by night roosting gulls earlier in the year.

Conclusions of Phase 1 Study

The main conclusions of the initial evaluation of potential bird hazards to aircraft related to existing and potential landfills in the Winnipeg region were stated as follows in Davis and Miller (1995). Comments reflecting additional information are included in square brackets where relevant.

1. The proposed BFI landfill will attract gull numbers that are similar to, or slightly higher than, the numbers using the Summit Road Landfill.
2. In spring, and perhaps in the summer and fall, gulls from the landfill will use a regional night roost on Netley Lake or Lake Winnipeg to the northeast of the landfill. If these roosting patterns persist, then gull flight paths to and from the BFI site will not interfere with aircraft approaches and departures on Runway 18/36 of WIA. [Subsequent studies

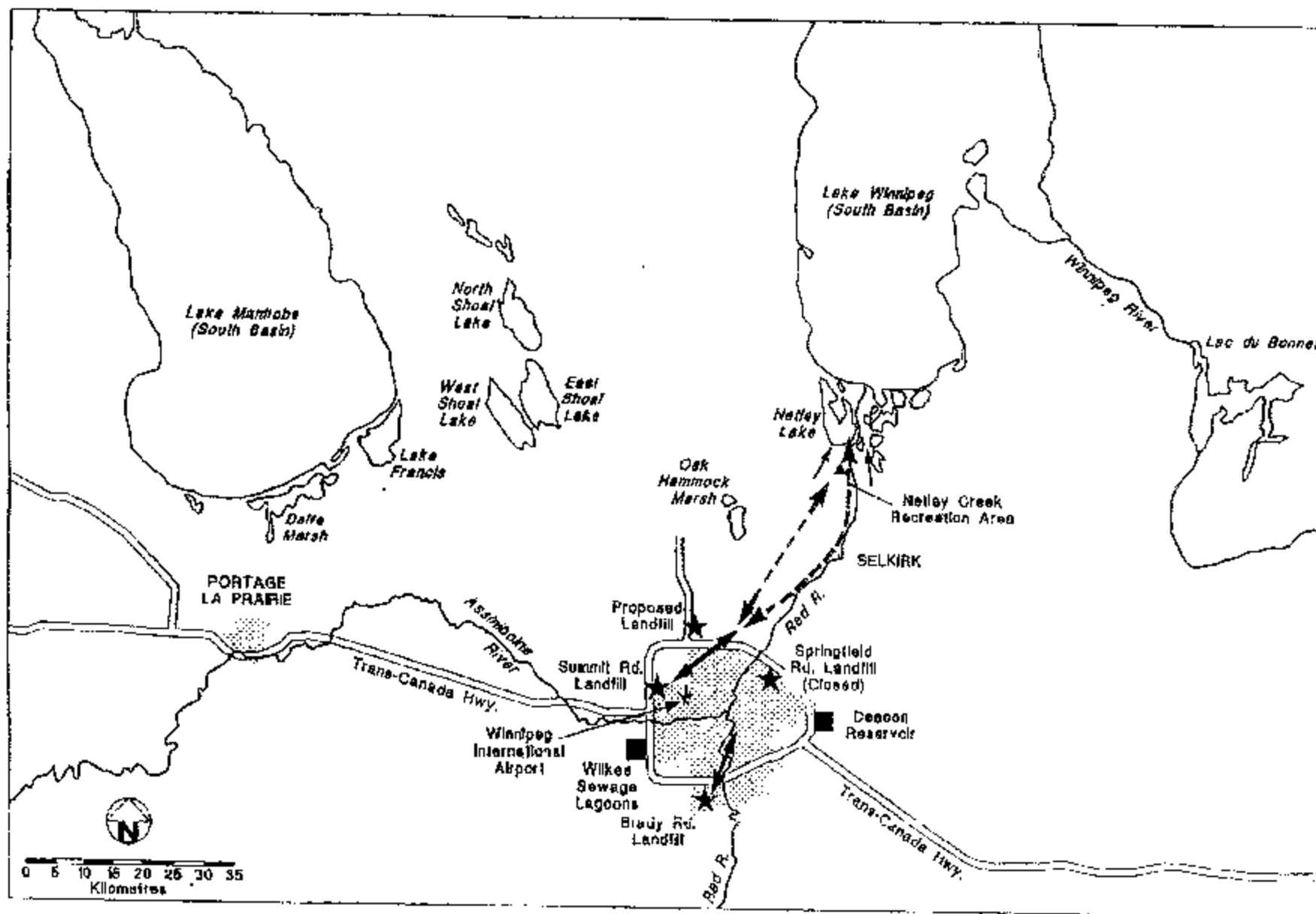


Figure 3. Observed (solid lines) and hypothesized (dashed lines) flight paths of gulls between night roosts on Netley Lake/Lake Winnipeg and existing Winnipeg Landfills, spring 1995.

have indicated that these roosting patterns do not persist in the late summer period - see later sections.]

3. Most aircraft departing on Runway 36 will turn to the east or west before reaching the BFI site. Those aircraft that maintain runway heading and pass over the site will be over 3,200 ft agl above the site and will be above virtually all of the gulls there.
4. Aircraft on approach to Runway 18 will pass over the BFI site at 1,200 to 1,500 ft agl, or more. Studies of the towering behaviour of gulls at Winnipeg landfills are needed to determine what proportion of the gulls at a landfill might interact with aircraft at these altitudes. [Towering studies are being conducted.]
5. If a hazard is predicted to exist, or is shown to occur once operations begin, then it is possible to institute effective gull control at the site. Effective control is an important recurring cost item. Control is a major commitment that cannot be undertaken lightly.
6. The existing Summit Road landfill is presently creating a serious bird hazard to aircraft using both Runways 13/31 and 18/36 at WIA.
7. Based on the partial spring data, it is apparent that the proposed BFI landfill will be significantly less hazardous to aircraft safety than is the present situation. [Additional data from the late summer indicate that this statement may apply only to the spring period.]
8. The data and conclusions of this report must be considered tentative in the absence of reliable data for a full annual cycle. We recommend that such a study be undertaken and that it should focus on the issues outlined in the Data Requirements section of this report. [This study is presently underway.]

The findings of the Phase 1 report remain valid. However, the subsequent studies indicate that the gull roosting locations change after the nesting season and, therefore, the main gull flight paths also change.

Phase 2 Study - Late Summer/Fall Migration

The Phase 2 studies began in mid July 1995 and are designed to continue until freeze-up drives the gulls out of the Winnipeg area for the winter. This Interim Report summarizes data collected up to and including 8 September. Because the data are preliminary, only major, clear-cut findings are presented.

Preliminary Findings

In mid July, at least 3,200 gulls frequented the Summit Road Landfill (Table 1). These were virtually all Franklin's gulls that arrived from the NE, N and NW. Similarly, over 2,500 gulls were visiting the Brady Road Landfill. These were also almost all Franklin's gulls that arrived from northerly directions (Table 2).

Sometime in late July and early August, there was a major shift in the night roosting locations of gulls and an increase in gull numbers in the Winnipeg region. By 9-10 August, there were about 11,500 gulls (mostly Franklin's) at the Summit Road Landfill. Of these, about 5,300 arrived from roosts to the north and 6,200 from roosts to the south of the landfill. The southern night roost was at the West End Water Pollution Control Centre located just south of Wilkes Avenue on the west side of the Perimeter Highway. This area is referred to as the Wilkes Sewage Lagoons in the rest of this report.

The numbers of gulls at the Summit Road Landfill remained between 11,000 and 13,000 through to 7-8 September (Table 1). During this period, the number of gulls arriving from the north each day declined from about 5,300 to 1,400 and the species composition changed until only ring-billed and herring gulls arrived from the north. The approximately 11,000 gulls that arrived from the Wilkes Sewage Lagoons were mostly (85%) Franklin's gulls. An influx of Franklin's gulls apparently passed through the Winnipeg area in late August. Our observer recorded about 29,000 gulls (>90% Franklin's) approaching the Summit Road Landfill from the south on 31 August. Over 19,000 of these gulls arrived within one 10-minute period. It is extremely difficult to estimate numbers accurately when so many birds are involved in such a short time. Thus, there is undoubtedly substantial, but unquantifiable, error associated with this estimate. Nonetheless, it is clear that large numbers of gulls were involved (Table 1).

Table 1. Summary of observations of gull arrivals at the Summit Road Landfill, July-early September 1995.

Location of Observer	Date	Observation Period		Dur. (h)	Number of Gull Arrivals	Species Composition
		Start	End			
N	12 Jul	05:00	08:00	3.0	1,221	86% FG
NE	18 Jul	05:25	11:05	5.7	1,095	mostly FG
NW	19 Jul	05:30	11:40	6.2	2,088	mostly FG
Total N					3,183	
N	9 Aug	05:50	10:25	4.6	5,298	mostly FG
S	10 Aug	05:45	09:40	3.9	6,160	mostly FG
Total N and S					11,458	
N	15 Aug	06:15	09:20	3.1	2,917	50% FG
S	16 Aug	06:15	09:15	3.0	7,948	90% FG
Total N and S					10,865	
N	29 Aug	06:30	09:30	3.0	1,330	90% HG and RBG
S	31 Aug	06:30	09:30	3.0	27,318*	92% FG
Total N and S					28,648	
N	7 Sep	06:45	10:45	4.0	1,390	100% RBG and HG
S	8 Sep	06:15	09:45	3.5	10,948	85% FG
Total N and S					12,338	

* Includes 19,120 gulls that were estimated to have arrived in one 10-min period.

Table 2. Summary of observations of gull arrivals at the Brady Landfill, July-early September 1995.

Location of Observer	Date	Observation Period			Number of Gull Arrivals	Species Composition
		Start	End	Dur. (h)		
N	20 Jul	05:40	10:40	5.0	2,542	99% FG
N	10 Aug	06:10	09:10	3.0	8,773	95% FG
NE	21 Aug	06:25	09:25	3.0	4,581	85% FG
NW	22 Aug	06:25	09:05	2.7	13,217	85% FG
N	7 Sep	06:45	09:45	3.0	14,235	70% FG

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The late summer patterns of gull numbers and movements were similar at the Brady Road Landfill (Table 2). In mid July, a minimum of 2,500 gulls used the landfill with most gulls arriving from the NE. By 10 August, the numbers using the landfill increased dramatically to nearly 9,000, mostly (95%) Franklin's gulls. This corresponded to the onset of night roosting at the Wilkes Sewage Lagoons, 12 km to the NW and at large ponds at Fort Whyte, 6-7 km to the north. The numbers using the Brady Road Landfill increased to 13,000 to 15,000 in late August and early September. The proportion of Franklin's gulls declined to about 70% by 7 September.

The Wilkes Sewage Lagoons provided the main night roosting site for gulls in the Winnipeg region in late summer (Table 3). There were about 13,500 present on 10 August and numbers peaked in early September at about 19,000. The latter total was determined in the evening by counting gulls returning to the lagoons from the north (5 Sept.) and the east (7 Sept.). About 10,500 gulls returned from the north, the direction of the Summit Road Landfill and about 8,500 returned from the easterly quadrant, the direction of the Brady Road Landfill.

The series of ponds at the Fort Whyte Centre began to be used by night roosting gulls in early August with about 1,500 present on 9 August. By late August and early September, the numbers of gulls roosting at Fort Whyte had increased to 7,500 to 8,000 (Table 3). Most of these gulls apparently fed at the Brady Road Landfill during the day. One exception to this pattern may have occurred on 31 August when the very high numbers of gulls (see above) arrived at the Summit Road Landfill. On that date, about 7,800 gulls arrived at Summit Road from the SSE, the direction of Fort Whyte. On the previous survey on 16 August, only 11 gulls arrived from the SSE and only 255 gulls arrived from the SSE on the following survey (8 September). Thus, it is possible that the gulls from Fort Whyte went to Summit Road Landfill instead of the Brady Road Landfill on 31 August. No observations were made at Brady Road Landfill on 31 August.

An additional smaller roost at the Deacon Reservoir on the east side of Winnipeg was also used. A peak of about 2,000 gulls were present on 7 September. We have not yet examined gull movements in relation to this reservoir.

Table 3. Numbers of roosting gulls at various Winnipeg-area locations, July-early September 1995.

Date	Deacon Reservoir	Wilkes Sewage Lagoons	Fort Whyte Centre	South Winnipeg Ponds*	Species Composition

LGL Interim Report, p. 11

The late summer patterns of gull numbers and movements were similar at the Brady Road Landfill (Table 2). In mid July, a minimum of 2,500 gulls used the landfill with most gulls arriving from the NE. By 10 August, the numbers using the landfill increased dramatically to nearly 9,000, mostly (95%) Franklin's gulls. This corresponded to the onset of night roosting at the Wilkes Sewage Lagoons, 12 km to the NW and at large ponds at Fort Whyte, 6-7 km to the north. The numbers using the Brady Road Landfill increased to 13,000 to 15,000 in late August and early September. The proportion of Franklin's gulls declined to about 70% by 7 September.

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Table 3. Numbers of roosting gulls at various Winnipeg-area locations, July-early September 1995.

Date	Deacon Reservoir	Wilkes Sewage Lagoons	Fort Whyte Centre	South Winnipeg Ponds*	Species Composition
18 Jul	0		0		
9 Aug			1,469		91% FG, 9% RBG, <1% HG
10 Aug		13,365			98% FG
14 Aug	145				mostly RBG
21 Aug				0	
23 Aug			7,260		59% FG, 29% RBG, 12% HG
28 Aug		15,185			76% FG
5,7 Sep		18,855**			mostly FG
6 Sep			8,000		73% FG, 19% RBG, 8% HG
7 Sep	1,930				mostly RBG and HG

* Includes reservoir at Wilkes Ave./Lottie St. and ponds at Lindenwood Dr., S. Winnipeg Technical Ctr., Scurfield Pk., and Vanderbilt Dr.

** Sum of gull arrivals observed evenings of 5 September (10,396 from N) and 7 September (8,459 from E).

The main gull flight paths in the late summer in the Winnipeg area are shown on Figure 4.

Preliminary Conclusions - Late Summer Period

It is apparent that the gulls in the Winnipeg region move closer to their main sources of food after the nesting season is completed. The night roost locations used in the late summer were relatively small bodies of water compared to optimum roosts used in other areas. In early September, there were about 30,000 gulls roosting in the Winnipeg area: 19,000 at Wilkes Sewage Lagoons, 8,000 at Fort Whyte, and 2,000 at Deacon Reservoir. The main feeding areas were the two City of Winnipeg Landfills. In early September, there were about 13,000 gulls feeding at Summit Road Landfill and about 13,000 to 15,000 at Brady Road Landfill.

There is a concern related to the opening of the proposed BFI Rosser Landfill and the closing of the Summit Road Landfill. In the absence of any gull control activities at the Rosser site, the gulls that presently feed at Summit Road Landfill would probably move to the Rosser site to feed. If the gulls continued to roost at the Wilkes Sewage Lagoons, then the gulls would pass near the Winnipeg International Airport on their twice-daily flights between the Rosser landfill and the night roost. This could create bird hazards to aircraft approaching Runways 13 and 18 and departing Runways 31 and 36 at WIA.

It is not known whether gulls feeding at the Rosser landfill would continue to roost at the Wilkes Sewage Lagoons. The lagoons are 21 km to the SSE of the proposed Rosser landfill. Oak Hammock Marsh is about 21 km to the NNE of the Rosser site. Because Franklin's gulls nest and roost at Oak Hammock in May and June, they may continue to roost there in August and September since the marsh is just as close to the Rosser site as are the Wilkes Sewage Lagoons.

When air safety is concerned, it is best to assume the worst case for potential hazards. Therefore, we assume that the gulls will roost at the Wilkes Sewage Lagoons and will attempt to feed at the BFI Rosser landfill. Therefore, an effective gull control program will have to

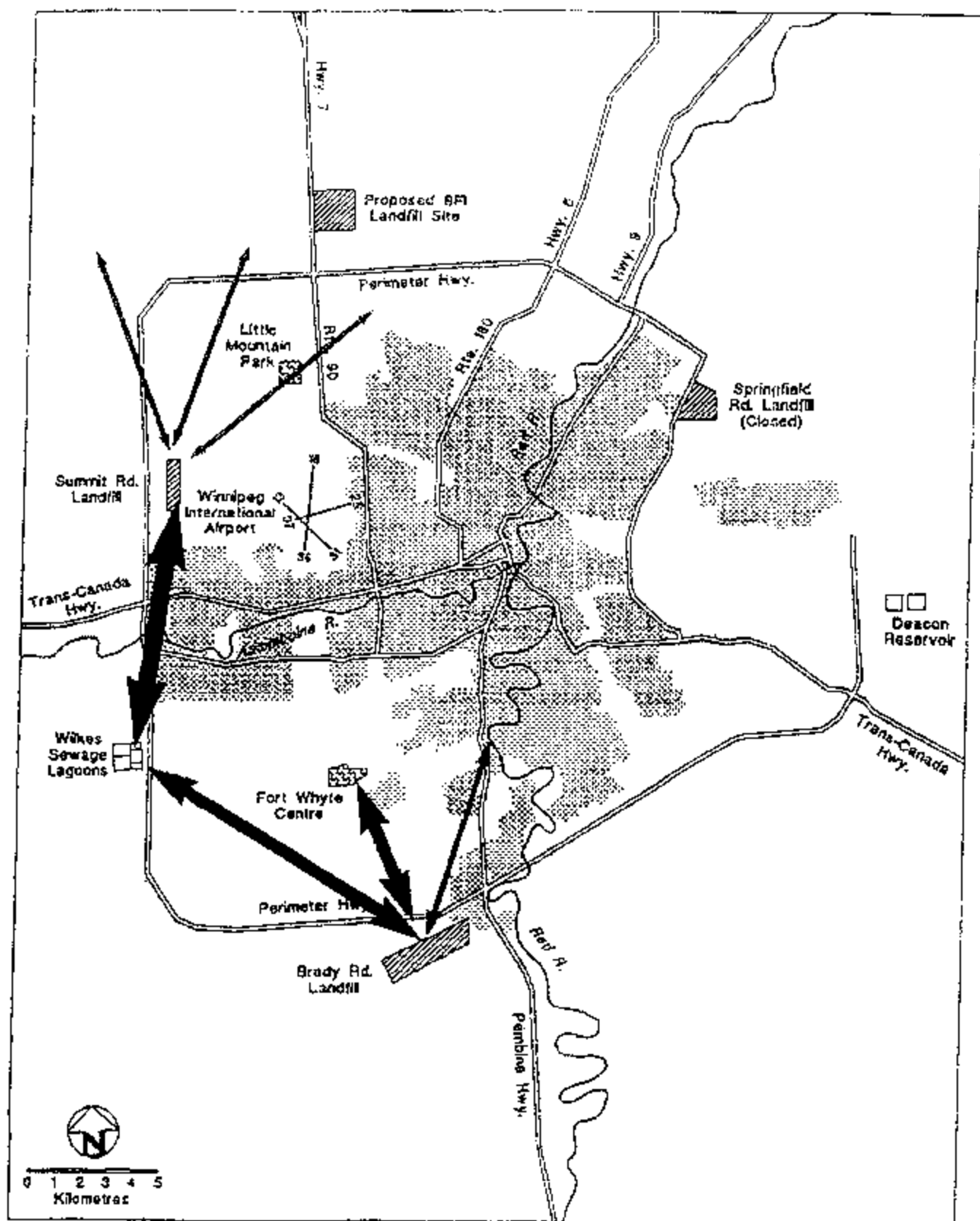


Figure 4. Approximate gull flight paths between landfills and night roosts in the Winnipeg area in August and early September 1995.

be part of the regular operating procedures at the new landfill. The gull control program will also remove any potential concerns related to gulls towering over the landfill site.

Gull Control Program

The Standard Operating Procedures (SOPs) at a BFI landfill include the smallest practical tipping face, proper levels of daily cover, and a generally clean and tidy site. The use of these SOPs at the proposed landfill would reduce its attractiveness to birds in comparison with the existing Summit Road Landfill. However, even very clean landfill sites can attract thousands of gulls to the continuous supply of food at the active tipping area. Perhaps the main advantage of a clean site to gull control is that it restricts available food to the active area where gull control activities can be concentrated.

Existing Gull Control Programs

Successful gull control at landfills has been a relatively recent development. In fact, BFI has been a leader in the development of successful gull control techniques at landfills. They have funded several studies and experiments and are currently operating the successful control program at the Tower Landfill, adjacent to the new Denver International Airport. This program was designed and monitored by LGL Limited. It involves habitat management and the use of four types of pyrotechnics. The program is regularly reviewed by a committee consisting of the U.S. Federal Aviation Administration, Denver International Airport, City and County of Denver, U.S. Department of Agriculture (Animal Damage Control Unit), BFI, and LGL Ltd.

Other successful gull control programs include

- The City of San Diego Landfill at the Miramar Naval Air Station in San Diego, California, where a program of habitat management, pyrotechnics, distress calls, stuffed models of injured gulls, and shotgun patrols has eliminated hazards at a major F-14 (Tomcat) training area.

- Halton Regional Landfill between Toronto and Hamilton where a program based on falconry, pyrotechnics, distress calls, shotgun patrols and dead gull carcasses has been successful at controlling gulls since the program was initiated about 18 months ago.
- City of Anchorage Landfill in Alaska where an overhead wire system, supplemented with pyrotechnics and shotgun patrols, has been successfully controlling gulls for about 5 years.
- There are several other landfills where a variety of control techniques have been or are being successfully used to control gull numbers.

Clearly, the techniques for gull control at landfills are now available. What is needed is a clear management commitment to insuring that the control program is successful and that it is maintained over the long term. A budgetary commitment is also required.

Gull Control at the Proposed Rosser Landfill

The gull control program (GCP) for the new site has not been finalized pending the results of the full annual cycle of gull studies. However, the program will have several important attributes.

1. The GCP will be in place at the landfill when it begins operation. Thus, gulls will never become used to feeding there. This is important because gulls will learn that the Rosser site is not a source of available food and, therefore, they will not make regular trips to the site from their night roosting areas.
2. A key to successful gull control at landfills is to prevent gulls from using any part of the landfill property. The presence of suitable loafing habitat allows gulls to opportunistically take advantage of feeding opportunities that occur at a landfill. In addition, gulls on the ground are magnets drawing other gulls that may be flying in the area. If no gulls are allowed on the landfill, then they cannot take advantage of transitory feeding opportunities and they will not attract other gulls to the site.

3. Habitat management plays an important role in minimizing gull numbers and use of a landfill. In addition to the SOPs, the amount of loafing habitat (bare ground in exposed areas) should be minimized by deferring land clearance until absolutely necessary and by revegetating final cover as soon as possible.
4. A series of parallel lines should be strung over those potential gull loafing areas that are inevitably created at a landfill. These lines have been very effective at preventing California, ring-billed and herring gulls from using loafing areas. The line spacing to preclude Franklin's gulls would have to be determined by experimentation. It should be noted that overhead wires over the active disposal area are not recommended, at this time.
5. The main element of the GCP should be the use of a variety of active deterrent and scaring methods. The key to these methods is that they must be properly used to prevent habituation by the gulls. It is important that the patterns of use of the deterrent devices be determined by the behaviour of the gulls involved.
6. The GCP would use a combination of pyrotechnics (several types for variety), distress call playbacks, models of injured gulls, killing of a small number of gulls to reinforce other scare techniques, and falconry. The use of falconry may be particularly appropriate for control of Franklin's gulls. The precise combination of control methods will be determined based on experimentation supervised by a competent biologist.
7. The success of the control program will be monitored to determine whether it is meeting pre-set performance criteria. If the performance criteria are not met, then the control program will be upgraded to ensure that compliance is achieved. Monitoring will be by professional biologists experienced in landfill gull control.

The specifics of the gull control program will be determined after completion of the current gull studies that will define the species involved, timing, and potential magnitude of the control required.

Data Requirements

The Phase 1 report discussed the additional data that were required to obtain a full understanding of gull numbers and behaviour in the Winnipeg region. Studies are underway to gather the required data. The previous report stated (p. 18) that

"The requirement for additional data on spring migration should be evaluated after data from the late summer and autumn are collected. If these data indicate stable patterns of gull use of the Winnipeg area through late summer and fall and if these patterns are similar to the patterns observed in spring, then it is probable that additional data from the spring migration will not be necessary."

The results from the late summer period indicate that the patterns of use of night roosts change with season. It will, therefore, be necessary to determine the roosting patterns that occur during the early spring migration in late March and April.

Preliminary Conclusion

The conservative approach to air safety dictates that a gull control program should be part of the standard operating procedures at the proposed Rosser landfill. Although the potential bird hazard at the landfill may occur for only a few months per year, it is necessary to conduct the control program continuously from the spring arrival of gulls in the Winnipeg area to their fall departure. Thus, gulls will never feed at the landfill and they will not develop behaviour patterns that include regular flights to the landfill.

APPENDIX 7

Gulls Associated with the St. John's Airport and the Robin Hood Bay Waste Disposal Site, Newfoundland, 1995

**GULLS ASSOCIATED WITH THE ST. JOHN'S AIRPORT
AND THE ROBIN HOOD BAY WASTE DISPOSAL SITE, NEWFOUNDLAND**

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SUMMARY

Transport Canada has identified a concern about the large numbers of gulls that occur on and around the St. John's Airport. These high numbers are no doubt strongly influenced by the presence of the Robin Hood Bay Landfill, about 4 km to the east of the airport. Substantial numbers of gulls are known to move between the landfill and Windsor Lake located WSW of the airport. Many of these gulls fly through aircraft approach/departure paths and some of these gulls occasionally land at the airport.

The presence of gulls on and near the airport creates potential bird hazards to aircraft using the airport. Collisions of jet and turbine aircraft with flocks of gulls can lead to serious aircraft accidents. It is important to quantify the numbers involved and to determine the flightlines that are used by the gulls. Transport Canada commissioned LGL Limited to conduct a brief preliminary survey of the situation. Field work for this study began on 16 November 1994 and was completed on 17 March 1995.

The present study was conducted during the non-nesting season of gulls. At these times, gull distribution and movements are determined by the locations of night roosting areas, feeding areas and loafing areas. Gulls roost communally in large aggregations in remote areas where they are safe from terrestrial predators. Roost locations are traditional and are used year after year. In the morning, gulls leave the roosts and travel to feeding and/or loafing areas. During the day, gulls spend their time feeding and loafing. Once feeding is completed, gulls spend long periods (often several hours) loafing and preening in relatively large open areas where they can see the approach of terrestrial predators. Loafing often occurs in areas directly adjacent to feeding areas but it can also occur in locations that are several km distant from the main feeding areas.

In addition to using traditional feeding, loafing and roosting areas, gulls also use traditional flight paths among the areas. These paths are usually the shortest routes, but there may be diversions to include en route washing or loafing areas. Gulls have been known to travel over 60 km between night roosts and major feeding areas (e.g. landfills), in some circumstances. Thus, any study of gull movements around an airport must include a large study area to insure that all of the major determinants of gull movements in the area are known and understood.

Key Findings

Large numbers of gulls frequent the Robin Hood Bay Landfill during the winter. The species involved (Herring Gull, Great Black-backed Gull and Glaucous Gull) are all big birds that could damage an aircraft. The gulls that feed at the landfill loaf on the ice of nearby Quidi Vidi Lake in the winter. The overall numbers involved approach 25,000 gulls. Some of these gulls roost at night on the cliffs, ocean and pack ice along the east side of the Avalon Peninsula.

Of concern to the airport, is the fact that substantial numbers of gulls roost at night at Little Bell Island in Conception Bay on the west side of the Avalon Peninsula. These birds often stop at Windsor Lake, and probably Newfound Pond, during the flights to and from Little Bell Island. Thus, these gull flights pass very close to the south end of Runways 16/34 and 02/20 at the St. John's Airport. During mid winter when the lakes are frozen, the gulls do not stop at Windsor Lake, but follow a more southerly route between the night roost and the day-use areas. These flights are not hazards to aircraft safety because they mostly occur below the altitudes of aircraft on approach to Runways 02 and 34.

It is apparent that the study was conducted at the time of year (winter) when gulls associated with the landfill cause the fewest concerns to the safety of aircraft using the airport. This was confirmed by airport personnel who noted that gulls are most numerous and difficult on the airport during the spring, summer and early fall. These are the periods when Windsor Lake and Newfound Pond are ice-free and are used by gulls. Even though this preliminary study was conducted when gull hazards to aircraft were at their lowest level, the level of hazard was still significant.

Conclusions

It is clear that the Robin Hood Bay Landfill is attracting thousands of large gulls, some of which have the potential to create hazards for aircraft using the St. John's Airport. Although the critical data have not been collected, it is apparent that gull behaviour during the winter freeze-up period is less likely to create bird hazards to aircraft problems than is the behaviour that occurs at other times of the year.

Airport staff report that gulls are most numerous and difficult on the airport during the spring, summer and early fall. These observations refer to gulls landing on airport runways, taxiways and other airside locations. Needless to say, the presence of these gulls creates a hazard to aircraft safety and requires action by controllers on the airport. It is not known whether the gulls that land at the airport come directly from the Robin Hood Bay Landfill or whether they are the gulls that loaf and stage on Windsor Lake and Newfound Pond. Knowledge of the source of these birds may be important in determining whether gulls dispersed by a control program at the landfill will create an even more significant hazard.

Gulls that regularly fly through the aircraft approach/departure paths may be of even greater concern than the gulls that land at the airport. These gulls may not be noticed and are probably beyond the range of bird control efforts at the landfill. Regular flights between the landfill and Windsor Lake and Newfound Pond could create significant hazards to aircraft safety. There is a suggestion from the late autumn data that such flights might be common in the spring, summer and fall when Windsor Lake and Newfound Pond are ice-free. At present, there are no data on the existence or significance of this concern.

It is apparent from the data from "Christmas Censuses" in the region that the number of gulls wintering in the St. John's area is artificially inflated by the presence of the Robin Hood Bay Landfill. If the landfill were not present, or if it supported fewer gulls, then the numbers of gulls in the area would probably decline.

It is tempting to recommend that a gull control program be instituted at the Robin Hood Bay Landfill. However, achievement of control would be extremely difficult and the cost to make such a program effective on a long term basis would undoubtedly be quite high. Details of gull movement patterns in the area during the spring, summer and fall need to be assessed to determine whether hazardous gull flight patterns are occurring. If not, then aircraft safety may be maintainable through gull control at the airport itself. This would certainly be less expensive than controlling gulls at the landfill.

Finally, there is a risk that a gull control program at the landfill will lead to gull movement and behaviour patterns that will also create hazards to aircraft using the St. John's Airport. Gulls change their behaviour patterns in response to control programs at landfills. Knowledge of gull behaviour in the area is needed to determine if the new behaviour patterns are likely to pose significant safety problems. Hazardous patterns are most likely to occur if

control at the landfill is only partially successful. For example, large numbers of gulls may attempt to loaf on the large airport rather than on the much smaller landfill with its increased levels of harassment.

Recommendations

Clearly, there is a significant concern about landfill-related gull hazards to the safety of aircraft using the St. John's Airport. The following approach is recommended to address this serious problem.

1. Study gull numbers and movements in the St. John's area to document bird hazard levels and to determine which gull behaviour patterns create the greatest risks to aircraft safety.
2. Based on the results of the above study, determine the best method for reducing hazards. The options include gull control at the Robin Hood Bay Landfill, increased gull control at the airport, gull control at loafing areas, etc. It is imperative that the risks associated with each control option be understood.
3. It is important that the various stakeholders communicate regularly to define the extent of the problem and to determine ways of alleviating the concern. At a minimum, the stakeholders include Transport Canada (responsible for air safety), St. John's Airport, and the City of St. John's (operator of the Robin Hood Bay Landfill).

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INTRODUCTION

Transport Canada has identified a concern about the large numbers of gulls that occur on and around the St. John's Airport. These high numbers are no doubt strongly influenced by the presence of the Robin Hood Bay Landfill, a few km to the east of the airport. Substantial numbers of gulls are known to move between the landfill and Windsor Lake located WSW of the airport. Many of these gulls fly through aircraft approach/departure paths and some of these gulls have landed at the airport, on occasion.

The presence of gulls on and near the airport creates potential bird hazards to aircraft using the airport. It is important to quantify the numbers involved and to determine the flightlines that are used by the gulls. There is a concern that the numbers of gulls using the landfill and the airport may have increased due to the recent closure of major parts of the Newfoundland fishery.

Transport Canada commissioned LGL Limited to conduct a brief preliminary survey of the situation. Field work for this study began on 16 November 1994 and was completed on 17 March 1995.

STUDY AREA

The present study was conducted during the non-nesting season of gulls. At these times, gull distribution and movements are determined by the locations of night roosting areas, feeding areas and loafing areas. Gulls roost communally in large aggregations in remote areas where they are safe from terrestrial predators. Roost locations are traditional and are used year after year. In the morning, gulls leave the roosts and travel to feeding and/or loafing areas. During the day, gulls spend their time feeding and loafing. Once feeding is completed, gulls spend long periods (often several hours) loafing and preening in relatively large open areas where they can see the approach of terrestrial predators. Loafing often occurs in areas directly adjacent to feeding areas but it can also occur in locations that are several km distant from the main feeding areas.

In addition to using traditional feeding, loafing and roosting areas, gulls also use traditional flight paths among the areas. These paths are usually the shortest routes, but there

may be diversions to include en route washing or loafing areas. Gulls are known to travel over 50 km between night roosts and major feeding areas (e.g. landfills), in some circumstances. Thus, any study of gull movements around an airport must include a large study area to insure that all of the major determinants of gull movements in the area are known and understood.

The locations of the major sites surveyed during the present study are shown on Figure 1. In addition to the St. John's (Torbay) Airport itself, the major areas for gulls that were surveyed were the Robin Hood Bay Landfill (feeding and loafing), Quidi Vidi Lake (loafing), Windsor Lake (loafing and roosting), and Virginia Lake (loafing). Other potentially important areas were surveyed for the following reasons. Cape Spear was monitored to determine whether daily gull movements occurred along the coast (such movements were observed in previous years). Little Bell Island in Conception Bay was used as a night roost by gulls from the Robin Hood Bay Landfill. Kenny's Pond was previously known as a gull day use area. The coast between Logy Bay and Quidi Vidi Gut contains cliffs that were used by roosting and loafing gulls. St. John's Harbour was a feeding area and a loafing area.

In addition to the surveys at specific sites, observations were also made of the gull flight lines among the various sites. Specific emphasis was placed on major flight lines that could affect the airport. These involved observations at and near the airport itself, the Robin Hood Bay Landfill, Quidi Vidi Lake, Virginia Lake, Windsor Lake and Little Bell Island.

SURVEY COVERAGE AND METHODS

The frequency of survey coverage at each major site is detailed in Table 1. All surveys were conducted by the second author, Bruce Mactavish. The numbers, species and behaviour of gulls were determined at each location surveyed. The locations of the various survey sites are outlined on Figure 1. On selected occasions, the age distributions of the major gull species were determined based on plumage characteristics.

Observations of gulls were made using standard techniques. Sightings were facilitated by the use of Bausch and Lomb Elite 8X42 binoculars and a Bausch and Lomb ED 77mm spotting telescope with 20X and 30X eyepieces.

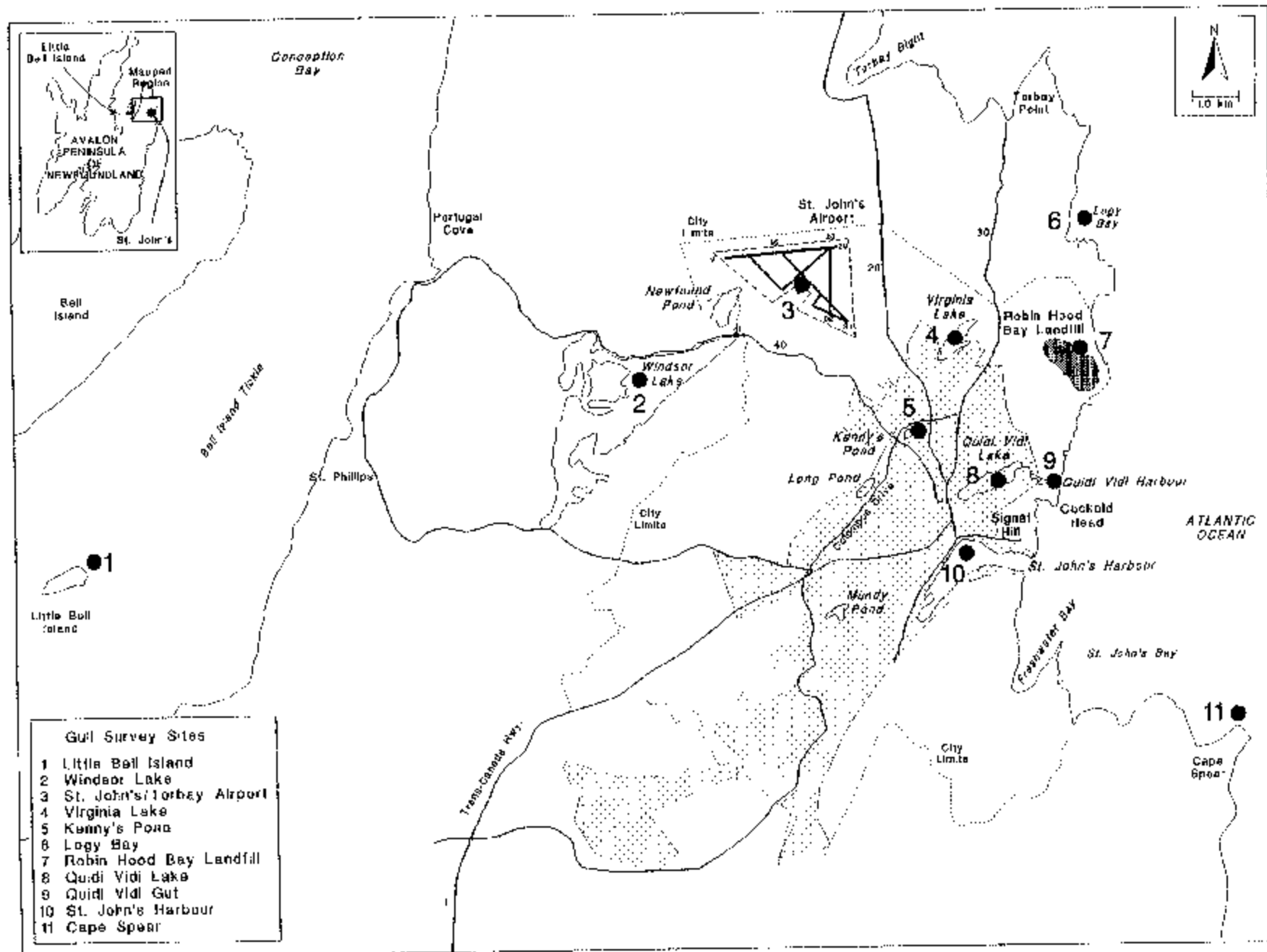


Figure 1. Principal features affecting gull distribution in the St. John's, NF area.

Table 1. Dates and locations of gull surveys (17 Nov. 1994 to 17 March 1995).

DATE	LOCATION									
	Cape Spar	Compass Bay (Lake Beldia)	Kerney's Pond	Lox Bay	Quail Hill Cr.	Quail Hill Lake	Quail Hill Bay (Mudflat)	St. Louis Harbour	Tracy Airport	Virginia Lake
1994										
Nov. 17										
Nov. 20		✓								✓
Nov. 21			✓			✓	✓			✓
Nov. 22									✓	
Nov. 23										✓
Nov. 24							✓			
Nov. 25		✓								
Nov. 27			✓				✓			
Nov. 28						✓				✓
Nov. 30			✓						✓	✓
Dec. 1							✓			
Dec. 2						✓				
Dec. 4					✓	✓		✓		
Dec. 5						✓				
Dec. 6						✓	✓	✓		✓
Dec. 7								✓		
Dec. 8						✓				
Dec. 10	✓									
Dec. 11					✓	✓	✓			
Dec. 12			✓			✓				✓
Dec. 13						✓			✓	✓
Dec. 14								✓		
Dec. 15					✓	✓	✓			
Dec. 20						✓				
Dec. 22						✓		✓		✓
Dec. 26							✓	✓		
Dec. 30						✓				
Dec. 31	✓									
1995										
Jan. 1						✓				
Jan. 5							✓	✓		
Jan. 7										
Jan. 9					✓	✓				
Jan. 10						✓				
Jan. 11							✓		✓	
Jan. 13							✓	✓		
Jan. 14	✓					✓				
Jan. 15		✓				✓				✓
Jan. 16						✓	✓	✓		✓
Jan. 17						✓	✓			
Jan. 18							✓			
Jan. 19				✓	✓		✓			
Jan. 20										✓
Jan. 21	✓									
Jan. 23						✓				
Jan. 24				✓	✓	✓	✓			
Jan. 25		✓				✓				
Jan. 27					✓	✓	✓	✓		
Jan. 30					✓	✓	✓			
Feb. 2						✓	✓			
Feb. 7						✓				
Feb. 8						✓				
Feb. 9						✓	✓			
Feb. 10						✓		✓		
Feb. 14						✓				
Feb. 15					✓	✓		✓		
Feb. 16						✓				
Feb. 17						✓				
Feb. 18	✓									
Feb. 19						✓				
Feb. 21						✓	✓			
Feb. 22						✓	✓			
Feb. 24						✓	✓			
Feb. 25				✓		✓		✓		
Feb. 27						✓				✓
Feb. 28								✓		
Mar. 17						✓				
Mar. 04	✓					✓				
Mar. 05		✓				✓		✓		
Mar. 06						✓	✓			
Mar. 08						✓	✓			
Mar. 09					✓	✓	✓			✓
Mar. 12	✓					✓				
Mar. 13				✓		✓	✓			
Mar. 16						✓	✓			

DAY-USE AREAS

Gulls spend the day feeding and loafing. These behaviours sometimes occur at the same site and sometimes at different sites.

Feeding Areas

Robin Hood Bay Landfill

The Robin Hood Bay Landfill site is the main source of food for gulls in the St. John's area during winter. There are very few other feeding opportunities for gulls at this season. The steep rocky coast of northeast Avalon Peninsula does not offer much feeding habitat for gulls.

The numbers of gulls at the Robin Bay Landfill were censused on 33 occasions from 17 November 1994 to 16 March 1995 (Table 2). Overall gull numbers at the landfill ranged from 3,112 on 13 March to 17,088 on 10 February. The reasons for these substantial fluctuations are discussed later in the report.

The Herring Gull was the most common species at the landfill with numbers ranging from 1,705 to 11,600 (Table 2). The larger Great Black-backed Gull was also common with numbers between 320 and 5,820. Substantial numbers of Glaucous Gulls were present (range 10 to 940). Iceland Gulls and Lesser Black-backed Gulls were uncommon at the site (Table 2).

Not all of the gulls at the landfill at one time were feeding. Usually most of the gulls were loafing near the active waste disposal area and on other parts of the landfill property.

St. John's Harbour

The number of gulls in St. John's during the winter is almost completely a function of the number of gulls using the Robin Hood Bay Landfill. The exception is 1,000 - 2,500 Iceland Gulls that feed daily in St. John's Harbour and along the coast of the St. John's area through the winter season. Iceland Gulls visited the landfill only in very small numbers (less

Table 2. Numbers of gulls recorded at Robin Hood Bay Landfill (17 Nov. 1994-16 March 1995).

DATE	SPECIES					TOTALS
	Herring Gull	Iceland Gull	Lesser Black-backed Gull	Glaucous Gull	Great Black-backed Gull	
1994						
Nov. 17	5,900	2	2	14	820	6,738
Nov. 21	6,600	0	0	10	1,213	7,823
Nov. 25	10,500	0	1	10	1,915	12,426
Nov. 27	2,500	1	1	25	1,050	3,577
Nov. 28	4,800	0	0	20	1,300	6,120
Dec. 2	4,100	0	0	25	715	4,840
Dec. 6	3,510	0	0	150	1,140	4,800
Dec. 12	6,000	1	1	135	1,950	8,087
Dec. 19	5,940	2	0	168	1,275	7,385
Dec. 26	2,600	3	0	200	1,570	4,373
1995						
Jan. 7	4,700	3	0	375	2,600	7,678
Jan. 13	3,600	1	0	310	1,700	5,611
Jan. 15	2,000	5	1	250	1,500	3,756
Jan. 18	4,550	6	2	690	3,300	8,548
Jan. 23	1,705	1	0	320	1,390	3,416
Jan. 25	4,610	1	0	940	4,350	9,901
Jan. 27	5,000	7	0	545	3,100	8,652
Jan. 30	5,570	3	1	425	2,475	8,474
Feb. 2	8,180	10	1	770	4,200	13,261
Feb. 3	6,100	18	1	705	5,540	12,364
Feb. 8	9,820	13	0	760	5,820	16,413
Feb. 10	11,600	23	0	755	4,710	17,088
Feb. 14	5,700	5	0	380	2,510	8,595
Feb. 15	8,350	15	0	450	3,450	12,265
Feb. 17	7,390	28	0	520	4,180	12,118
Feb. 22	9,690	35	0	550	2,450	12,725
Feb. 24	7,050	63	0	835	2,510	10,458
Mar. 03	6,520	8	0	575	1,880	8,983
Mar. 06	4,085	4	0	240	320	4,649
Mar. 08	4,385	8	0	510	925	5,828
Mar. 09	3,350	8	0	415	550	4,323
Mar. 13	2,400	2	0	200	510	3,112
Mar. 16	4,100	3	0	625	2,500	7,228

than 1% of the gulls at the landfill - Table 2). They were very rarely seen flying overland near the St. John's Airport and therefore, are not expected to pose a hazard to aircraft at the St. John's Airport during winter.

St. John's Harbour has several raw sewage outflows that provide the main source of food for Iceland Gulls in the area. Interestingly, few other gulls make use of this food source.

Other Feeding Areas

There are no other significant sources of food for gulls in the winter in the St. John's area. A few dozen gulls have learned to feed on bread scraps thrown out by citizens for the feral waterfowl wintering at three locations in the city.

Christmas Bird Counts at three locations on the southern Avalon Peninsula, outside the influence of the St. John's area indicate the relative paucity of gulls away from urban settings. The three locations were surveyed in the late December 1993-early January 1994 period. The numbers of gulls (excluding the pelagic Black-legged Kittiwake) recorded in each survey were 288 at Ferryland, 318 at Cape Race, and 178 at Cape St. Mary's. Comparisons with the numbers of gulls recorded during this study in the St. John's area indicates the reliance of wintering gulls on human presence.

Loafing Sites

Gulls use several locations in the St. John's area for daytime loafing. The suitability of a loafing site depends on the weather, snow and ice conditions.

Robin Hood Bay Landfill

The Robin Hood Bay landfill is one of the two main loafing sites in the St. John's area. Quidi Vidi Lake is the other major area (see next section). Most of the gulls at the landfill site at any one time are loafing. The large open expanses of cleared land provide good conditions for loafing, although water for bathing and drinking is usually not available in mid winter. The overall numbers of gulls, including both feeding and loafing birds, present at the

Robin Hood Bay Landfill were given in Table 2. There was a steady interchange of gulls between feeding and loafing sites on the landfill property.

Quidi Vidi Lake

Quidi Vidi Lake is one of the two main winter loafing areas in the St. John's region. Fresh water is always available for bathing and drinking, although the availability of water becomes very restricted for a few days during prolonged cold spells as the river mouths all but completely freeze over. The flat wide open expanse of ice on the lake provides excellent gull loafing habitat.

Quidi Vidi Lake is about 2.5 km SW of the Robin Hood Bay Landfill (Figure 1). In winter, the lake was a major loafing area for many of the gulls that fed at the landfill. Estimates of the numbers and species of gulls found at Quidi Vidi Lake are presented in Table 3. The numbers present varied widely, ranging from 715 on 9 December 1994 to 13,111 on 27 January 1995. Herring Gulls and Great Black-backed Gulls were the most common species with Glaucous and Iceland Gulls present in much smaller, but similar, numbers. Very small numbers of the Common Black-headed Gull, Mew (=Common) Gull, Ring-billed Gull, Yellow-legged Gull, Lesser Black-backed Gull and Ivory Gull were also recorded at Quidi Vidi Lake (Table 3). The Yellow-legged Gull is a southern European species and the single individual recorded on 6 dates represents one of the very few records for North America.

The presence of ice on Quidi Vidi Lake greatly affected the numbers of gulls that loafed there. More gulls used the lake when ice was present than when there was only open water. On four surveys of open water from 25 November to 5 December, the maximum gull count at Quidi Vidi Lake was 2,690. The lake was 75% ice covered on 6 Dec and the gull count had risen to 8,611 (Table 3). The lake was again free of ice from 7 to 19 December. The maximum number of gulls during this ice-free period was 3,606. The lake was 95% frozen on Dec. 20 when the gull count climbed to 8,254; it remained high through January. Numbers declined in February when offshore sea ice became available for loafing (see later section).

The condition of the ice on the lake has an important influence on the numbers of loafing gulls. Gulls do not like to land if there is a cover of deep soft snow on the ice surface. In the Table 3.

Table 3. Numbers of gulls recorded at Quidi Vidi Lake (17 Nov. 1994-16 March 1995).

DATE	SPECIES										TOTALS
	Com. Black-headed Gull	Mew Gull	Ring-billed Gull	Herring Gull	Yellow-legged Gull	Iceland Gull	Lesser Black-backed Gull	Glaucous Gull	Great Black-backed Gull	Ivory Gull	
1994											
Nov. 25	0	0	3	1,400	0	75	0	5	400	0	1,883
Dec. 2	0	0	0	1,850	0	78	0	32	730	0	2,690
Dec. 4	0	0	0	990	0	148	0	36	87	0	1,261
Dec. 5	0	0	0	1,100	0	240	0	32	990	0	2,362
Dec. 6	3	0	3	5,730	0	400	0	120	2,355	0	8,611
Dec. 9	0	0	0	75	0	10	0	30	600	0	715
Dec. 11	2	0	3	1,100	0	300	0	100	2,100	1	3,606
Dec. 12	4	0	4	350	0	90	0	20	300	1	769
Dec. 13	0	0	3	1,130	0	70	0	25	660	0	1,888
Dec. 19	6	1	5	1,500	0	170	0	80	750	0	2,510
Dec. 20	9	1	3	4,770	0	280	1	165	3,025	0	8,254
Dec. 22	11	1	4	4,300	0	240	1	140	3,460	1	8,098
Dec. 26	10	0	5	3,800	1	225	2	175	2,200	1	6,417
Dec. 30	6	1	2	1,140	0	125	2	35	280	0	1,591
1995											
Jan. 1	5	0	4	4,750	0	310	1	265	3,900	0	9,235
Jan. 5	3	0	5	5,800	0	250	2	300	2,700	0	9,060
Jan. 9	0	0	0	✓	1	✓	0	✓	✓	0	6,000
Jan. 10	5	1	4	6,100	1	400	2	330	1,740	0	8,581
Jan. 13	10	2	5	5,200	0	300	1	170	3,100	0	8,788
Jan. 16	5	1	4	3,000	1	435	3	200	2,800	0	6,449
Jan. 17	8	1	4	3,500	0	500	2	200	3,000	0	7,215
Jan. 18	6	1	5	5,100	1	320	3	220	4,025	0	9,681
Jan. 20	0	0	0	✓	0	✓	0	✓	✓	0	5,000
Jan. 23	2	2	5	5,350	1	240	2	530	5,900	0	12,032
Jan. 25	5	1	4	4,860	0	410	2	330	4,740	0	10,372
Jan. 27	3	0	2	6,575	0	170	1	150	6,210	0	13,111
Jan. 30	2	0	4	2,000	0	55	2	57	1,250	0	3,370
Feb. 2	2	0	5	5,490	0	295	3	360	4,390	0	10,545
Feb. 3	1	0	2	3,650	0	110	2	105	1,505	0	5,375
Feb. 8	3	1	3	1,700	0	45	2	35	1,280	0	3,069
Feb. 10	3	0	3	1,730	0	60	1	35	1,320	0	3,152
Feb. 14	3	1	3	1,920	0	60	1	40	1,095	0	3,123
Feb. 15	2	0	0	2,110	0	60	1	40	775	0	2,988
Feb. 17	3	1	2	2,850	0	60	2	30	2,000	0	4,948
Feb. 22	1	1	3	4,410	0	350	1	230	3,460	0	8,456
Feb. 24	2	1	2	4,860	0	300	4	140	2,080	0	7,389
Mar. 03	0	1	3	970	0	20	1	70	620	0	1,685
Mar. 06	1	0	0	390	0	35	1	40	40	0	507
Mar. 08	0	0	3	380	0	30	1	21	60	0	495
Mar. 09	2	0	2	2,550	0	50	1	100	1,930	0	4,635
Mar. 13	0	0	2	885	0	25	2	47	260	0	1,221
Mar. 16	1	0	0	1,080	0	105	2	15	740	0	1,943

✓ indicates species present.

St. John's area, the wind usually prevents this from happening. A wet surface on bare ice was particularly attractive to gulls.

When the lake was ice free, gulls also rested on the sports fields to the north of the lake, if the fields were not snow covered (rare in winter). Disturbance from recreational walkers and dogs often prevented gulls from using this location for extended periods.

Quidi Vidi Lake was the only lake in the St. John's area used by gulls throughout the winter. Based on other observations by BDM, it attracted more gulls in winter than during other seasons.

Virginia Lake

Virginia Lake is about 1.5 km west of the landfill, marginally the closest significant fresh water body to the landfill. It is directly on the route of gulls flying between the Robin Hood Bay Landfill and the night roost at Little Bell Island (see later section).

Virginia Lake was used by gulls when it was ice free, and on rare occasions in winter when the ice cover was bare of snow. The lake was surveyed 9 times during this study (Table 4). Surrounded by trees providing a wind break, the water rarely gets rough even during storms as the other larger lakes do. The sheltering trees also mean that the lake stays covered with snow during most of the winter. It is rarely used by gulls in winter. The exceptions occur when major, usually brief, mild spells melt the snow on the ice resulting in a wet smooth ice surface. Virginia Lake was surveyed on those dates when these conditions occurred. The only examples of significant numbers of gulls recorded on Virginia Lake during the mid winter of 1994/1995 were 3,160 on 12 December, 247 on 16 January, 1,710 on 25 February, and 1,500 on 9 March (Table 4).

Windsor Lake/Newfound Pond

Windsor Lake and neighbouring Newfound Pond, like Virginia Lake, are on the direct route for gulls flying between the Robin Hood Bay Landfill and the Little Bell Island night roost. The east end of Windsor Lake is about 7 km west of the landfill. Newfound Pond is about 2 km west of the Terminal Building at the St. John's Airport (see Figure 1).

Table 4. Numbers of gulls using Virginia Lake as a Day-Use Site

Date	Herring Gull	Great Black-backed Gull	Glaucous Gull	Lesser Black-backed Gull	Totals
Nov. 17	990	270	0	1	1,361
Nov. 28	1,250	360	6	0	1,616
Dec. 6*	0	0	0	0	0
Dec. 12**	2,200	900	60	0	3,160
Dec. 20	present	present	0	0	100
Jan. 16**	60	175	12	0	247
Feb. 25**	1,100	500	110	0	1,710
March 9**	present	present	present	0	1,500
March 13	0	0	0	0	0

* Lake frozen with snow cover on most days after this date.

** Bare ice with wet surface.

Windsor Lake is the largest lake on the northeast Avalon Peninsula. It provides the gulls with a 4 km stretch of open water to fly along. Gulls used Windsor Lake to bath and drink when it was not frozen. Newfound Pond is smaller and protected from wind by tall trees around the shore. It was not surveyed because of the difficult access to the pond edge, but judging from the numbers of gulls seen flying to, from and over the pond it seemed to attract gulls by the hundreds. It may be used more heavily than Windsor Lake, particularly on windy days when there are large waves on Windsor Lake.

Windsor Lake was visited on 16 dates during the study (Table 5). Gulls were counted at Windsor Lake on six surveys when the lake was ice-free (17 to 30 November); numbers during this period ranged from 16 to 1,650 (Table 5). The large size of Windsor Lake meant that it was more prone to rough water than other freshwater bodies in the study area. On 17, 20 and 30 November, gulls were seen continually arriving at and departing from the lake while the overall flock size remaining relatively unchanged. The gulls were actively bathing and preening. It appeared that the gulls were stopping only long enough to bath before then flying west toward the Little Bell Island roost. The actual numbers of gulls using Windsor Lake on these days was probably much higher than the counts suggest.

Table 5. Numbers of gulls using Windsor Lake as a Day-Use Site.

Date	Herring Gull	Black-backed Gull	Glaucous Gull	Totals
Nov. 17	175	40	0	215
Nov. 20	445	78	2	525
Nov. 21	480	40	0	520
Nov. 23	present	present	0	1,650
Nov. 28	12	4	0	16
Nov. 30	142	42	2	186
Dec. 6	present	present	0	200
Dec. 12	800	700	0	1,500
Dec. 22*	115	160	1	276
Jan. 15	0	0	0	0
Jan. 16	23	270	1	294
Jan. 20	0	0	0	0
Feb. 5	0	0	0	0
Feb. 17	0	0	0	0
Feb. 25	0	0	0	0
Feb. 27	0	0	0	0

* Lake surface 100% frozen from this point onward.

Gulls at least occasionally roosted at night on Windsor Lake (see Night Roosting).

Gulls used Windsor Lake during the freeze-up period. On 12 December, 1,500 gulls were loafing on the recently formed ice edge. After the lake became completely frozen (between 12 and 22 December), it was only occasionally used by gulls. The lake was completely devoid of gulls on most (6 of 8) winter visits with the exception of 22 December (276 gulls) and 16 January (294) (Table 5).

Windsor Lake is about 500 feet above sea level. Therefore, it tends to freeze earlier than most of the other lakes in the study area.

Kenny's Pond

Kenny's Pond is a small pond with an open manicured shoreline. It is located directly between Quid Vidi Lake and Windsor Lake (see Figure 1). It is used by gulls for bathing and loafing. The relatively small size of the pond limits the numbers of gulls that can fit onto it. It was used in winter only when the ice cover was bare and wet. The numbers of gulls recorded on Kenny's Pond are given in Table 6.

Table 6. Numbers of gulls using Kenny's Pond as a Day-Use Site.

Date	Herring Gull	Great Black-backed Gull	Glaucous Gull	Totals
Nov. 21	28	0	0	28
Nov. 26*	460	12	0	472
Nov. 30	426	39	2	467
Dec. 12	45	5	0	50

* Kenny's Pond mostly frozen from this date onward.

Other Day-Use Sites

Gulls used a variety of other Day-Use Sites in the St. John's area during the course of the study. Before the ground became snow-covered, gulls congregated in flocks reaching several hundred at some shopping mall parking lots, school grounds and other open flat areas. Frequently, these flocks dispersed as soon as the business day commenced at about 08:00.

The gravel pits adjacent to the west end of the Robin Hood Bay Landfill were attractive to loafing gulls before there was snow on the ground. The site offered an undisturbed setting for loafing. Counts of 2,430 gulls (2,200 Herring and 230 Great Black-backed) and 750 gulls were obtained at the gravel pits on 17 and 21 November, respectively. None were present there after the end of November.

Mundy Pond in southwestern St. John's (see Figure 1) is a relatively large pond in the city. It has a wide perimeter of low open land. Several hundred gulls loafed there when the pond was ice free. The gulls bathed, drank and rested on the pond, but also loafed on the adjacent waste land and baseball playing field. Gulls also loafed on the pond when it was ice covered, as long as it was not also snow covered. No counts were made at the pond, but numbers and gull activity were casually noted during regular drive bys.

The coast from Cockold Head, 3 km south of the Robin Hood Bay Landfill to Torbay Point, 6 km north of the landfill site (see Figure 1) was an important gull Day-Use area. Depending on weather, snow and ice conditions gulls loafed on the rocky cliffs and on the ocean surface. This coastline is not easily accessed at any point so regular surveys were not conducted. Views were occasionally obtained from Quidi Vidi Gut, from the landfill, and at Logy Bay. During the last two weeks of November, before snow covered the land, several hundred gulls, particularly Great Black-backed Gulls loafed on barren hill tops adjacent to the coast at Quidi Vidi Gut. The ground here was heavily littered with regurgitated pellets from gulls, indicating heavy use.

Gulls rested on the ocean during the day, if the ocean was not too rough. The prevailing west winds insured that on many days, gulls were able to take advantage of relatively sheltered coastal waters protected by the high coastal cliffs. The bigger gulls, Great Black-backed and Glaucous, were more common than Herring Gulls resting on the ocean during the day. For example, at 09:15 on 19 January off Quidi Vidi Gut, there was a flock of 500 Great Black-backed Gulls resting on the ocean and a mixed flock of 50 Great Black-backed and Herring gulls resting along the shoreline. Most of the 1,800 gulls resting on the ocean off the Robin Hood Bay Landfill at 10:00 on 15 February were Great Black-backed Gulls. All species of gulls freely loafed on the sea ice when it was close to shore. Three thousand gulls, more Herring than Great Black-backed, were resting on sea ice off the landfill at 10:00 on 15 February. The first sea ice thick enough to hold the weight of gulls was present on 5 February. Westerly winds kept the ice beyond sight of land for about 60% of the late winter.

NIGHT ROOSTING LOCATIONS

Gulls roost at night in large flocks at traditional locations, such as open water, where they are safe from terrestrial predators. During the present study, gulls were found roosting at three

locations: Little Bell Island in Conception Bay, Windsor Lake, and the 10 km of coastline from Signal Hill north to Torbay Point (see Figure 1).

Little Bell Island

Little Bell Island is situated in Conception Bay. The island is 24 km WSW of the Robin Hood Bay Landfill. It is a small, mostly treeless island, approximately 1.0 X 0.25 km in size. It is known to serve as a nesting site for many Herring and Great Black-backed Gulls during the summer. During the November through March period of this study, the Little Bell Island area was an important gull night roost. It was the focal point for a major gull flight path that bordered the south boundary of the St. John's Airport (see Gull Flight Paths, later).

It was not possible to determine the numbers of gulls roosting in the Little Bell Island area. The closest vantage point was at Chamberlains Beach, 4 km to the east on the shore of Conception Bay. Evening watches were conducted on 20 and 26 November, 15 and 26 January, 19 February and 5 March. Each watch started about an hour before sunset, and ended 30 minutes after sunset. The main roosting spot appeared to be on the top or the west (=backside) of the island, out of sight from Chamberlains Beach. Depending on snow cover, gulls were visible on the grassy headland of the east end of Little Bell Island. It cannot be ruled out that the gulls may have eventually moved out onto open water to spend the night. Before freeze up of still water on 20 November, several thousand gulls appeared to roost on the gravel beach and barachois pond at the SE corner of the island. With good visibility near sunset a steady stream of small flocks of gulls could be seen flying toward the island low over the water from the northeast. This was the line of flight expected for gulls approaching directly from Windsor Lake and the Robin Hood Bay Landfill area.

Indications of the numbers using Little Bell Island for roosting were obtained on two dates when a passing Bald Eagle flushed the gulls. On 26 November, 3,000 gulls were flushed by an eagle. This observation occurred 25 minutes before sunset; thus, it is not the total number of gulls roosting in the area. At five minutes after sunset on 5 March, a massive flock estimated to be 8,000 to 10,000 gulls flushed up from an unseen location on the far side of the island. Previous to this, only 350 gulls had been visible from the Chamberlains Beach viewing location.

Windsor Lake

As noted earlier, Windsor Lake is a large body of water located 2 km SW of the St. John's Airport. It is directly on the line of flight for gulls flying between the Robin Hood Bay Landfill and the night roost at Little Bell Island (see Gull Flight Paths). The lake was used during the day for loafing, drinking and bathing. The extent to which gulls used the lake for night roosting is uncertain. The surface area of the lake is certainly large enough to meet the requirements for a gull night roosting site.

Windsor Lake was surveyed for roosting gulls on three dates before it froze over in early December. Surveys began near sunset and continued until it was too dark to see gulls. On 20 November, several hundred gulls were resting on Windsor Lake 40 minutes after sunset, and were presumed to be roosting. On 21 November, most of the 380 gulls present 30 minutes after sunset flew west in large groups five minutes later. Fewer than twenty gulls were visible 40 minutes after sunset. On 26 November, 1,650 gulls were observed resting on Windsor Lake from 20 minutes after sunset until it was too dark to see, 45 minutes after sunset. The gulls gathered into a tight flock before complete darkness. This behaviour is indicative of night roosting and suggests that the gulls did indeed settle on the lake for the night.

More work is needed to determine the relative importance of Windsor Lake as a night roost location for gulls.

East Coast of Avalon Peninsula

The coast from Torbay Point, 6 km north of the Robin Hood Bay Landfill south to Signal Hill, 3 km south of the landfill was found to serve as a major gull night roosting area. Precise numbers of roosting gulls and exact roosting sites were difficult to determine and seemed to be variable. Access to the outer coast was restricted by the rugged precipitous terrain and nearly complete lack of roads. Roosting locations seemed highly variable depending on snow conditions on land and cliffs, roughness of ocean, and the presence of sea ice.

Each day from the afternoon through until after sunset, large numbers of gulls flew from the loafing site at Quidi Vidi Lake east through Quidi Vidi Gut to the ocean. Most gulls then

turned north along the coast. The gulls roosted both on the water and on the rocky cliffs. Roosting on cliffs was most prevalent when there is no snow cover.

An evening watch was conducted from Cockold Cove Head, near Quidi Vidi Gut on 9 January. In the previous twenty-four hours, there had been heavy rain which melted all the snow cover. At sunset, there were 1,800 gulls resting on the water in a single sweeping flock that stretched from 200 to 700 meters from shore. In addition, there were 2,175 gulls resting on the steep rocky slopes next to the sea, a flock of 775 gulls one km north of Quidi Vidi Gut, and a flock of 1,400 gulls one km to the south, at the bottom of Signal Hill. The same numbers of gulls were still discernible on the water up to 30 minutes after sunset, while the closer gulls on the cliffs were visible 45 minutes after sunset. There was little doubt that these gulls were intending to roost at these locations. The species composition was Great Black-backed Gull - 90%, Glaucous Gull - 8%, and Herring and Iceland Gulls combined - 2%. The small number of Herring Gulls probably reflects a lower tolerance for roosting in exposed locations and rough water than by the larger Great Black-backed and Glaucous Gulls. However, during the watch several hundred Herring Gulls flew east out from Quidi Vidi Lake and north along the coast beyond the landfill site area to an unknown roosting location.

The observation effort from Cockold Head was not repeated due to difficulties in getting down from the location in the dark. However, a part of this coast, including the roost location of 1,400 gulls, was visible from a road. Gulls were not seen roosting here on sunset visits on 4, 9, 12 and 19 December, 25 February, and 12 March. Only a fraction of the roost area one km north of Quidi Vidi Gut, where 775 gulls were seen on 9 January, was visible from the road. Groups of 110 and 300 Great Black-backed Gulls seen here 4 and 19 December, respectively, were only an indication of the number that might have been hidden from view.

The roosting location of the large numbers of gulls seen flying north along the coast from the loafing site at Quidi Vidi Lake in the late afternoon and evening is uncertain. On 17 February, three flocks of gulls totalling 7,000 individuals were present on the sea in Logy Bay as late as 40 minutes after sunset, strongly suggesting roosting in Logy Bay. There were only 400 here after sunset a week later on 25 February. Most of the 6 km of coast between the Robin Hood Bay Landfill and Torbay Point is inaccessible. The high steep coast provides significant shelter from the prevailing west winds of winter. These cliffs which provide nest

sites for large numbers of Herring and Great Black-backed Gulls may also be suitable for terrestrial roosting when the snow is not too deep.

Sea ice off the landfill area provides important roosting habitat, when it is present. In the 1994/95 winter season, 5 February was the first date when the sea ice was thick enough to support gulls. Sea ice was available for roosting and loafing sporadically until 2 March when northern pack ice reached St. John's. After 2 March, sea ice was present on most days to the end of the study period. Ice movement caused by wind and the southerly flowing current may displace roosting gulls during the night. At Cape Spear (see Figure 1) during the first two hours of daylight on 4 March, a continuous flight of gulls totalling several thousand was observed flying from the east and south eastern horizon toward St. John's. The ocean that morning was 90% ice covered and the winds had been 20-30 km/hr from the NW overnight.

GULL FLIGHT PATHS

Gulls use traditional flyways to travel among feeding, loafing and night roosting areas. These flight paths tend to be the shortest distance between two points, although there may be deviations to take advantage of particular loafing areas. At some time during the day, the Robin Hood Bay Landfill was the main destination for most of the gulls in the St. John's area. The principal flight routes used by gulls are depicted in Figure 2.

Gulls that were roosting or loafing along the coast approached the Robin Hood Bay Landfill by flying along the coast and turning west directly into the landfill. The heavy gull movements between the landfill and Quidi Vidi Lake occurred both along the coast and directly over land (Figure 2).

During the open water period, gulls from the night roost at Little Bell Island approached the landfill from the west. In the winter, however, most gulls were observed approaching the landfill from the direction of Quidi Vidi Lake or the ocean. Only a light movement of gulls approaching from the west was observed. These gulls were frequently seen dropping from high altitudes into the landfill and were easily missed among the melee of gulls at low level. In the winter, it was apparent that large numbers of gulls from the night roost at Little Bell Island stopped at Quidi Vidi Lake to wash and preen before travelling NW to the landfill. Figure 2.

Gulls using the Little Bell Island roost appeared to travel back and forth to the landfill by two different routes. The northernmost route ran east/west between the landfill and the east side of Conception Bay. It took the gulls over Virginia and Windsor Lake, two major loafing/bathing sites during the open water season. This flight path passed just south of the southern boundary of the St. John's airport (Figure 2). Frequent observations of this location showed that the gull path rarely came closer than 300-500 m from the southern boundary of the airport or about one km from the ends of Runways 20/02 and 34/16.

The more southern line of flight was between the Little Bell Island roost and Quidi Vidi Lake. This flight path was most observable in the afternoons and evenings when gulls were leaving the lake to fly toward the roost. Gulls flew west and northwest from Quidi Vidi Lake over the city. Birds flying northwest passed over Three Ponds Barrens toward Windsor Lake. From Windsor Lake the gulls presumably flew to Little Bell Island on Conception Bay. Birds flying west from Quidi Vidi Lake were not followed. But a westward flight from Quidi Vidi Lake is the most direct route to Little Bell Island. After Windsor and Virginia Lakes froze in early December, there was a noticeable decrease in gull traffic on the northern route close to the airport and a corresponding increase on the southern route. This change was due to the great increase in the use of Quidi Vidi Lake as a loafing and bathing site and the nearly complete cessation of use of Windsor and Virginia Lakes.

GULL POPULATIONS IN THE ST. JOHN'S AREA

Numbers of Gulls

The Robin Hood Bay Landfill was clearly the major attractant to gulls in the St. John's area. The numbers and species of gulls at the landfill were reviewed in Table 2. The principal species present were Herring Gulls and Great Black-backed Gulls.

Observations indicated that there was a steady movement of gulls between the Robin Hood Bay Landfill and Quidi Vidi Lake. Many of the gulls that fed at the landfill flew to the lake and spent some hours loafing there. The numbers and species present at Quidi Vidi Lake were presented in Table 3.

In assessing the numbers of gulls in the St. John's area and the numbers that used the landfill, it is necessary to combine the numbers present at the landfill and at Quidi Vidi Lake. The two areas were surveyed consecutively on the same day on 27 occasions from 25 November to 16 March. The combined numbers of gulls present (from Tables 2 and 3) are summarized in Table 7. The numbers per 5 day interval spread throughout the study period are plotted on Figure 3.

Table 7. Numbers and species of gulls at Robin Hood Bay Landfill and Quidi Vidi Lake, 25 November 1994 to 16 March 1995.

Date	Herring Gull	Glaucous Gull	Great Black-backed Gull	Other Gull Species	Totals
Nov 25	11,900	15	2,315	79	14,309
Dec 2	5,950	57	1,445	78	7,530
6	9,240	270	3,495	406	13,411
12	6,350	155	2,250	101	8,856
19	7,440	248	2,025	182	9,895
26	6,400	375	3,770	245	10,790
Jan 13	8,800	480	4,800	319	14,399
18	9,650	910	7,325	344	18,229
23	7,055	850	7,290	253	15,448
25	9,490	1,270	9,090	423	20,273
27	11,575	695	9,310	183	21,763
30	7,570	482	3,725	67	11,844
Feb 2	13,670	1,130	8,690	316	23,806
3	9,750	810	7,045	134	17,739
8	11,520	795	7,100	67	19,482
10	13,330	790	6,030	90	20,240
14	7,620	420	3,605	73	11,718
15	10,460	490	4,225	78	15,253
17	10,240	550	6,180	96	17,066
22	14,100	780	5,910	391	21,181
24	11,910	975	4,590	372	17,847
Mar 3	7,490	645	2,500	33	10,688
6	4,475	280	360	41	5,156
8	4,765	531	985	42	6,323
9	5,900	515	2,480	63	8,958
13	3,285	247	770	31	4,333
16	5,180	640	3,240	111	9,171

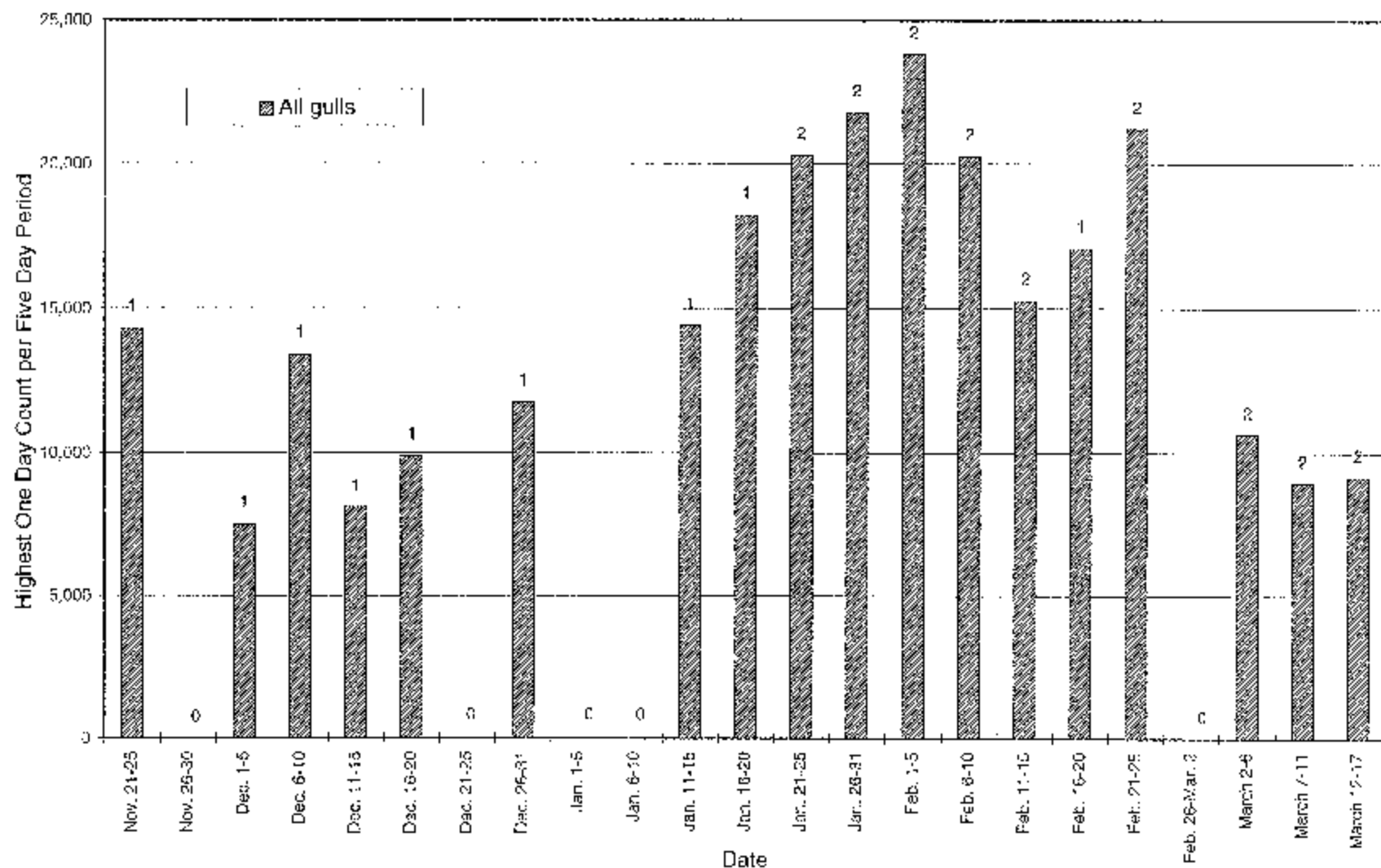


Figure 3 Highest one day count of all gulls per five day period at Quidi Vidi Lake and Robin Hood Bay Landfill, combined -- 21 November 1994 to 17 March 1995. Numbers at the top of each column indicate the number of censuses in that five day period.

The total numbers of gulls present at the Robin Hood Bay Landfill and Quidi Vidi Lake ranged from 4,333 on 13 March to 23,806 on 2 February. The wide range in numbers was partly due to the time of year, weather conditions, ice conditions on Quidi Vidi Lake, and ice conditions on the ocean.

The peak numbers of gulls occurred in January and February. During this period the average high count for the 9 five day periods was 19,134 gulls (Table 7; Figure 3). The numbers of gulls declined dramatically after 3 March when sea ice from the north drifted to the latitude of St. John's. The average for the six combined censuses from 3 to 16 March was 7,267 gulls. The lower numbers were directly attributable to the presence of the sea ice. The gulls chose to loaf on the sea ice instead of at Quidi Vidi Lake and at the landfill. Accurate counts of gulls on the sea ice were impossible to obtain because of the scattered nature of the loafing flocks, the distance from shore, and poor access to the coast. In spite of the reductions in numbers of gulls at the landfill, it was our impression that the numbers of gulls that fed at the landfill did not change but rather that large numbers of gulls that formerly loafed at the landfill and the lake had switched to loafing on the sea ice.

The numbers and the proportion of the gulls that occurred at Quidi Vidi Lake fluctuated (Figure 4). The highest numbers of loafing gulls at Quidi Vidi Lake occurred in January. Gull counts were consistently higher at Quidi Vidi Lake than at the Robin Hood Bay Landfill at this time. The slightly milder than average temperatures in January 1995 allowed for a large area in the middle of the lake to remain open. There was heavy use of the open water by gulls for bathing. A return to normal winter temperatures in February reduced gull use of Quidi Vidi Lake when larger numbers of gulls loafed at the landfill. As a result, counts from the landfill exceeded those from Quidi Vidi Lake throughout February (Figure 4). Overall, the combined totals of gulls at Quidi Vidi Lake and the landfill were similar in January and February.

The numbers of gulls documented in Table 7 represent minimum estimates of the numbers present in the St. John's area. During the open water season, numerous minor loafing sites were used, making total counts very difficult. After freeze up, Quidi Vidi Lake was the only fresh water body used for loafing. At this season, the majority of the gulls using the Robin Hood Bay Landfill were either at the landfill or at Quidi Vidi Lake from mid morning to mid afternoon. However, even then, there were many uncounted gulls loafing along the coast adjacent to the landfill area and to Quidi Vidi Lake. Even though a complete count was not

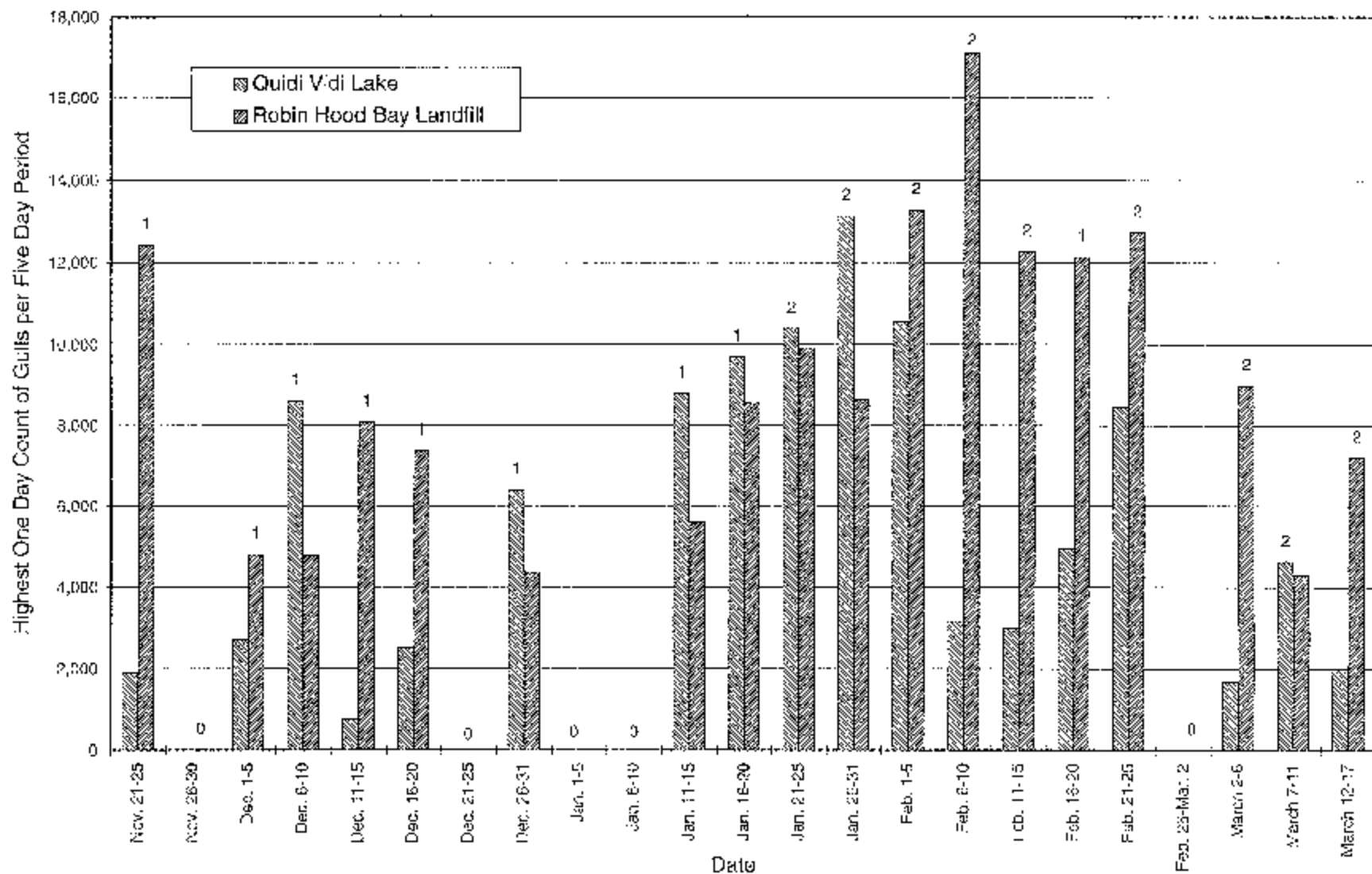


Figure 4 Highest one day count of all gulls per five day period at Quidi Vidi Lake and Robin Hood Bay Landfill, combined -- 25 November 1994 to 17 March 1995. Numbers at the top of each column indicate the number of censuses in that five day period.

possible, it was clear that substantial numbers of gulls were present in the St. John's area and that a high proportion of them were dependent upon the Robin Hood Bay Landfill.

Species Composition

The gull species composition was determined during the 27 consecutive surveys of the Robin Hood Bay Landfill and Quidi Vidi Lake. The combined data for the two areas are presented in Table 7. The data for each area are presented in Tables 2 and 3. The general patterns of abundance for the four most common species are summarized in Figure 5 and discussed in the following paragraphs.

Herring Gull

Large numbers of Herring Gulls were present throughout the study period with peak monthly totals ranging from 9,200 to 14,100 from November through February. The numbers were lower in March (Table 7) which was thought to reflect the heavy use of sea ice for loading at that time. Herring Gulls were common at both the landfill and at the main loading area at Quidi Vidi Lake (Tables 2 and 3).

Great Black-backed Gull

The Great Black-backed Gull is the largest gull in the St. John's region. It was the second most common species with as many as 9,300 being present in January. The numbers steadily increased in late November and December before the January peak was reached (Table 7). The numbers declined in mid and late February even though the numbers of Herring Gulls remained high through the month. The numbers of Great Black-backs decreased further during March when the sea ice was present in nearshore waters. The numbers of Great Black-backed Gulls were more or less equally divided between the landfill and Quidi Vidi Lake (see Tables 2 and 3).

Glaucous Gull

The Glaucous Gull is a large arctic-nesting gull that winters in the St. John's area. Numbers in the area were low when the study began in late November, but increased steadily

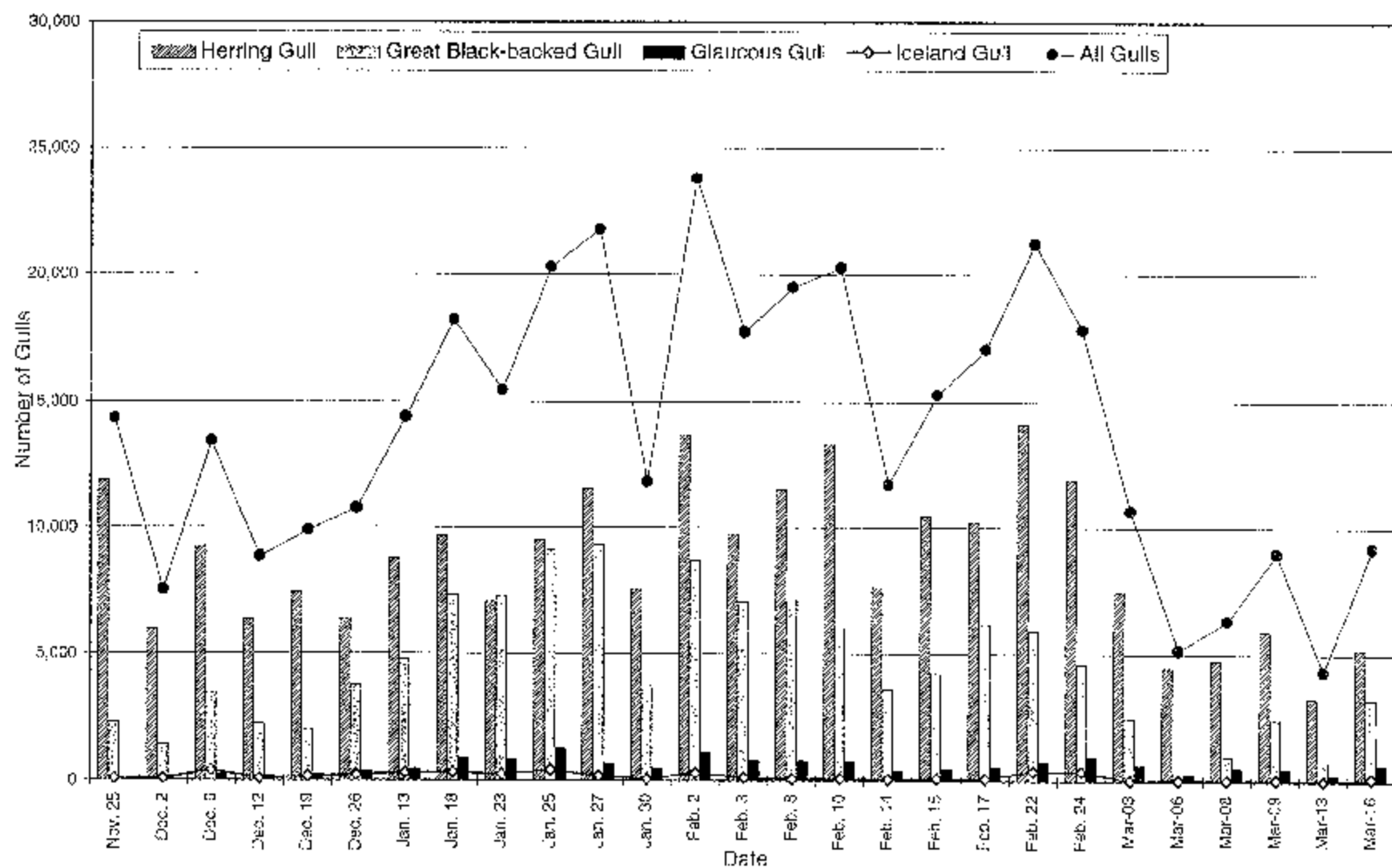


Figure 5 Numbers and species of gulls present at Quidi Vidi Lake and Robin Hood Bay Landfill, combined -- 25 November 1994 to 16 March 1995.

until a peak of nearly 1,300 was reached in late January (Table 7). Similar to the two previous species, numbers of Glaucous Gulls declined in March when the sea ice was present. In general, the numbers of Glaucous Gulls were somewhat higher at the Robin Hood Bay Landfill than at the Quidi Vidi Lake loafing area.

Other Species

Altogether, ten species of gulls were recorded during this study. Most were seen in extremely small numbers and are not discussed in detail here. The sightings of these uncommon species are summarized in Tables 2 and 3. Numerically, the most important of the 'other' species was the Iceland Gull. The Iceland Gull was seen in only small numbers at the landfill (Table 2) but the numbers at Quidi Vidi Lake were higher - reaching a peak of 500 on 17 January (Table 3). The Iceland Gull was most common in the St. John's Harbour and along the coast (see earlier).

Age Composition

The ages of gulls can be differentiated on the basis of plumage for the first few years of life. Age data for the three most common species were collected at the Robin Hood Bay Landfill and at Quidi Vidi Lake on 8 dates spread throughout the study period. The data are discussed below.

Herring Gull

The overwhelming majority of Herring Gulls wintering in the St. John's area were adults (Figure 6). It was possible to distinguish four age classes of Herring Gulls: 1st-year, 2nd-year, 3rd-year, and adults (all subsequent ages). At the beginning of the study, 12% of the Herring Gulls present were in the three sub-adult age classes (Table 8). Later in the study, the proportion of sub-adults in the wintering population declined with the percentage of sub-adults ranging from 2.5% to 8.9%. It is possible that some of the immature gulls migrated further south. Younger gulls are known to often winter further south than the adults.

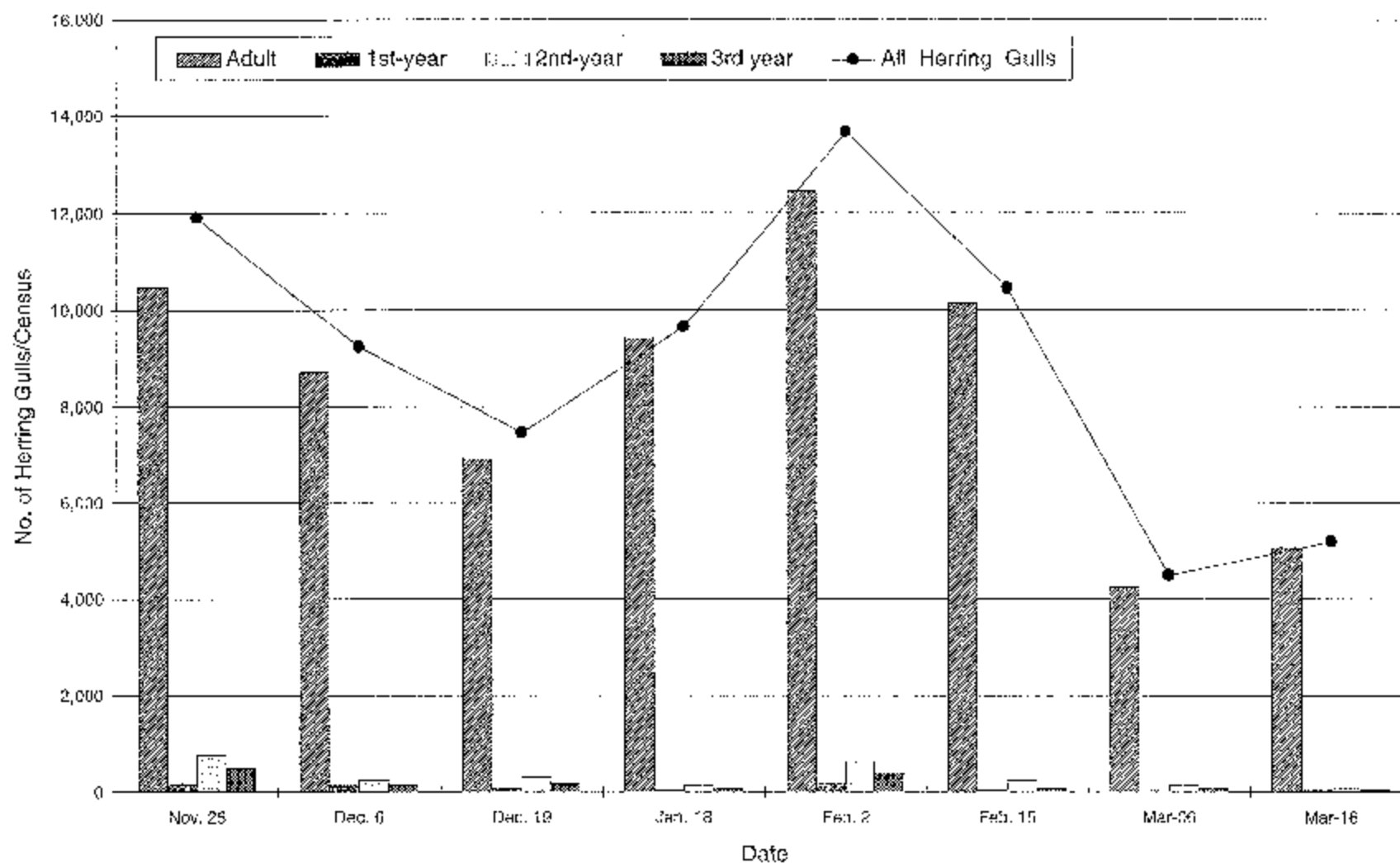


Figure 6 Age composition of Herring Gulls at Quidi Vidi Lake and Robin Hood Bay Landfill from 25 November 1994 to 16 March 1995.

Table 8. Age composition of Herring Gulls at Quidi Vidi Lake and the Robin Hood Bay Landfill from 25 November 1994 to 16 March 1995.

Date	Adult		1st-year		2nd-year		3rd-year		All Herring Gulls
	N	%	N	%	N	%	N	%	
1994									
Nov. 25	10,472	88.0	164	1.4	761	6.4	503	4.2	11,900
Dec. 6	8,713	94.3	129	1.4	240	2.6	158	1.7	9,240
Dec. 19	6,904	92.8	67	0.9	298	4.0	171	2.3	7,440
1995									
Jan. 18	9,408	97.5	29	0.3	145	1.5	68	0.7	9,650
Feb. 2	12,453	91.1	191	1.4	629	4.6	397	2.9	13,670
Feb. 15	10,136	96.9	31	0.3	230	2.2	63	0.6	10,460
Mar. 6	4,242	94.8	9	0.2	143	3.2	81	1.8	4,475
Mar. 16	5,050	97.5	26	0.5	67	1.3	37	0.7	5,180

Great Black-backed Gull

The majority of Great Black-backed Gulls wintering in the St. John's area were adults (Figure 7), although a higher proportion of sub-adult Great Black-backs was present than in the Herring Gull. As in the Herring Gull, the proportion of sub-adults was highest (30.0%) on the first survey (25 November) and declined to 13.3% to 21.2% (Table 9). The most prominent immature age class was the 1st-year class which usually comprised between 10% and 20% of the Great Black-backs that were present.

Glaucous Gull

The 1st- and 2nd-year age classes of Glaucous Gulls were combined because of the difficulty in distinguishing them (Table 10). The Glaucous Gull differed from the two previous species in that adults were relatively less common (Figure 8), comprising only between 14.3% and 46.7% of the wintering Glaucous Gull population. The combined 1st/2nd

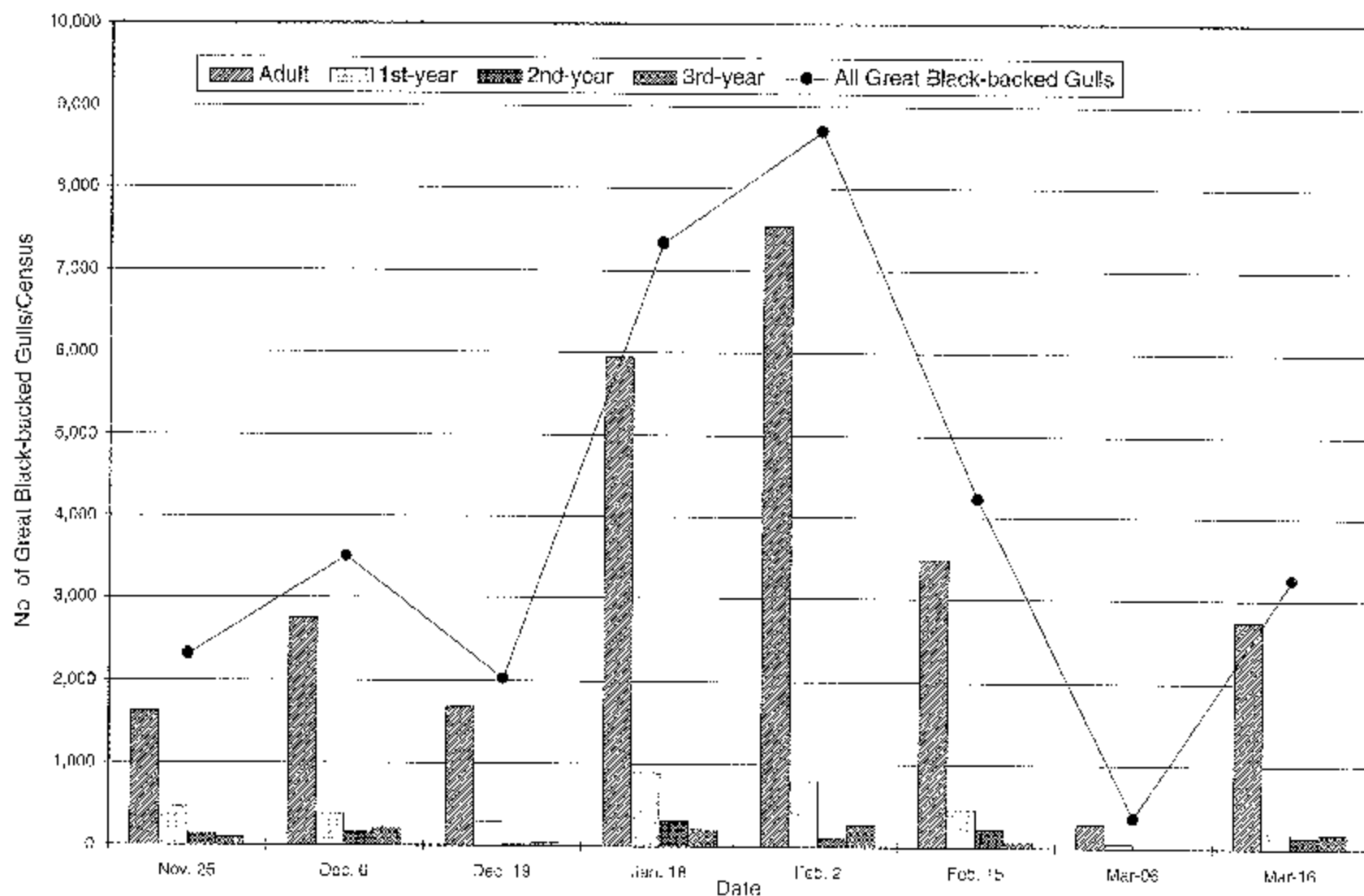


Figure 7 Age composition of Great Black-backed Gulls at Quidi Vidi Lake and Robin Hood Bay from 25 November 1994 to 16 March 1995.

Table 9. Age composition of Great Black-backed Gulls at Quidi Vidi Lake and the Robin Hood Bay Landfill from 25 November 1994 to 16 March 1995.

	Adult		1st-year		2nd-year		3rd-year		All Great Black- backed Gulls
Date	N	%	N	%	N	%	N	%	
1994									
Nov. 25	1,621	70.0	463	20.0	139	6.0	92	4.0	2,315
Dec. 6	2,754	78.8	374	10.7	154	4.4	213	6.1	3,495
Dec. 19	1,680	83.0	290	14.3	15	0.7	40	2.0	2,025
1995									
Jan. 18	5,941	81.7	879	12.0	300	4.1	205	2.8	7,325
Feb. 2	7,534	86.7	791	9.1	104	1.2	261	3.0	8,690
Feb. 15	3,473	82.2	456	10.8	220	5.2	76	1.8	4,225
Mar. 6	286	79.2	49	13.7	14	3.9	11	3.1	360
Mar. 16	2,738	84.5	182	5.6	139	4.3	181	5.6	3,240

Table 10. Age composition of Glaucous Gulls at Quidi Vidi Lake and the Robin Hood Bay Landfill from 25 November 1994 to 16 March 1995.

	Adult		1st & 2nd-year		3rd-year		All Glaucous Gulls
Date	N	%	N	%	N	%	
1994							
Nov. 25	7	46.7	5	33.3	3	20.0	15
Dec. 6	87	32.1	162	60.0	21	7.9	270
Dec. 19	75	30.1	146	59.2	27	10.7	248
1995							
Jan. 18	177	19.5	483	53.1	250	27.4	910
Feb. 2	307	27.2	675	59.7	148	13.1	1,130
Feb. 15	147	30.0	274	55.9	69	14.1	490
Mar. 8	76	14.3	413	77.7	42	8.0	531
Mar. 16	166	26.0	452	70.7	22	3.3	640

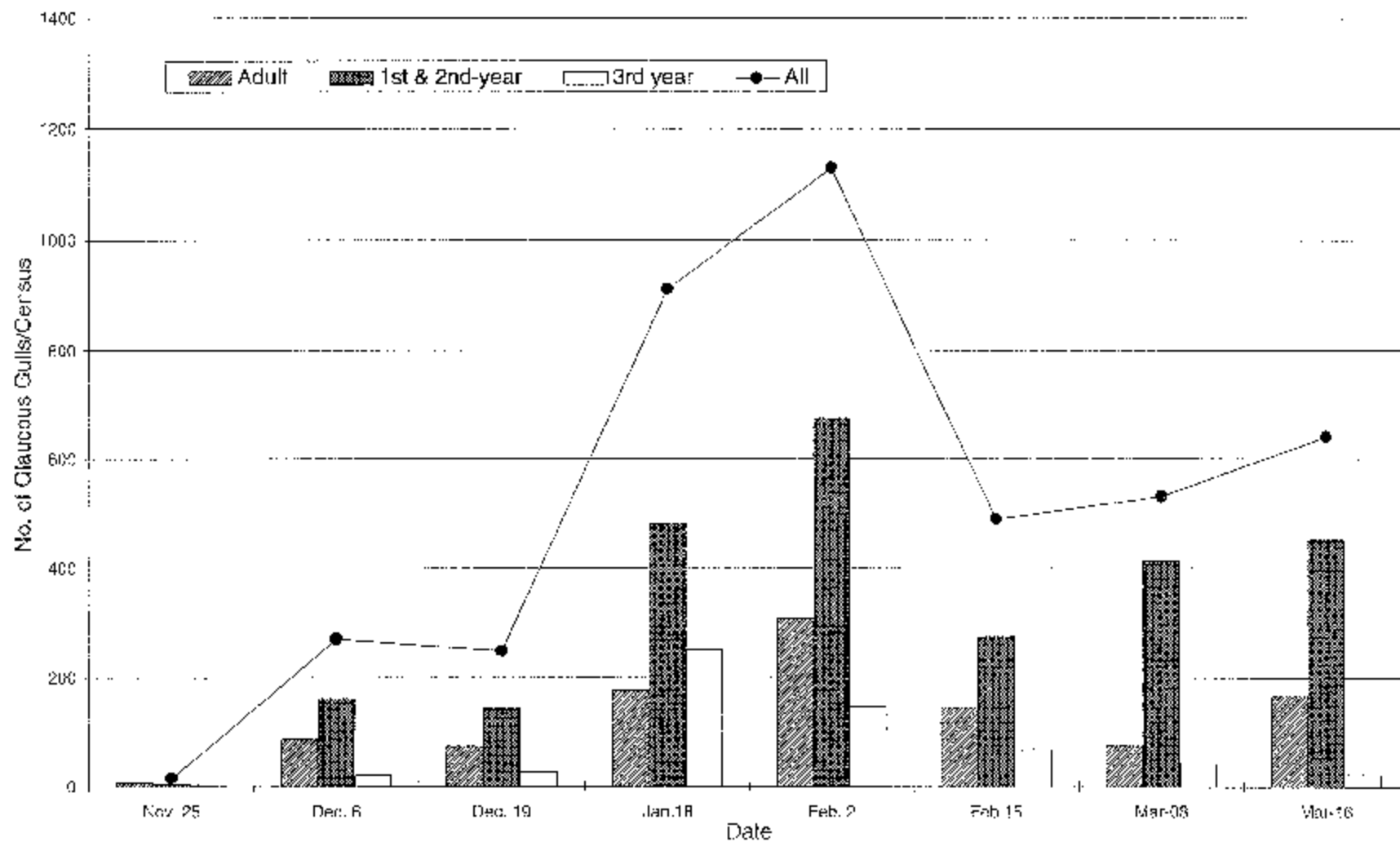


Figure 8 Age composition of Glaucous Gulls at Quidi Vidi Lake and Robin Hood Bay Landfill from 25 November 1994 to 16 March 1995.

year group was the most common, usually comprising between 53% and 78% of the Glaucous Gulls. The 3rd-year class was also well represented in the population.

POPULATION TRENDS

The present study determined the numbers of gulls in the St. John's region in the winter of 1994-95. When evaluating the potential effects of gulls on airport operations in the area, it is important to understand whether the numbers of gulls have changed in recent years. Of particular interest is whether the recent changes and closures in the Newfoundland fishery have had noticeable effects on gull numbers and behaviour. Gulls used to feed intensively around fishing boats and around coastal fish processing plants. Thus, the closure of much of the Newfoundland fishery starting in July 1992 has eliminated a major food source for gulls. There are no quantitative data from previous years to compare with the results of the present survey. In order to determine whether there have been recent changes in the numbers and/or behaviour of gulls, we interviewed knowledgeable persons with direct experience in the area.

Changes in gull numbers and behaviour in St. John's are difficult to quantify. With so many gulls present before the fisheries moratorium, it would be difficult to notice any changes unless they were drastic. No such drastic changes have been noticed by any of the people that were interviewed.

The manager of the Robin Hood Bay Landfill, Dave Barry, said that he had not noticed any changes in numbers. Then, after a moment of thought, he added that before the moratorium, there were times when the gulls were so thick that you could not see the equipment moving the garbage. However, this observation could simply be attributable to normal seasonal variations in gull numbers.

Jim Rowsel has been working in the Control Tower at the St. John's Airport since 1978. He did not think there had been a change in gull numbers at the airport since the moratorium.

Paul Linegar, Chris Brown, John Wells, Ken Knowles and the second author have been very active bird watchers in the St. John's area since the early 1980s, or earlier. Recent changes in gull numbers that have been noticed are an increase in Great Black-backed and Glaucous Gulls at the Robin Hood Bay Landfill and Quidi Vidi Lake in winter, and the increased boldness of Herring Gulls looking for food during June in the City of St. John's.

All observers were under the impression that the Great Black-backed Gulls began increasing in the winter at Quidi Vidi Lake a few years before the fishing moratorium was called. However, fish plants began closing around the province some years before the moratorium and at about the same time as the apparent increase in Great Black-backed Gulls. The large gulls like Great Black-backed and Glaucous do well at fish plants. It is possible that these gulls that had been at least partially dependant on fish plants in winter turned to the Robin Hood Bay Landfill for food.

At the time when Atlantic cod became very scarce off the northeast Avalon Peninsula, Herring Gulls became notably aggressive scavengers at garbage bags in residential St. John's. This behaviour was reported to local newspapers and television stations by numerous city residents. The behaviour is most prevalent in June and early July. Spawning capelin, a major food source for gulls during this time period, were also drastically reduced in numbers. This is probably at least part of the reason that Herring Gulls seemed hungry enough to tear open bags of garbage in residential areas. Pierotti and Good (1994) quote J. Chardine to the effect that Herring Gull numbers in Newfoundland declined in the early 1990s because of the crash in capelin stocks.

A recent study of Yellow-legged Gulls (similar to Herring Gulls) in the Spanish Mediterranean found that fledging success of gull chicks declined significantly in a year when there was a 2-month moratorium on commercial fishing that coincided with the chick-rearing period (Oro et al. 1995). In this case, the gulls switched to alternate aquatic foods rather than to garbage.

CONCLUSIONS

It is clear that the Robin Hood Bay Landfill is attracting thousands of large gulls, some of which have the potential to create hazards for aircraft using the St. John's Airport. Although the critical data have not been collected, it is apparent that gull behaviour during the winter freeze-up period is less likely to create bird hazards to aircraft problems than is the behaviour that occurs at other times of the year. This is related to gull use of the night roost on Little Bell Island and the use of Windsor Lake and Newfound Pond as day-use sites and as staging sites. During the late November and early December period of this study, gulls used Windsor Lake, and probably Newfound Pond, as staging sites on flights between the night roost at Little Bell Island and the Robin Hood Bay Landfill. These gulls passed through the

Approach/Departure Paths for Runways 16/34 and 02/20, south of the airport. When Windsor Lake froze, most gulls used Quidi Vidi Lake as the major staging area en route between the night roost and the landfill. This route did not pass close to the airport.

It should be noted that airport staff report that gulls are most numerous and difficult on the airport during the spring, summer and early fall. These observations refer to gulls landing on airport runways, taxiways and other airside locations. Needless to say, the presence of these gulls creates a hazard to aircraft safety and requires action by controllers on the airport. It is not known whether the gulls that land at the airport come directly from the Robin Hood Bay Landfill or whether they are the gulls that loaf and stage on Windsor Lake and Newfound Pond. Knowledge of the source of these birds may be important in determining whether gulls dispersed by a control program at the landfill will create an even more significant hazard.

Gulls that regularly fly through the aircraft approach/departure paths may be of even greater concern than the gulls that land at the airport. These gulls may not be noticed and are probably beyond the range of bird control efforts at the landfill. Regular flights between the landfill and Windsor Lake and Newfound Pond could create significant hazards to aircraft safety. There is a suggestion from the late autumn data that such flights might be common in the spring, summer and fall when Windsor Lake and Newfound Pond are ice-free. At present, there are no data on the existence or significance of this concern.

It is apparent from the data from "Christmas Censuses" in the region that the number of gulls wintering in the St. John's area is artificially inflated by the presence of the Robin Hood Bay Landfill. If the landfill were not present, or if it supported fewer gulls, then the numbers of gulls in the area would probably decline.

It is tempting to recommend that a gull control program be instituted at the Robin Hood Bay Landfill. However, achievement of control would be extremely difficult and the cost to make such a program effective on a long term basis would undoubtedly be quite high. Details of gull movement patterns in the area during the spring, summer and fall need to be assessed to determine whether hazardous gull flight patterns are occurring. If not, then aircraft safety may be maintainable through gull control at the airport itself. This would certainly be less expensive than controlling gulls at the landfill.

Finally, there is a risk that a gull control program at the landfill will lead to gull movement and behaviour patterns that will also create hazards to aircraft using the St. John's Airport. Gulls change their behaviour patterns in response to control programs at landfills. Knowledge of gull behaviour in the area is needed to determine if the new behaviour patterns are likely to pose significant safety problems. Hazardous patterns are most likely to occur if control at the landfill is only partially successful. For example, large numbers of gulls may attempt to loaf on the large airport rather than on the much smaller landfill with its increased levels of harassment.

Recommendations

Clearly, there is a significant concern about landfill-related gull hazards to the safety of aircraft using the St. John's Airport. The following approach is recommended to address this serious problem.

1. Study gull numbers and movements in the St. John's area to document bird hazard levels and to determine which gull behaviour patterns create the greatest risks to aircraft safety.
2. Based on the results of the above study, determine the best method for reducing hazards. The options include gull control at the Robin Hood Bay Landfill, increased gull control at the airport, gull control at loafing areas, etc. It is imperative that the risks associated with each control option be understood.
3. It is important that the various stakeholders communicate regularly to define the extent of the problem and to determine ways of alleviating the concern. At a minimum, the stakeholders include Transport Canada (responsible for air safety), St. John's Airport, and the City of St. John's (operator of the Robin Hood Bay Landfill).

LITERATURE CITED

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- Oro, D., M. Bosch and X. Ruiz. 1995. Effects of a trawling moratorium on the breeding success of the Yellow-legged Gull *Larus cachinnans*. *Ibis* 137:547-549.

APPENDIX 8

Federal Register notes, May 25, 1995

Federal Aviation Administration

Request for Comment and Information;
Draft Report to Congress on Potential
Hazards to Aircraft by Locating Waste
Disposal Sites in Vicinity of AirportsAGENCY: Federal Aviation
Administration (FAA), DOT.ACTION: Request for comment regarding
Report to Congress on the potential
hazards to aircraft by locating waste
disposal sites in the vicinity of airports.SUMMARY: This notice requests comment
to help fulfill a requirement in Section
203 of the Airport and Airway Safety
Capacity, Noise Improvement, and
Intermodal Transportation Act of 1992
(Public Law 102-581).Section 203(b)(2) directs the Secretary
of Transportation to conduct a study to
determine whether a municipal solid
waste facility, located within a 5-mile
radius of the end of a runway, has the
potential for attracting or sustaining bird
movements (from feeding, watering, or
roosting in the area) and poses a hazard
to runways or approach and departure
patterns of aircraft. The Secretary of
Transportation has directed the Federal
Aviation Administration (FAA) to
conduct this study.This notice solicits comments from
the public on a draft report, as directed
by Congress. The FAA believes a wide-
range of public views will be beneficial
in developing a comprehensive final
Report to Congress.DATES: Comments must be received by
June 26, 1995.ADDRESSES: Send all comments in
triplicate to: Airport Safety and
Compliance Branch, AAS-310, Federal
Aviation Administration, 800 Independence
Ave., SW, Washington, DC 20591.FOR FURTHER INFORMATION CONTACT:
Benedict D. Castellano, Manager,
Airport Safety and Compliance Branch,
AAS-310, Federal Aviation
Administration, 800 Independence
Ave., SW, Washington, DC 20591.SUPPLEMENTARY INFORMATION: The
Federal Aviation Administration (FAA)
maintains that there exists a potential
safety hazard when a waste disposal site
is located within 5,000 feet of a runway
used by piston-powered aircraft and
within 10,000 feet of a runway used by
turbo-engine aircraft. Additionally,
when a waste disposal site is located
within a 5-mile radius of a runway, such
site may be incompatible with aircraft
operations when the site attracts or
sustains hazardous bird movements
from feeding, watering, or roosting areas
into or across the runways and/orapproach and departure paths of
aircraft.In conducting the study mandated by
Congress, the FAA examined the history
of birds striking aircraft and reviewed
several scientific papers published on
the subject of landfills and birds. A draft
report has been developed which
outlines Federal regulations and
policies on the subject, and discusses
the basis of FAA criteria for siting of
landfills. The report contains FAA's
findings and future concerns. It includes
a recommendation for continuing the
current policy to object to the
establishment of waste disposal sites
within the criteria specified above.All comments received on this draft
report will be fully considered in the
development of the final report, to be
submitted to Congress.Issued in Washington, DC, on May 19,
1995.

Ray Uhl,

Acting Director, Office of Airport Safety and
Standards.Draft Report on the Potential Hazards
to Aircraft in Locating Waste Disposal
Sites in the Vicinity of Airport

Purpose

This report is submitted to Congress
in response to Section 203(b)(2) of the
Airport and Airway Safety, Capacity,
Noise Improvement, and Intermodal
Transportation Act of 1992 which
directs the Secretary of Transportation
to conduct a study to determine whether
a municipal solid waste facility, located
within a 5-mile radius of the end of a
runway, has the potential for attracting
or sustaining bird movements (from
feeding, watering, or roosting in the
area) and poses a hazard to runways or
approach and departure patterns of
aircraft.

Scope of Report

Because most wildlife movements are
seasonally influenced, a complete study
of the issues presented would require
that researchers document all wildlife
activity for at least 1 year. In order to
produce more credible information, at
least 3 years of study data would be
necessary to calculate valid statistical
averages. Given the limited time frame
specified in the Act for completing this
study, it was not considered feasible to
formulate and carry out a fully scientific
research project to address the issue of
siting landfills near airports. Instead,
this report was developed from
historical data, past studies, and
research on the incidents and accidents
involving bird strikes and aircraft, and
on the potential of solid waste disposalsites to attract and sustain bird
movements.Aircraft Bird Strikes Historical
BackgroundIt is generally agreed that birds and
aircraft are not compatible even though
they share the common thread of flight.
Bird strikes with aircraft were recorded
as early as 1912, when a Wright Flyer
crashed after striking a bird off the
Pacific coast. Calbraith Rodgers, the
pilot who drowned in the crash, became
the first aviation fatality attributed to a
bird strike.Developments over the last 80 years
have brought aviation to unprecedented
levels of sophistication. However, this
increased level of sophistication has not
provided aircraft with an immunity to
damages resulting from strikes with
wildlife. Modern aircraft carry more
passengers at greater speeds than ever
before, thus increasing the potential for
catastrophe. At high speed, even small
animals become damaging projectiles to
large aircraft. According to V.F.E.
Soloman, a noted Canadian bird hazard
specialist, a 4-pound bird struck at 260
knots exerts a force of 14 tons; at 520
knots, the force becomes 57 tons.Bird strikes have been responsible for
more than 100 deaths in the United
States. Some of the more notable
accidents that were attributed to bird
strikes included: On March 10, 1960, a
Lockheed Electra departing Boston's
Logan Airport struck starlings and
crashed, resulting in 82 deaths. In 1973,
a Learjet departing Dekalb-Peachtree
Airport in Georgia struck a flock of
cowbirds (small blackbirds) and
ingested them into the engines. Both
engines sustained compressor stalls,
causing the aircraft to crash, killing all
seven on board. On November 12, 1975,
a DC-10 departing John F. Kennedy
Airport ingested gulls on takeoff roll,
aborted the takeoff, caught fire, and was
completely destroyed. The accident
resulted in a number of injuries, but no
deaths. Fortunately, the 139 passengers,
who were airline employees, were able
to evacuate the burning craft quickly.Although it has been argued that these
accidents are no longer relevant and that
modern aircraft have become more
resistant to damage and disaster from
bird strikes, this is not the case. In 1988,
in Bahar Dar, Ethiopia, a Boeing-737 on
takeoff struck a flock of speckled
pigeons and crashed, killing 35
passengers and injuring 21 others.The reports that followed the
incidents mentioned above noted that
birds had been attracted by either waste
disposal operations or by trash on or
about the vicinity of the airport.
Following the 1973 Learjet crash, the

National Transportation Safety Board recommended that the Federal Aviation Administration (FAA) "implement a procedure for more stringent and continued surveillance of all facilities subject to the provisions of the Airport and Airway Development Act and impose timely sanctions against operators of facilities, which receive federal aid and do not fully comply with the requirements imposed upon them by the provisions of this act." A provision in the Act specifies that grant recipients, to the extent reasonable, maintain compatible land uses around an airport.

Whether or not a catastrophe results, bird hazards can be responsible for unnecessary risk and expense. The FAA receives an average of 2,000 bird strike reports each year. This reporting system is voluntary and does not reflect the total number of strikes or cost estimates of damage to aircraft or the aviation industry. It is generally accepted that more than half of all strikes go unreported. Far less information is received on cost estimates. Information regarding the amount of damage is seldom reported because pilots normally fill out the strike report before the actual extent of damage is determined.

However, damage to aircraft from birds can be severe and costly. According to a recent Environmental Impact Statement (EIS) for John F. Kennedy International Airport, after ingesting 1 bird, a Boeing-747 aborted its takeoff, blew 10 tires, and damaged the brakes while stopping. The resulting damage from this one incident cost the airline \$200,000. Additionally, the EIS reported that between 1979 and 1993, bird strikes caused 46 instances of engine damage, 22 instances of nonengine damage, and 51 aborted takeoffs (USDA 1994).¹

Landfills as Attractions to Birds

A number of scientific papers have been published regarding the association of birds and waste disposal operations. It is generally accepted that large numbers of birds commonly frequent landfills in search of food. In a recent study conducted by the United States Department of Agriculture's Denver Wildlife Research Center (DWRC) for the FAA, 699,477 individual birds of 42 species were recorded at 3 landfills in 958 observation periods (Bellant et al. 1994).²

¹ Final Environmental Impact Statement, Gull Hazard Reduction Program, John F. Kennedy International Airport, United States Department of Agriculture, May 1994, pp. 1-7, 1-10.

² Jerrold L. Bellant et al., "Gull and Other Bird Abundance at Three Mixed Solid Waste Landfills

Although gulls may be found at inland landfills, they are one of the more common bird species associated with coastal landfills. Additionally, crows, starlings, blackbirds, pigeons, sparrows, and vultures have been documented as common visitors to most landfills regardless of the location (Lake 1984).³

Bird populations that impact human health and safety have been less understood and documented. However, in 1971 the Environmental Protection Agency (EPA) released a report that surveyed land disposal sites reporting bird aircraft hazards. In the discussion section on page 26 it stated, "there is little doubt that improper solid waste disposal sites in many areas of the country contribute to the bird/aircraft strike hazard at airports." Furthermore, it was stated in the summary and conclusions that, "analysis of judgments following two lawsuits resulting from aircraft/bird strike accidents indicated a strong possibility that both government and a disposal site owner could be liable for an accident attributed to birds if the disposal site was knowingly attracting birds and contributing to the risk of bird/aircraft collisions" (Davidson et al. 1971).⁴ Considering the reports referenced above, FAA believes there is enough information available to support the conclusion that landfills are attractive to birds and that a potential hazard will exist whenever numbers of birds are drawn into or across air traffic corridors.

The FAA has initiated research to understand, identify, and manage potentially hazardous wildlife populations better on or near airports. Actual research is being completed under a contract with DWRC. DWRC is recognized as one of the most experienced organizations in the field of nuisance wildlife management. Although wildlife hazard research is currently underway, it remains in preliminary stages. This preliminary research will establish a solid data base that will be used for later comparisons.

More research is also needed to assess the effectiveness of wildlife control techniques. It is common for operators of waste disposal facilities to include wildlife control techniques in proposals to locate or expand operations in the vicinity of airports. These techniques

in Northern Ohio." OCT Interim Report, DTFA01-91-Z-02004, (1992), p. 23.

³ David W. Lake, "Airport Bird Hazards Associated With Solid Waste Disposal Facilities," Proceedings: Wildlife Hazards to Aircraft Conference and Training Workshop, (1994), p. 221.

⁴ George R. Davidson, Jr. et al., "Land Disposal Sites Near Airports Reporting Bird/Aircraft Hazards," Open-File Report, (TSR 1.8.004/0), U.S. Environmental Protection Agency, 1971, p. 2.

include the use of pyrotechnic devices, broadcast bird distress calls, and as a last resort, lethal control. Although these controls are often presented as being sufficient to offset any wildlife attraction caused by the landfill activity, there is little documentation that these controls will significantly mitigate the attractiveness of a landfill to birds over an extended period. Thus, there is no assurance that such efforts would actually alleviate a bird hazard near an airport should one arise after the landfill is constructed. There exists ample information regarding bird dependence on landfills. Conversely, there is little information documenting successful long-term mitigation of the problem.

Landfill Siting Near Airports

Locating a waste disposal site, particularly in and around urban areas, has become a very serious problem for most communities, from both physical and political viewpoints. As a result, there has been an increasing need to expand existing sites and establish new waste disposal facilities and landfills. A proposal to establish such a facility close to a populated or recreational area will, in most cases, result in considerable controversy and public opposition. Landfill proponents often consider or select sites located at the end of runways or in the vicinity of airports as solutions to these issues. These locations are often near, but outside, population centers; are noise impacted or otherwise unattractive for building development; provide readily available and inexpensive land; and generally provide a location with good road access. As a result, these sites stand a much greater chance of being accepted by the public for landfill use. Because of its concern that the attractiveness of these landfills to bird populations has a potential to impact the safety of aircraft operating to and from airports, the FAA has taken a number of actions and established policies and procedures to evaluate the impact of potential landfill sites adjacent to airports.

Federal Regulations, Policies, and Procedures

A. Federal Aviation Regulations Part 139. Airports which serve any scheduled or unscheduled passenger operation of an air carrier that is conducted with an aircraft having a seating capacity of more than 30 passengers are required by Federal Aviation Regulations Part 139 to have an airport operating certificate from the FAA. This certificate is only granted after the airport is inspected by an FAA airport certification inspector to ensure

that all minimum safety standards of Part 139 have been met. Under Section 139.337, all operators of certificated airports shall provide for "the conduct of an ecological study, acceptable to the Administrator, when any of the following events occurs on or near the airport: (1) An air carrier aircraft experiences a multiple bird strike or engine ingestion. (2) An air carrier experiences a damaging collision with wildlife other than birds. (3) Wildlife of a size or in numbers capable of causing an event described in paragraph (a) (1) or (2) of this section is observed to have access to any airport flight pattern or movement area." Based in part on this study, FAA may require the airport operator to formulate and implement a wildlife hazard management plan.

B. Order 5200.5A, Waste Disposal Sites On Or Near Airports. FAA issued Order 5200.5 on October 16, 1974, to provide internal guidance regarding FAA's official position on siting landfills near airports in an effort to reduce potential airport/wildlife hazards. The current Order 5200.5A, "Waste Disposal Sites On or Near Airports," and the original Order 5200.5, contain criteria concerning the establishment, elimination, or monitoring of landfills, open dumps, waste disposal sites, or other similar facilities on or in the vicinity of airports. Orders, such as 5200.5A, are internal directives that provides guidance to FAA employees. Advisory circulars are public information and may be instructive to those who receive grants from the FAA. These orders and advisory circulars have no authority over facilities located off airport property. Also, FAA has no authority to approve or redirect land use outside of the airport perimeter. For airports that receive Federal funds, the owner, operator, or grant recipient must comply with terms of the grant obligation to the extent reasonable to restrict the use of land adjacent to or in the immediate vicinity of the airport to activities and purposes compatible with normal airport operations. However, in most cases landfills are located outside the airport property and are often beyond the airport owner's jurisdictional control.

Order 5200.5A sets forth the policy that waste disposal sites are incompatible with aircraft operations when located within those areas adjacent to an airport that are defined through the application of the following three criteria: (1) when located within 10,000 feet of any runway end used or planned to be used by turbine-powered aircraft; (2) within 5,000 feet of any runway end used by piston-powered

aircraft; and (3) when located within a 5-mile radius of a runway end, such that it attracts or sustains hazardous bird movements from feeding, watering, or roosting areas into or across the runways and/or approach and departure paths of aircraft. Although frequent movements of birds across aircraft approach and departure paths could be a safety concern beyond the 5-mile radius, this distance was considered a reasonable limit for application of the FAA criteria. The earlier version of the FAA order had no such limit.

C. FAA Notification Requirements. To assist FAA in its ability to monitor the siting of landfills near airports, the Congress in 1992 enacted legislation to amend the Federal Aviation Act to allow the Secretary of Transportation to require that persons proposing to establish sanitary landfills notify the Secretary when such notice will promote safety and the efficient use or preservation of navigable airspace. A proposed FAA regulatory amendment will establish an area within a 5-mile radius from an airport for requiring such a notification.

D. EPA Notification Requirements. Because of safety concerns and a lack of jurisdiction, FAA actively sought the assistance of the EPA to consider airport safety concerns when processing landfill siting permits. FAA suggested that the criteria in Order 5200.5A be incorporated into EPA's revision of its solid waste disposal regulations. As a result of FAA comments, the EPA adopted a regulatory requirement in the Solid Waste Disposal Facility Criteria, 40 Code of Federal Regulations Section 258.10, that landfill owners or operators notify the affected airport and appropriate FAA office whenever they intend to expand or propose a new landfill within 5 miles of an airport. However, EPA chose not to prohibit landfill operations within the 5,000 and 10,000 foot distance criteria identified by FAA. Instead, it required operators within these areas to demonstrate to the State agency having the authority to issue the permit that the operation does not pose a bird hazard to aircraft.

Basis of FAA Criteria for Siting of Landfills

FAA believes that any open household or putrescible waste disposal activity within 5,000 feet of a runway serving piston-powered aircraft and 10,000 feet from a runway serving turbine-powered aircraft is incompatible with safe aircraft operations. Outside this criteria but within 5 miles of the runway edge, FAA will review proposed landfill locations on a case-by-case basis. Under these circumstances, if the

site falls directly under the approach or departure path or has the potential to increase birds in the active airspace, FAA will generally consider the site as being incompatible with the airport. If the site were located between the 10,000-foot limit and the 5-mile limit away from the approach or departure path and would not likely attract birds across the active airspace, FAA will not consider the site incompatible. During this case-by-case evaluation, factors such as the native bird populations, local geography, and the airport traffic patterns are considered.

The distance used in FAA's guidance is based on several factors. Bird strikes are voluntarily reported to FAA from ground level to several thousand feet above ground level (AGL). Most bird strikes occur below 500 feet with numbers diminishing to insignificant levels above 3,000 feet. Based on normal performance characteristics, departing aircraft should be at approximately 500 feet AGL after traveling 10,000 feet from the runway end and approaching 3,000 feet AGL at 5 miles. These distances and altitudes form the basis for the minimum criteria designated for a turbine-powered aircraft.

Criteria for piston-powered aircraft specifies a lesser distance of 3,000 feet due to different performance characteristics. These aircraft are slower and make more noise relative to a bird's ability to respond. The engine noise and slower airspeed allow the operator and bird more time to react and avoid striking each other. Additionally, piston-powered aircraft do not have engine intakes that can ingest birds.

The 5-mile area is specified in Order 5200.5A to allow FAA the opportunity to review the traffic patterns, geography, and juxtaposition of the proposed landfill site and airport. As birds do not respect minimum distances, this review provides FAA an early opportunity to comment on proposed disposal sites in critical air traffic areas immediately outside the 5,000 and 10,000 foot zones. The review also takes into account existing numbers of birds in the area and other natural, man-made, or geographical features such as refuges, water reservoirs, or coastlines that may be located across air traffic paths from the proposed disposal site. As a note of reference, the 5-mile radius is also used in other countries, such as Canada, which restricts landfill development within 8 kilometers, or 4.8 miles of an airport reference point.

Future Concerns

There are indications that bird species with the greatest potential to create wildlife hazards on airports are

increasing and that future resolutions to these hazards may become more complex. Certain species that frequent landfills, such as ring-billed gulls, are increasing in unprecedented numbers. At the same time, the public is becoming more involved in wildlife management issues. The National Environmental Policy Act may require public involvement in the solution of a wildlife-related airport safety problem. The public's involvement may be costly and time consuming, resulting in a trade-off of accepting potential hazards while possible solutions are debated.

The likelihood of bird strikes may be further exacerbated by design changes to modern aircraft, which incorporate larger inlet engines to achieve reduced noise levels. These larger, quieter engines give birds less warning and require them to avoid a larger surface area.

Findings

1. FAA believes that current data is insufficient to permit an accurate and consistent quantification of the risk created by locating landfills within 5 miles of an airport. Although a quantified risk assessment is not available, the potential hazard of bird strikes has been established in reports following aircraft accidents.

2. FAA believes that landfills constitute a potential hazard to aviation if located within 5 miles from a runway end for the following reasons:

a. Bird strikes in the vicinity of waste disposal activities located within 5 miles of an airport have been a factor in numerous accidents, some involving loss of human life.

b. Bird activity is generally recognized to occur at altitudes that brings it into the path of aircraft during approach and departure operations, the most critical time for aircraft performance.

c. Modern aircraft, with quieter engines and larger engine inlets, increase the potential for bird strikes due to the reduced warning resulting from quieter engines with greater frontal areas which combine to increase the chances of birds being struck or ingested.

d. Bird mitigation techniques, although offered as a solution, have not been proven effective over extended periods of time. In addition, future mitigation programs will become more complicated and require more time to implement, resulting in a trade-off of potential hazards.

e. Landfills are intense attractants to birds. When located in or adjacent to airspace used by aircraft, a potential hazard will result.

3. As total bird control is not possible, the best solution is to restrict actions on or in the vicinity of an active airport to reduce bird attractions.

4. The distance criteria contained in FAA Order 52.005A serve as a reasonable basis for determining the incompatibility of a landfill site with airport operations.

Recommendations

Although not a solution to all airport-related bird hazards, locating intense attractions to wildlife, such as landfills, outside the areas specified by the FAA reduces the risk of a potentially hazardous collision between aircraft and birds. Progress has been made toward this goal by the EPA. Although EPA stops short of prohibiting landfills within the 5,000 and 10,000 foot areas designated by the FAA, it does require that operators of existing municipal solid waste landfills within those areas demonstrate to the State agency that issues municipal solid waste permits that such units do not pose a bird hazard to aircraft. Additionally, proponents of new or expanded landfill sites within 5 miles of an airport must notify the affected airport and the FAA of their intentions.

In an effort to enhance aviation safety, FAA recommends that no new or expanded municipal solid waste or putrescible landfill be located within the FAA specified 5,000 and 10,000 foot criteria or in the approach/departure areas within 5 miles of an airport if deemed incompatible with safe aircraft operations.

IFR Doc. 95-12899 Filed 5-24-95; 8:45 am
BILLING CODE 4710-12-M

National Highway Traffic Safety Administration

Research and Development Programs Meeting

AGENCY: National Highway Traffic Safety Administration, DOT.

ACTION: Notice.

SUMMARY: This notice announces a public meeting at which NHTSA will describe and discuss specific research and development projects and request suggestions for agenda topics.

DATES AND TIMES: The National Highway Traffic Safety Administration will hold a public meeting devoted primarily to presentations of specific research and development projects on June 27, 1995, beginning at 1:30 p.m. and ending at approximately 5:00 p.m. The deadline for interested parties to suggest agenda topics is 4:15 p.m. on June 8, 1995.

Questions may be submitted in advance regarding the agency's research and development projects. They must be submitted in writing by June 19, 1995, to the address given below. If sufficient time is available, questions received after the June 19 date will be answered at the meeting in the discussion period. The individual, group, or company asking a question does not have to be present for the question to be answered. A consolidated list of the questions submitted by June 19 will be available at the meeting and will be mailed to requesters after the meeting.

ADDRESSES: The meeting will be held at the Ramada Inn, near Detroit Metro Airport, 8270 Wickham Rd., Romulus, MI 48174. Suggestions for specific R&D topics as described below and questions for the June 27, 1995, meeting relating to the agency's research and development programs should be submitted to the Office of the Associate Administrator for Research and Development, NRD-01, National Highway Traffic Safety Administration, Room 6206, 400 Seventh St., SW, Washington, DC 20590. The fax number is 202-366-5930.

FOR FURTHER INFORMATION:

NHTSA intends to provide detailed presentations about its research and development programs in a series of quarterly public meetings. The series started in April 1993. The purpose is to make available more complete and timely information regarding the agency's research and development programs. This tenth meeting in the series will be held on June 27, 1995.

NHTSA requests suggestions from interested parties on the specific agenda topics. NHTSA will base its decisions about the agenda, in part, on the suggestions it receives by close of business at 4:15 p.m. on June 8, 1995. Before the meeting, it will publish a notice with an agenda listing the research and development topics to be discussed. NHTSA asks that the suggestions be taken from the list below and that they be limited to six, in priority order, so that the presentations at the June 27 R&D meeting can be most useful to the audience. Please note that almost all of these topics have been discussed at the previous nine meetings to some extent and that presentations at the tenth meeting will be reports on current status, results, and plans.

Specific Crashworthiness R&D topics are:

Improved frontal crash protection problem analysis and program status, Advanced glazing research, Highway traffic injury studies, Head and neck injury research,

APPENDIX 9

Ontario Region Bird Survey

ONTARIO REGION BIRD SURVEY (a study of bird presence and control at two Ontario Airports)

INTRODUCTION

A year ago I set out what I was going to do to answer the questions of what birds were using the airports, what was attracting them there, how the control programs were working and what if anything could be done to improve them.

Birds were surveyed at and around Ottawa and North Bay Airports in several different ways and the data has been compiled and analyzed using SAS (a computer statistical analysis package) and some simple means calculations. I am now in the process of making sense of everything, for the report that will be completed by the end of next month.

Today I will present what I have completed.

OUTLINE

- 1. Bird Strike Statistics**
 - (a) Birds most often struck
 - (b) Relationship between Strikes and Flight Movements
 - (c) Birds likely to cause damage (species, size, number struck)
- 2. Survey of Birds Using the Airfield**
 - (a) Birds Utilizing the Airfield Surface
 - (b) Birds Utilizing the Space Above the Airfield
- 3. Survey of Birds <2km from Airport**
 - (a) Bird densities by habitat
- 4. Movement of Birds from adjacent landuse/habitats to airfield**
- 5. Bird Control**
 - (a) Relocation of North Bay Landfill.
 - (b) Comparison of Gulls on Airport Lawns and Lawns

- < 2 km from Airfield (OTTAWA)
- (c) Comparison of Birds Commuting to Airport from adjacent Building Sites (OTTAWA)
- (d) Comparison of Gull Presence and Commuting before and after relocation of Chip Stand (OTTAWA)

6. Conclusions and Recommendations

1. Bird Strike Statistics

First I looked at the statistics which have been kept since approximately 1977 to see which birds were the problems at the two airports.

OVERHEAD 1

(a) Birds most often struck

Many more birds have been struck at the Ottawa Airport. Ring-billed gulls are the biggest problem, followed by Snow Buntings and Sparrows. Swallows and Rock Doves are a lesser problem.

At North Bay Snow Bunting is the most commonly struck bird, but again there are much fewer strikes.

This list gave me an idea of which birds I should pay special attention to in the analysis of the survey results.

(b) Relationship between Strikes and Flight Movements

You may think that there are less strikes at North Bay because there are less flight movements. I plotted the annual movements against the annual strikes at the two airports and did a correlation test. A perfect correlation would be a 1 to 1 relationship, and for both airports, this is far from the case. In fact a straight line may be the best fit, because, as movements increase strikes stay fairly constant.

In the case of North Bay the more northerly latitude and lack of agricultural land likely result in less birds being in the area and thus less birds struck.

It would be interesting to include data for all Canadian Airports and see if the results are still the same. I hope to do this analysis and include it in the final report.

(c) Birds likely to cause damage (species, size, number struck)

This analysis is not complete. Results will be presented in the final report. What I feel is of interest is whether species struck, size of species struck or number of species struck is related to whether damage is caused. For

example--does the probability that damage will result from a strike increase as the size of the bird struck increases?

This is another analysis which may lend itself to a larger data set than the two airports as the number of strikes that result in damage is low.

2. Survey of Birds Using the Airfield

Birds at the airfield were looked at in two ways, birds on the ground or close to it, (flying from one spot on the ground to another) and Birds flying over the whole place "in transit" so to speak

(a) Birds Utilizing the Airfield Surface

1. Density of Birds

At both airports the observers drove transects scattered around the airport throughout the year and day to census the birds that were present. Density was compiled as per hectare (1 hectare being the average size of the transects). The airport was divided into three habitats--Pavement, Managed Grass (regularly cut) and Un-managed grass (annually cut).

About 25 different species were observed at each airport. As some species are only here for part of the year, I computed the mean densities from only the data for months when they are expected to be here. For example, Snow Buntings are in the Ottawa area from Oct. to April, thus data from the summer, was not used. Snow Buntings have an average density of 25/ha on managed grass. That means flocks can be smaller and also much larger. No other birds is ever present in such large numbers. However, some Crow, Rock Dove, Gulls, Horned Lark Bobolink etc. have means over 1 and can be present in larger numbers on occasion. Maximum flock sizes are in the final report.

Only 2 birds frequent the North Bay Airport in appreciable numbers--the Horned Lark and the Snow Bunting. I included the Water Pipit because there was an average of nearly 2 individuals in managed grass. However, this was only during the month of October, and this is an uncommon migratory bird.

For most of the year the Horned Lark is quite common. The Snow Bunting is common in all habitats in the winter, but again in smaller numbers than in Ottawa. You probably notice that Ring-billed gulls are absent. In fact not a single Ring-billed gull was present in any sample transect.

1. Habitat Preference

Recording the birds by habitat enables us to see where the most hazardous (often struck) birds tend to hangout. The top 2 (ring-billed gull and snow bunting) prefer both the runways and the adjacent managed grass (which in the case of the snow bunting is usually covered with some snow). The Rock

Dove is also more common on the paved surfaces. Swallows are everywhere. House Sparrows are found in managed and un-managed grass, while the field type sparrows (Savannah, Song and Vesper), frequent the longer grass areas. It is not clear from the statistics which sparrows are being struck. Although, as I noticed mostly House Sparrows on, over and near the runways I assume it may be them.

In North Bay, as expected, Snow Buntings are everywhere. The difference in length between the long (un-managed) short (managed) grass was less--grass did not grow as long. Thus these habitats may not have been as different here. The same situation occurs with the horned lark, which frequents the runways less, but equally prefers the long and short grass. The top two commonly struck species spend a significant amount of their time at the airfield in the managed grass sections.

(b) Birds Utilizing the Space Above the Airfield

1. Transit flights/15 min.

Here we looked at birds which flew over the airport on their way somewhere else. This should tell us if there is a flight path over the airport. For example birds flying from a roost to a daily feeding area. Observations were made for 15 minutes to the north and south of the tower so that most of the airports would be scanned.

I divided the flights observed up into winter, summer and migratory season. Overall, there is very little traffic over the airport. At any time during the year there is likely to be 1/2 a crow flying over every 15 minutes--but there can be as many as 21. In all times but summer there is likely to be one or two gulls flying over every 15 minutes and as many as 25.

Large flocks of Canada Geese are common in the spring and fall--with flocks as large as 360. These birds tend to be traveling over the western portion of the airfield, probably following the Rideau River.

There are even less birds in transit over the North Bay Airport. Only one bird, the crow, has a mean of 1/15 minutes, during the winter season. Gulls are not a problem, with 0.05 birds per 15 in the summer when they should be most common.

1. Direction of flights

An interesting aspect of the transit flight results was the direction the birds were flying, particularly at the North Bay Airport. When you look at all flocks observed (all species-54), birds are not flying randomly in all directions. A significantly large proportion of the flights are heading North and North-west.

Gulls are heading North and North West. With Crows the pattern is not as obvious. However it is interesting when you look at a map of the airport that...

North west is the direction of the old landfill which closed on July 1st, 1994, one month before sampling began at the airport.

3. Survey of Birds < 2 km from Airport

(a) Landuse/habitat Preference

The area around the airport was sampled in a similar manner to the airport, except that the sites were walked through instead of driven through. Many species were found, however a few showed up continuously. I have compiled densities (birds/area), and frequency of presence (chance of at least one of species being there) as for the airfield surveys, but there is not time to go into them.

For the birds which were present, often there was enough data to statistically determine the land use or habitat that the bird prefers. I will discuss mostly the Ottawa results. Building sites always included some lawn, pavement and or trees. These sites attracted Rock Doves, House Sparrows, House Finches, Starlings, Robins and Barn Swallows. Most of these birds nest in cavities or on platforms hence the desirability of buildings.

Managed grass (lawns) attracted mostly Crows and Gulls. Barn Swallows showed up in this group as well, probably because the golf course site also contained buildings.

Eating sites included two Chic Stands and a Drive Inn. These sites attracted many birds off and on but were the favorites of Grackles (often at the Drive Inn dumpsters) Mourning Doves in the gravel of the Drive Inn lot and Ring-billed Gulls at all the sites. Fields were preferred by Blackbirds and the small sparrows. Fields included corn, soybean, pasture and a shrubby old field.

Around the North Bay Airport, there were fewer birds and thus it was more difficult to statistically analyze the preference of the birds. Crows and Gulls were found at the Eating site, which here was the landfill. Ravens were common here too and also at the gravel pit. There just seem to be less birds around the airport which is reflected in low densities on the airport as noted above.

4. Movement of Birds from adjacent landuse/habitats to airfield

A 100m boundary between the airport and adjacent land uses was observed for 10 minute periods and all birds passing over "commuting" so to speak to the airfield were recorded. Whether a bird moves from an adjacent

land use to the airfield is important because birds which stay in these areas are not a problem, those that move back and forth to the airfield ARE.

These sites were a subset of the 'vicinity' sites (those that actually bordered the airport), and some wooded sites. Woods were excluded from the vicinity sampling because of the difficulty in surveying them and the assumption that if what is in there does not come out, it is not a problem. Again each bird was examined statistically to see which habitat contributed more of the particular bird species. Barn Swallows, Starlings, Rock Doves and House Sparrows, as expected from part 3, came from buildings. Red-winged Blackbirds came from everywhere but buildings. Only Crows came out of the woods.

Managed Grass contributed Barn Swallows and Starlings. The only Managed Grass site which bordered the airport was the Hylands Golf course which contains buildings, that could have contained Barn Swallow nests.

The chip stand, which used to be at the north west corner of the airport contributed more gulls than any other land use. It was not uncommon for birds to fly from the north field when a gull became vocal upon the availability of food.

Some interesting relationships come to light when I associated the 'commuting' results with something else I did to the habitat preference data from the airport surveys. For each habitat (P, M & U) I looked at the bird counts from the sites which made them up to see if any species preferred some sites within a habitat over others. I also did the same for the 'commuting' data to see if certain sites within a habitat contributed more of any species.

There were four building sites. Site 10, (First Air Hanger) contributed the most Barn Swallows and Barn Swallows preferred 2 of the 8 paved surfaces surveyed, both located to the south of the First Air Hanger---and was found significantly more in 2 of the 7 managed grass sites surveyed also in the same general area of the same hanger.

Although only one 'Eating' site was located on the airport boundary, it is interesting that the gulls were found most often on the 2 paved sites, which were in the North Field. The one managed grass site preferred significantly out of the 7 sites within that habitat was also in this northern portion of the airport.

5. Bird Control

(a) Relocation of North Bay Landfill

There is no data for number of birds before the Landfill relocated as the study began right after it was moved (July 1st, 1994). However, the

Airport keeps detailed records of how many birds of each species were shot and how many were scared off by various methods.

I totaled the number of gulls shot and scared off for each month and then compared the mean before closure (1988 to 93/94) to the mean after the site closed. Although I don't have all the data from closure to present yet, I performed the analysis on the months where I had data for at least one month after relocation.

I kept the months separate to better compare periods when bird abundances should be similar. There is a big difference for all months. The mean after the landfill left is less than any year it was there and falls well outside of the deviation from the mean expected, given the fluctuation in mean number shot or scared in previous years.

Given equal effort has been put into the control of gulls in all years, this clearly indicates moving the landfill away from the airport significantly reduced the number of gulls on the airfield.

**(b) Comparison of Gulls on Airport Lawns and Lawns
< 2 km from Airfield (OTTAWA)**

Presumably if birds are being controlled on the airport, their numbers should be less than in similar places off the airport. The only habitat that is similar is the managed grass (lawns). Therefore I compared lawns on and off the airfield. I compared the Ring-billed Gull because it is the focus of much control effort as well as the most hazardous species and common on lawns.

There were 7 managed grass sites on the airfield and 3 in the vicinity (a golf course, a school yard, and a large field on the DND base).

The general linear model was highly significant $F=5.79$; $p=0.0001$. The mean for the 3 non airport sites was 1.58 birds per ha and 0.09 birds per ha on the airfield. Or to think of it in whole birds 158 gulls/100 ha off airfield and 9 per/100 ha on the airport.

I used a T test to compare all sites on airfield to all sites off a rfield. The school yard contributed most to the higher mean for the off airport sites. The large lawn was in the middle and the golf course contributed the least. School yards potentially offer garbage which is positive for gulls and golf courses have trees interspersed amongst the grass which is negative for gulls.

(c) Comparison of Birds Commuting to Airport from adjacent Building Sites (OTTAWA)

Four building sites were adjacent to the airport. Two hangers, an office building/hanger and the control tower/office complex. Initial examination of the data show that overall less birds commute from the control tower/office complex, which was designed to deter nesting than from the other 3 buildings. More statistical analysis is needed on this part, however, in examining the buildings preferred by the different species none preferred the tower/office building.

(d) Comparison of Gull Presence and Commuting before and after relocation of Chip Stand (OTTAWA)

In May of 1995 the large chip stand located at the North-west corner of the airport was relocated a few blocks to the north. There was a significant difference in not only the number of gulls at this site before and after the move but in the number of commutes as well. Airport staff felt there were less gulls in the North field, however, gulls appeared in the data so infrequently anyway that no relationship was clear between chip stand move and gulls on the airfield. However, I believe this can be inferred from the drop in commutes.

6. Conclusions and Recommendations

1. There generally are not large numbers of birds on the airfields, especially in North Bay. The exceptions are Snow Buntings which are often present in large flocks in winter and gulls in occasional large flocks in summer.
2. Ring-billed gulls are attracted to grass cutting in exceptionally large numbers. The numbers drop off the next day. Grass should be cut at night.
3. Four of the most hazardous birds (Ring-billed Gull, Snow Bunting, Swallow & Rock Dove) occur often short grass and not longer grass. If these birds increase in abundance the airports may consider keeping the grass longer (done other places). The birds which prefer the longer grass are not those which are often struck. The Snow Bunting is looking

for grit and weed and grass seeds and its control is less clear.

4. There are no large flocks of birds regularly flying over either airport. The Ottawa tower should be aware that Canada Geese are passing by in the spring and fall and that they feed in fields to the south of the airport and follow the Rideau river to and from the Ottawa River.
5. Transit flights in North Bay head toward the old landfill site (perhaps old habits are hard to break), and presumably there was even more bird traffic when the landfill was active. Control of gulls (and other birds too) has become less necessary since relocation. Landfills should not be permitted near airports.
6. Buildings attract cavity and platform nesting birds such as Rock Doves, House Sparrows and Starlings which have been involved in bird strikes. These birds move actively and often to the airfield and back. This does not occur when active steps are taken to deter nesting. Buildings near the runways should be designed or adapted to deter these species.
7. There are less gulls on lawns around the Ottawa Airport than on it, therefore bird control is having an effect.
8. Landuses where food is available outdoors (in addition to landfills) such as chip stands outdoor markets and cafe's, and drive inns should not be allowed near an airport, or at the very least be subject to strict rules

APPENDIX 10

Calgary International Airport Bird and Wildlife Study

Calgary
International
Airport
Bird & Wildlife Study

Goals & Objectives

Phoenix Wailer Evaluation

Bird & Wildlife Inventory

- Bird Checklist**

- Risk Evaluation**

- Recommendations**

Examination of Regional Influences

- Location of Bird Hot Spots**

- Land Use Issues**

Bird Checklist

Study Area

Airside

Groundside

Vicinity

Nesting Status

Confirmed

Probable

Possible

Relative Abundance by Season

Additional Information

Expected and Possible Species

Population Status

COSEWIC Status

Checklist of the Birds of the Calgary International Airport and Surrounding Area

	Dec 16 Mar 15	Mar 16 Apr 30	May 1 Jun 15	Jun 16 Jul 31	Aug 1 Sep 15	Sep 16 Oct 31	Nov 1 Dec 15
Canada Goose	...	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■
Mallard		■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■
Bald Eagle	■	■				■	■
Northern Harrier		■	■	■■	■■	■■	■
Swainson's Hawk		(■)	■■	■■■	■■■	■■	
Red-tailed Hawk		■■	■■	■■	■■	■■	
<i>Ferruginous Hawk</i>		(■)	■	■	■	■	
Rough-legged Hawk	■	■■*				■■	■■
Franklin's Gull		■■■■	■■■■■	■■■■■	■■■		
Ring-billed Gull		■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■
California Gull		■■■	■■■	■■■	■■■	■■■	
Herring Gull		(■■)			(■■)	(■■)	

Legend

Species	Nesting Status
bold	confirmed
<u>underlined</u>	probable
<i>italicised</i>	possible

Abundance	
■	0-5 individuals
■■	6-25 individuals
■■■	26-75 individuals
■■■■	76-250 individuals
■■■■■	greater than 250 individuals

Calgary International Airport Bird Strikes by Species

	1994	1993	1992	1991	1984-88	Total	Percent
Gull	0	13	1	5	42	61	35.5
Duck	4	2	3	1	6	16	9.3
Hawk	3	2	0	1	8	14	8.1
Owl	0	2	0	0	4	6	3.5
Pigeon	0	3	0	0	1	4	2.3
Goose	1	0	0	1	0	2	1.2
Lark	0	0	0	0	2	2	1.2
Crow	1	0	0	0	0	1	0.6
Sparrow	0	0	0	1	0	1	0.6
Kestrel	0	0	0	0	1	1	0.6
Sandpiper	0	0	0	0	1	1	0.6
Bluebird	0	0	0	0	1	1	0.6
Unknown	9	2	11	8	32	62	36.1
Total	18	24	15	17	98	172	

Source: Bird Strikes to Canadian Aircraft [1984-88, 1991, 1992, 1993, & 1994 Summary Reports], Transport Canada, Airports, Environmental Services, Safety and Technical Services

Risk Evaluation

Abundance

Occurrence

Flocking

Behaviour & Habitat

Runway Usage

Habituation

Evasive Response

Weight

Abundance

More Birds $\Rightarrow$ More Conflict

Calculation:

Average Abundance from Checklist

Checklist Symbols Converted to Numbers

■	= 1
■■	= 2
■■■	= 3
■■■■	= 4
■■■■■	= 5
■■■■■	= 3½ (1 for each large square, ½ for each small square)

Adjusted for Vagrants and Probables

Result is Doubled and Rounded

Example: RING-BILLED GULL

Checklist Abundance

Dec 16 Mar 15	Mar 16 Apr 30	May 1 Jun 15	Jun 16 Jul 31	Aug 1 Sep 15	Sep 16 Oct 31	Nov 1 Dec 15
	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■

$$\text{Average} = (5 + 5 + 5 + 5 + 5 + 2\frac{1}{2}) / 6 = 4.51$$

$$\text{Abundance Rank} = 9$$

Occurrence

More Often $\Rightarrow$ More Conflict

Calculation

Months of Year or Proportion of Day

Number of Months Present in Calgary Area

Vagrants score 0

Visitors and Erratics are Halved

Scores over 10 are reduced to 10

Example: RING-BILLED GULL

mid-March to end November = $8\frac{1}{2}$ months

Occurrence Rank = 9

Flocking

Flocking $\Rightarrow$ Trouble

Calculation

Amount of Time in Flocks

Size of Flocks

Flock Size		Flock Score
1-2	solitary or in pairs (= non-flocking)	0
3-15	small	1
16-50	medium	2
51-200	large	3
>200	very large	4

20% Time Slices

Allocate Time Slices to Flock Sizes

Multiply Number of Slices by Flock Score

Maximum score = 16 (Starling)

Multiply Result by $\frac{2}{3}$ and Round

Scores over 10 are reduced to 10

Example: RING-BILLED GULL

Flock size	1-2	3-15	16-50	51-200	>200
Time slices	0	1	1	2	1
Flock score	0	1	2	3	4
Slice score	0	1	2	6	4

Score = 13

Multiply by $\frac{2}{3}$ and round

Flocking Rank = 9

Behaviour & Habitat

Runway Usage

Feeding, Flying or Loafing
Near Runways and Flight Paths

Habituation

Learning to Avoid Aircraft
Uncommon Species $\Rightarrow$ Low Habituation
Few Natural Predators $\Rightarrow$ Low Habituation

Evasive Response

Mobility in Flight
Large and Slow $\Rightarrow$ Bad Evasive Response
Dense Swirling Flocks $\Rightarrow$ Bad Evasive Response

Calculation

0-4 Scale

"0" = Good (Low Conflict)

"4" = Bad (High Conflict)

Scores Added

Scores over 10 are reduced to 10

Example: RING-BILLED GULL

Runway Usage	Habituation	Evasive Response
4	3	2

Behaviour & Habitat Rank = 9

Weight

Does Not Directly Increase Conflict

Large Bird $\Rightarrow$ More Damage

Calculation

Male Weight $\neq$ Female Weights $\Rightarrow$ Use Heavier

Rank	Weight Range (grams)
0	< 15
1	15 - 30
2	30 - 60
3	60 - 90
4	90 - 180
5	180 - 270

Rank	Weight Range (grams)
6	270 - 540
7	540 - 810
8	810 - 1620
9	1620 - 2430
10	> 2430

Example: RING-BILLED GULL

Females Weigh 471 grams

Males Weigh 566 grams

Weight Rank = Male Rank = 7

Total Risk Calculation

Rank Scores Added

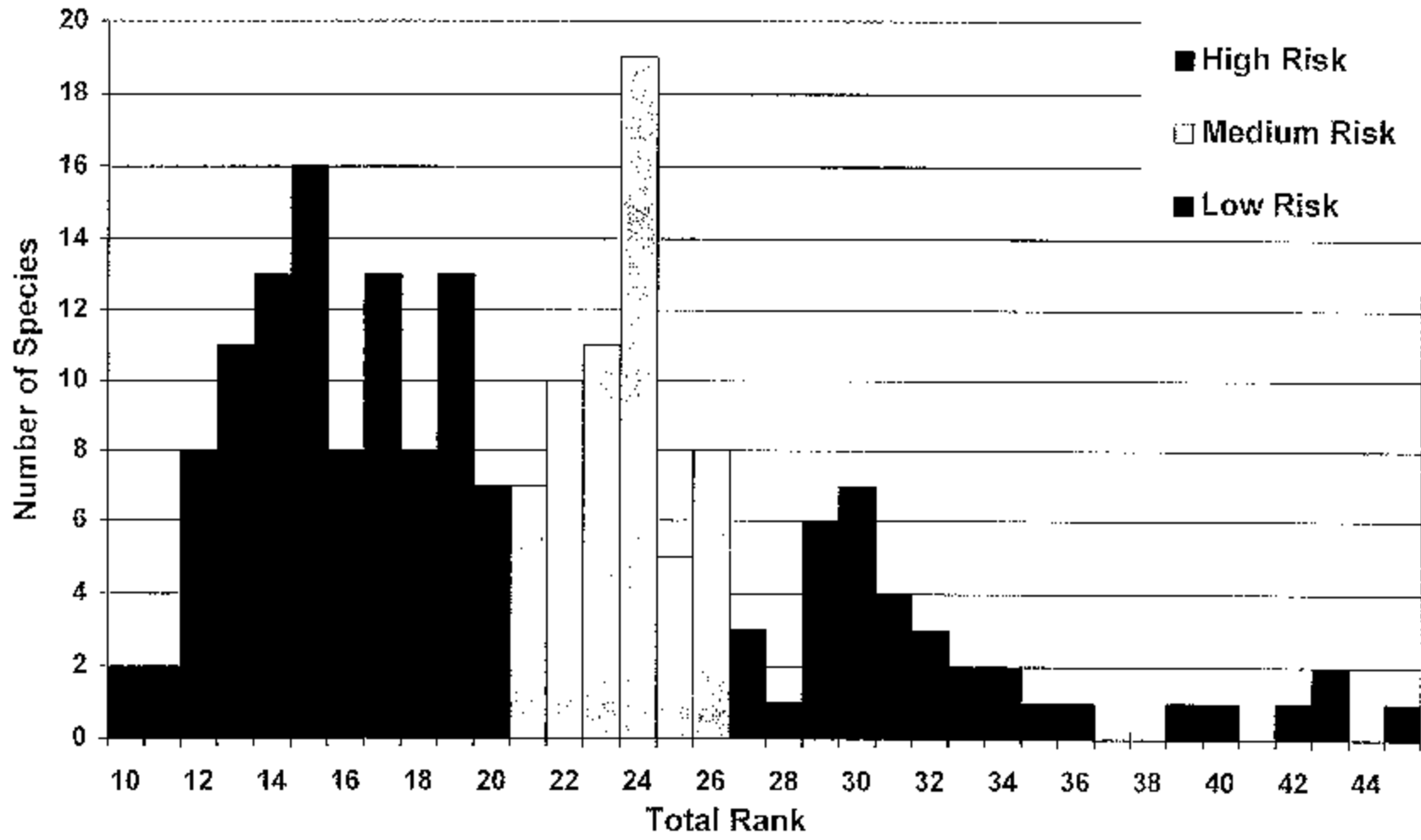
Example: RING-BILLED GULL

Abundance Rank	Occurrence Rank	Weight Rank	Flocking Rank	Behaviour Rank	Total Rank
9	9	7	9	9	43

Divided Into Low, Medium and High Risk

Risk Ranking	Total Rank
Low	0-20
Medium	21-26
High	27-50

Distribution of Total Rank Scores



High Risk Species

Canada Goose
* Green-winged Teal
* Mallard
* Northern Pintail
* Blue-winged Teal
* Northern Shoveler
* Gadwall
* American Wigeon
* Canvasback
* Redhead
Lesser Scaup
* Ruddy Duck
* Swainson's Hawk
* Red-tailed Hawk
* Gray Partridge
* American Coot
* Killdeer
Franklin's Gull
Mew Gull

Ring-billed Gull
California Gull
Herring Gull
Thayer's Gull
* Rock Dove
* Horned Lark
Cliff Swallow
* Black-billed Magpie
* American Crow
* Common Raven
* European Starling
* Savannah Sparrow
Snow Bunting (Visitor)
* Red-winged Blackbird
* Yellow-headed Blackbird
* Brewer's Blackbird
* House Sparrow

Medium Risk Species

Horned Grebe			
Leared Grebe			
American White Pelican	Vagrant		
Great Blue Heron	Visitor		
Black-crowned Night-Heron			
Tundra Swan	Vagrant		
Trumpeter Swan	Vagrant		
Greater White-fronted Goose	Vagrant		
Snow Goose	Vagrant		
Cinnamon Teal			
Eurasian Wigeon	Vagrant		
Ring-necked Duck			
Common Goldeneye			
Bufflehead			
Common Merganser	Visitor		
Bald Eagle	Visitor		
Northern Harrier			
"Hartan's Hawk"			
Ferruginous Hawk	Visitor		
Rough-legged Hawk	Erratic		
Golden Eagle	Visitor		
Merlin			
Peregrine Falcon	Visitor		
Gyr Falcon	Visitor		
Sandhill Crane	Vagrant		
Black-bellied Plover			
American Avocet			
Greater Yellowlegs			
Lesser Yellowlegs			
Solitary Sandpiper			
Willet			
* Spotted Sandpiper			
Marbled Godwit			
Semipalmated Sandpiper			
Least Sandpiper			
Baird's Sandpiper			
Pectoral Sandpiper			
Stilt Sandpiper			
Short-billed Dowitcher			
Long-billed Dowitcher			
* Common Snipe			
Wilson's Phalarope			
Bonaparte's Gull			
Great Horned Owl		Visitor	
Snowy Owl		Erratic	
Long-eared Owl			
* Short-eared Owl		Erratic	
Tree Swallow			
* Barn Swallow			
American Robin			
American Pipit			
Cedar Waxwing			
Chipping Sparrow			
* Clay-colored Sparrow			
* Vesper Sparrow			
* Le Conte's Sparrow			
Lapland Longspur		Visitor	
* Western Meadowlark			
* Brown-headed Cowbird			
Common Redpoll		Erratic	

APPENDIX 11

Bird Hazards to Aviation: Possible New Safety and R&D Projects

1. Transport Canada Publication No. TP 11655E		2. Project No. 8091		3. Recipient's Catalogue No. CP136/CP173	
4. Title and Subtitle Reduction of Bird Hazards to Aircraft — Research and Development of Strobe Light Technology as a Bird Deterrent				5. Publication Date December 1993	
				6. Performing Organization Document No. CP173	
7. Author(s) J. Green, J. Bahr (Delta Group) and R. Erwin, J. Buckingham, H. Peel (Southwest Research Institute)				8. Transport Canada File No. ZCD1450-121	
9. Performing Organization Name and Address Delta Environmental Management Group Ltd. 1075 West Georgia, Suite 2630 Vancouver, B.C. V6E 3C9				10. DSS File No. XSD92-00127-1635	
				11. DSS or Transport Canada Contract No. T8200-2-2593/01-XSD	
12. Sponsoring Agency Name and Address Transportation Development Centre (TDC) Guy Favreau Complex 200 René Lévesque Blvd. West West Tower, Suite 601 Montreal, Quebec H2Z 1X4				13. Type of Publication and Period Covered Final	
				14. Project Officer Trevor Smith	
15. Supplementary Notes (Funding programs, titles of related publications, etc.) This research was funded by the Department of National Defence (CRAD) and Transport Canada Airports Group (AKKP).					
16. Abstract A two-phased assessment of the effectiveness of strobe lights to reduce bird strikes to aircraft was conducted from 1990 to 1993. Phase I included the construction and subsequent laboratory testing of a strobe device to assess bird reactions and determine the optimum strobe light design. Phase II was to have involved the in-flight evaluation of an airborne version of the strobe device. The Phase I tests demonstrated that test birds were aware of and responded physiologically to strobe light stimuli (i.e., significantly increased heart rates). It was concluded that if birds were to associate the strobe light with a threatening stimulus such as an approaching aircraft, the proposed strobe deterrent may be an effective means of reducing the potential for bird strikes to aircraft. Fifteen test options were subsequently evaluated for use during Phase II, two of which were recommended for in-flight testing of a strobe device. Neither option was considered to be financially or technically acceptable by TDC, and the project was terminated in December 1993. Although the Phase I study established a basis and design for aircraft-mounted strobe light deterrents, it is still not known if strobe light systems can effectively reduce the potential for bird hazards to aircraft. Further research and development is recommended.					
17. Key Words Birds, hazard, aviation, safety, strobe, light, deterrents			18. Distribution Statement Limited number of copies available from the Transportation Development Centre		
19. Security Classification (of this publication) Unclassified		20. Security Classification (of this page) Unclassified		21. Declassification (date) —	22. No. of Pages 90 + apps.
				23. Price —	

EXECUTIVE SUMMARY

During the late 1980s, Transport Canada, as the federal department responsible for aircraft safety, expressed interest in evaluating the potential of strobe light technology for reducing bird strikes to aircraft. Transport Canada's Transportation Development Centre (TDC), in collaboration with National Defence and Transport Canada's Airport Group, subsequently undertook a phased program to develop and evaluate the potential for strobe light technology to reduce bird strikes to aircraft.

Following a review of existing information on the responses of birds to strobe light stimuli, a two-phased project was initiated. Phase I included the construction of an experimental strobe device, and laboratory testing of this device to assess bird reactions and determine the optimum strobe light design to maximize reactions of birds to strobe lights. Phase II was intended to include the construction and in-flight evaluation of an airborne version of a strobe device.

This report describes the research undertaken in Phase I and the major findings. Recommendations for undertaking Phase II, particularly the airborne system design parameters and the test plan, are also discussed. At the decision of the Transportation Development Centre, the project did not continue to Phase II for financial and technical reasons.

Study Design and Approach

The Phase I laboratory assessment involved intensive and systematic evaluation of the responses of Laughing Gulls to specific combinations of strobe frequencies and colours, as well as a variety of additional shorter tests to assess the responses of Laughing Gulls and American Kestrels to alternative strobe light specifications. The following tests were completed during Phase I:

- The main test involved a full factorial design consisting of four strobe frequencies (5 Hz, 9 Hz, 15 Hz, and 50 Hz) and four wavelengths (white, magenta, blue and yellow). Twelve (12) replicates of each factor level combination were completed for Laughing Gulls (i.e., 4 frequencies x 4 colours x 12 replicates = 192 tests).
- The additional tests which were completed after the main test included:
 - Exposure of Laughing Gulls (12 replicates) and American Kestrels (12 replicates) to an array of four flash tubes with alternating white/magenta lights, randomized frequencies (5 Hz, 10 Hz, 15 Hz, and 20 Hz), and simulated motion;
 - Exposure of Laughing Gulls (12 replicates) and American Kestrels (12 replicates) to an array of two flash tubes with alternating white/magenta lights and randomized frequencies (5 Hz, 10 Hz, 15 Hz, and 20 Hz);

- Exposure of Laughing Gulls (12 replicates) to two flash tubes with white lights and increasingly faster strobe flashes within a low frequency range (i.e., 0.5 Hz, 1.0 Hz, 1.5 Hz and 2.0 Hz);
- Exposure of 6 uncaged Laughing Gulls to strobe light stimuli consisting of four flash tubes with alternating white/magenta lights, randomized frequencies (5 Hz, 10 Hz, 15 Hz, and 20 Hz) and simulated motion; and
- Assessment of the heart rate and behavioural responses of Laughing Gulls to an audio recording of barking dogs.

Important Conclusions from the Laboratory Assessment

Important conclusions derived from the Phase 1B laboratory study include:

- Strobe lights produced detectable physiological responses in birds. Strobe light stimuli, regardless of the wavelength (colour) or frequency, did elicit a strong and statistically-significant increase in heart rates. On average, Laughing Gulls showed an increase of 45.4 beats per minute. Average time to maximum heart rate was 3.5 seconds.
- Laughing Gulls with low baseline heart rates showed significantly larger increases in heart rates than did birds with high baseline heart rates.
- Higher strobe frequencies (i.e., 50 Hz) elicited a significantly faster heart rate response (i.e., time to maximum heart rate) than the lower strobe frequencies (i.e., 5 Hz). In contrast, data trends suggested that lower frequencies elicited larger increases in heart rates than did high frequencies.
- Although differences in heart rate responses of Laughing Gulls to strobe light colours (i.e., wavelengths) were not significant, data trends suggest that white strobe light may elicit larger and more rapid increases in heart rates over baseline heart rates than other colours elicit.
- Moving strobe lights (i.e., the four flash tube test) appeared to elicit stronger heart rate responses than those elicited by a stationary strobe light (i.e., the two flash tube tests). Data trends suggested that a four flash tube - red/magenta strobe light with simulated motion (i.e., a randomized firing sequence for the four xenon tubes) produced larger and faster heart rate responses than those produced by a two flash tube - red/magenta strobe light.
- Of all the strobe light combinations tested, the system that simulated a two flash tube - increasingly faster strobe flashes (within a low frequency range) appeared to be the least effective in eliciting changes in heart rate.
- Overt behavioural responses by caged and uncaged Laughing Gulls were restricted to minor head movements and pacing. Some birds showed no

behavioural responses. The radio-telemetry harnesses and caging of the test birds were believed to have restrained behavioural responses by test birds.

- Heart rate data suggest that habituation may have occurred in Laughing Gulls which were repeatedly tested, but that the decrease in heart rates during successive tests was extremely small.

The Phase 1 tests clearly demonstrated that test birds were aware of and responded physiologically to strobe light stimuli. The documentation of significant heart rate responses in test birds in absence of overt avoidance (physical) responses suggests that while strobe lights may be effective in attracting the attention of birds (i.e., increasing awareness), they do not generally result in obvious fright responses by birds when isolated from other threatening stimuli.

On the basis of our Phase I study and other studies on the responses of birds to aircraft stimuli, we conclude that the association of the strobe light with other threatening stimuli such as an approaching aircraft may be effective in:

- Increasing the awareness of birds to an approaching aircraft; and
- Increasing the distance at which birds become aware of an approaching aircraft, thereby increasing the period of time in which birds may take evasive action away from the approaching aircraft. This could result in most birds strikes becoming near misses.

If birds were to associate the strobe light with a threatening stimulus such as an approaching aircraft (i.e., 'negative' habituation to a stimulus), we believe that the proposed strobe light deterrent could be an effective means of initiating evasive responses in birds and reducing the potential for bird strikes with aircraft during take-off roll and landing, and in flight.

Recommended Design Specifications for a Strobe Light Deterrent

Based on the results of existing research and our Phase 1 tests, we recommend that the following strobe light specifications be utilized in an aircraft-mounted strobe system during the Phase II studies:

- Strobe Frequency
A randomized selection of at least two strobe frequencies should be used, which combine a low range (i.e., 5 to 15 Hz) and a high range (i.e., 50 Hz) strobe frequency. Based on the results of the Phase I study, such a combination would produce both a higher physiological response (i.e., increased heart rates), and a faster physiological response (i.e., increased time to maximum heart rate). A range of frequencies may also affect a broader range of bird species than would a single frequency.

- Strobe Light Colour

Alternating white/magenta lights should be used in combination with the alternating frequencies recommended above. Whereas the Phase I tests support the use of white strobe lights, other relevant studies support the use of magenta or white strobe lights.

- Strobe Intensity

Given the inverse relationship between the perceived intensity of a strobe light and strobe frequencies, the light should be as bright as possible.

- Simulated Motion

As moving strobe lights appear to elicit larger and more rapid changes in heart rates than stationary lights, and may be useful in attracting attention to the strobe light and any stimuli associated with the strobe light (e.g., an approaching aircraft), it is recommended that light motion be achieved or simulated through wide-spacing of separate flash tubes or randomized flashing of flash tubes.

Assessment of Test Options for Phase II

Following the completion of the Phase I laboratory study, The Delta Group, in cooperation with the Southwest Research Institute, undertook a detailed assessment of fifteen (15) research options (6 ground-based methods and 9 in-flight methods) for evaluation of the responses of birds to strobe light deterrents. Two in-flight testing methods were recommended for use during the Phase II program. Option 5 would involve tracking of individual groups of birds with an aircraft-mounted radar during approach of the aircraft towards individual groups of birds. Option 9 would involve focused monitoring of a fleet of aircraft under real operating conditions. Neither option was considered acceptable to the Transportation Development Centre, and the project was terminated in December 1993.

Final Conclusions

Although the Phase I laboratory study established a basis and design for aircraft-mounted strobe light technology, it is still not known whether an aircraft-mounted strobe light system can effectively alert birds to approaching aircraft, thereby reducing the potential for bird hazards to aircraft. Further research and development is recommended.

APPENDIX 12

SICA Safety Review



SICA SAFETY REVIEW

Presentation By Terry Kelly

PRESENTATION OVERVIEW

- **System Safety and Safety Reviews**
- **Findings**
- **Recommendations**



ROLE OF SYSTEM SAFETY

- Independent safety advisor
- Clients
- Independent risk assessments
- Product: Effectiveness of Mitigation

SICA SAFETY REVIEW

- Team composition
- Aim
- Method

RISK ASSESSMENT

- **References:**
 - volume one, pp 12-16
 - volume two, pp 12-13
- **Habitat/hazard/exposure**
- **Risk/probability/severity**
- **Mitigation - hazard & risk**

FINDINGS

- **Volume One - Hazard-related (micro)**
- **Volume Two - System Deficiency-related (macro)**

RECOMMENDATIONS

■ Recommendation One

- **"The MOU...be finalized so as to serve as a formal basis for the inter-agency management of aviation risk"**

RECOMMENDATIONS

■ Recommendation Two

- **"The SICA Draft Management Plan be modified to include systematic prescriptions to deter species of high risk and to include conservation targets for designated species."**

RECOMMENDATIONS

■ Recommendation Three

- ▶ **"A 'Risk Abatement' document be prepared and finalized which prescribes the contingencies which may be taken on a day-to-day basis to mitigate aviation risk when required."**

RECOMMENDATIONS

■ Recommendation Four

- ▶ **"The YVRAA, the CWS and TC coordinate the systematic and ongoing collection of avifauna information related to the SICA and the Wildlife Control Program"**

RECOMMENDATIONS

■ Recommendation Five

- **"The function of the Wildlife Habitat Advisory Committee on Compensation (WHACC) be reviewed and modified to ensure that, as a minimum, Environment Canada retains the authority to make operational decisions regarding the risks posed by the habitat within the SICA with advice offered by operational experts from the YVRAA and TC".**

RECOMMENDATIONS

■ Recommendation Six

- **"The YVRAA coordinate with the CWS their plan to aggressively discourage the presence of Snow Geese on or near the southwest boundary of the airport, thereby reducing the probability that Bald Eagles which may frequent the SICA will disperse geese into the flight path of aircraft".**

RECOMMENDATIONS

■ Recommendation Seven

- ▶ **"Artificial Barn-Owl nesting installations be relocated to suitable sites other than on Sea Island".**



RECOMMENDATIONS

■ Recommendation Eight

- ▶ **"Raptor perching poles installed in the SICA be removed and installed on protected land of Sea Island; raptor numbers at SICA be monitored; and consideration be given to the development of a trial program at YVR for the trapping and relocation of raptors found airside".**



SUMMARY

- **Risks may be manageable if:**

- **comprehensive planning**
- **interdisciplinary systems approach taken**
- **continuous monitoring and updating**
- **effective communications**

APPENDIX 13

ICAO ADREP Information: Le Bourget Falcon 20 Crash

ICAO ADREP INFORMATION

Special report, Report Number 1

PRELIMINARY REPORT

DASSAULT-BREGUET-FALCON 20
COLLISION WITH BIRD/BIRD STRIKE-INITIAL CLIMB
UNCONTAINED FAILURE-FIRST ENGINE-INITIAL CLIMB
FIRE-CIRCUIT PATTERN/BASE LEG
COLLISION WITH TERRAIN-EMERGENCY/UNCONTROLLED DESCENT

ACCIDENT

TYPE OF OPERATION		FILE DATA	
TYPE	NON-SCHEDULED/INTERNATIONAL PASSENGER	ICAO FILE	95/0010-C
		FROM STATE	FRANCE
DATE, TIME AND METEOROLOGICAL DATA		AIRCRAFT DATA	
DATE	95-1-20	MASS CATEGORY	5701 - 27 000 KG
TIME	17:31	STATE OF REGISTRY	FRANCE
LIGHT	DUSK/TWILIGHT	REGISTRATION	F-GILN
GEN WEATHER	VISUAL METEOROLOGICAL CONDITIONS		
LOCATION		DAMAGE, INJURY AND TOTAL ON BOARD	
LOCATION	PARIS/LE BOURGET	A/C DAMAGE	DESTROYED
STATE/AREA	FRANCE	INJURY FATAL SERIOUS MINOR NONE UNKNOWN TOTAL	
DEPARTED	PARIS/LE BOURGET	CREW	3 0 0 0 0 3
DESTINATION	SIBIU	PAX	7 0 0 0 0 7

NARRATIVE

AFTER WAITING FOR A STORM TO END, THE A/C TOOK OFF FOR SIBIU IN ROMANIA. DURING ALIGNMENT, THE PILOTS NOTICED SOME LAPWINGS ON THE RWY. IMMEDIATELY AFTER THE TURN AROUND, A GLOW APPEARED AT THE LEVEL OF THE LEFT JET ENGINE AND THEN A FLAME AT THE REAR OF THE A/C. THE CREW PERFORMED A SHORT VISUAL MANOEUVRE: THE ELECTRICAL AND HYDRAULIC CIRCUITS RAPIDLY BECAME INOPERATIVE. THE A/C LANDED WITH ITS GEAR RETRACTED AFTER 1 MIN, 40 SEC OF FLIGHT, WITHIN A/D TERRITORY NEAR THE POINT OF DEPARTURE, AND SLID APPROX 400 M. IT WAS COMPLETELY DESTROYED BY IMPACT AND FIRE. THE INITIAL CAUSE OF THE ACCIDENT WAS UNCONTAINED DAMAGE TO THE LEFT ENGINE, WHICH SET THE TAIL COMPARTMENT ON FIRE. DEAD BIRDS WERE STREWN ON THE GROUND IN THE TAKE-OFF AREA. PIECES OF THE LEFT ENGINE WERE FOUND ALONG THE INITIAL CLIMB PATH. THE FAN DISK WAS FOUND AT 400 M ALONG THAT PATH.

APPENDIX 14

Weitech Bird Control Unit

BIRD STRIKE COMMITTEE CANADA.

The Weitech Bird Control Unit.

Introduction.

Trillium Windmills was incorporated in June 1986 to import from England and distribute throughout Canada the Rutland Windcharger, which is used to charge 12 or 24 volt batteries in remote areas where there is no hydro. In 1993 the company added the Solarex Solar modules to its product line, and in 1994 we added the Koenders Windmills for pond aeration and the Weitech sonic and ultrasonic pest control products. We also opened a ware house in Tonawanda as we now distribute the Rutland Windchargers in the States

Weitech inc.

Weitech have been manufacturing sonic and ultrasonic pest control products for 9 years and amongst their product range are their Bird Gard repelling units which carry actual specific bird distress calls, the Ringbill Gull, the Herring Gull, and the Common Crow, while their other Bird Gard units carry synthetic bird alarm calls.

The Specific Bird Gard Distress Calls.

These units have the actual distress call of the bird recorded onto a micro chip, so when the repeller is directed towards a group of gulls the birds hear the call and assume that one of their number is in distress. When the call goes out for the second time 17 seconds later the birds start to become airborne and will circle the area where they have been either feeding or sitting. The repeller will continue to sound out the distress call, the birds are unable to identify where the bird is that is in distress, so they assume the area is inhospitable and they leave.

We have put together two independent stand alone systems as follows:

System 1.

This consists of the following components:

1 Weitech Bird Gard ABC Standard one speaker unit with the Ringbill Distress Call.

1 only 5 watt solar module.

1 only 6.5 AH Gel battery with plastic battery box, battery cable with clips and mounted onto a 4 FT 4" x 4" wood post complete with carrying handle.

This system is effective over an area of 400 ft with a spread of 200 ft.

System 2.

This consists of the following components:

1 Weitech Bird Gard Super ABC with 1 single 4 speaker box and 2 Distress Calls, Ringbill and Herring Gull.

1 Rutland WG 500 Windcharger.

1 only 35 AH Gel Battery, plastic boxes to contain the control panel, regulator to prevent battery overcharge and mounted onto a 3 FT aluminium pole with all necessary wiring.

We suggest this is mounted onto an 18" x 18" cement patio slab.

This system is effective over an area of 400 ft in a full circle.

Non Specific Bird Gard Repellers.

Weitech have two non specific Bird Gard Repellers as follows:

Bird Gard GNB Garden and Building Repeller.

Bird Gard AVA Commercial Agriculture-Airport Bird Repeller with 6 speakers.

These two systems operate by creating sounds which block or distort the birds hearing senses making the birds nervous and unable to function normally. This causes the birds to leave the area.

Rodent Control.

Weitech also manufacture 3 ultrasonic and sonic pest control systems for use in controlling mice in homes restaurants, warehouses and storage areas. All have been approved by Agriculture Canada and on a personal note I can vouch for their effectiveness in controlling mice and bats.

Transonic 100. Ultrasonic repeller. Covers up to 1000 square feet.

Transonic 200. Ultrasonic repeller. Covers up to 1500 square feet. We have sold a number of these to Transport Canada.

Transonic CIX. Sonic repeller with 3 volume controls and 5 settings. We have sold a number of these to Transport Canada.

Electric Fencing.

The Rutland Windcharger was originally developed to supply power to the Welsh Hill Farmer for his electric fencing systems. Electric fencing may also offer Transport Canada a solution to some of the animal problems on airfields that I read about in the press. If you can electrically fence to keep animals in you can also electrically fence to keep them out, and the power for the fence line can be supplied from a Rutland Windcharger.

Conclusion.

Trillium Windmills is in the position of being able to offer Transport Canada a number of different systems for the effective control of gulls and rodents at Federally operated airports. We would like to work with Transport Canada, and if there are other pests which it is thought could be controlled sonically or by electric fencing, please let us know and we will be pleased to work with you to find an effective solution.

Thank you for your attention

Peter Sanguinetti,
President,
Trillium Windmills Inc
November 30, 1995.

APPENDIX 15

Update to TP 1247 "Land Use in the Vicinity of Airports"

PART 3
BIRD HAZARDS

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3.1 GENERAL

This part provides guidance to all parties involved in planning and development activities involving land-uses that could be attractive to birds in the vicinity of an airport site. Birds of all types may be hazardous to aircraft because they can cause structural damage or loss of engine power as a result of collisions.

Airports provide naturally attractive areas to many species of birds. The hazard created by birds is greatest at and in the vicinity of airports due to the concentration of aircraft activity close to the ground, where the majority of birds fly. Also, the safety of aircraft operating into and out of an airport can be affected by land use activities which attract birds that are relatively far removed from the airport. Birds create flight safety problems at and near airports in three ways:

1. The relatively safe, wide-open grassed areas common to airports provide optimal conditions for some hazardous birds. These areas provide the basic elements of security from predators and humans, access to food and water sources, and a place to rest and loaf. If an airport is near land use activities that attract birds, they will often spill-over onto airport lands in order to take advantage of the opportunities provided by these conditions;
2. If an airport lies in the flight path used by flocks of birds moving between day time feeding sites such as landfills, and night time roosting sites such as rivers and lakes, their twice daily flights can intersect the flight paths of aircraft landing and taking off from the airport. Gulls will fly over 60 km between a roosting site and a feeding site;
3. Some birds, such as gulls, will frequently soar at altitudes up to 3000 feet above a feeding area such as a food waste disposal site during thermal conditions. If the feeding site lies under the approach-departure path of a runway, there is the possibility that aircraft can strike bird flocks involved in this towering activity. Also, general aviation aircraft flying circuits in the vicinity of an airport can strike these birds.

Many airports effectively reduce the natural attraction of birds, primarily through major habitat management and manipulation projects, as well as through active wildlife control techniques such as pyrotechnics, falconry, and other bird scaring tactics. While these on-airport programs are effective, they can be neutralized by the presence of land use activities that attract hazardous birds in large numbers outside the airport boundary.

Given the considerations described above, it is therefore important that land uses surrounding an airport be regulated or managed with the same goal as on-airport land use; to minimize the attraction to birds. Examples of such land-uses are: garbage dumps, food waste landfill sites, coastal commercial fish processing plants, certain recycling and composting facilities, and the planting of crops that may either attract birds or adversely affect flight visibility.

Any of these or any other facility in the environs of an airport site which has the potential to attract birds should be studied by a bird hazard specialist early in the planning process to ensure that bird behavior patterns would not develop which may ultimately affect the safe operation of aircraft. This should be done in consultation with the airport operator.

For some additional guidance, Annex A to this Part contains guidelines on the acceptability of specific land use practices other than waste disposal facilities within prescribed distances from an airport reference point. Annex B contains guidelines on the acceptability of miscellaneous activities near airports which have the potential to attract birds that are hazardous to aircraft, and recommended remedial actions. Selection criteria that can be used to locate facilities such as food waste disposal sites which have the potential to create bird behavior dynamics that can affect flight safety are discussed in the following section:

3.2 DISPOSAL OF WASTE FACILITIES

Garbage dumps, food waste landfill sites, and certain recycling and composting facilities are considered to be a potential hazard to aircraft operations because they can attract large flocking birds such as gulls which have become well adapted to human development, and the food provided by human waste. Their protected status as migratory birds has allowed their numbers to increase dramatically in the past two decades. These birds are far-ranging in their daily food searching activities, and show a preference for the habitat provided at airports. Because of their numbers, size, flocking behavior, and preference for managed habitats such as airports, gulls have become the most serious bird hazard to aircraft. World-wide they are involved in over one third of aircraft bird strike incidents.

Gulls and other birds attracted to these human waste disposal sites can become a threat to air safety by intersecting aircraft flight paths while flying to and from feeding and roosting sites, soaring above feeding sites, or by using airports as resting and loafing sites and thereby creating a bird strike threat when flying in the airport environment.

In order to ensure that human waste disposal sites do not become a threat to flight safety, great care must be taken during the site selection process to ensure that unforeseen dynamics are not created, and consideration must be given to the fact that gulls will fly over 60 Km between a roosting site and a feeding site. It is therefore

recommended that in the initial stages of the planning process for a human waste disposal site, a bird hazard expert be consulted to ensure that the chosen site is not one that will result in serious flight safety consequences. The following are general guidelines which can be used in order to ensure that a waste disposal site does not create bird hazards to aircraft:

- A waste disposal site must be situated so that the flight path taken by birds flying between roosting sites and the waste disposal site does not cross the airport, or intersect aircraft flight paths.
- A waste disposal site must be situated so that birds soaring above the site do not affect the approach-departure paths of aircraft, or general aviation aircraft flying circuits in the vicinity of the airport.
- A waste disposal site must be situated far enough away from any airport to ensure that birds do not begin to use the airport as a feeding, resting, or loafing area.
- When multiple food waste disposal sites are located near an airport, the opening or closing of one or more facilities should be carefully studied to ensure that birds will not begin using new flight paths that interfere with safe aircraft operations.
- Consideration must be given to the fact that birds frequently use different roosting sites or feeding sites depending on seasonal factors, so bird studies that are conducted must be carried out for at least a full twelve month period.
- If waste disposal sites are improperly located with respect to flight safety considerations, every effort must be made to manage the site so that it is free of birds. There is technology currently available that can make waste disposal sites unattractive and/or unavailable to birds. Pyrotechnic or falconry programs implemented as soon as a site begins to operate will ensure that birds never have the opportunity to feed and become a 'magnet' for other birds.

3.3 REGULATORY TOOLS

Under the authority of the Aeronautics Act, Federal Airport Zoning Regulations can be enacted to prohibit the use of land outside airport property boundaries where such land uses are hazardous to aircraft operations. When zoning initiatives are undertaken at an airport, it is recommended that the above mentioned activities not be allowed within 8 km of the airport reference point. This provides a measure of protection to ensure that hazardous birds do not spill-over onto airport lands to rest, feed, and loaf, and also ensures that departing aircraft would normally be above the height at which birds soar under thermal conditions. Prohibitions for bird hazard considerations should only be included upon the expert advice of a bird hazard specialist.

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Outside the 8 km boundary, only consultation and coordinated planning by all parties can provide for a measure of protection in cases where gulls would likely travel longer distances between a roosting site and a feeding site, and thereby intersect the flight paths of aircraft landing and taking off from the airport.

ANNEX A

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GUIDELINES ON THE ACCEPTABILITY OF MODERATELY HAZARDOUS LAND USE ACTIVITIES OTHER THAN WASTE DISPOSAL FACILITIES WITHIN A PRESCRIBED DISTANCE FROM AN AIRPORT REFERENCE POINT

The following land use practices are not recommended for areas 3.2 Km or less, from the airport reference point (at some airports, more than one reference point may be established for the purpose of defining the area) because they are normally not as significant a bird attractant as facilities such as food waste disposal sites. The birds attracted to these moderately hazardous land use activities are generally of smaller size, less far-ranging in their food searching activities, and may be a concern to aircraft operations only during limited time periods such as migrations or unusual climatic conditions.

AGRICULTURAL ACTIVITIES

NOT RECOMMENDED

SUGGESTED ALTERNATIVES

1-Crops

Grains:

Barley
Oats
Wheat-(particularly Durum)
Corn
Sunflower
Clover

Rye
Buckwheat
Flax
Timothy
Alfalfa

Fruits:

Berries
Cherries
Grapes
Apples

Vegetables-except
potatoes

2 Livestock

Feedlots: (beef cattle)
Piggeries

Pasture fed

COMMERCIAL ACTIVITIES NOT RECOMMENDED

Outdoor (drive in) theaters

MANAGED AND/OR SUPPLEMENTED NATURAL HABITATS
NOT RECOMMENDED

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(Refuges-Sanctuaries)

Migratory waterfowl refuges/feeding stations/crops (see 1)

Designated game-mammal refuges

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Lagoons

Sewage lagoons

Manage as
bird-free
facility

Stormwater retention ponds

(Implement
bird
deterrent
techniques)

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ANNEX B

GUIDELINES ON THE ACCEPTABILITY OF MISCELLANEOUS ACTIVITIES WITH THE POTENTIAL TO ATTRACT BIRDS THAT ARE A KNOWN HAZARD TO AIRCRAFT

Airport operators should be aware of other basic bird attractants in the vicinity of their facility. The list below provides examples of such attractants, the typical land use activities where they may be found, and suggested remedial measures. In some cases, remedial action is a viable alternative to the exclusion of a particular land use from an area around the airport.

ATTRACTION	TYPICAL ACTIVITIES	SUGGESTED REMEDATION
Food waste	Restaurants (indoor-outdoor)	Improve maintenance and disposal
	Picnic areas	Cover garbage containers
		(Use bird deterrent techniques)
Freshly tilled-plowed soil	Cropping activities-sod farming	Plow-till at night
High mouse-insect activity	Grass and hay cutting	Cut-bale at night
	Hay baling (before and after)	Remove bales as soon as possible
Livestock-manure piles	Barnyards	Manage as bird-free facility (implement bird deterrent techniques)
Stables	Racetracks	
	Fairgrounds	
	Game farms	

PART III

BIRD HAZARDS

3.1 GENERAL

Birds of all types can be hazardous to aircraft because they can cause structural damage or loss of engine power. The hazard created by birds is greatest at and in the vicinity of airports due to the concentration of aircraft activity close to the ground, where the majority of birds fly.

Airports are naturally attractive areas to many species of birds because the wide open, short grass areas provide the basic elements of security from predators and humans, a place to nest and loaf (just generally sit about) and access to food and water sources. Programs at Transport Canada operated airports effectively reduce this natural attraction of birds to airport lands, primarily through major habitat management and manipulation projects, as well as through day to day vigilance and the use of bird-scaring techniques. While these on-airport activities are effective, they can be neutralized by the presence of attractive land use or activities outside the airport boundary. Hazardous bird types will be persistent in their attempts to use the airport as a convenient stopover and resting place before or after feeding at a nearby location. It is therefore important that land uses in the general airport-surrounding area be regulated with the same goal as on-airport land use, to minimize the attraction to birds.

The following information provides guidelines on the acceptability of different land use practices for the vicinity of airports and should only be included upon the expert advice of a bird hazard specialist. General land use practices have been evaluated on their relative attractiveness to the traditionally hazardous bird species.

3.2 BIRD HAZARD SPECIALIST REQUIREMENTS

Aircraft zoning regulations are enacted to prohibit the use of land outside airport property boundaries where such land uses are hazardous to aircraft operations. Provisions must be made for prohibiting the location of garbage dumps, food waste landfill sites, coastal commercial fish processing plants, and/or the planting of crops, that may either attract birds or adversely affect flight visibility, within 8 KM of an aerodrome reference point. Prohibitions for bird hazard considerations should only be included upon the expert advice of a bird hazard specialist.

The above activities are extremely attractive to bird species that are:

- (a) a hazard to aircraft because of their larger size, behavioral characteristics (flocking, soaring), and their preference for airport environments, and
- (b) far-ranging in their daily food-searching activities.

3.3 COMMERCIAL ACTIVITIES

The following land use practices are NOT RECOMMENDED FOR AREAS 3.2 KM OR LESS, FROM THE AIRPORT REFERENCE POINT (At some airports, more than one reference point may be established for the purpose of defining the area.) because they attract bird species that:

- (i) because of their smaller size, behavioral characteristics, and not particularly far-ranging in their food-searching activities, and/or
- (ii) are of concern as aircraft hazards chiefly during limited time spans only, i.e., migration, infrequent climatic conditions.

(a) Agricultural Practices

Not RecommendedSuggested Alternatives

(i) Crops

Grains: Barley
Oats
Wheat
(particularly Durum)

Rye
Buckwheat
Flax

Canola

Corn
Sunflower
Clover

Timothy
Alfalfa

Fruits: Berries
Cherries
Grapes
Apples

Vegetables
(except potatoes)

(ii) Livestock

Feedlots: Beef Cattle
Piggeries Livestock

Pasture-fed

(b) Commercial Activities

Outdoor (Drive-In) Theatres

(c) Managed and/or Supplemented Natural Habitats
(Refuges, Sanctuaries)

Migratory Waterfowl Refuges/Feeding Stations/Crops
[see (a)(i)].

Designated Game - Mammal Refuges

3.4 OTHER ACTIVITIES

Airport authorities should be aware of the basic attractants. The list below provides a guide to such attractants, the typical land use activities where they may be found, and suggested remedial actions. In these cases, remedial action (if attainable) is a viable alternative to the exclusion of a particular land use from an area around the airport.

<u>Attraction</u>	<u>Typical Activities</u>	<u>Suggested Remedial Action</u>
Food Garbage	- Restaurants (indoor/outdoor) - Picnic Areas	- improve maintenance/disposal - covered garbage containers
Freshly Tilled/ Plowed Soil	- Cropping Activities - Sod farming	- plow/till at night
High Insect/Mouse Activity	- Grass and Hay cutting activities - Baling of hay (before and after)	- cut/bale at night - remove bales as soon as possible
Livestock Manure Piles	- Barnyards - Stables - Racetracks - Fairgrounds - Game Farms	
Lagoons	- Sewage Lagoons - Stormwater Retention Ponds	

APPENDIX 16

USDA APHIS ADC Airport Training Program 1995



USDA APHIS ADC AIRPORT TRAINING PROGRAM

1995

Janet L. Bucknall, State Director, USDA APHIS ADC NJ/PA/LI&NYC,
140-C Locust Grove Rd., Pittstown, NJ 08867-9529.

The USDA APHIS Animal Damage Control Program (ADC) is in the process of planning an Airport Training Program. The goal of the program is to certify ADC wildlife biologists to work with the aviation community to reduce or eliminate wildlife hazards on airports. Biologists will be provided with information on administrative and technical aspects of ADC airport work through presentations delivered by personnel from the FAA, civil and military airports, ADC, and perhaps other sources. The Program will permit a more standardized and professional ADC response to airports' requests for assistance in reducing wildlife hazards.

Although final Program guidelines are not yet available, the Program will probably be designed for certification of Wildlife Biologists. Each biologist would require certification prior to his or her work on airports. This is designed to ensure the delivery of consistent, professional, accurate ADC assistance to airports in protecting human safety from wildlife hazards.



An initial training session is planned for the winter of 1995/96, where approximately 25 ADC wildlife biologists would become certified. Subsequent training sessions would be held depending on program needs and other factors. The 3-4 day training session will consist of presentations and discussions in the following general areas: 1. Wildlife Hazards at Airports (Introduction), 2. Airport/Airbase Environments, 3. Administration and Funding for Airport Projects, 4. Agency and Airport Roles and Responsibilities, 5. ADC Procedures for Airport Assistance.

Funding for the ADC Airport Training Program should come from a variety of sources. Airports requesting ADC assistance and entering into Cooperative Agreements with ADC may pay a significant portion of training costs. Other possible sources may be developed, and could include other parts of the aviation community, professional societies, the ADC Program, etc.

The ADC Airport Training program is being designed by a committee composed of ADC wildlife biologists from NY, NJ, the Eastern Regional Office, and the ADC Denver Wildlife Research Center.

APPENDIX 17

Gull Facts for Airport Biologists

GULL FACTS FOR AIRPORT BIOLOGISTS

by

RICHARD A. DOLBEER

1. There are about 50 species of gulls in the world of which 15 are regularly found in North America.
2. The sexes are identical in plumage with males generally being slightly larger than females. For example, male laughing gulls weigh 10% more than females on average whereas male herring gulls weigh 19% more than females.
3. Gulls are generally long lived with annual survival rates of 70 to 90%. Banded herring gulls recovered after 20 years are not uncommon and the record is over 30 years. Gulls begin losing bands due to wear and salt corrosion after 10 to 15 years so we really do not know how long they may live in the wild.
4. Male and female gulls form pairs during the nesting season and both sexes contribute about equally to nest building, incubation, and feeding of chicks. Clutch size is usually 3 and incubation takes about 20 (laughing gull) to 28 days (great black-backed gull). Young fledge 35 (laughing gull) to 50 days (great black-backed gull) later. Gulls will persistently renest if nests are destroyed early in the nesting season.
5. Gulls attain adult body size within 6 to 8 weeks of hatching but do not obtain adult plumage and mature sexually until 2 years (for small gulls) to 4-5 years (for large gulls). Plumage is generally all brown in the summer-fall of hatching year. Plumage acquires more adult characteristics with each successive molt. Plumage of immatures can be quite variable. Species identification of immature gulls can sometimes be difficult as can age classification.

Convenient sources of information about gulls and other birds

- Dunning, J. B., Jr., editor. 1993. CRC Handbook of Avian Body Masses. CRC Press, Boca Raton, Florida. 371pp. (Convenient source of information for birds throughout the world)
- Grant, P. J. 1986. Gulls: A Guide to Identification. Buteo Books, Vermillion, South Dakota. 352pp. (Detailed plumage characteristics)
- Ehrlich, P. R., D. S. Dobkin, and D. Wheye. 1988. The Birder's Handbook. Simon & Schuster, New York. 785pp. (Provides a wealth of conveniently summarized life history information on most North American bird species)
- Robbins, C. S., B. Bruun, and H. S. Zim. 1983. Birds of North America. Golden Press, New York. 360pp. (Excellent field guide providing range maps for all bird species nesting in North America)

FACTS FOR COMMON GULL SPECIES OF NORTH AMERICA

Species	Mean body mass lbs (g)		Mean length inches (cm)		Age (year) of first reproduction
	Male	Female	Bill to tail	Wingspan	
Bonaparte's Gull (<u>Larus philadelphia</u>)	0.5 (212)		11 (28)	32 (81)	2-3
Franklin's Gull (<u>Larus pipixcan</u>)	0.6 (280)		11 (28)	35 (89)	2-3
Laughing Gull (<u>Larus atricilla</u>)	0.8 (345)	0.7 (312)	13 (33)	41 (104)	2-3
Mew Gull (<u>Larus canus</u>)	1.0 (432)	0.8 (375)	14 (35)	42 (107)	3-4
Ring-billed Gull (<u>Larus delawarensis</u>)	1.2 (566)	1.0 (471)	16 (41)	49 (124)	3-4
California Gull (<u>Larus californicus</u>)	1.4 (657)	1.2 (556)	17 (43)	52 (132)	3-4
Herring Gull (<u>Larus argentatus</u>)	2.7 (1226)	2.3 (1044)	20 (51)	55 (140)	3-5
Glaucous-winged Gull (<u>Larus glaucescens</u>)	2.2 (1010)	2.2 (56)	22 (56)	54 (137)	3-5
Western Gull (<u>Larus occidentalis</u>)	2.2 (1011)		21 (53)	55 (140)	3-5
Great Black-backed Gull (<u>Larus marinus</u>)	4.0 (1829)	3.3 (1488)	24 (61)	65 (165)	4-5

APPENDIX 18

**At Air Travel's Hub; A day in the life of Pearson International,
Canada's busiest airport.**

her feet, which were charred and blistered."

Bob DeFreitas, director of customer services for the VIA corridor, warmly praised the Davis family: "It's wonderful what they did, opening their home to hundreds of people and keeping them comfortable until help could arrive. Yet, they wanted nothing in return for their kindness." However, on December 19 in a ceremony at the Brighton town hall, VIA publicly thanked the Davis family and presented them with an all-expenses-paid round-trip to anywhere in the VIA network. The family is planning to go to British Columbia this summer.

—Derek Baldwin in Trenton, Ont., *Trentonian*

Sarnia's Grateful Dentist

HELENE SHINGLES, 77, fills cavities and fits dentures five days a week and even makes house calls—free of charge. The Sarnia, Ont., dentist,



Helene Shingles

who has run a no-charge clinic for seniors in need since 1980, sees more than 1,000 patients a year. She maintains her own equipment, and raises money through donations and yard sales at her home.

When colleagues and civic dignitaries held a reception in her honour at Marshall Gowland Manor, the residence where she does much of her work, Ralph Crawford, representing the Canadian Dental Association, said there should be "a Dr. Shingles in every community."

"There are other free dental clinics," said Alderman David Boushy, "but they all depend heavily on taxpayers' money and grants."

Shingles lost her family in Poland during World War II and immigrated to Canada. "Canada was very good to me," she tearfully told the reception audience. "I promised myself that one day I would try to repay Canadians for their help."

The Dr. Helene Shingles Dental Foundation aims to raise \$500,000 to endow the service she has started. "I'll definitely work until I'm 80," she says. "By that time, I hope, there will be another dentist to take over."

—Cathy Dobson in Sarnia, Ont., *Observer*

If you read a published item about someone who inspires you, send it to Heroes Editor, Reader's Digest, 215 Redfern Ave., Westmount, Que., H3Z 2V9. Include the name and date of the source. The first person to contribute an item we reprint will be paid \$100. Submissions cannot be acknowledged or returned.

At Air Travel's Hub

A day in the life of Pearson International, Canada's busiest airport

By MARGARET POLANYI

SLIPPING out of his house into the inky, early-morning darkness, Bob Metcalfe glances at his car's dashboard clock. It's 5:30 a.m. He turns the radio on to catch the traffic report. He doesn't want to be late for his shift at Lester B. Pearson International Airport on the outskirts of Toronto.

Today the 42-year-old wildlife control officer's mind is on coyotes. He saw one hunting rodents on the

airfield recently, and it's his job to keep wildlife away from runways, where some 1,000 planes land or take off daily. If hit, an animal can damage an aircraft. Sucked into all the engines, a flock of birds could bring a plane down.

Driving along an airfield service road, Metcalfe spots a dark silhouette slinking beside one of the three runways. "Bird van 257, I have a coyote northbound on 33," he radios the control tower. "Proceed on 33." comes the response. Accelerating to 70 km/h along the runway, Metcalfe is driving parallel to the coyote in a matter of seconds. Predictably, the animal veers full tilt onto the grassy shoulder and heads for a nearby valley.

Bob Metcalfe is but one of the 15,000 people who keep Canada's busiest airport running 24 hours a day. From baggage handlers and

The circular aeroquay, now known as Terminal 1, opened in 1964



ticket agents to customs inspectors and food-service employees, all play a part in getting more than 65,000 daily passengers to 140 destinations in Canada and around the world.

When the structure now known as Terminal 1 was opened in 1964 by Prime Minister Lester B. Pearson, he called the circular aeroquay—intended to minimize walking distances—a “showplace in airport design.” Today the Mississauga airport covers 2,792 hectares and has three terminal buildings. Only once has the airport officially been closed to air traffic, when freezing rain turned runways into a slippery mess on January 28, 1994; it has remained open even during major snowstorms.

A massive operation, Pearson has its own water, sewage and garbage-disposal services. Every day up to five million litres of fuel, enough to fill the tanks of 100,000 cars, are pumped from an underground refuelling system into the bellies of planes that come and go from 6 a.m. until midnight.

“In many respects it’s a city within a city,” says Lloyd McCoomb, the airport’s general manager. A city complete with its own radio channel, a bank where you can get a mortgage, emergency medical clinics, chapels, jail, hotel rooms, and 53 restaurants and shops.

METCALFE notices a flock of gulls searching the soil for worms. Stopping his truck, he pushes a button on a tape recorder. Screeching sounds of gulls in distress are broad-

cast over a loudspeaker on the side of his truck. Soon the sky is filled with retreating white flecks.

Next, Metcalfe scans the dark waters of Etobicoke Creek. He points a pyrotechnical pistol out the open window and pulls the trigger, to produce a white flash and a loud pop. There is a sound of beating wings as eight ducks and a great blue heron leave in search of safer pastures.

As the wildlife search continues, Pat Paterson calms a passenger down at the Air Canada transborder check-in counter. “My flight is in eight minutes,” says businessman Greg Brophy, headed to Los Angeles to be presented with an award. Brophy is lucky. His flight is 23 minutes late.

There has been a steady stream of passengers since Paterson came on shift at 6 a.m. Joe Clark, the former prime minister, strolls up to get a U.S. Customs form. Another passenger shows Paterson a ceremonial dagger he wants to carry on board. She tells him he’ll have to pack it in a box and check it with his luggage.

In a building nearby, Matilda Pereira is keeping an eye on the clock. It’s 9:15 a.m. By noon she has to prepare 178 fruit salads for a Czech Airlines breakfast, one of several assignments she was given when she came on shift at 6:30. Pereira is lead hand in the cold production area of Flight Kitchen No. 1, run by Cara Operations.

“I need a knife,” Pereira calls out, dressed in antislip rubber-soled shoes, a white coat and pants. Her

dark hair is swept back in a net. After a coworker hands her a knife, she reaches into a bin filled with honeydew melons. Displaying the precision and speed acquired in 27 years in the flight kitchen, Pereira slices the melons into identical pieces.

Between 15,000 and 20,000 meals are produced daily by the kitchen’s 550 employees. All meals leave the kitchen two hours before departure time, some with an ethnic flavour. Today, for example, on a flight to Korea, stir-fried beef with fried noodles is being served.

While Pereira is removing 165 slices of ham from a meatcutter, a machine in Terminal 3 is processing hundreds of pieces of luggage. System operator Rohan de Silva studies a computer screen, watching for jams. When bags leave the check-in counter on a conveyor belt—part of a system of belts three kilometres long—they enter a giant, gumgelike area. A laser scans the bar code on the baggage tag so that the article will proceed within three minutes to the right pier.

De Silva’s computer beeps. A photo eye is picking up a jam caused by a suitcase wheel at the Canadian Airlines check-in counters. De Silva runs to the scene, plucks the offender from the conveyor belt and quickly presses the reset button to get things rolling again. “You have to get there within two minutes,” de Silva explains. Otherwise there will be more jams.

Doug Dyball is just sitting down for lunch in the maintenance garage

AT AIR TRAVEL’S HUB

when the phone rings. The Operations Control Centre is alerting him to some debris on the apron, the area where planes refuel and take on cargo.

Grabbing his jacket, Dyball jumps into an orange truck. In 21 years he has seen all sorts of debris on runways, taxiways and the apron: nuts and bolts, small aluminum bits of airplane, balloons, screwdrivers, earmuffs. Maintenance crews scour these areas six times daily.

As Dyball approaches the debris, he spots a large cardboard box marked LIVE LOBSTERS. It’s probably fallen off a cargo cart.

At 2 p.m. Peter Howcroft looks out the panoramic windows of the air-traffic control tower. He is one of six men and women sharing a cramped space 27 metres above the airfield. Today Howcroft is working the ground position. Nothing can move along Pearson’s 22 taxiways and high speed exits without his permission.

Glancing up at a radar monitor, Howcroft spots a green code indicating an approaching plane. He writes its flight number on a notepad. Minutes later a silver silhouette appears on the horizon. Without lifting his binoculars, Howcroft recognizes it as a DC-9.

The plane touches down on runway 33. “Air Canada 617, turn right at Bravo and taxi to Delta Quebec,” Howcroft says into his microphone. The pilot repeats the instructions, and Howcroft watches the plane’s progress intently as it turns into the

specified taxiway. At a busy airport, there is potential danger even when a plane has reached the ground. A green flick on a monitor confirms this plane is moving in the right direction.

At 3:40 P.M. Zasko Duma, a contractor working on the roof of Terminal 3, decides to go for a coffee. Approaching a food stall, he notices an elderly woman who is crying.

"Can I help you?" he asks. The woman, wearing a thick coat and kerchief, stares at him. Then she begins speaking in a language he recognizes as Ukrainian. Duma remembers how hard it was for him when he stepped off a plane from Yugoslavia 20 years ago speaking no English.

Using a mixture of Serbian and Ukrainian, Duma learns that the woman's son was supposed to meet her at the gate. He explains that her son is probably stuck in traffic. He takes her to the information counter where her son is immediately paged.

Finally a man approaches the lost woman. In Ukrainian he explains that her son was delayed at school, where he was picking his children up, so he is here to get her instead. The woman's face lights up, and she swings around to hug Duma.

Some of the human dramas at Pearson end up in the hands of Father Paul Healy. One of three airport chaplains, the Roman Catholic priest holds daily Mass in a small interfaith chapel located close to Air Canada check-in counters and a hot-dog

stand. Equipped with Bibles, prayer mats and several Korans, the chapel has a simple altar and a wooden cross on the wall. In a guest book, someone has written, "With gratitude for a little corner of peace in such a turmoil."

A well-known presence at the airport for 15 years, Father Healy regards the employees as his family. On his desk there is a picture of Duma Favreau Moore, an Air Canada flight attendant diagnosed with cancer in June 1991. "Until the day she died, 15 months later, he was there," says Moore's sister, Linda Favreau Armstrong. "She could talk to him about anything."

The energetic 68-year-old priest is also there to help distraught passengers. He persuaded a woman with a fear of flying to take a plane to Chicago so she could attend a relative's funeral. The priest sat with the woman for three hours in his small office adjoining the chapel. She wept, but also talked, and finally let him take her to the plane.

When a Jewish passenger had a heart attack on a plane, Father Healy was called to the scene. The man was lying in the aisle, his eyes closed. Turning to the man's wife, Father Healy told her he was a priest. "I'm here to help," he said. "Would you like me to say some of the Psalms?" Without hesitating she replied: "Please, Father. That's exactly what he would want." Father Healy stayed with the man until ambulance attendants arrived.

Those needing medical help are



Pearson International, looking south towards Lake Ontario

seem rehearsed? There are other tell-tale signs. Inspectors are suspicious when people claim their cameras are not new but don't know how to open them, or when suitcases smell strongly of perfume,

masking perhaps the smell of drugs.

Once when Smith was inspecting a suitcase, he was perplexed to see the clothes move. He lifted one piece and saw the head of a live snake. He quickly closed the bag and called Agriculture Canada.

Inspectors are always on the alert for "carriers" who arrive with drugs taped to their bodies. When someone is caught with drugs, he is arrested. Then the Mounties are called in. With a staff of over 200, they are a major presence at Pearson.

As the sun sets on this crisp November day, RCMP Cpl. Mike Carter is busy hiding plastic explosives in a Terminal 2 lounge. It's training day for Johnny, a three-year-old German shepherd.

Pulling a plastic glove over one hand, Carter reaches into a metal case and pulls out a yellow block of the plastic explosive DM12. He crosses the lounge, opens a glass case containing a fire extinguisher and hides the explosive in the hose. Then Carter places more DM12 under a seat. As a finishing touch, he

often surprised to learn there is an emergency clinic in each terminal. Like other nurses there, Susan Silver must be prepared for the unexpected. Today it's a woman with a contact lens lodged behind her eyeball. The nurse peers into the badly swollen eye. "I don't see it," Silver tells the woman. She gently sweeps the surface with a damp cotton swab and covers the eye with a patch. Then she directs the patient to a medical centre near the airport where a doctor can retrieve the lens.

Downstairs, the lines at Canada Customs are getting longer. Late afternoon is peak time. Within a few short hours, inspectors will check some 2,000 passengers. A small percentage will be taken aside to have their suitcases searched.

Customs inspectors expect everyone to be nervous. "We are looking for what's not normal," says customs spokesman Duncan Smith, "like excessive nervousness."

Inspectors consider how people answer questions. Do the replies

buries some TNT in a nylon sack in the soil around a plant.

Minutes later Johnny bounds into the lounge. "Let's go," Carter shouts, slipping off the leash. Johnny barks, then darts around, his long black snout leading the way. In seconds the exuberant dog sniffs his way over to the fire cabinet. Shooting a look at Carter, Johnny sits down beside the cabinet—the signal that he has found explosives. "Good boy," says Carter, tossing Johnny's favourite pink rubber toy into the air.

The exercise begins again with the same impressive results. Training is important to keep Johnny alert.

It's 6 p.m., and in the darkness outside, an incoming Beech 18 twin-propeller cargo plane is landing on runway 05L. Just after it turns off the runway, the plane's brake line snaps. Murray Farber, the manager, gets a call.

Farber rushes off to deal with the disabled plane, stopping quickly on the way to unlock the Distinguished Visitor's Lounge in Terminal 2 for a foreign diplomat. Then, arriving on the tarmac in a yellow operations van, he is told the Beech 18 needs to be towed.

An hour later a special tow bar is found for the old aircraft, and it is being dragged across the airfield

towards a maintenance hangar. All goes well until, glancing in his rearview mirror, Farber suddenly sees the plane do a 360-degree turn. The tow bar has broken.

The plane is now blocking a taxiway, and the likelihood of finding another tow bar is almost nil. Farber needs someone fast to fix the broken bar. Speaking into a microphone attached to his lapel, he asks his office to find a machinist who can solve the problem.

Minutes later Bernardo Paniccia arrives on the scene, although this is not his usual job. The millwright deftly throws the broken bar into the back of his truck and within the hour returns with it newly welded. The plane is on its way. Farber is thrilled.

As the day draws to a close, Farber writes a glowing report about Paniccia for bailing them out of a tough situation. But the millwright is modest about his contribution: "We're all here to make the airport operate."

There is now a cold bite in the night air. It is approaching midnight, the terminals are almost empty of passengers, and cleaning crews have taken to the 195,000 square metres of floor space. Soon a coyote will be prowling around again and another day will begin at Canada's busiest airport.

Whether you are in a boardroom or a classroom, at a job interview or a community meeting, the words you use—and misuse—create a powerful and lasting impression. Here are five common usage blunders that could rob you of The Verbal Edge.

WRONG: "A woman is different than a man."

RIGHT: "A woman is different from a man."

"My high-school English teacher would have had apoplexy if I had used the phrase *different than*," says Ron Price of Mission, B.C., one of many readers who have written to us about this error, "and yet daily on radio and TV, it is used by supposedly educated men and women."

The adjective *different* does not suggest a comparison. It merely states a fact. The conjunction *than* is used to link two nouns that (1) share a quality or attribute—such as weight, intelligence or success—but in varying degrees; or, (2) are being compared because of that shared trait.

For example, a woman can be *smarter* or *luckier than* a man, but she cannot be *different than* a man; she is *different from* him.

THE EDGE: Associate the two F's in *different* with the F in *from*.

The Verbal Edge

WRONG: "Heighth"
RIGHT: "Height"

Jackie Binkley of Angusville, Man., regards the mispronunciation of this word as a pet peeve of hers.

Possibly because people associate *height* with other words that describe dimensions—*length*, *depth*, *width*, *breadth*—it is frequently misspelled and mispronounced.

THE EDGE: Words can be the measure of the man. *Height*, like *weight*, ends in a hard T.

WRONG: "This silent epidemic affects millions."

RIGHT: "This silent epidemic affects millions."

Affect and *effect* can sound alike, but they aren't interchangeable, as Sherry Mengerling of Edmonton observes in a letter to us.

Affect is a verb describing action. (It may help to associate the A in *affect* with *action*.) It means to influence or act upon (The incident *affected* her concentration). To act out

How sustains one's capacity to live with danger without being overwhelmed by it, hope is the will to struggle against obstacles even when they appear insuperable.

— "The Challenge of Peace: God's Promise and Our Response"
(National Conference of Catholic Bishops)

APPENDIX 19

**Symposium: Repellents in Wildlife Management.
August 8-10, 1995, Denver, CO**

SYMPOSIUM
REPELLENTS
IN WILDLIFE
MANAGEMENT

August 8-10, 1995
Marriott Tech Center
Denver, CO

Organized and sponsored by:
Denver Wildlife Research Center
Animal Damage Control Program
Animal and Plant
Health Inspection Service
U.S. Department of Agriculture

SYMPOSIUM
REPELLENTS IN WILDLIFE MANAGEMENT

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SYMPOSIUM REPELLENTS IN WILDLIFE MANAGEMENT

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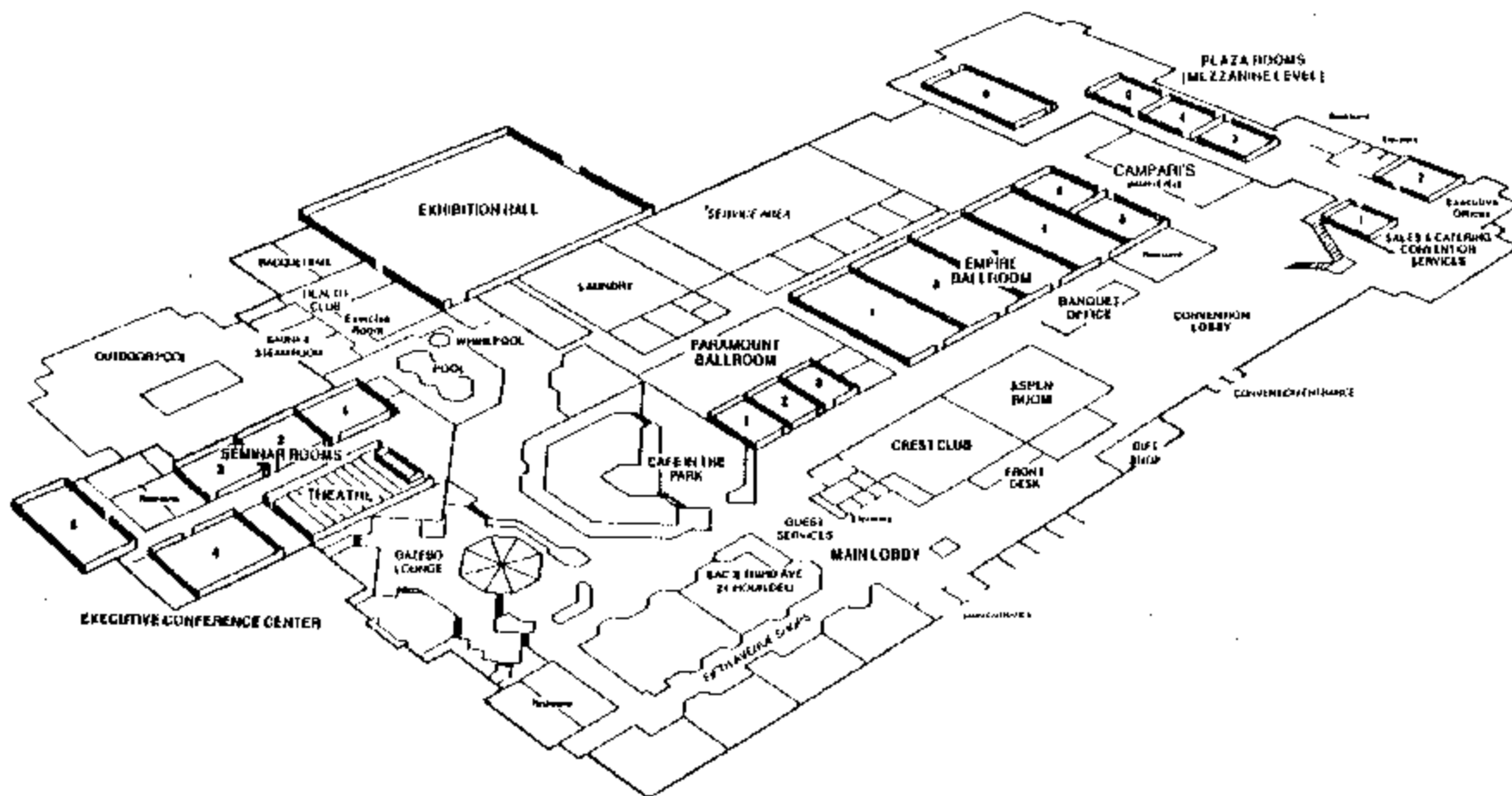
Denver Wildlife Research Center (DWRC), Animal Damage Control (ADC), Animal and Plant Health Inspection Service (APHIS), U. S. Department of Agriculture (USDA)

The Denver Wildlife Research Center (DWRC) functions as the research arm of the Animal Damage Control (ADC) program in the U. S. Department of Agriculture's Animal and Plant Health Inspection Service (APHIS). Approximately 25 percent of ADC's annual budget is spent on research. The Center helps manage wildlife populations by providing scientific information on conflicts between humans and wildlife. DWRC research activities emphasize socially acceptable methods that reduce or stop wildlife damage effectively and economically, minimizing risks for humans, wildlife, and the environment.

Planning Committee:

Diana L. Dwyer, Conference Chair
Kathleen A. Fagerstone, Program Chair
Michael Avery
Larry Clark
Russ Mason
Clay Mitchell
Dale Nolte

SYMPOSIUM
REPELLENTS IN WILDLIFE MANAGEMENT
August 8-10, 1995



MARRIOTT - DTC

AGENDA

SYMPOSIUM

REPELLENTS IN WILDLIFE MANAGEMENT

August 8-10, 1995
Marriott Tech Center
Denver, CO

AGENDA

MONDAY, AUGUST 7, 1995

5:00 - 7:00pm Registration (Lobby)

TUESDAY, AUGUST 8, 1995

7:30 - 9:00am Registration (Empire 1&2)

7:30 - 9:00 Continental Breakfast (Empire 1&2)

OPENING SESSION

(Empire 1&2)

9:00 - 9:10 Bobby R. Acord, Deputy Administrator, USDA/APHIS/Animal Damage Control

9:10 - 9:40 **THE CHEMICAL SENSES AND REPELLENCY: PROGRESS AND PROGNOSIS**
Gary Beauchamp, Monell Chemical Senses Center

SENSORY CAPABILITIES

Moderator: Russ Mason, USDA/APHIS/Denver Wildlife Research Center

9:40 - 10:00 **FOOD AVERSION LEARNING AND WILDLIFE DAMAGE MANAGEMENT**
Russ Reiding, USDA, Lincoln University

10:00 - 10:20 **SPECIES DIFFERENCES IN OLFACTORY PREFERENCE AND ABILITY**
Larry Clark, USDA / APHIS / National Wildlife Research Center

10:20 - 10:40 **Break**

10:40 - 11:00 **UNDERSTANDING GRIT-USE BEHAVIOR IN BIRDS: A PROTOCOL FOR DEVELOPING SAFER GRANULAR PESTICIDES**
Louis Best, Iowa State University

11:00 - 11:20 **THE CHEMISTRY OF PLANT/ANIMAL INTERACTIONS**
Paul Reichardt, University of Alaska

11:20 - 1:00 **Lunch (on your own)**

Tuesday, August 8, 1995 - continued

AVIAN CHEMICAL REPELLENTS

Moderator: Mike Avery, USDA/APHIS/Denver Wildlife Research Center

1:00 - 1:20pm

AVIAN REPELLENTS

Russ Mason, USDA / APHIS / Denver Wildlife Research Center

1:20 - 1:40

CHEMICAL BIRD REPELLENTS: HOW TO IDENTIFY THEM WITHOUT EXCESSIVE TRIAL AND ERROR EXPERIMENTATION

Larry Clark, USDA / APHIS / National Wildlife Research Center

1:40 - 2:00

CHEMICAL BIRD REPELLENTS: A REVIEW OF RELATIVE EFFICACY

Larry Clark, USDA / APHIS / National Wildlife Research Center

2:00 - 2:20

DILUTION AND DETOXICATION COSTS OF PLANT SECONDARY METABOLITES: RELEVANCE TO FOOD SELECTION OF AVIAN HERBIVORES

Walter Jakubas, Southern Illinois University

2:20 - 2:40

SUCROSE AS A FEEDING DETERRENT FOR FRUIT-EATING BIRDS

Carlos Martinez del Rio, University of Wyoming

2:40 - 3:00

Break

3:00 - 3:20

CINNAMAMIDE: A NON-LETHAL CHEMICAL REPELLENT FOR BIRDS AND MAMMALS

Elaine Gill, Central Science Laboratory, United Kingdom

3:20 - 3:40

REJEX-IT™ AG-36, THE FIRST LOW RISK BIRD AVERSION AGENT TO CONTROL GEESE AND OTHER NUISANCE BIRDS ON TURF

Peter Vogt, RJ Advantage, Inc.

3:40 - 4:00

CAGE TRIALS ON THE REPELLENCY OF METHYL ANTHRANILATE TO FOUR SPECIES OF PEST BIRDS IN AUSTRALIA

Ron Sinclair, Animal and Plant Control Commission, Australia

4:00 - 4:20

AN EVALUATION OF THREE FOOD FLAVOURING COMPOUNDS AS BIRD REPELLENTS

Richard Porter, Manaaki Whenua-Landcare Research, Havelock North, New Zealand

4:20 - 4:40

EVALUATION OF FUNGICIDES AS FEEDING REPELLENTS FOR HOUSE SPARROW MANAGEMENT IN AN ARID ENVIRONMENT

Bhagwandas Rana, Central Arid Zone Research Institute, India

4:40 - 5:00

AN INTEGRATED STRATEGY TO DECREASE EARED DOVE DAMAGE IN SUNFLOWER CROPS.

Ethel Rodriguez, Plant Protection Services, Montevideo, Uruguay

5:30 - 7:00

Social Reception

(Food Service, Admission by badge)

WEDNESDAY, AUGUST 9, 1995

7:15 - 8:15am Continental Breakfast (Empire 1&2)

MAMMALIAN CHEMICAL REPELLENTS

Moderator: Dale Nolte, USDA/APHIS/Denver Wildlife Research Center

- 8:15 - 8:35 **THE OTHER SIDE OF THE COIN: USING ANALYSES OF INTRASPECIFIC COMMUNICATIONS TO FIND SUBSTANCES ATTRACTIVE TO RODENTS**
Bennett Galef, McMaster University, Ontario, Canada
- 8:35 - 8:55 **LEARNING AND FOOD SELECTION IN HERBIVORES**
Fred Provenza, Utah State University
- 8:55 - 9:15 **ANIMAL DILEMMAS: COPING WITH REPUGNANCE AND PAIN**
Carl Gustafson, Animal Dilemmas?
- 9:15 - 9:35 **BEHAVIORAL PRINCIPLES GOVERNING THE USE OF DECEPTION-BASED AVERSIVE CONDITIONING**
Mike Conover, Jack Berryman Institute, Utah State University
- 9:35 - 9:55 **TESTING REPELLENTS TO REDUCE REFORESTATION DAMAGE BY GOPHERS, DEER, AND ELK**
Gary Wimmer, USDA / APHIS / Denver Wildlife Research Center
- 9:55 - 10:10 **Break**
- 10:10 - 10:30 **EFFECTIVENESS OF VARPOL ROPE® ON NORWAY RAT (RATTUS NORVEGICUS) AND HOUSE MOUSE (MUS MUSCULUS) IN LABORATORY AND FIELD CONDITIONS**
J. D. Willhide, Arkansas State University
- 10:30 - 10:50 **LABORATORY EVALUATION OF HERBAL POWDER, INDIARA-M, AS A RODENT REPELLENT**
Nisha Patel, Central Arid Zone Research Institute, Jodhpur, India
- 10:50 - 11:10 **EVALUATION OF PINE NEEDLE OIL AS AN AVIAN AND RODENT REPELLENT**
Shirley Wager-Pagé, USDA / APHIS / Denver Wildlife Research Center
- 11:10 - 11:30 **BEHAVIORAL RESPONSES TO PINE NEEDLE OIL IN POCKET GOPHERS (GEOMYS BURSARIUS, THOMOMYS TALPOIDES)**
Gisela Epple, Monell Chemical Senses Center
- 11:30 - 12:40 **LUNCHEON FOR ATTENDEES**
(Admission by ticket or badge)
- 12:40 - 1:00 **REPELLING SQUIRRELS FROM FOOD SOURCES WITH CAPSAICIN**
Paul Curtis, Cornell University

Wednesday, August 9, 1995 - continued

1:00 - 1:20 **REDUCING DEER DAMAGE TO WOODY AND HERBACEOUS PLANTS**
James Lutz, University of Minnesota

1:20 - 1:40 **COMPARATIVE ANALYSIS OF THE EFFECTIVENESS OF DEER
REPELLENTS**
Abderrahim El Hani, Jack Berryman Institute, Utah State University

INTERSPECIFIC ODORS AND REPELLENCY

Moderator: Gary Larson, USDA/APHIS/ADC Eastern Region

1:40 - 2:00 **REPELLENCY OF PLANT, NATURAL PRODUCTS, AND PREDATOR ODORS
TO WOODCHUCKS**
Jay Bean, Vassar College

2:00 - 2:20 **REPELLENCY OF PREDATOR URINE TO WOODCHUCKS AND MEADOW
VOLES**
Robert Swihart, Purdue University

2:20 - 2:40 **REVIEW AND CURRENT STATUS OF SYNTHETIC PREDATOR ODOR
SEMIOCHEMICALS AND THEIR ROLE IN WILDLIFE MANAGEMENT**
Pontus Lindgren, University of British Columbia, Canada

2:40 - 3:00 **Break**

3:00 - 3:20 **THE USE OF PREDATOR ODORS TO ELICIT AN AVOIDANCE RESPONSE
AND CONTROL FEEDING DAMAGE BY THE HAWAIIAN ROOF
RAT(RATTUS RATTUS)**
Michael Burwash, University of British Columbia, Canada

3:20 - 3:40 **SULPHUROUS PREDATOR ODOURS AS REPELLENTS TO PREVENT
BROWSING BY BRUSHTAIL POSSUMS (TRICHOSURUS VULPECULA) AND
RABBITS (ORYCTOLAGUS CUNICULUS)**
David Morgan, Manaaki Whenua-Landcare Research, Christchurch, New Zealand

3:40 - 4:00 **DISRUPTION OF MONTANE VOLE (MICROTUS MONTANUS)
POPULATIONS WITH SYNTHETIC MUSTELID SEMIOCHEMICALS**
Thomas Sullivan, University of British Columbia, Canada

4:00 - 4:20 **SCENT GLAND EXUDATE AS A POSSIBLE REPELLENT FOR URBAN
JAVELINA**
Dale Bode, University of Arizona

4:20 - 4:40 **A LABORATORY METHOD FOR EVALUATING THE REPELLENCY OF
ODORS TO RATS (RATTUS SPP.)**
Mark Tobin, USDA / APHIS / Denver Wildlife Research Center

THURSDAY, AUGUST 10, 1995

7:30 - 8:30am Continental Breakfast (Empire 1&2)

REPELLENCY, APPLICATIONS, AND ISSUES

Moderator: Gary Witmer, USDA/APHIS/Denver Wildlife Research Center

8:30 - 8:50 **CHEMICAL IRRITATION: AN OVERVIEW OF TRIGEMINAL NERVE FUNCTION**
Bruce Bryant, Monell Chemical Senses Center

8:50 - 9:10 **A MATTER OF BALANCE: HOW ENVIRONMENTAL FACTORS MAY AFFECT REPELLENT EFFICACY**
Markus Merkenz, P.A.W. Research Services, British Columbia, Canada

9:10 - 9:30 **THE ROLE OF CHEMICAL ECOLOGY IN IDENTIFYING REPELLENTS FROM NATURAL PRODUCTS**
Bruce Kimball, USDA / APHIS / Denver Wildlife Research Center

9:30 - 9:50 **EXPERIMENTS ON CHEMICAL CONTROL OF BEHAVIOR IN THE BROWN TREE SNAKE (BOIGA IRREGULARIS)**
Dave Chiszar, University of Colorado

9:50 - 10:10 **ATTRACTANTS AND REPELLENTS FOR BROWN TREE SNAKES**
Larry Clark, USDA / APHIS / National Wildlife Research Center

10:10 - 10:30 **Break**

10:30 - 10:50 **IN-WATER ELECTROSHOCK TECHNIQUES TO REPEL AQUATIC ANIMALS**
Larry Koiz, USDA / APHIS / Denver Wildlife Research Center

10:50 - 11:10 **ELECTRONIC RODENT REPELLENT DEVICES: EFFICACY TEST PROTOCOLS AND REGULATORY ACTIONS**
Steve Shumake, USDA / APHIS / Denver Wildlife Research Center

11:10 - 11:30 **REPELLENTS: INTEGRATING SENSORY MODALITIES**
Mike Avery, USDA / APHIS / Denver Wildlife Research Center

11:30 - 11:50 **ATTITUDES OF THE GENERAL PUBLIC AND PROFESSIONAL WILDLIFE GROUPS TOWARD REPELLENTS**
Robert Schmidt, Utah State University

11:50 - 1:15 Lunch (on your own)

Thursday, August 10, 1995 - continued

REGULATORY AND MARKETING CONSTRAINTS TO REPELLENT DEVELOPMENT

Moderator: Kathleen Fagerstone, USDA/APHIS/Denver Wildlife Research Center

1:15 - 1:45pm

AN OVERVIEW OF THE PESTICIDE REGISTRATION PROCESS
Robert Forrest, U.S. Environmental Protection Agency

1:45 - 2:00

**CONSIDERATIONS FOR REGISTRATION OF REPELLENTS FOR USE ON
PESTICIDE FORMULATIONS**
Ellen Mihaich, Rhone-Poulenc

2:00 - 2:15

REGISTRATION ISSUES FROM A SMALL BUSINESS PERSPECTIVE
Marty Proops, IntAgra, Inc.

2:15 - 2:30

**REGULATORY AND MARKETING CONSTRAINTS TO REPELLENT
DEVELOPMENT**
Judith Hushon, ERM Program Management Company

2:50 - 2:50

Break

PANEL ON RESEARCH NEEDS

Moderator: Kathleen Fagerstone, USDA/APHIS/Denver Wildlife Research Center

2:50 - 3:00

RESEARCH NEEDS FROM A WILDLIFE PROFESSIONAL'S POINT OF VIEW
Bob Byrne, Wildlife Management Institute

3:00 - 3:10

**THE IMPACT AND FRUSTRATIONS OF WILDLIFE/AGRICULTURE
CONFLICTS**
Karl Gebhardt, Ohio Farm Bureau Federation

3:10 - 3:20

THE PUBLIC IS ATTRACTED BY THE USE OF REPELLENTS
Cathy Liss, Animal Welfare Institute

3:20 - 3:30

BIRD DETERRENT RESEARCH AND DEVELOPMENT: MARINE OIL SPILLS
Tim Reilly, Marine Spill Response Corporation

3:30 - 3:40

**TARGETED DELIVERY OF PESTICIDES: RESEARCH NEEDS FOR
REPELLENTS BY THE CROP PROTECTION INDUSTRY**
Kristin Brugger, DuPont Agricultural Products

3:40 - 4:00

Questions/Discussion

4:00 - 4:15

Closing Remarks

ABSTRACTS

SYMPOSIUM REPELLENTS IN WILDLIFE MANAGEMENT

August 8-10, 1995
Marriott Tech Center
Denver, CO

--ABSTRACTS--

THE CHEMICAL SENSES AND REPELLENCY: PROGRESS AND PROGNOSIS

GARY K. BEAUCHAMP, Monell Chemical Senses Center, 3500 Market St., Philadelphia, PA 19104-3308

Abstract: The chemical senses (olfaction, gustation and chemical irritation or pain) were likely the first to evolve. Their functions are among the most basic - to attract and to repel. Attracting compounds often signal food or sex; repelling compounds presumably signal danger. Among the chemical senses, only olfaction appears to have two functional roles; one is to modulate social behaviors and one is involved in the identification of food. Whether an odor attracts or repels often depends to a large degree on learning. Consequently, dissociated olfactory stimuli may be relatively poor candidates for repellents since, after repeated exposure, pest animals are likely to ignore them. Taste, in contrast, is primarily related to the identification of food and the avoidance of poisons. Learning, here, appears to be relatively unimportant. Therefore, dissociated bitter tastes are good candidates for repellents. The development of effective, specific, bitter repellents, however, is complicated by the fact that herbivores tend to be relatively insensitive to many bitter compounds. Chemical irritants warn of danger (e.g., mutagens, carcinogens); painful stimuli, almost by definition, are to be avoided. Although irritants may be the most potent of repellents, the extent to which a compound is irritating varies for many different species, pest and non-pest alike, which makes them difficult to use in certain situations. Finally, it is likely that the most effective strategy in the formulation of effective repellents will employ stimuli that activate a combination of the chemical (and other) senses. Research should focus in this area.

SENSORY CAPABILITIES

FOOD AVERSION LEARNING AND WILDLIFE DAMAGE MANAGEMENT

RUSSELL F. REIDINGER, JR., Center for Excellence in Geographic Information Systems and Wildlife Management, Room 252 Founders Hall, Lincoln University, Jefferson City, MO 65102

Abstract: Food aversion learning (FAL) occurs experimentally when a mammal is presented with a distinctive-tasting food (conditioned stimulus) followed by a postingestional illness (unconditioned stimulus). With many bird species, visual cues appear more important than taste. Aversions occur after a single pairing of stimuli, and can be robust. These attributes have stimulated interest in possible applications of FAL to managing wildlife damage. During the past ten years, studies contributed information on aspects of FAL of particular interest in wildlife management, including: the relationships between predation, consumption, and food aversion learning; relationships between preexposure of stimuli to learning; synergism among unconditioned stimuli; social mediation of learned aversions; potentiation and overshadowing of stimuli; and, interactions with other stimuli such as external stressors, and pheromones.

Studies also continued on illness producing compounds, such as methiocarb as a bird repellent or lithium chloride for coyote control, that have already been proposed or used in wildlife management. These studies focussed on visual or odor cues to enhance effectiveness of the learned aversions, or on data required for registration or reregistration of the compound.

Compounds already registered for use on crops such as herbicides, insecticides, or fungicides, or naturally occurring or common compounds such as sucrose or charcoal, were evaluated for their abilities to induce learned aversions in birds and small mammals. Evaluations included: insecticide (Thiram) treated twigs to repel hares (*Lepus americanus*), or to repel deer mice (*Peromyscus spp.*), or to deter consumption of apple twigs by meadow voles (*Microtus pennsylvanicus*); insecticide (Cygon and Sevin) or emetic (emetine dihydrochloride) treated squash; and lettuce leaves

to repel woodchucks (*Marmota monax*); the insecticide Phosmet to repel fruit-eating birds; the insecticide imidacloprid to repel redwinged blackbirds (*Agelaius phoeniceus*) from rice seed; and, the fungicide Ziram to repel birds from dendrobium orchids. Oral estrogens were evaluated as unconditioned stimuli.

Eggs were treated with different unconditioned stimulus to induce food aversion learning, and to attempt to protect untreated eggs from predation. Green colored eggs were paired with Landrin to reduce egg predation by crows (*Corvus brachyrhynchos*). Carbachol and estrogens were injected into eggs to protect untreated eggs from predation by mongooses (*Herpestes auripunctatus*) or raccoons (*Procyon lotor*). Eggs were injected with methiocarb to protect California least tern eggs (*Sterna antillarum browni*) from predation by common crows (*Corvus corax*). Eggs treated topically with dimethyl anthranilate and injected with methiocarb or other unconditioned stimuli were evaluated as repellents with captive fish crows (*Corvus ossifragus*).

FAL varied in its effectiveness in these studies. Partly because of the high cost of reregistration or registration of pesticides, and limited prospects for commercial profits, few vertebrate repellents are registered that are based on FAL. Nonetheless, FAL remains an important concept whose attributes could be applied in the development of improved repellents, baits, and baiting systems.

SPECIES DIFFERENCES IN OLFACTORY PREFERENCE AND ABILITY

LARRY CLARK, USDA/APHIS/National Wildlife Research Center, Engineering Research Center, Colorado State University-Foothills Campus, NWRC Room B05, Ft. Collins, CO 80523

Abstract: There is now general agreement that most, if not all, birds can perceive olfactory cues. While the species list of birds that use olfactory information is growing, there is still a paucity of mechanistic data on olfactory ability of birds relative to that which exists for mammals. In contrast the description of avian olfactory anatomy is more complete and systematically described than that existing for mammals. Directed research into these areas would be useful for the study of form-function relationships. Nonetheless, existing data show that the olfactory acuity of some species of birds is on par with that reported for mammals. It is also clear that both birds and mammals find at least some odors objectionable. In contrast to trigeminal stimuli, where bird and mammals largely differ in their responses to specific chemicals, olfactory "repellents" cross taxonomic class. Odors that are repellent tend to be so for all species within foraging guilds, irrespective of taxonomic classification. For example, herbivores tend to be repelled by sulfur containing compounds, whereas carnivores are attracted to such compounds. Because sulfur and amine containing compounds tend to occur in the urine of predators as a result of catabolism of proteins, some have speculated that the avoidance of these compounds by herbivores is a manifestation of a fear response. Both birds and mammals may also form conditioned odor avoidance responses. Resistance to habituation and magnitudes of the avoidance largely depend on salience of the conditioned stimulus and localization and nature of the paired aversive experience.

UNDERSTANDING GRIT-USE BEHAVIOR IN BIRDS: A PROTOCOL FOR DEVELOPING SAFER GRANULAR PESTICIDES

LOUIS B. BEST, Department of Animal Ecology, 124 Science II, Iowa State University, Ames, IA 50011.

Abstract: Granular pesticides are used extensively and many are highly toxic to birds. Past formulation decisions were based primarily on human safety and efficacy considerations, with little attention to avian risks. Potential routes of avian exposure to granular pesticides include birds perceiving the granules as a source of grit and picking them up intentionally. Understanding avian grit-use behavior and the physical characteristics of grit particles that influence their consumption by birds could aid in formulating safer granular pesticides. Natural grit-use patterns were systematically characterized for bird species that frequent rowcrop fields where granular pesticides are applied. This then allowed a comparison of the characteristics of commonly used pesticide granules with those of grit naturally consumed by birds.

Experiments, conducted in aviaries under controlled conditions, were designed to further elucidate the effects of grit size, shape, surface texture, and color on grit selection and to document grit retention time in gizzards. Birds consuming small grit had more particles in their gizzards than birds consuming large grit, and birds seemed to prefer angular/oblong grit over rounded/spherical grit. Yellow, green, and white grit particles were used disproportionately more and black and blue particles used disproportionately less than other grit colors. Experimentation then focused on bird preferential consumption of various carriers used for pesticide granules and on the integrity of granules once consumed. Birds strongly preferred silica granules and were least likely to consume those made of gypsum with a graphite coating. Some carriers disintegrate very rapidly in gizzards whereas others may persist for days. This could influence grit consumption rates and toxicant release and absorption in the birds' digestive tracts. With some understanding of avian grit-use patterns and bird responses to various granular carriers, it is then possible to evaluate relative avian risks associated with different granular pesticide formulations. Experimental work is underway to assess how pesticide consumption per granule, granule carrier type, and granule size and color influence avian exposure to granular pesticides. The effects of weather and food availability also are being considered in such evaluations.

THE CHEMISTRY OF PLANT/ANIMAL INTERACTIONS

PAUL B. REICHARDT, Department of Chemistry and Biochemistry, University of Alaska, Fairbanks, AK 99775-0520

Abstract: Ecologists have long appreciated that herbivory in natural ecosystems can be extensive while at the same time rather selective. Over the last decade or two, chemical approaches to studying plant/animal interactions have led to an appreciation that plant chemistry dictates, or at least strongly influences, patterns of herbivory. Although this chemistry is often rather complex, two basic factors have emerged: plant chemistry influences herbivores in both positive and negative ways both by determining the dietary quality of plants and by providing feeding clues.

In our investigations of plant/animal interactions, we have found it useful to concentrate on comparisons of plant tissues with different patterns of use. Taking cues from selective use of plant parts, growth stages, and biogeographically distinct populations we have discovered examples of chemically-mediated herbivory which have led to the development of three working principles or hypotheses: 1) There is a molecular basis for chemical cues; 2) The molecular diversity of chemical signals implies specific mechanisms for plant-initiated attraction to or repellence of herbivores; and 3) There are dynamic elements to many plant chemical defenses which have their basis in changes within the plant induced by developmental change, tissue damage, or seasonal influences.

By paying close attention to these principles, one can learn valuable lessons for attempts to translate the basic elements of plant/animal interactions into useful chemically-based wildlife management techniques.

AVIAN CHEMICAL REPELLENTS

AVIAN REPELLENTS

J. RUSSELL MASON, USDA/APHIS, Denver Wildlife Research Center, c/o Monell Chemical Senses Center, 3500 Market Street, Philadelphia, PA 19104-3308.

Abstract: I will discuss visual, auditory, tactile, chemosensory, and physiologic repellents currently available for use in the United States. Discussion of tactile, chemosensory and physiologic repellents will be emphasized for several reasons. First, these products are preferred by users. Second, application of these substances is regulated by state and federal agencies. Third, only five active ingredients are legally available at the present time. This lack reflects difficulties in obtaining regulatory approval and limited market size.

CHEMICAL BIRD REPELLENTS: HOW TO IDENTIFY THEM WITHOUT EXCESSIVE TRIAL AND ERROR EXPERIMENTATION

LARRY CLARK, USDA/APHIS/National Wildlife Research Center, Engineering Research Center, Colorado State University-Foothills Campus, NWRC Room B05, Ft. Collins, CO 80523
E. A. ARONOV, Monell Chemical Senses Center, 3500 Market St., Philadelphia, PA 19104

Abstract: Chemical bird repellents can be categorized into two broad groups: (1) Associative Repellents normally induce a gastro-intestinal illness in the target species and the animal subsequently forms a learned aversion to sensory cues, e.g. taste, smell, associated with the illness inducing agent. Methiocarb is a well known example of an Associative Repellent. (2) Sensory Repellents are intrinsically aversive, i.e., require no learning, because they stimulate pain/irritation receptors. Methyl anthranilate is an example of a Sensory Repellent. We have studied the chemical molecular-structure activity relationships of avian Sensory Repellents using the pharmacophore approach. This approach is the same that is used in the computer assisted design of new drugs. Briefly, we found that compounds containing benzene rings are critical for sensory repellency. However, not all such compounds are effective repellents. Only those aromatic structures whose rings are electron rich are good repellents. Substituents attached to the benzene ring that detract from this basicity tend to diminish repellency. A quantitative consideration of physicochemical, electronic, topological and electrostatic features of molecules showed that overall pK and substituent pK's are good predictors of repellent activity. These findings will be discussed and compared to the substantially different features known to be important for mammalian repellency.

CHEMICAL BIRD REPELLENTS: A REVIEW OF RELATIVE EFFICACY

LARRY CLARK, USDA/APHIS/National Wildlife Research Center, Engineering Research Center, Colorado State University-Foothills Campus, NWRC Room B05, Ft. Collins, CO 80523

Abstract: An extensive list of potential bird repellents has been tested in the laboratory. These compounds were largely drawn from the U.S. Food and Drug Administration's GRAS (generally recognized as safe) list and from compounds listed in Fenaroli's Handbook of Flavor Ingredients, and were used to generate a predictive model for the identification of sensory bird repellents. Bird repellents derived from flavor ingredients promise to be an important source for effective but safe and environmentally low impact wildlife management tools. Flavor ingredients generally are well characterized with respect to human health and safety. Because most of these ingredients are derived from natural products and are not lethal to the target species they have a higher chance of public acceptance. In view of these characteristics and the recent registration process for methyl anthranilate under FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act) the U.S. Environmental Protection Agency is considering an exemption of such nonlethal bird repellents from FIFRA requirements. I will present the first compilation of relative efficacy for avian sensory repellents. Such a compilation and relative ranking will prove useful in targeting compounds for future development.

DILUTION AND DETOXICATION COSTS OF PLANT SECONDARY METABOLITES: RELEVANCE TO FOOD SELECTION OF AVIAN HERBIVORES

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C. G. GUGLIELMO, Department of Biological Sciences, Simon Fraser University, Burnaby British Columbia, V5A 1S6 Canada
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Abstract: A central question in research on plant/animal interactions is what factors influence herbivore diet selection. Plant secondary metabolites (PSMs) are one of the principal mechanisms plants use to defend themselves against

herbivory. One approach to investigate the influence of PSMs on herbivore diet selection is to treat forage selection and PSM ingestion as costs and incorporate these costs into various models suggested by optimal foraging theory. Models that accurately predict the interactions of herbivores within a community are needed to better manage ecosystems and to predict the consequences of plant chemistry changes caused by global atmospheric changes. We investigated whether the food selection of an avian herbivore may be influenced by the amount of energy and nitrogen it utilizes to detoxify PSMs. We determined the detoxication costs associated with one of the primary winter foods of ruffed grouse (*Bonasa umbellus*), quaking aspen (*Populus tremuloides*) flower buds, and the bud's principal PSM, coniferyl benzoate (CB). Captive ruffed grouse feeding on buds containing 2.4% CB dry mass were 24% less efficient in energy utilization ($P < 0.005$) than when feeding on buds containing 1.5% CB. Coniferyl benzoate diluted the nutrient content of the diet, but did not inhibit digestive function, nor exhibit other toxic effects. The energetic cost of detoxication, via the glucuronic acid and ornithine conjugation pathways, ranged from 10-14% of the daily metabolizable energy intake. Ornithine excretion increased the minimum daily nitrogen requirement of birds feeding on 2.4% CB buds by 90% above that of birds feeding on a diet with no PSMs. Maintenance of pH homeostasis during the production of acidic detoxication products resulted in increased ($P = 0.003$) ammonium excretion but was not correlated to sodium excretion rates. Future research should seek to determine whether avoidance of PSMs in other plant/animal interactions is based on detoxication costs and nutrient dilution, and the feasibility of using these costs to predict PSM repellency.

SUCROSE AS A FEEDING DETERRENT FOR FRUIT-EATING BIRDS

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MICHAEL L. AVERY, USDA/APHIS, Denver Wildlife Research Center, 2820 E. University Ave., Gainesville, FL 32601

Abstract: Some fruit-eating birds such as American Robins (*Turdus migratorius*), European Starlings (*Sturnus vulgaris*) and Cedar Waxwings (*Bombycilla cedrorum*) are considered agricultural pests because they feed on ripening cultivated fruit. Economic losses due to bird damage on blueberries, grapes, and cherries can be very high and are expected to increase in the future due to increased demand for fresh fruit, increased conversion of land to human uses, and lack of effective and environmentally safe methods to deter fruit-eating birds. Our research has unveiled a physiological trait common to many fruit-eating species in the phylogenetically related families Muscicapidae, Mimidae and Sturnidae. These birds are unable to digest sucrose because they lack the intestinal enzyme sucrase which hydrolyzes sucrose into glucose and fructose prior to absorption. Birds lacking intestinal sucrase activity prefer glucose and fructose to sucrose solutions. They reject concentrated sucrose solutions and artificial gel fruits made with sucrose. The aversive effect of sucrose seems to be the result of osmotic diarrhea and concomitant dehydration caused by the presence of an undigested osmotically active substance in the gastrointestinal tract.

Although sucrose is a common sugar in many fruit species and varieties, it is usually present in very low concentrations in cultivars damaged by birds. The primary sugars in these fruits are glucose and fructose. Is it reasonable and feasible to attempt development of high-sucrose cultivars with the goal of deterring birds in fruit crops? Variation in the proportion of sucrose in mature fruits is present among strawberry, cherry and blueberry cultivars. Consequently, genetic resources are available to develop high-sucrose cultivars through traditional breeding practices or bioengineering. We suggest that sucrose-intolerant birds such as American Robins and European Starlings will avoid eating high-sucrose fruits in an agricultural setting provided that i) sucrose concentration in these fruits is sufficiently high; ii) there is little free water available; and iii) high-sucrose fruits are planted in relatively large stands. Despite the obvious need for more data, we believe that increasing the sucrose content of small-berried fruits is a promising direction in integrated pest management research that can result in substantial reductions in bird damage.

CINNAMAMIDE: A NON-LETHAL CHEMICAL REPELLENT FOR BIRDS AND MAMMALS

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RICHARD W. WATKINS, JOANNE E. GURNEY, and DAVID P. COWAN, Central Science Laboratory (Ministry of Agriculture, Fisheries & Food), London Road, Slough, Berkshire, SL3 7HJ, United Kingdom

Abstract: The quest for benign, environmentally sensitive yet effective means of vertebrate pest management has led to an increased interest in the use of non-lethal chemical repellents designed to make the target food unpalatable during its vulnerable period. Contemporary work has focused on naturally occurring compounds or those derived from natural products, and there are a number that show promise in deterring feeding by mammals or birds. One such compound is Cinnamamide. Cinnamamide is a synthetic derivative of cinnamic acid, a naturally occurring plant secondary compound, that was identified as a potential bird repellent through studies of feeding preferences of the Bullfinch (*Pyrrhula pyrrhula*) in English pear orchards. Cinnamamide deters feeding by a wide range of bird species and, unlike most of its contemporaries, it also deters feeding by mammals, including rabbits (*Oryctolagus cuniculus*), mice (*Mus musculus*) and rats (*Rattus norvegicus*). This is unusual owing to functional discrepancies in trigeminal reception between mammals and birds. Cinnamamide has also been shown to deter feeding by molluscs and insects. Studies to determine cinnamamide's mode and site of action suggest that both primary (smell, taste, and buccal cavity irritation) and secondary (post-ingestional) receptors are involved, but that their relative contribution may differ between birds and mammals. This paper describes the efficacy of cinnamamide against birds and mammals under laboratory, pen and field conditions. Its mode of action in both birds and mammals is discussed, together with its potential for generating a conditioned taste aversion in certain situations, and we conclude by considering practical field applications for the compound.

ReJeX-IT™ AG-36, THE FIRST LOW RISK BIRD AVERSION AGENT TO CONTROL GEESE AND OTHER NUISANCE BIRDS ON TURF

PETER F. VOGT, RJ Advantage, Inc., 501 Murray Rd., Cincinnati, OH 45217-1014

Abstract: ReJeX-IT™ AG-36, a methyl anthranilate based product, was approved in 1994 for general use on turf as one of the first products to meet the US EPA's criteria for "reduced risk" presenting minimal risk to applicators, target, people, pets, and wildlife. While the effectiveness varied widely in the beginning, most of these problems have been solved with the use of the proper spreader/stickers. With these modifications, the product can be tailored to the specific needs, and effectiveness can be extended from weeks to month, where applicable. The proper use not only improves effectiveness but also leads to a reduction in aversion agent applied, which all lead to cost reductions. Depending on the type of turf, one gallon can protect from 8,000 - 16,000 sq. ft. of turf.

CAGE TRIALS ON THE REPELLENCY OF METHYL ANTHRANILATE TO FOUR SPECIES OF PEST BIRDS IN AUSTRALIA

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Abstract: Like most countries involved in extensive agricultural production, Australia has many native and introduced species of birds that damage a very wide range of crops. Scare tactics and shooting are the main forms of pest bird control that are employed by farmers but these are rarely cost effective. Exclusion netting is becoming more widely used but it is limited to high value crops subjected to high levels of damage. There is no chemical registered in Australia for use as a repellent that will effectively reduce bird damage and the "clean, green and economically efficient" image being promoted by Australian agriculture imposes rather extreme limitations on the search for an effective chemical.

Methyl anthranilate (MA) is receiving some attention because it is a substance which occurs naturally in both animals and plants, particularly in 'Concorde grapes' (*Vitis labrusca*), is essentially non-toxic and is manufactured commercially for use as a flavouring in confectionary and as a base for perfumes. Registration of an effective formulation to be used as a bird repellent on crops could be achieved with relative ease in Australia.

The repellency of MA was evaluated in choice feeding cage trials with the introduced European starling (*Sturnus vulgaris*) and with three native pest bird species, the silvereye (*Zosterops lateralis*), and the Adelaide rosella (*Platycercus elegans*) and the little corella (*Cuculius sanguineus*). The chemical was either mixed in with laboratory feed or applied as a seed dressing at concentrations up to 0.75% (w/w).

The trials demonstrated that when an alternative food source was available, MA (at 0.5% - 0.75% w/w) was highly repellent to the three species of native birds and to the European starling in Australia. The level of repellency observed was similar to that reported for other northern hemisphere species. When no alternative to MA-treated food was available, the repellent effect of the chemical was transient and although there was some variation between birds within species, all the starlings, rosellas and corellas tested gradually increased their intake of treated food over time. The results have been sufficiently promising to warrant testing of MA in the field on a range of crops.

AN EVALUATION OF THREE FOOD FLAVOURING COMPOUNDS AS BIRD REPELLENTS

RICHARD E. R. PORTER, Manaaki Whenua-Landcare Research, Private Bag 1403, Havelock North, New Zealand

Abstract: There is an increasing demand in New Zealand for nonlethal bird repellents to protect food crops and prevent poisonous mammal baits being eaten by native birds. Three food flavourings dimethyl anthranilate (DMA), methyl anthranilate (MA), and a peppermint extract (Optamint®) were applied to wheat as surface coatings at different concentrations, then offered to individually caged house sparrows (*Passer domesticus*). The birds were given two choices, in one container one of four levels of treated wheat (0, 0.25, 0.5 & 1.0% by weight for DMA & MA; 0, 1, 3, 5% by weight for Optamint) and a second contained untreated rape seed as an unpalatable control. Neither DMA nor MA significantly stopped house sparrows eating wheat, even at 1% level of treatment. Optamint significantly reduced consumption of wheat at the 5% level of treatment, but not 1% or 3%. The birds did not eat any of the rape seed. All three levels of peppermint treated wheat were phytotoxic to grass. This study demonstrated that two commonly tested and reported food flavourings (DMA & MA) would have to be applied at a higher rate to wheat to repel house sparrows.

EVALUATION OF FUNGICIDES AS FEEDING REPELLENTS FOR HOUSE SPARROW MANAGEMENT IN AN ARID ENVIRONMENT

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Abstract: The experimental sparrows (*Passer domesticus*) were trapped in mist nets at Jodhpur (26° 18'N - 73° 08'E). The sample size for each experiment was 10 (5 males and 5 females). The sparrows were individually caged and maintained on laboratory diet, until they were acclimatised to laboratory conditions. Thereafter, birds were provided pearl millet (*Pennisetum typhoides*) mixed with 2% ground nut oil for three days as prebaiting. Water was available *ad-libitum*. On the fourth day, birds were starved for 24 hours and then were allowed to feed on 5 toxicants - Zineb, Mancozeb, Dithan M-45, Bavistin, Apron (Metalaxyl) and Calixin (Tridemorph)-treated baits at the concentrations of 0.1%, 0.15%, 0.2% and 0.3% for the next 24 hours. Equal quantities of treated and plain baits (10g) each were provided in separate containers to each sparrow. The body weight of each sparrow was recorded before initiation of experiments. Position of the food containers were also altered every day to avoid place preference. Total daily intake was measured after collecting the spilled food and food was replenished daily. The absolute values of daily intake were transformed to relative body weight. All experiments were continued for seven days and repellency rate was estimated.

Acceptability of poisoned bait: Poisoned bait was less palatable than plain bait in all the trials. A significant difference was not found between the 0.1% concentration of Zineb and the 0.3% concentration of Mancozeb. However, with both the concentrations of Zineb and Dithan M-45, the intake of poisoned bait by (*P. d. indicus*) was significantly ($P < 0.01$) higher than intake of the other toxicants. When the palatability ratios are compared, it is revealed that acceptability of Calixin-treated bait by (*P. d. indicus*) is minimal as compared to that of plain bait, followed by Apron (0.15%) and Zineb (0.3%) baits. Interestingly, Dithan M-45-treated bait was found quite palatable to sparrows in comparison to other fungicide-treated baits.

Aversive effect: 0.3% Zineb resulted in 80% repellency. Bavistin at 0.2% concentration gave a repellency of 60%, and 0.15% Apron-treated bait resulted in 90% repellency. On the other hand, 90% of sparrows were repelled by a 1.0% Calixin poisoned bait.

The lowest repelling effect was found with the 0.1% concentration of all fungicide treated baits. The ingestion of toxicant (mg/kg) was found to be inversely proportional to the concentration of fungicides in all experiments. However, the Dithan M-45 fungicide bait ingested by (*Passer*) was found to be maximum at all concentrations.

It is concluded that Apron, followed by Zineb and Calixin, are the most effective aversive chemicals for the management of House sparrow, (*P. d. indicus*). These fungicides are easy to use and least hazardous to nontarget animals species in the ecosystem.

AN INTEGRATED STRATEGY TO DECREASE EARED DOVE DAMAGE IN SUNFLOWER CROPS

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RICHARD BRUGGERS, USDA/APHIS/Denver Wildlife Research Center, Building 16, Denver Federal Center, Denver, CO 80225

ROGER BULLARD, Hauser Labs, 2624 Wedgewood Ave., Longmont, CO 80503

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Abstract: Granivorous birds damage crops consuming vital human food supplies. Bird repellent chemicals have been one of the popular considerations for crop protection. In Uruguay, repellents tested have been considered either not effective long enough or not economically affordable. Unfortunately, most of these tests have not been conducted under an integrated application strategy where factors involved in the repellent problem and appropriate application techniques are considered. In Uruguay, variable weather often lengthens the sunflower crop maturation. A heterogeneous agroecosystem in a temperate climate assures suitable food for maintaining high Eared Dove populations. Eared Doves, which are adapted to granivory, gregariousness, and probably nomadism, damage mature sunflowers. These factors, in combination with an unpredictable commodities market create economic conditions where farmers can only make low, short-term money investments.

The emphasis of this research has been the determination of application techniques and development of a suitable strategy for reducing this damage. Research at three levels (laboratory, semi-field and field) has focused on repellent selection, chemical formulation, timing of application and methods of application. Experiments conducted in the laboratory and semifield with the bird repellent methiocarb, calcium carbonate white paint, and these in combination led to the development of a repellent formulation. The paint was as effective a repellent as the methiocarb-paint combination, and it was also less expensive and non-toxic. Field studies led to other cost advantages. Since dove flocks generally damage the border more than the center of fields, repellent applications were made to both entire plots and to the border only. Paint-only, and methiocarb-paint border applications were as effective as applications to the entire plot. Also, the timing of repellent applications was studied. Dove flocks started visiting plots in exponential numbers during the mature stage. Applications of paint-only were effective for 12 days. Thus, one application of paint-only when doves start to visit the plot can protect it from damage until harvest. In conclusion, this integrated strategy offers

a series of application choices the farmer could use depending on the factors involved. Choices include one or more applications, and partial or total aerial applications of diluted white paint.

MAMMALIAN CHEMICAL REPELLENTS

THE OTHER SIDE OF THE COIN: USING ANALYSES OF INTRASPECIFIC COMMUNICATIONS TO FIND SUBSTANCES ATTRACTIVE TO RODENTS

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Abstract: Norway rats exhibit substantial enhancement of their preference for a food after interacting with conspecifics that have eaten that food. Such socially induced increases in food preferences of 'observer' rats are surprisingly powerful (causing rats to abandon learned taste aversions and reversing congenital rejections of obnoxious flavorants) and durable, often lasting for weeks.

Analyses of conditions under which exposure to a food affects preference revealed that 'demonstrator' rats were more than mere passive carriers of food odors. Exposing a rat to a food did not affect its later preference for the food, while exposing a rat to an anesthetized demonstrator rat that had either eaten or been dusted with the food markedly increased an observer's preference for it. We conclude that a demonstrator rat provides a context within which exposure to food-related cues influences observer rats' subsequent food preferences.

Further experiments revealed that the context that made exposure to a food effective in altering observer rats' later food choices was emitted: (1) by live rats (not dead ones) and (2) from rats' anterior (not their posterior) end, suggesting that rat breath might provide the relevant context.

Rats breathe only through their noses (not through their mouths). Consequently, comparison of chemical constituents of air from rats' mouths with those of air from rats' noses should permit identification of candidate chemicals that, when experienced together with a food, might enhance preference for it. Mass-spectrometric examination of differences in air taken from the noses and mouths of rats revealed the presence of two promising sulfur compounds, carbon disulfide and carbonyl sulfide, though practical considerations allowed us to work only with carbon disulfide.

We allowed naive observer rats to interact with a rat-sized piece of cotton batting (a surrogate demonstrator) that we had brushed with food and moistened with a dilute solution of carbon disulfide (1 p.p.m.). Rats that interacted with carbon-disulfide-anointed surrogates subsequently preferred the food with which the surrogate had been brushed, as did observer rats that interacted with an anesthetized demonstrator rat brushed with the food; rats that interacted with a surrogate we had brushed with the same food and moistened with distilled water did not.

Some (but not all) field tests of effects of carbon disulfide on intake of baits were positive with rats eating three or four times more carbon-disulfide tainted bait than normal bait.

We discovered recently that, after leaving a feeding site, rats deposit urine trails attractive to conspecifics. We have also identified conditions under which the urine in trails deposited by rats does not attract conspecifics.

We intend to pursue an analogous strategy to that we used in analyzing rat breath, comparing the chemistry of attractive and unattractive urine, then testing the attractiveness to rats of chemicals differentiating one from the other. With luck, we will be able to use artificial chemical trails to lure rats directly to poison baits.

LEARNING AND FOOD SELECTION IN HERBIVORES

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Abstract: We are finding that the food preferences of herbivores are remarkably malleable, which implies animals can be deterred from eating selected plants, but this is likely to be most successful if we devise management strategies that integrate information on the dynamics of food selection. Food selection depends on preference (i.e., making choices among alternatives), which in turn depends on palatability. Palatability involves interactions between taste and postingestive feedback, which calibrates taste (hedonic sensations) commensurate with a food's homeostatic utility. Thus, palatability changes in response to a food's utility. The sensation of being satisfied to the full (i.e., satiety) occurs when animals ingest adequate kinds and amounts of nutritious foods. Animals prefer foods that cause satiety and acquire aversions to foods that cause malaise due to excesses of nutrients and toxins or deficits of nutrients. Even within meals, palatability increases when a food ameliorates malaise and decreases when a food causes malaise. An animal's experiences, particularly early in life, also influence a food's palatability. Young animals acquire preferences for foods mother eats and they are reluctant to eat unfamiliar foods. Accordingly, familiarity and novelty come to control taste-feedback interactions, even within meals. For instance, animals that experience malaise when eating a meal of novel and familiar foods will subsequently avoid the novel foods. Furthermore, animals that experience malaise when eating a meal of only novel foods will avoid the foods that are most novel. Conversely, herbivores that experience mild malaise from eating a meal of familiar foods, will avoid foods eaten too frequently or in excess. Thus, eating any food to satiety is likely to cause a mild aversion which will cause animals to eat a varied diet. These findings imply that: (1) the reason most repellents are effective only temporarily is because they merely change the flavors of familiar foods (i.e., a novelty effect), (2) in the absence of aversive (positive) postingestive effects, feeding deterrents (attractants) based merely on offensive (pleasant) flavors are not likely to be effective, and (3) any management program designed to deter herbivores from eating particular foods must provide a variety of nutritious alternatives.

ANIMAL DILEMMAS: COPING WITH REPUGNANCE AND PAIN

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Abstract: With much toil and rigmarole psychology has been re-evolving over the past 30 years. The impetus for change was brought about when the dominance of radical behaviorism receded. The conceptual framework of this philosophical perspective failed to account for various empirical observations of researchers in both human and animal laboratories and failed to find validation through application of its derived procedures to the rising demand for solving human educational and mental health dilemmas. Many psychologists struggled for years and continue to struggle to maintain the integrity of the radical behaviorist perspective. They worked hard to force round anomalies into square holes or to ignore the anomalies altogether. At the other extreme, perspectives have been revitalized that deny even the appropriateness of scientific processes to understanding of human and animal behavior. In coping with the demise of radical behaviorism and in the absence of a unifying perspective psychology became divided, at times chaotic. No subdivision of psychology has been diminished more than animal research. Experimental, comparative and physiological psychologists abandoned their endeavors and rushed to embrace and pursue alternate paths: neuroscience, ethology (sociobiology and now a rising field called evolutionary psychology), and clinical endeavors. Still other psychologists have elevated to the status of independent sciences the study of the intervening variables once shunned by psychology, memory, cognition and emotion.

In this presentation I will trace the foundations of the application of conditioned taste aversion methods to management of animal misbehavior. I will integrate the history of conditioned taste aversion research and methods with change occurring in psychology over the past 30 years and show how the turmoil present in psychology has been reflected in the development and evaluation of conditioned taste aversion applications. Finally, I will review and integrate recent reconceptualizations of the different associative processes of the skin and gut defense systems and relate these independent associative processes to the use of various behavioral strategies, repellents, barriers, and conditioned taste aversions for reducing wild and domestic animal damage.

BEHAVIORAL PRINCIPLES GOVERNING THE USE OF DECEPTION-BASED AVERSIVE CONDITIONING

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Abstract: In many cases, the ability to directly apply a repellent to the plant, animal, or item that we want to protect from wildlife damage is lacking. Deception-based aversive conditioning (DBAC) is one method that can be used to extend protection to these items (hereafter called models). In DBAC, the model is not treated; instead baits which mimic the model are treated with a chemical that will sicken, but not kill, the animal consuming them. To be effective, models and baits must be indistinguishable. In most attempts to use DBAC, baits did not closely mimic models and the attempts failed. I hypothesize that if baits and models are indistinguishable, animals will stop consuming models when the costs (in terms of illness) of making a mistake and consuming a poisonous bait outweigh nutritional benefits of consuming a model. This implies that key variables affecting the success of DBAC include the severity of the illness, nutritional value of the model, ratio of baits to models, and alternate sources of nutrients.

TESTING REPELLENTS TO REDUCE REFORESTATION DAMAGE BY GOPHERS, DEER, AND ELK

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Abstract: Reforestation success in the Pacific Northwest is often hindered by feeding activities of pocket gophers, deer, and elk. Damage by gophers commences after spring planting and can be acute during winter when forage is scarce. Trees can be damaged until they exceed about 6 years in age. Deer and elk damage occurs during winter and spring and until lower branches grow above browsing height (about 1½ meters). Traditional damage control methods involve toxic baits and kill trapping for gophers and the use of tubes around seedlings for deer and elk. These methods are becoming less favorable because of costs, social acceptance, or environmental hazards. Repellents offer a potential solution with fewer constraints. We have tested a wide array of commercially available repellents, unregistered compounds, and unpalatable plants in pen and field trials. These materials contained bitter, hot, sulphurous, toxic, or otherwise noxious substances. Only predator odors (coyote and bobcat urine) were consistently effective (>50%) in deterring feeding by gophers and deer. A one-year field trial with the bitter compound, denatonium benzoate, was ineffective in deterring feeding on seedlings by gophers. Encapsulated predator odors were field tested for their ability to slow gopher reinvasion of a reforestation unit, but were only marginally effective. A field test of four compounds (3 sulfur-based, 1 bitter) in an area of deer and elk damage suggests that these materials will only be marginally effective in deterring damage. We conclude that effective damage reduction repellents for these species in these situations will be difficult.

EFFECTIVENESS OF VARPOL ROPE® ON NORWAY RAT (*Rattus norvegicus*) AND HOUSE MOUSE (*Mus musculus*) IN LABORATORY AND FIELD CONDITIONS

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Abstract: There is a wide variety of wildlife repellents for many different animals. Most of these are liquids that are applied to vegetation to prevent grazing or browsing damage. This study is based on the observations made during the efficacy testing of Varpol Rope® a temporary repellent for Norway rats (*Rattus norvegicus*) and the House mouse (*Mus musculus*). Animals were tested under both laboratory and field conditions. Laboratory testing was done with a

modified T-maze (Y-shaped) at Arkansas State University. Field testing was conducted at the Bottomland Naturals Inc. facility in Newport, Arkansas. Over 140 hours of videotape was recorded during the 1800 individual trials, resulting in an 80% repellency. Testing was conducted from June to September 1989.

LABORATORY EVALUATION OF HERBAL POWDER, INDIARA-M AS A RODENT REPELLENT

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Abstract: A herbal nontoxic compound, Indiara-M, was tested for its feeding repellency effects against two rodent pests, Indian desert gerbil, (*Meriones hurrianae*) and five striped squirrel, (*Funambulus pennanti*) inhabiting the desert biome. The compound consisted of the active ingredients of several plants including (*Ipomea muricata*), (*Acorus salamis*), (*Allium sativum brassica* sp.), (*Allium sepa*) and Rametha. The compound was tested under laboratory conditions in cages. The study revealed that the consumption of preferred food, (*Pennisetum typhoides*), when mixed with Indiara-M powder (5% w/w basis) was reduced by 60 and 68 percent in (*M. Hurrianae*) and (*F. Pennanti*) respectively whereas the consumption of alternate food was increased. On increasing the concentration of Indiara-M powder to 6% in the preferred food, its consumption was further reduced by 80 and 93% in the test gerbils and squirrels, respectively. The efficacy of the test compound as a feeding repellent was found to be reduced with the increased periods of exposure.

EVALUATION OF PINE NEEDLE OIL AS AN AVIAN AND RODENT REPELLENT

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Abstract: Terpenoid compounds, abundant in coniferous plants, are effective feeding deterrents for a number of species; including, showshoe hares (*Lepus americanus*), voles (*Microtus* sp.), and pocket gophers (*Geomys bursarius*) and (*Thomomys* sp.). Turpentine, a pine tire byproduct, decreased feed intake of brown-headed cowbirds (*Molothrus ater*) but not that of red-winged blackbirds (*Agelaius phoeniceus*) nor common grackles (*Quiscalus quiscula*). Saturation of clay particles with Siberian pine needle oil decreased grit ingestion by European starlings (*Sturnus vulgaris*). Different sources of terpenoid compounds were utilized in each of these studies and there are no comparative data regarding the repellency of individual substances or mixtures to representative mammals and birds. Therefore, intraspecies responsiveness to the repellent effects of pine needle oil on feeding behavior of prairie voles (*Microtus ochrogaster*), deer mice (*Peromyscus maniculatus*), and European starlings was evaluated. Test stimuli were prepared using commercially available Siberian pine needle oil. Apple pieces were coated with 0, 1.0, and 10% pine needle oil (v/v) - vegetable oil solutions and presented to test subjects in their home cages in two choice tests. Two hour consumption of pine needle oil coated apple pieces was compared to ingestion of the alternative food choice, oil coated apples. Pine needle oil (1.0% v/v) coating significantly decreased ingestion of apples compared to oil coated apples by prairie voles (40%) and deer mice (34%). Pine needle oil (10% v/v) coating decreased apple ingestion 60% by prairie voles and deer mice. Pine needle oil (10% v/v) slightly inhibited apple ingestion by European starlings decreasing intake by 27% compared to consumption of oil coated apples. Therefore, it appears that European starlings are less sensitive to pine needle oil's deterrent effect compared to prairie voles and deer mice. These results suggest that pine needle oil or its constituents may be useful as a general repellent for vertebrates, although birds appear to be less sensitive than mammals.

BEHAVIORAL RESPONSES TO PINE NEEDLE OIL IN POCKET GOPHERS (*Geomys bursarius*, *Thomomys talpoides*)

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Abstract: Essential oils from coniferous trees contain secondary metabolites that act as feeding deterrents for a number of herbivorous mammals. In the present study, effects of pine needle oil and its odors on feeding, area avoidance and gnawing of electrical cable were investigated in plains pocket gophers and in northern pocket gophers. Both species were offered sweet potato from single feeding stations placed into home cages of individually housed animals. Stations contained either a scent dispenser with pine needle oil or with mineral oil. The dispensers allowed subjects to smell but not to contact the stimuli. The food remained uncontaminated by the oils. Plains pocket gophers retrieved significantly less food from stations scented with pine needle oil, but northern pocket gophers took food indiscriminately from experimental and control stations. In another experiment, subjects of both species were tested in a maze consisting of a start box that was connected to two goal boxes by tunnels. Both goals contained food. One goal box contained a scent dispenser with pine needle oil, the second a scent dispenser with mineral oil. Subjects spent significantly less time in goals scented with pine needle oil than in goals with mineral oil. They also consumed less food in pine scented goals. In an experiment performed with plains pocket gophers only, animals were introduced into a maze consisting of a start box from which two large, soil packed tunnels could be entered. Embedded in the soil of one tunnel was a barrier of electrical cable that had been impregnated with pine needle oil, the second tunnel contained a barrier of mineral oil soaked cable. In overnight trials, pocket gophers removed significantly less material by gnawing from pine needle oil impregnated cable than from mineral oil soaked cable. In this experiment the animals could contact the soaked cable. Therefore, responses may have been mediated by taste, olfaction or other chemosensory systems. In the other experiments, however, direct contact with the stimuli was impossible, and responses to pine oil under these conditions must have been due to volatile cues. The results show that pine needle oil contains compounds that are aversive to plains pocket gophers as well as to northern pocket gophers. At least some of the active compounds are volatile. Under natural conditions they may function as feeding deterrents. Once identified, some of the compounds may be suitable repellents for control of pocket gopher damage to agricultural and forest products and to underground cable.

REPELLING SQUIRRELS FROM FOOD SOURCES WITH CAPSAICIN

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Abstract: Red squirrels, eastern chipmunks, and gray squirrels cause significant damage to maple syrup tubing systems. Squirrel damage to tubing and pipelines cost maple producers in Vermont at least \$500,000 annually. Squirrels are also responsible for a large proportion of nuisance wildlife complaints each year. Shooting, trapping, and other direct lethal controls used to reduce squirrel damage take time, energy, and money; and are only partly successful for resolving conflicts. Consequently, we have initiated studies with capsaicin, the active ingredient in hot peppers, to determine its effectiveness as an aversive agent to squirrels. Whole sunflower seeds and sunflower hearts were used to test the effectiveness of several capsaicin concentrations. The heat index of each formulation was measured in Scoville Units (SUs). We tested concentrations from 2,450 to 82,500 SUs with caged and free-ranging gray squirrels. The pepper was bonded to the seed with a food-grade starch glue. Seeds were presented to caged squirrels ($n = 18$) in two stainless-steel feeders. One feeder contained 25 grams of untreated sunflower hearts, while the other feeder contained 25 grams of sunflower hearts treated with 2,457 SUs, 8,250 SUs, 27,500 SUs, or 82,500 SUs of capsaicin. For free-ranging squirrels,

sunflower seeds were presented on wooden feeder trays, each containing four compartments. At each tray, untreated seed was provided along with three different capsaicin concentrations ($n = 18$ replicates). Caged gray squirrels significantly reduced their total daily seed consumption at only the highest pepper concentrations (27,500 and 82,500 SUs). Free-ranging squirrels showed a much greater aversion to whole sunflower seeds treated with capsaicin. At even low pepper concentrations (8,250 SUs), seed consumption was about 13% of that for untreated seeds (2.9 vs. 21.6 grams/hour, respectively). At 82,500 SUs, squirrels ate only 4% (0.82 grams/hour) of the amount consumed for control seeds. Many hurdles still must be overcome before capsaicin can be registered as a squirrel repellent. The efficacy of different formulations should be examined to determine the minimum concentration of capsaicin that will reliably protect both seeds and tubing under field conditions. Changes in the starch glue may also be required to provide sufficient longevity so that only a single repellent application would be needed to provide several months of protection. A commercial product must still be registered both with the EPA and State Pesticide Bureaus. Although the company which holds the patent for the formulation is interested in pursuing EPA registration of capsaicin as a squirrel repellent, the tests required for several potential applications may still be cost-prohibitive. It is likely that USDA support for both research and registration will be needed.

REDUCING DEER DAMAGE TO WOODY AND HERBACEOUS PLANTS

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Abstract: Woody and herbaceous plants in urban and rural landscapes, nurseries, orchards, and Christmas tree plantations are becoming increasingly susceptible to deer damage. Most existing repellents are either ineffective, or are effective for short periods of time. This project presented four plant species treated with chicken eggs, Deer-Away, Hinder(1:20), Tree Guard, Milorganite, chicken eggs with Tree Guard, and chicken eggs with Transfilm, to twenty captive white-tailed deer (*Odocoileus virginianus*). Only chicken eggs alone and Deer-Away deterred deer from feeding on the containerized nursery stock. Chicken eggs alone performed significantly better than Deer-Away.

In a second experiment, pairwise comparisons were made with Deer-Away and Hinder(1:1 and 1:5), Tree Guard, Miller Hot Sauce(0.62 and 6.2%), and two experimental predator urines. Pelletized deer food was treated and presented to ten captive deer. Both rates of Miller Hot Sauce and predator urine #1 significantly reduced deer feeding on pelletized deer food. Deer-Away, Hinder 1:1, and predator urine #2 reduced feeding to a lesser degree. Hinder 1:5 slightly reduced feeding. Tree Guard was completely ineffective.

COMPARATIVE ANALYSIS OF THE EFFECTIVENESS OF DEER REPELLENTS

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Abstract: Considerable research has been conducted with regard to taste and odor repellents used to inhibit deer damage. This paper is an analysis of the literature regarding the effectiveness of repellents for white-tailed deer (*Odocoileus virginianus*) and mule deer (*O. hemionus*). Factors affecting repellent effectiveness include the number and species of deer involved, palatability, availability of alternative forage, weather, amount and concentration of repellent used, and the length of time after application of the repellent. For example Big Game Repellent (BGR) is more effective at protecting yews (*Taxus spp.*) during the early and middle parts of winter, but becomes less effective as the winter progresses, possibly due to decreasing food sources.

INTERSPECIFIC ODORS AND REPELLENCY

REPELLENCY OF PLANT, NATURAL PRODUCTS, AND PREDATOR ODORS TO WOODCHUCKS

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Abstract: Woodchuck (*Marmota monax*) damage to lawns, gardens, orchards, and other agriculture areas is of concern to homeowners and farmers throughout the northeastern region of the country. The damage caused by woodchucks is due not only to their appetite for cultivated plants and the buds and bark of certain trees, but also because of their burrows. The burrows of woodchucks are at best, unsightly when they appear in one's yard and at worst, potentially dangerous when they appear next to home and building foundations. Currently the only effective control methods are live-trapping and relocation, shooting, or lethal trapping. Each of these techniques, though effective, has serious drawbacks that may limit its use in residential areas. Using odors to repel the animals could provide a non-lethal option to help mediate the vegetation and property damage caused by these animals. For this reason, we studied the effectiveness of several different commonly available odorant chemicals for their ability to repel woodchucks from a highly attractive food source. Approximately 15 different burrow sites were tested during the months of April and May on the campus of a small, suburban college in New York state. Testing occurred in 3 hr sessions between the hours of 0700 and 1100 and between 1400 and 1900 each day. The two ends of the apparatus were baited with approximately 30 gms of fresh green peppers. Strips of filter paper containing 0.1 ml of either the odorant chemical or distilled water were placed at the edges of the bowls containing the peppers. Passive infrared monitors recorded entries of woodchucks into one end or the other of the apparatus. Data analyses compared the number of entries into the odorant and control baited ends of the apparatus and showed that woodchucks reliably avoided the side of the apparatus containing geranium oil, d-pulegone, coyote urine, and Deer Away (p 's < 0.05). The animals did not, however, show a consistent response to the presence of cinnamon leaf oil, pennyroyal oil, or Siberian pine needle oil. The data suggest that some of these products may be effective in repelling woodchucks and thus protecting cultivated vegetation in other situations as well.

REPELLENCY OF PREDATOR URINE TO WOODCHUCKS AND MEADOW VOLES

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Abstract: Woodchucks (*Marmota monax*) and meadow voles (*Microtus pennsylvanicus*) can be serious pests in orchards, where they damage young fruit trees by gnawing on main stems. Previous work indicated that topical application of bobcat urine to apple trees could reduce woodchuck damage by an average of 98%. Here we report on field trials designed to determine whether various fractions of bobcat urine could achieve comparable reductions in gnawing activity. Trials with smooth sumac (*Rhus glabra*) resulted in an average reduction in gnawing over a 4-week period, relative to controls, of 86% for undiluted urine, 56.4% for a methanol extract of urine, and 24.7% for a solution containing 5 nitrogen compounds (indole, phenylacetamide, 1-methylhydantoin, 2,6-dimethylpyrazine, valerolactam) in the approximate concentrations they were found in urine. Trials with apple seedlings and cuttings resulted in an average reduction in gnawing over a period of 2-3 weeks, relative to controls, of 90.3% for undiluted urine, 48.7% for an aqueous extract of urine, 35.4% for a solution containing a single sulfur-containing compound extracted from urine (3-mercapto-3-methylbutanol), and 29.6% when this compound was mixed with 3 additional sulfur volatiles from urine.

Reductions due to the nitrogen- and sulfur-containing fractions were not significant. We also conducted laboratory trials in which we recorded the amount of time meadow voles spent on treated versus untreated halves of an arena. Preliminary trials indicated strong aversions ($P < 0.001$) to areas containing bobcat, red fox (*Vulpes vulpes*), or coyote (*Canis latrans*) urine, significant aversions ($P = 0.02$) to ammonia, but no aversion ($P = 0.28$) to woodchuck urine. In subsequent trials we tested various fractions of bobcat urine and found that the aqueous extract and solutions containing either 3-mercapto-3-methylbutanol, mercaptoethanol, or thiophenol caused significant aversions, but the mixture of 5 nitrogen compounds did not. Woodchucks and meadow voles respond aversively to predator urine, but we were unable to identify fractions of bobcat urine capable of eliciting aversions comparable in magnitude to those achieved with undiluted urine.

REVIEW AND CURRENT STATUS OF SYNTHETIC PREDATOR ODOR SEMIOCHEMICALS AND THEIR ROLE IN WILDLIFE MANAGEMENT

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Abstract: The use of synthetic predator odor semiochemicals as area repellents has considerable potential for protection of forest and agricultural crops. Certain predator odors originating from feces, urine, or scent (anal) gland secretions elicit a "fear" response when detected by prey species. At least some genera (e.g. *Microtus*) appear to have an innate response to these odors. Synthetic constituents from the weasel family (Mustelidae) have been particularly effective in laboratory and field bioassays with a variety of mammal species.

Semiochemicals from the stoat (*Mustela erminea*) and red fox (*Vulpes vulpes*) have successfully reduced feeding damage to forest seedlings by snowshoe hares (*Lepus americanus*). Synthetic compounds from stoat anal-gland secretions have generated significant avoidance responses in voles (*M. montanus* and *M. pennsylvanicus*) and northern pocket gophers (*Thomomys talpoides*) in small-scale field trials. When applied on a larger scale (1-4 ha), some degree of population disruption has been recorded for both pocket gophers and montane voles. Field trials of semiochemicals for protection of coniferous tree seedlings from feeding damage by black-tailed deer (*Odocoileus hemionus columbianus*) have yielded inconsistent results.

We are currently testing stoat semiochemicals on an operational scale to protect coniferous forest plantations from vole damage in the interior of British Columbia, Canada. These large-scale treatments are designed to evaluate efficacy, density of application of odor devices, and overall cost-effectiveness. These trials are being conducted in conjunction with intensive studies of the long-term exposure of voles to odors and subsequent disruption of population dynamics. Commercialization of semiochemical products (mammal management devices) is expected in the very near future.

THE USE OF PREDATOR ODORS TO ELICIT AN AVOIDANCE RESPONSE AND CONTROL FEEDING DAMAGE BY THE HAWAIIAN ROOF RAT (*Rattus rattus*)

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Abstract. The Roof rat (*Rattus rattus*) has been identified as the primary pest species causing extensive feeding damage in Hawaiian macadamia nut orchards. This rodent's arboreal lifestyle has also contributed to the decline in numbers of

indigenous bird species on the islands. This study explored the potential use of predator odors in controlling the Roof rats' feeding behavior.

Initially, nine predator odors were laboratory tested for an avoidance response in wild caught Roof rats. Eight of the odors were synthetic derivatives of non-native predator secretions, while one native predator odor, mongoose feces, was also tested. The testing arena was a two-choice open box design in which responses could be recorded directly by video taping. Variables measured were: time to emerge from transfer cage into testing arena, time to first eating bout, number of eating bouts, time spent, and consumption. A significant treatment interaction was found in the number of eating bouts, and a significant sex interaction in consumption. Isopenthenyl methyl sulfide (IPMS) and 2-propylthietane (PT) odors produced lower numbers of eating bouts than 3,3-dimethyl-1,2-dithiolane (DMDIT) and trimethyl thiazoline (TMT) odors; and males were found to consume more than females overall. Though few significant interactions were found, a comparison of descriptive statistics for the study produced valuable results. This summary of results allowed the comparison of treatments by each variable measured, from which the two most promising odors (DMDIT and TMT) were selected for field trials.

Field testing was performed in a macadamia nut orchard near the town of Hilo, Hawaii. Radio telemetry and mark-and-recapture live-trapping were used to assess the predator odors' effectiveness in the field. Two trials were performed using TMT, DMDIT and a control (no treatment). The study design consisted of six 4 hectare grids (two per treatment) with a minimum grid separation of 400 m. For both trials, resident animals were marked, and 36 animals (six per grid) radio-collared and followed for two weeks prior to treatment application. Once each radioed animal's area of use pattern had been mapped, the assigned predator odor was applied to the nine (trial 1, 16 in trial 2) adjacent trees most frequented by the individual. Live-trapping provided information on non-radioed rat activity in and around the treatment areas. Radioed animals were monitored for two weeks following each treatment application.

The treated tree visitation frequency decreased following odor application, however similar changes were also observed in the control grids. There also appears to be a shift in the area of use pattern by individual animals. The initial study design was based on information suggesting that the size and location of a rat's area of use was fairly stable, though it now appears that shifts may be common.

Final analysis of telemetry and mark-recapture data is still in progress. The lab and field trial results suggest that non-native predator odors may elicit an innate fear response in the Roof rat, and that further research into potential management applications should be investigated.

SULPHUROUS PREDATOR ODOURS AS REPELLENTS TO PREVENT BROWSING BY BRUSHTAIL POSSUMS (*Trichosurus vulpecula*) AND RABBITS (*Oryctolagus cuniculus*)

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Abstract: Repellents are being developed as an alternative to the use of poisons, traps, and firearms, for controlling damage to forest and farm plantings by the introduced Australian brushtail possum and European rabbit. Six synthetic sulphurous predator odours were tested: propylthietane (PPT), propyldithiolane (PDT), dimethylthietane (DMT), and dimethyldithiolane (DMD) from both the anal gland secretions of the genus *Mustela* and from fox faeces; pentanymethylsulfide (PMS) from mustelid anal glands; and trimethylthiazoline (TMT) from fox faeces. Compounds were prepared as 5% solutions in paraffin oil and applied to the foliage of (*Pinus radiata*) seedlings. The seedlings were presented to possums in outdoor pens. In each trial, seedlings sprayed with "Treepel" (a commercial, egg-based repellent) were also presented so that the effectiveness of the new compounds could be compared with a standard, moderately effective repellent. The amount of foliage left unbrowsed was assessed daily for 6-14 days. DMD, PPT, and PMS were significantly more repellent than Treepel. DMT and PDT were equally as repellent as Treepel, but TMT was significantly less repellent. Trials are presently underway to test the response of rabbits to these compounds.

Brush-tail possums are marsupials that evolved separately to the eutherian predator species from which the compounds tested in this study were originally isolated. However, possums were repelled by most of these odours suggesting that they were familiar with them, perhaps as secretions of marsupial predators. The odorous, sulphur-containing compounds may therefore be universal by-products of meat digestion. If such a universal mechanism of chemical communication does exist between herbivores and predators, development of broad-spectrum herbivore repellents may be possible.

DISRUPTION OF MONTANE VOLE (*Microtus montanus*) POPULATIONS WITH SYNTHETIC MUSTELID SEMIOCHEMICALS

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Abstract: The role of mammalian semiochemicals in wildlife management and crop protection has received considerable attention in recent years. This study was designed to test the hypothesis that the continuous presence of predator odor from synthetic anal-gland compounds of the stoat (*Mustela erminea*) would disrupt field populations of the montane vole (*Microtus montanus*). Two experiments (A-winter treatment and B-year round treatment) were conducted in "old field" grasslands at the Agriculture Canada Research Station, Summerland, British Columbia, Canada, from 1983-1986 and 1993-1995, respectively. The major anal-gland compounds were 2-propylthietane and 3-propyl-1,2-dithiolane mixed in a 1:1 ratio; dispensed in glass capillary tubes (30 mg/tube) at approximately 50 tubes/ha in experiment A, and dispensed in PVC plastic release devices (10 mg/device) at 200-400 devices/ha in experiment B. Semiochemicals in capillary tubes lasted throughout each of the three winters (October to March) of experiment A, whereas the PVC devices were replaced monthly throughout summer and winter in experiment B.

In experiment A, montane vole populations declined significantly in three successive winters on treatment areas. These declines were related to poor survival of voles. In addition, feeding damage to apple trees (*Malus domestica*) was significantly lower on treatment than control areas. In experiment B, vole populations declined immediately after treatment in May to a low density of 17.5 voles/ha in late July, compared to 93.0 voles/ha on controls. Thereafter, there were 1.5 to 3.1 times as many voles on control than treatment areas. Control populations reached peak densities of 115 to 139 voles/ha in November whereas treatment populations reached densities of 77 to 93 voles/ha. All populations then declined overwinter. These stoat semiochemicals appeared to disrupt vole populations with poor survival of voles and continual influxes of new animals, which presumably reflected resiliency to depopulation. Feeding damage to lodgepole pine (*Pinus contorta*) seedlings, planted in these control and treatment grasslands, was significantly lower for trees with odor devices compared to those without. These semiochemicals have considerable potential for disrupting vole populations when applied on relatively long-term basis. Our study reports the first practical utilization of mammalian semiochemicals to disrupt the population dynamics of a target pest population.

SCENT GLAND EXUDATE AS A POSSIBLE REPELLENT FOR URBAN JAVELINA

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Abstract: Javalina (*Tayassu tajacu*) are social animals which live in stable herd groups. Rarely, if ever, do herds infringe upon the home ranges of neighboring herds although there are examples of herds using the same water holes. Javalina also have a strong scent which may announce a herd's presence in the area and mark their home range. As urban areas have increased and available habitat has decreased, more animals have adapted to suburban environments. This in turn has resulted in conflicts between these animals and humans including landscape damage, garbage raiding

and occasional biting of pets or humans. In an attempt to develop a repellent for urban javelina, an oily exudate was collected from the scent gland of several javelina and analyzed using gas chromatography. Analysis showed that there was a marked difference in composition between male and female javelina. Female javelina showed several compounds while the males showed only one distinct compound. This compound was identified as one of two commercially available compounds, homogentisic acid or homogentisic acid lactone. Testing is underway to determine whether application of this scent to areas frequented by urban javelina results in behavior changes or repels javelina from treated areas.

A LABORATORY METHOD FOR EVALUATING THE REPELLENCY OF ODORS TO RATS (*Rattus* spp.)

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Abstract: Rats (*Rattus* spp.) damage a wide variety of agricultural crops. Numerous studies have demonstrated the potential of predator odors for repelling rodents and reducing damage. Recent studies in Hawaii indicate that roof rats (*Rattus rattus*) avoid traps that have recently captured mongooses (*Herpestes auropunctatus*). Thus, we conducted laboratory arena trials to explore the use of mongoose feces and urine for repelling rats. We conducted the trials in a 1.5 x 0.6 x 1.2-m rectangular arena that was partitioned in half with a single opening allowing passage between sides. A 31 x 10 x 10-cm stainless box placed in each side of the arena contained a bowl, a chunk of coconut, and 1 of 4 substances (male mongoose feces, male mongoose urine, butyric acid, or water) applied to the lip of the bowl. We released rats individually into the arena and video-recorded their behavior for 15 min. We will discuss the results in reference to conducting laboratory tests to evaluate rodent odor repellents.

REPELLENCY, APPLICATIONS, AND ISSUES

CHEMICAL IRRITATION: AN OVERVIEW OF TRIGEMINAL NERVE FUNCTION

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Abstract: Much chemically induced aversive behavior can be accounted for by stimulation of trigeminal nerve endings during active consumption or casual exposure. The trigeminal nerve is a branch of the general somatosensory nervous system, innervating the nasal and oral mucosae, corneas and facial skin. The endings of this nerve are sensitive to a broad range of chemical as well as thermal and mechanical stimuli. Behavioral responses to trigeminal stimulation range from indifference to extremes of aversive behavior reflecting the range of sensations induced, innocuous to extremely noxious and painful. The major factors that determine trigeminal chemical sensitivity are the permeability of the exposed surface and the intrinsic sensitivities of the underlying nerve endings.

Permeability is determined to a large extent by the degree of cornification present, with the cornea and nasal mucosa being more permeable than the oral mucosa or the skin. The effectiveness of chemical trigeminal stimuli correlates highly with lipophilicity, the ability of a compound to dissolve in and transit cellular membranes.

The neural coding of noxious chemical stimuli is understood largely in terms of several types of nerve fibers that are sensitive to both endogenous and exogenous compounds. Well known are the polymodal nociceptors, that are sensitive to extreme chemical, mechanical and thermal stimulation, and which signal pain. Chemonociceptors are specifically sensitive to chemical stimuli and are likely to be primarily sensitive to compounds associated with inflammation and/or ischemia. A recently described class of nerve fibers are sensitive to acid and cooling and are implicated in nociception.

Finally, other classes of nociceptors may be sensitized by chemicals to become hypersensitive to thermal and mechanical stimuli.

The molecular mechanisms underlying chemonociception are only now coming to light. Classical ligand-receptor interactions as well as non-specific interactions with the lipid bilayers of nociceptor cell membranes are both implicated.

Successful development and use of trigeminal irritants depends upon the full consideration of the factors discussed above as well as further research on the mechanisms underlying trigeminal chemical, thermal and mechanical sensitivity.

A MATTER OF BALANCE: HOW ENVIRONMENTAL FACTORS MAY AFFECT REPELLENT EFFICACY

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Abstract: Effective use of feeding repellents in the control of problem wildlife depends on the environmental context in which the repellents are applied. Environmental and biological factors that may be important when applying predator-based repellent technologies are considered from a behavioural ecology perspective. Conceptual models examining the effects of cover, alternative forage value, predator density, target species home range size, and target species population dynamics on the efficacy of these repellents are presented. I expect that there is an inverse relationship between quantity of hiding-cover available to the target species and efficacy. Data are reviewed which indicate that provision of cover affects the efficacy of predator-based repellents encountered by target species in a controlled situation. Efficacy of any feeding repellent is likely directly proportional to the value of alternative forage available to the target species. The length of time that predator-based repellents remain effective after initial placement may be directly proportional to the predation pressure associated with the site in which the repellents are applied. Target species home range size may be inversely proportional to the efficacy of feeding repellents. Finally, for species that undergo population cycles, the stage of cycle (crash, climb or peak) may have some effect on the efficacy of these repellents. These hypotheses are examined within the context of optimal foraging theory and population dynamics. I conclude that there is considerable merit in using repellents that have a biological basis in the control of wildlife damage. However, the success of repellent use is dependent upon critical evaluation of the biological and environmental context in which they are applied. Recommendations are made for wildlife managers and researchers.

THE ROLE OF CHEMICAL ECOLOGY IN IDENTIFYING REPELLENTS FROM NATURAL PRODUCTS

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Abstract: Chemical ecology is a multidisciplinary field that focuses on chemical and animal interactions. At DWRC, we have benefited by the close collaboration of chemists and biologists when studying the interactions of vertebrates with natural products. Typically, this incorporates chemical assays that provide information on the characteristics of chemical cues with bioassays that generate information on the mechanisms that drive animal behavior. Two recent studies illustrate the role of chemical ecology in characterizing compounds that repel animals.

The first study investigated whether toxic cardiac glycosides mediate herbivore avoidance of digitalis (*Digitalis purpurea*) extracts. We conducted a series of multiple-choice feeding trials and chromatographic analyses with solvent extracts of digitalis. The various extracts employed were chosen to generate information concerning the characteristics of the chemical cues. Chromatographic analyses were used to detect the presence of the cardiac glycosides in the extracts. Contrary to prior thought, the cardiac glycosides were not the aversive cues avoided by herbivores. Additional

chemical and biological assays will further enable us to identify the polar compounds of digitalis that are avoided by herbivores. This initial test indicates that digitalis is a probable source of non-toxic herbivore repellents.

In the second study, chemical assays were employed to relate the chemical characteristics of a forage to the feeding behavior of black bears (*Ursus americanus*). Bears strip the bark from trees to feed on sapwood because the carbohydrates present in the sapwood are an excellent source of high energy food. However, bitter tasting terpenoids which are present in sapwood may deter feeding in omnivorous bears. The sapwood of Douglas-fir (*Pseudotsuga menziesii*) trees was analyzed for terpenoids and carbohydrates. Statistical analyses of the chemical and feeding behavior data indicate that terpenoid and carbohydrate content are related to forage preference. This information will be used to provide valuable insight into silvicultural practices that may alleviate bear damage and/or the development of repellents which deter bears.

EXPERIMENTS ON CHEMICAL CONTROL OF BEHAVIOR IN THE BROWN TREE SNAKE (*Boiga irregularis*)

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Abstract: Two classes of experiments on chemical control of behavior have been conducted with (*B. irregularis*) in our laboratory. Most of our work has focused on the identification of prey-derived chemical cues that trigger ingestive behaviors. Hopefully, these cues might serve as attractants in trapping efforts on Guam. The second group of experiments has focused on repellents that might induce avoidance behavior in (*B. irregularis*). An important observation has been that the magnitudes of attractant and repellent effects are paradigm specific. That is, apparently slight changes in the research setting or in dependent variables are associated with substantial shifts in the efficacy of putative attractants and repellents. This has caused us to recognize that foraging behaviors and other movement patterns are multifaceted and sequenced entities, having some components that may be responsive to attractants and repellents and some components that are less responsive or not responsive at all. Of special importance is the fact the (terminal) ingestive behaviors of (*B. irregularis*) are strongly responsive to various chemical cues whereas the snakes' (initial) searching behaviors are far less responsive. Three ideas related to research strategy flow from these points. First, we must guard against the tendency to focus experimentation only upon responsive behaviors we are wanting to control or to exploit in the field. Second, we must develop broader research paradigms, permitting measurement of all components of the movement patterns under consideration. Third, since different phases of movement patterns likely rely upon different combinations of sensory input, it is necessary to take a factorial approach to the analysis of stimulus effects. For example, chemical cues generally have strong effects on terminal behavioral components and weaker effects on initial ones, but it remains possible that chemical cues may interact (perhaps strongly) with visual or other cues during early phases of movement episodes. If this is so, then working only with chemical cues will leave us ignorant of ways to potentiate their effects through capitalization upon interactions.

ATTRACTANTS AND REPELLENTS FOR BROWN TREE SNAKES

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Abstract: The brown tree snake (*Boiga irregularis*) is native to the islands of Papua New Guinea and Northern Australia. An introduced population exists on Guam and has been implicated in the decline of that island's avifauna, and the snakes are regularly implicated as the cause of power outages on the island. Concern exists for accidental introduction on the Hawaiian Islands. Baited traps using live mice have been used in control efforts, but the logistics of maintaining live mice in the field is difficult and expensive. The object of this study was two fold. First, using reports of the efficacy

of small mammal and bird feces as attractants we set out to identify active fractions of these potential prey odor sources. If active fractions could be identified, there is a possibility of encapsulating reagent grade attractant without having to process feces or urine. Second, the relevant appetitive behavior for a successful snake bait should result in the snake's entry into a trap. Initially four snakes 9-11 feet in length were obtained from the Philadelphia Zoo. These snakes were attracted to warm water-extracted vole and starling feces. Snakes tended to avoid aqueous acid bird feces extracts. Snakes were indifferent to aqueous-base bird feces extracts. Snakes avoided Big Game Repellent, cadaverine, butanethiol, and ethanethiol. In summary, potential prey odors lost their attractiveness quickly upon fractionation, suggesting the overall odor profile is important for attractiveness. We are focusing efforts to easily encapsulate these chemical signals so that field operatives will not need to process raw feces. Sulfur and amine bearing volatiles may be repellent to brown tree snakes. These same compounds are often attractive to mammalian carnivores. This raises the possibility that predator odors may be generally repellent to brown tree snakes. If true, commercially available materials may be used to treat potential hiding places around air cargo areas and electric power plants.

IN-WATER ELECTROSHOCK TECHNIQUES TO REPEL AQUATIC ANIMALS

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Abstract: Non-lethal electroshocking apparatus are being developed at the Denver Wildlife Research Center for repelling aquatic mammals and birds from selected areas. These devices are augmented with infrared motion sensors to turn on the apparatus only when warm-blooded animals are present, thereby conserving electrical energy and allowing battery operation. Electronic safety controls are incorporated to prevent animals from being over-exposed or repeatedly exposed to the electrical fields. The technical basis for this equipment is based upon research originally reported in the electrofishing literature. Obviously, any animal immersed in water is highly susceptible to electrical shock, but permanent injury can be avoided by controlling the intensity of the electrical energy. As the intensity of the electrical field is increased, the severity of the electrical shock experienced by an animal is known to progress through several stages including mild irritation, extreme agitation, electroanesthesia (an unconscious state), tetany (characterized by muscular rigidity), and death. Fortunately, with proper engineering, in-water electroshocking apparatus can be designed to limit the degree of electrical shock to the desired threshold. Additionally, controlled studies with fish provide evidence that there is a predictable relationship between the intensity of the electrical shock and the magnitude of the electrical power transferred from the water into the fish. By applying this electrical model and measuring the electrical conductivity of the water, it should be possible to predict the level of electrical power density required in the water to elicit a particular electroshock response.

ELECTRONIC RODENT REPELLENT DEVICES: EFFICACY TEST PROTOCOLS AND REGULATORY ACTIONS

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Abstract: A wide variety of sonic/ultrasonic, electromagnetic, mechanical/vibrational, and electrical barrier devices have been researched, developed, and marketed over the past 30 years. Although there are currently no Environmental Protection Agency (EPA) registration requirements, human safety and repellent efficacy test data for these devices may be requested whenever they are commercially manufactured, marketed, and retailed. Research reports and data sets are reviewed for devices operating at selected frequency ranges, pulse rates, duty cycles, and intensity levels. Examples of laboratory and field test protocols are described. Recent EPA and Federal Trade Commission (FTC) regulatory actions are described in relation to the compliance requirements of the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) and provisions of the Federal Trade Commission Act (FTCA), respectively. State regulations may also be imposed on manufacturers and retailers of repellent devices when they are carried as stock items through local stores.

or through mail-order service companies. Research and development efforts to reduce habituation effects, incorporate and integrate ultrasonic devices into traditional rodent control methods, and improve efficacy are reviewed.

REPELLENTS: INTEGRATING SENSORY MODALITIES

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Abstract: Application of repellents for wildlife management can be viewed as a problem in communications. Successful application requires that the sender of the signal (the wildlife manager) transmit a signal or message ("stay away from here") that the receiver (target wildlife species) recognizes and understands. This is not a trivial exercise. Breakdowns in communication can occur at all stages of the process. Failure to achieve successful results in the field with supposedly effective repellents may reflect lack of understanding of the sensory capabilities of the target species as well as an inability to articulate the message well enough for the target animal to perceive and understand it. Generally, it is believed that application of multiple repellent techniques increases the likelihood of deterring the target species, but it is possible that this approach could detract from the communication process rather than enhance it. I will examine the effectiveness of using multiple sensory stimuli, with primary examples from studies of feeding deterrence in birds.

ATTITUDES OF THE GENERAL PUBLIC AND PROFESSIONAL WILDLIFE GROUPS TOWARD REPELLENTS

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Abstract: Surveys of both the general public and professional wildlife groups showed similar trends in attitudes toward chemical repellents. A mail survey was administered to 1500 adult residents of the United States stratified over 5 regions, with a response rate of approximately 50%. On a scale of 1 (not humane) to 5 (very humane), respondents ranked non-lethal chemical repellents with a mean score of 3.7. Another mail survey was sent to over 1000 employees of the U. S. Department of Agriculture's Animal Damage Control program, with a response rate over 70%. Chemical repellents scored a mean of 4.3 on a humaneness scale similar to the one used for the general public, and a mean of 3.6 on an effectiveness scale (1= not effective to 5=very effective). Finally, a survey was administered to 500 randomly selected members of The Wildlife Society, with a response rate of 86%. When asked about the ethical acceptability of techniques used to control growth of wildlife populations, chemical repellents were rated as ethical, but there were significant differences between women and men in their responses. On a scale of 0 (not ethical) to 10 (very ethical), the mean score for women was 5.23 and the mean score for men was 7.52. In general, chemical repellents scored higher on a humaneness/ethical scale than did lethal technologies for wildlife damage management.

REGULATORY AND MARKETING CONSTRAINTS TO REPELLENT DEVELOPMENT

AN OVERVIEW OF THE PESTICIDE REGISTRATION PROCESS

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Abstract: Two statutes allow the U.S. Environmental Protection Agency (EPA) to regulate sale and use of pesticides. Under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), EPA regulates the distribution, sale and use of pesticides. The Federal Food, Drug and Cosmetic Act (FFDCA) authorizes EPA to establish tolerances for pesticides used on food crops. Repellents are considered to be pesticides and must be registered with the EPA. Data required for registration of an active ingredient include product chemistry, toxicology, wildlife and aquatic organisms, environmental fate, and residue chemistry. In addition, product specific data are required. Two recent EPA initiatives may impact development of new products for repellents. Under the Reduced-Risk or Safer Pesticide Initiative (PR Notice 93-9), applicants seeking to register new active ingredients submit, along with the registration application, a "reduced risk rationale" documenting how their new pesticide presents opportunities to reduce risks to human health and the environment. These pesticides will be given preference in EPA's priority planning system. Another initiative proposed in September 1994 will reduce or eliminate regulatory requirements for certain low risk pesticides; this initiative is expected to be finalized by the end of 1995.

CONSIDERATIONS FOR REGISTRATION OF REPELLENTS FOR USE ON PESTICIDE FORMULATIONS

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Abstract: Pesticides are inherently toxic to the species they are designed to control. However, non-target species can be exposed to pesticides when foraging over treated areas or when the pesticide drifts off-site. The majority of the registered pesticides will have some effect on some non-target species. The challenge is to reduce or prevent the ingestion of pesticides by non-target species in order to improve the safety and selectivity of the pesticide.

The addition of a repellent to pesticide formulations may help prevent pesticide ingestion by non-target species. Repellents work through many mechanisms. For example, some induce pain or a sensitization response immediately, preventing ingestion, while others act as emetics resulting in a learned avoidance. The toxicity of the pesticide dictates the type of repellent needed. For example, acutely toxic pesticides would need a repellent that would prevent ingestion while an emetic could be sufficient for chronically toxic pesticides.

In general, there are two primary types of formulations: liquids (included in this are water dispersible granules and wettable powders) and granulars. It would be fairly easy to include a repellent in a liquid formulation in order to keep non-target species away from a sprayed area. On the other hand, granular pesticide formulations are often designed to maximize the active ingredient concentration on the substrate in order to be cost-effective. This effort to maximize the active ingredient results in only a small fraction of the formulation left in order to add other components to the granular matrix. Adding components to the granular substrate above a certain defined level will result in the loss of the necessary flow characteristics. In both cases, however, every extra component adds cost to the formulation. If a repellent is to be used, then there is a need for it to markedly improve the safety of the formulation, or it will not be cost-effective.

The cost of adding another component to a formulation coupled with the need to demonstrate repellent efficacy of the pesticide poses a unique dilemma with regard to testing for regulatory requirements. Additional testing to register a repellent for use in a pesticide formulation is understandable, however, if the repellent requires the same level of testing as a technical grade pesticide active ingredient many companies would choose not to expend the necessary effort and cost to register the repellent.

REGISTRATION ISSUES FROM A SMALL BUSINESS PERSPECTIVE

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Abstract: IntAgra, Inc. is a small, employee-owned corporation that manufactures and markets animal repellents to both consumer and commercial markets. The company holds three basic EPA registrations, as well as three supplemental registrations.

Maintaining EPA and state registrations is very costly and time-consuming. The recent reregistration process has added to this burden.

As a small business with limited resources, IntAgra must rely on others to develop repellent technologies and EPA registrations.

REGULATORY AND MARKETING CONSTRAINTS TO REPELLENT DEVELOPMENT

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Abstract: Repellents are a unique class of agents in that they repel pests because they are disagreeable to them. They are not covered effectively by the pesticides or biocides laws and regulations of the U. S., Canada, or the E. C. which are focused more on agents that exert their influence through morbidity or mortality, hence the use of the stem word "cide". Similarly, States, Provinces and Member countries are not sure how best to handle repellents. Repellents are exempted under the Australian and New Zealand laws. In general, repellents are unfairly subjected to the rigorous screening reserved for pesticides and biocides.

In the U. S., the introduction by the EPA of the concept of reduced risk pesticides has assisted somewhat since these materials generally fit into this category, especially when compared to the "cides". They are assigned a higher rating which moves them forward in the review backlog. Canada does not have legislation that allows for the more rapid handling of biochemicals or reduced risk pesticides, nor does the E. C. which is just formulating its Directive.

Another problem with repellents comes in demonstrating their effectiveness. There are situations in which it is believed that a repellent is likely to be effective, but formal, study protocol testing is infeasible. One recently publicized example of this was the case of a spray can of cayenne derived aerosol as a bear repellent. EPA refused to permit its use without an appropriately controlled efficacy study.

There is also the difficulty in extending the efficacy beyond just the species tested. If a material was found to be effective against all bird species tested, EPA has been unwilling to generalize its effectiveness. How many species need to be tested to claim the entire class? Similarly, if a repellent worked for grapes, cherries, and blueberries, when can one expect it to universally work for other types of berries without further efficacy testing on each species? This is guidance that needs to be developed and represents an area where DWRC might develop some valuable inputs to EPA's review and decision process regarding both assigning of tolerances or exemptions from tolerance and labeling.

Similarly, more generalized language on labels would assist in review of the state registrations and in marketing of the products since fewer questions would be raised about efficacy.

PANEL ON RESEARCH NEEDS

RESEARCH NEEDS FROM A WILDLIFE PROFESSIONAL'S POINT OF VIEW

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Abstract: Historically, the broad field of animal damage management has not been a primary focus of the mainstream wildlife profession. As a result the issues and answers have been largely delegated to a small but dedicated group of specialists.

The cry for more and better repellents is often heard. However, in times of shrinking public dollars, that cry may not be able to be heeded. Scarce public dollars must be targeted in a systematic way to resolve the most pressing problems. Defining those problems from the broadest perspective possible is a critical step for their resolution.

Use of repellents, even effective repellents, in some situations, actually may be only stopgap efforts that provide a false sense of security to the parties involved. Developing an effective repellent regime ultimately may exacerbate "problems" by disseminating them to other areas. Effective repellents also may mislead the public by misdirecting attention away from the needs of habitat and population management. Effective solutions to most wildlife problems currently exist. However, the ability to use the solutions may be limited because of the public's unwillingness to deal with the harsh realities of life and ecological conflict.

The concepts of cultural carrying capacity, habitat alterations, planned development, "humaneness" and population management must be incorporated in broad wildlife management planning. A conceptual, prioritization process that explores the validity and nature of the wildlife complaints, the seasonal variations of complaints, the species involved, economics and attitudes of society will be addressed along with the needs for further developments of wildlife repellents.

THE IMPACT AND FRUSTRATIONS OF WILDLIFE/AGRICULTURE CONFLICTS

KARL R. GEBHARDT, Ohio Farm Bureau Federation, Two Nationwide Plaza, 6th Floor, Columbus, OH 43216-0479

Abstract: The Ohio Farm Bureau estimates close to 100 million dollars in damages to agricultural crops result from wildlife in Ohio. On a national level 83% of all farmers and ranchers reported that wildlife caused damage on their farms or ranches in 1993; 51% felt that those losses were higher than they could tolerate. Most complaints and actual crop damage in Ohio is a result of the expanding populations of white-tail deer, wild turkey, Canadian geese, raccoons, groundhogs, and blackbirds. In addition, the eastern coyote has become a major problem for Ohio's sheep industry.

Ohio law states: "The ownership of and the title to all wild animals in this state, not legally confined or held by private ownership legally acquired, is in the state, which holds such title in trust for the benefit of all the people." The management of the state's wildlife is vested with the Ohio Department of Natural Resources, Division of Wildlife. The perception by many in the agricultural community is that the Division of Wildlife is interested more in wildlife propagation than in preventing wildlife caused crop damage.

Historically, wildlife crop damage has been addressed by removing the problem through hunting and trapping. Some efforts with frightening devices and habitat alteration have been attempted but with limited long term success. With the continued advancement of civilization into the country, the use of frightening devices and habitat alternation is becoming more of a concern to the rural non-farm citizens. The need for research into cost effective practical methods to prevent wildlife/agricultural conflicts, such as repellents, is needed and would be supported by the agricultural community. These products and methods would serve as the first line of defense, but must be coupled with modifications in broad policy issues relative to wildlife management.

The problems being realized in Ohio appear to be indicative of what other states are experiencing. The agricultural community is the primary provider of wildlife habitat. Farmers enjoy having wildlife on the farm and part of the "rural environment" but they are also interested in protecting their livelihood. Any help is needed and would be appreciated.

THE PUBLIC IS ATTRACTED BY THE USE OF REPELLENTS

CATHY LISS, Animal Welfare Institute, P.O. Box 3650, Washington, DC 20007

Abstract: Americans have long been in favor of humane treatment of animals. Increasingly, the public is involved in dictating acceptable wildlife management practices. The USDA's Animal Damage Control program has been the recipient of much adverse publicity regarding its killing of target and non-target animals.

Growing opposition to various methods of lethal control such as use of steel jaw leghold traps or poisons will likely result in continuing restrictions or outright prohibitions against their use in the future. Alternative methods of wildlife control are critical. Non-lethal programs are key to the future of the Animal Damage Control program. Repellents represent an area of great promise. There is much research which needs to be conducted in this area including continuing isolation and identification of natural repellents. However the success with Methyl Anthranilate as a humane method of control demonstrates the utility of this approach. Just imagine the public's response to a switch from lethal methods of control to a new arsenal of tools which includes "grape juice"!

BIRD DETERRENT RESEARCH AND DEVELOPMENT: MARINE OIL SPILLS

TIMOTHY J. REILLY, Marine Spill Response Corporation, 1350 I Street, NW, Suite 300, Washington, DC 20005

Abstract: A wide range of techniques are available for deterring birds from coastal oil spills, including (but not limited to) pyrotechnics, aircraft, boats, flags, reflecting devices, and artificial sounds. Many of these deterrent devices have had little field testing to determine optimal deterrent strategies. MSRC developed a research and development plan which has identified critical research which would need to be conducted to determine these optimal strategies. This program was initiated through the generation of a report which described the state-of-the-art of deterring birds from marine oil spills. Following this report, MSRC hosted a workshop consisting of deterrent experts and practitioners from the private and public sectors. This panel determined priority areas of marine oil spill bird deterrent research and development. A group consisting of research personnel from government and industry are currently involved in implementing certain high-priority research and development projects as identified by the deterrent workshop panel. The present paper describes these research efforts.

TARGETED DELIVERY OF PESTICIDES: RESEARCH NEEDS FOR REPELLENTS BY THE CROP PROTECTION INDUSTRY

KRISTIN E. BRUGGER, DuPont Agricultural Products, Wilmington, DE 19880-0402 USA.

Abstract: Feeding repellents serve as a first-tier mitigation of pesticide impacts to vertebrates by reducing oral intake of toxic compounds immediately after application at the source of exposure. The usefulness of feeding repellents comes to play for compounds with high toxicity: exposure ratios (TER). There is a need to develop reliable first-tier mitigation strategies that match the chemical characteristics of pesticides in terms of physical chemistry (hydrolytic and photolytic half lives, dissociation constants), environmental fate (movement, metabolic fate in potential food items), formulation (solid, water-dispersible forms) and product delivery system (granule, spray). One approach could be to evaluate the physical-chemical traits of potential repellents and develop a ranking system to identify the contexts in which potential repellents might be used.

APPENDIX 20

Bird Strike Committee Europe

BIRD STRIKE COMMITTEE EUROPE



Ref: 10Z/21/01/05

5 September 1995

Mr V Thorn
Director of Environment and Support Services
180 Place de Ville
Ottawa
Ontario
K1A 0N8

Dear Mr Thorn

BIRD STRIKE COMMITTEE EUROPE, LONDON MAY 1996

Please find enclosed a Letter of Invitation to the May 1996 meeting of Bird Strike Committee Europe. At present the Canadian Committee seems to be at the forefront of work to combat this costly and hazardous subject. Your Committee appears to be about the only one, along with BSCE to produce proper meeting reports with copies of papers, this is a most important aspect. In addition your excellent video, posters and awareness leaflet are vital elements in the struggle to contain the problem. In view of the major initiatives it would be most useful if Bruce MacKinnon were able to attend the meeting of BSCE, perhaps to present a paper on the work of BSCE and of course to introduce your new video

If you need any further information, please do not hesitate to get in touch with me.

Yours sincerely

John Thorpe
Chairman, BSCE

cc: Mr B MacKinnon

Chairman: John Thorpe
Address: Civil Aviation Authority
Safety Promotion Section
Aviation House
Gatwick Airport

Personal Assistant: Julie James
Telephone: 44 293 573225/7
Fax: 44 293 573973
Telex: 878753





LETTER OF INVITATION

1 Date of Meeting

Bird Strike Committee Europe, the Civil Aviation Authority and the meeting sponsors cordially invite you to participate in the 23rd meeting of BSCE. This will be held in London from **Monday 13 May to Friday 17 May 1996**. If you are no longer involved in bird strike work and wish to be taken off the mailing list or have been replaced by someone else, it would be helpful if you could let us know.

2 Location of Meeting

Great Western Royal Hotel
Praed Street
Paddington
London, W2 1HE
United Kingdom

Tel: +44 171 723 8064
Fax: +44 171 723 1739

The Hotel is at the front of Paddington main line railway station, there is an entrance from the station direct into the hotel lobby. It is on the Circle, Bakerloo and District Underground lines. The hotel, see D4 on the enclosed large map, can be reached from:

- Heathrow Airport using Airbus A2, ask for Paddington Station, it stops outside the hotel.
- Gatwick Airport by non-stop rail to Victoria Station, every 15 minutes, taking 30 minutes. Either take a taxi to the hotel or turn right outside front of station and opposite theatre featuring 'Starlight Express', catch number 36 bus to Paddington station.

There is no car park at the hotel but car parking can be reserved nearby (it is expensive, 1995 prices are £13.20 for 9 hours and £17 for 24 hours). Please advise on your registration form if you need this.

3 Organiser's Address

John Thorpe, Chairman, BSCE
CAA Safety Promotion Section
Aviation House, Gatwick Airport South
West Sussex RH6 0YA
United Kingdom

Tel: +44 1293 573225
Fax: +44 1293 573973

4 Notification of Participation and Registration

It will help our planning if notification of participation and pre-registration is sent to the Chairman by completing Appendix 2, **as soon as convenient but before 15 March 1996** at the latest.

5 Subjects of Special Concern

The Steering Committee have decided that certain subjects are of particular concern and should be addressed at the 1996 meeting:

- The cost of bird strikes,
- Bird hazard management in the airport environment,
- Airports legal responsibilities,
- Very quiet new generation fan engines,
- Evaluation of reporting standards with particular reference to bird species struck.

You are invited to provide papers and presentations on these and other subjects, hence the early notification.

Currently Sponsored by:

Airport Operators Association
Britannia Airways
British Airports Authority
UK Flight Safety Committee



 **Britannia**

R.A.A. 



6 Working Papers

- Working papers should be **new material** with references to previous Proceedings. Please avoid repeating old information.
- All working papers should be sent to the BSCE chairman by **15 March 1996 at the latest**.
- Working papers received **before 15 March 1996** and considered by the Steering Committee to be suitable, will be copied and a high quality master copy sent to a contact person in each country. The contact person will then copy and distribute to all registered participants from that country. This will enable participants to read papers prior to the meeting whilst keeping postage to a minimum. Late papers arriving after 15 March may be distributed at the meeting and will be published following the meeting in the Proceedings, together with the Discussions and Recommendations. In order to obtain consistency of lay-out etc please help us by using the Style shown in Appendix 1.
- Participants sending or bringing copies of late papers to the meeting must give the Chairman a copy at the earliest opportunity and **must** obtain a Working Paper number from the Chairman's Secretary.

7 Presentations

It will be assumed that participants in the meeting have already studied the working paper, thus the oral presentation of a working paper should be a **summary of the main points of the paper** taking a maximum of **15 minutes**, in order to allow some time for questions and discussion. All papers and presentations are to be in **English**.

8 Hotel Reservations

- Please make your reservations as soon as possible with the **Great Western Royal Hotel**, clearly marking your request 'BSCE' (phone, fax numbers etc in para 2). The hotel will only hold our rooms until **1 January 1996**. The number of single rooms with en-suite bathrooms is limited, there is a re-building programme. The room rates (US dollars in brackets at 1.53 to the £) inclusive of tax are:

	Single	Double/Twin	Triple
Executive rooms with en-suite bath/shower inclusive of continental breakfast	£55.25	£94.00	£114.00
(full English breakfast £3 per person extra)	(84.50)	(144)	(175)
Budget room (no en-suite bathroom, breakfast extra)	£35.00	£62.00	-
	(54)	(95)	

A buffet lunch can be booked each day.

These prices also apply for the week before and week after the meeting for those who wish to combine the meeting with a holiday.

- In the event that all rooms in the Great Western Royal Hotel become full, the 2 to 3 star (59 rooms) Norfolk hotel, 25 London Street, tel +44 171 723 3386, fax +44 171 723 3505 is only 2 minutes walk. Their prices for rooms with bathroom, inclusive of tax and full English breakfast, are single £65, double/twin £75. There is also, in a nearby quieter street, the Delmere, 130 Sussex Gardens, phone +44 171 706 3344, fax +44 171 262 1863 which has 38 rooms with en-suite bathrooms at £73 inclusive of tax and continental breakfast, or £93 double/twin.

9 Accompanying Persons Programme

It is hoped that there will be an Accompanying Persons programme, each morning. It would be helpful to know in advance how many will wish to participate so that the right size coach can be arranged. It may be necessary for participants to pay their own entrance charges. Details of the exact programme will be finalised later, but may include:

- Tower of London/Crown Jewels and Tower Bridge.
- River trip on Thames to Greenwich Royal Observatory and Maritime Museum,

- Kew Botanical Gardens,
- Private visit inside Houses of Parliament and to Buckingham Palace for changing the guard ceremony,
- St Paul's Cathedral and Westminster Abbey.

10 Excursion on Saturday

Depending upon the demand, there may be a coach excursion on Saturday 18 May to take in some of the English heritage outside London, eg Warwick Castle, Stratford on Avon Shakespeare sites, canal boat trip/steam railway. The cost will depend on exact itinerary. (See Registration Form.)

11 Timetable

Date	Time	Event
Sunday 12 May	17.00-18.00 (18.00-20.00)	Early Registration Steering Committee Meeting for Working Group Chairmen)
Monday 13 May	08.00-09.00 09.00-09.30 09.30-10.30 10.45-12.30 12.30-13.30 13.30-15.00 15.15-17.00	Registration Official Opening and Chairman's Report Presentation of Statistics Papers Papers (continued) Lunch Presentation of Statistics and Remains Identification Papers Discussion on Subjects chosen by WG Chairmen, Dr Y Leshem, Israel and Dr J Wattell, Netherlands
Tuesday 14 May	08.30-10.30 10.45-12.30 12.30-13.30 13.30-15.00 15.15-16.30	Presentation of Aerodrome Papers Papers (continued) Lunch Papers (continued) Discussion on Subjects chosen by WG Chairman, Mr O Stenman, Finland
Wednesday 15 May	08.30-10.30 10.45-12.30 12.30-13.30 13.30-15.00 15.15-16.30 (16.30-18.00)	Presentation of Remote Sensing Papers Discussion on Subjects chosen by WG Chairman, Dr L S Buurma, Netherlands Lunch Presentation of Military Low Flying Papers Discussion on Subjects chosen by WG Chairman, Dr J Becker, Germany Steering Committee Meeting)
Thursday 16 May	08.30-10.30 10.45-11.15 11.15-12.30 12.30-13.30 13.30-15.00 15.15-16.30 16.30 (16.30-17.30)	Presentation of Impact Engineering Specialist Papers Papers (continued) Discussion on Subjects chosen by Group Chairman, Mr R Speelman, USA Lunch Working and Specialist Group Chairmen's Reports Endorsement of Recommendations Other Topics, Future Meetings etc Closing of Meeting Steering Committee meeting)
Friday 17 May	08.30 approx Return 19.00 approx	Technical visits, one group to: Rolls Royce at Derby to visit impact testing site and automated engine production factory the other group to: Slimbridge, Gloucester Wildlife and Wetlands Trust The journey times are approximately 2½ hours each way.

12 Exhibitors

If any recipients of this letter are aware of companies or organisations in their country selling bird scaring equipment etc, it would be helpful if they would send me the address and fax number of the company. This is so that they can be sent an invitation to exhibit at the London meeting. Alternatively, contact them direct and ask them to fax me the company address etc.

- **Type:**

Papers must have a good quality black print on A4 208 mm x 295 mm (8¼" x 11½") or American quarto paper with 20 mm margins on all sides to allow for printing and binding.

Due to problems with reproduction and readability, low quality dot matrix printing is to be avoided. Choose a medium weight, simple typeface (eg Futura Medium, Helvetica or Courier), ie one that is not bold, ornate or compressed. Lettering should be of such a size that it will be about as large as text type (7-10 point) when reduced in order to print the Proceedings.

- **Format:**

Text should be **single spaced** with double spacing between paragraphs. Text, including new paragraphs, should be left (or both) margin justified.

- **Front Sheet:**

Each paper submitted must start with a front sheet as shown on the sample overleaf which, at the top right-hand has BSCE/23 then a space for the organisers to insert a WP number. Below this should be a brief summary of not more than 200 words, followed by some 'key words' for index purposes.

The body of the paper should be started on a new sheet.

- **Heading and Paragraph Numbering:**

All headings shall be left justified and bold, if available. Section headings shall be in upper case and each section numbered 1 to ... Sub-headings shall be in upper and lower case and numbered 1.1, 1.2 etc. Sub-paragraphs may be lettered if desired. The above will make it easier to refer to paragraphs during discussions etc.

- **Figures and Tables:**

All figures and tables should be titled across the top with FIGURE or TABLE in capital letters followed by the number. The title should follow on the same line in upper and lower case letters.

- **Photographs:**

Photographs should be sharp and of good contrast, showing details in important areas. Prints should be made from monochrome (black and white) film whenever possible.

- **Page Numbers:**

Pages shall be numbered in **light pencil at the bottom centre of each page**. The organisers will renumber all pages when compiling the Proceedings.

- **Length of Papers**

The Steering Committee will, if necessary, reserve the right to edit papers in the Proceedings in order to economise on printing and postage costs.

FATALITIES AND CIVIL AIRCRAFT DESTROYED DUE TO BIRD STRIKES 1912-1995

by John Thorpe
Chairman, Bird Strike Committee Europe
Civil Aviation Authority
Aviation House
Gatwick Airport South
West Sussex
RH6 0YR
UK

Summary

Following a short introduction, the paper contains brief details of all accidents involving fatality or destruction of civil aircraft as a result of bird strikes. The paper is divided into three sections, transport aircraft, general aviation aircraft and helicopter. Over 50 aircraft have been written off and 190 people known to have been killed due to bird strikes.

(Key words: Civil statistics, damage, fatalities)

BSCE ATTENDANCE AND PRE-REGISTRATION
must be by 15 March 1996 please

Appendix 2

to be sent to:
Mr J Thorpe, Safety Promotion Section
Civil Aviation Authority, Aviation House
Gatwick Airport, RH6 0YR
United Kingdom

Full name: _____

Business Address: _____

Telephone number: _____

Fax number: _____ Telex number: _____

I will attend the 23 BSCE Meeting in London from to

I will be staying in the: Great Western Royal Hotel ☐ Other: _____

Do you require reserved car parking? from to

Have you reserved your hotel room? Yes ☐ No ☐

How many accompanying persons will be coming with you? ☐

I would like to present the following papers:

Audio visual needs:

OHP ☐ 35mm Slides ☐ VHS Video ☐ 16 mm film ☐ Other _____
Kodak Carousel

Working papers which have **NOT** been received by the BSCE Chairman before 15 March 1996, will only under exceptional circumstances, be presented orally at the meeting. However, they but will be published in the Proceedings.

Do you prefer to visit Rolls Royce or Slimbridge

Rolls Royce ☐

Slimbridge ☐

Number of persons likely to use the Accompanying persons tours, for which there may be a small fee ☐

Number of persons who would like to have a day coach excursion on Saturday 18 May, perhaps to Shakespeare country etc. ☐



To: All at Vienna 1994
 Certain members who were unable to attend
 New persons with an interest

Dear Colleague

CHAIRMAN'S NEWSLETTER - NUMBER 4, AUGUST 1995

1 BSCE22 Meeting in Vienna, August 1994

I hope you all had a good journey home from Vienna. I'm sure the 110 participants from 24 countries will join me in thanking Klaus Krziwanek and the Austrian Federal Ministry of Public Economy and Transport for a successful and thoroughly enjoyable meeting. On my return home I found that there had been a long failure of the electricity supply which cancelled the times I'd set on my video recorder. The cause - a Swan strike on the local power cables, so bird strikes affected me even when I was away!

Everyone should have received mid-January a copy of the Proceedings, 570 pages, of papers, discussion etc. If yours didn't arrive, or you weren't at the meeting, I have a few spare copies available. Julie had to re-do the front page of many papers to get them into a uniform style, please in future help us by using the style detailed in the Letter of Invitation.

2 1996 Meeting of BSCE23 in London 13-17 May

The Letter of Invitation is enclosed. Please note:

- the Special Subjects,
- hotel reservation direct to the hotel by 1 January,
- papers and registration to Chairman as soon as possible but by 15 March 1996 at the latest,
- new way of working, copies of papers received by 15 March will be sent exclusively to a contact person in each country. They are responsible for reproduction and dissemination to participants from their country. This will keep postage to a minimum and enable regular and new participants to read the papers before the meeting.

3 BSCE Working Groups and Policy

I am pleased to report that Jan Wattell of the University of Amsterdam has agreed to become Chairman of the Bird Remains Specialist Group. In Vienna, owing to the resignation of the Chairman and absence of the Vice Chairman, Nigel Horton, UK, at very short notice, Dr Henri Ouellet of Canada very kindly filled the gap.

At the Vienna BSCE Meeting the Plenary endorsed Steering Committee Policy Papers No 1 - Terms of Reference etc and No 2 - Duties of Host Country. Subsequently the Steering Committee have agreed to three proposed changes:

- "That the BSCE Chairman and Vice Chairman are elected for a 6 year term." The current 4 years was appropriate in the days of annual meetings.

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First Symposium on Bird Strikes in China	5	Serious Bird Strike Accidents/Incidents	7/8

- "That the Steering Committee includes a representative of the country hosting the previous meeting." This is so that his experience can help prepare for the next meeting.
- "That the Chairman and Vice Chairman of Working and Specialist Groups are elected by their respective groups and endorsed by the Steering Committee and a Plenary. There is no limit to the term of office but it is generally dependent upon the individual and his employer's wishes

Could you all please consider these proposals for ratification at the London meeting.

4 A New Age of Co-operation in the Middle East on Flight Safety and Migration Research from Dr Yossi Leshem - Chairman of the Statistics Working Group

On 31 August 1994, I had to leave, to my disappointment, in the middle of the BSCE conference in Vienna, I had to take part in a ceremony with our Prime Minister, Mr Itzhak Rabin. A book I wrote "Flying With The Birds", which sums up 10 years of research with the Israeli Air Force, won the "Major - General Itzhak Sade" Prize for military writing.

At the ceremony there were also 2 ministers, IAF senior Generals and hundreds of guests. Prime Minister, Mr Rabin, formally opened the new "migrating exhibit" based on 40 large pictures from the book, telling the story of the coexistence between aeroplanes and birds in Israel. (I hope that in May 1996, the exhibition will be available at our next conference in London.)

The book presents the idea that birds do not know any political boundaries and they cross from Jordan to Israel in the autumn and during the spring migration they fly back from Israel to Jordan. The book was also given to King Hussein by Mr Rabin as a present at the Peace Signing Agreement ceremony that took place on the border between the two countries. The research with the IAF saved the IAF 300 million dollars. When I told Mr Rabin this, he couldn't believe it and claimed that I was exaggerating, but the IAF officers verified my data.

A month later we presented to Mr Shimon Peres, the Israeli Foreign Affairs Minister, a large picture of a Bearded vulture (the meaning of the name Peres is Bearded vulture in Hebrew). We also presented to him a development plan of the new radar network which we want to progress in co-operation with Jordan, Israeli and Egypt. Mr Peres was very excited at the idea and promised to help us to get finance of 20 million dollars for the project. At our meeting in London, I hope I will be able to report some positive results from this exciting meeting.

At a later date, Yossi Leshem was able to meet USA Vice President, Al Gore, and show him the Israeli bird migration work. The Wall Street Journal picked up the story and there was a large item on the front page of 27 March 1995 issue. The idea of establishing an international bird migration research centre at Latrun by Society for the Protection of Nature in Israel, Tel Aviv University and others to use the GLOBE international computer project was enthusiastically discussed. It isn't often that politicians discuss flight safety.

Yossi Leshem
with Al Gore
and Yossi
Sarid, Israel
Minister of the
Environment



5 Aerodromes Working Group - Progress on Green Booklet 'Some Measure Used by Different Countries to reduce Bird Hazards'

Olavi Stenman has already received contributions from 19 countries in response to the Questionnaire, with a lot of useful information supplied. In September he hopes to have a meeting with his two vice chairmen, Jean Luc Briot, France and John Allan, UK to produce a rough draft with a view to the new version being available at the London meeting. Many thanks to all of you who have sent information.

6 Low Level Working Group via Dr Jurgen Becker, WG Chairman

The group held their 10th meeting 14/15 March 1995 in Traben Trarbach, Germany. It was attended by 14 participants from Belgium, Germany, Italy, Netherlands, Norway, Spain and UK. The main purpose of the meeting was to review progress on the radar observation of bird movements in Belgium, Germany and Netherlands. The opportunity was also taken to assess progress on the European Military Bird Strike Data Base, which now contains 26,581 reports from 10 countries over a period of up to 17 years. An important task will be evaluation of the bird strike data in relation to existing bird strike warning systems as proof of that effectiveness. A UK RAF report on the cost of using ATC radar versus the bird strike costs avoided by the system will be distributed in 1995. The Standardisation of Birdtams and flight restrictions at times of warnings were discussed as there is considerable difference from country to country.

7 Air Forces Flight Safety Committee (Europe) from Luit S Buurma, Netherlands

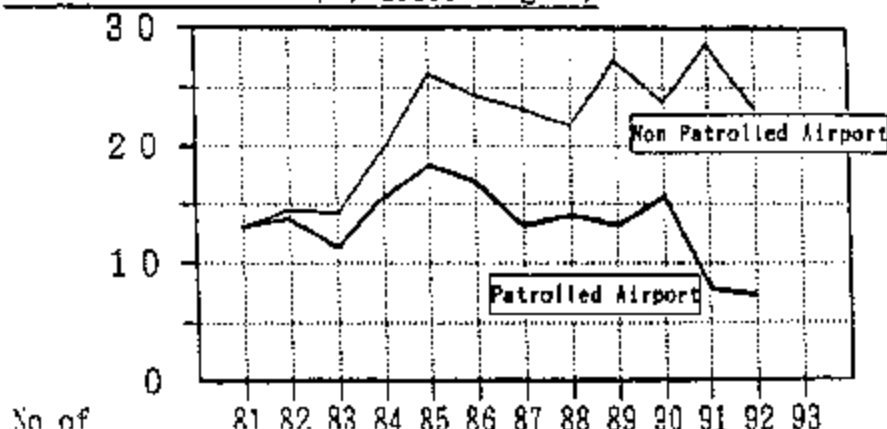
A meeting 28-31 August 1995 will be held in Toronto, Canada. This committee of NATO flight safety chiefs, meeting twice a year, regularly discusses the military bird strike problem and considers BSCE's Low Level Working Group also as its expert group. One of the focal points of the Toronto meeting will be the role of BSCE as an open forum for and bridge between many disciplines dealing with flight safety (civil and military) and birds (and to a certain degree nature in general). The status, progress and usefulness of the European Military Bird Strike Database will be discussed on the basis of some promising preliminary results using AFFSC(E) flying hour data. Anyone who wants to join the discussions and/or database should contact RNLAf/National Environment Section, PO Box 20703, 2500 ES, The Hague, Netherlands (Luit Buurma or Arie Dekker).

8 Bird Strike Committee Canada, Meeting 29-30 November 1994

- Transport Canada have revised their bird strike reporting form into a Bird/Wildlife Strike Report which is 2 sided and now looks quite different from the ICAO standard form. They have added several fields to the struck/damaged, eg tail rotor, pitot/static and cost information, as well as a very detailed table for engine damage. In the UK we plan to include an engine damage table to focus on aircrew indications and actions using space on the back of our fold and post form. This could be an item for the BSCE London agenda.

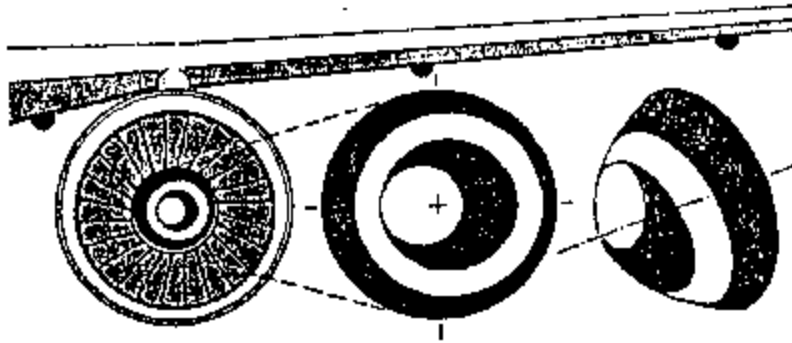
- An all Nippon Airways (ANA) paper provided via IATA Safety Information Exchange showed that Japanese government hired patrol teams, usually 2 persons check runway area using gunshot or shellcrackers. Currently 11 of 32 domestic airports used by ANA are patrolled. Government has difficulty in increasing number because of budget problems. The graph shows the effectiveness.

Ave. Strike Rate at A/P/10000 Flights.



Ref: 'Sensorbird' Mr H
Maekawa, Manager
Safety Promotion
Committee, All Nippon
Airways, 3-3-2 Haneda
Airport, Ota, Tokyo,
144 Japan.

The paper also stated that all ANA fleet of B747 and B767 aircraft had used engine spinner markings since 1985. There was **NO** improvement against birds.



The Abstract from Transport Canada paper TP11655E Strobe Light Technology as a Bird Deterrent states:

"A two-phased assessment of the effectiveness of strobe lights to reduce bird strikes to aircraft was conducted from 1990 to 1993. Phase I included the construction and subsequent laboratory testing of a strobe device to assess bird reactions and determine the optimum strobe light design. Phase II was to have involved the in-flight evaluation of an airborne version of the strobe device.

The Phase I tests demonstrated that test birds (Laughing gulls and American Kestrels) were aware of and responded physiologically to strobe light stimuli (ie significantly increased heart rates). It was concluded that if birds were to associate the strobe light with a threatening stimulus such as an approaching aircraft, the proposed strobe deterrent may be an effective means of reducing the potential for bird strikes to aircraft. Fifteen test options were subsequently evaluated for use during Phase II, two of which were recommended for in-flight testing of a strobe device. Neither option was considered to be financially or technically acceptable by Transportation Development Centre and the project was terminated in December 1993.

Although the Phase I study established a basis and design for aircraft-mounted strobe light deterrents, it is still not known if strobe light systems can effectively reduce the potential for bird hazards to aircraft. Further research and development is recommended."

Test of the Phoenix - Wailer Mk II consisting of a central speaker unit and four remote speakers, powered by a 12 volt deep cycle marine battery. The central unit is pre-programmed to cycle through a series of 94 sounds. The user can select or delete any number of the pre-programmed sound selections; alter the length of the duration of the sound emissions; change the duration of 'quiet time' between noise blasts and adjust the light level. Optional attachments include a solar panel for continually-charging the battery, thereby avoiding the need to conventionally recharge the battery, as well as a strobe light (recommended for certain types of pests). For the purposes of this study the optional solar panel and strobe light were not used.

It was tested against a variety of birds at Yarmouth Airport, Canada. It was concluded that it was very effective as a bird deterrent at airports and has the capacity to render its effective coverage area almost completely free of birds. From our experience it should not be considered a bird scare device but rather as a bird deterrent system in that it appears to create an environment of sound that birds find uncomfortable which causes them to move away from the area slowly rather than being startled and moving out immediately. When properly deployed the Phoenix Wailer can be extremely effective in reducing bird numbers and thus bird strikes by aircraft at airports.

Another project was to study the responses of Ring-bill gulls to the Phoenix Wailer Mk II (ie was the reaction delayed or immediate, was there habituation or was there no reaction at all). The test focused on Ring-billed gulls as these are the most commonly struck bird and they are also attracted to the chosen site. Laidlaw's West Carleton Landfill near Ottawa was selected as the location is much like an airport vicinity due to its large flat area which has big, noisy equipment.

Tests were performed with the devices alternatively turned on and off and at no point did the gulls

seem to react. In fact, they seemed somewhat oblivious to the wailer. Monitoring of the wailer sometimes showed that the gull numbers seemed to increase in front of the speakers. It was concluded that the gulls tolerated the wailer because they had a high desire to stay at the attractive landfill site. There was no immediate effect at this site, nor was there any information on habituation, therefore, further testing is recommended in more diverse areas.

9 First Symposium on Bird Strikes to Aircraft in China

The First Symposium on Bird Strikes in China was held 25-28 October 1994 in Kunming, 32 delegates were present from companies and institutes of China General Company of Aviation Industry, institutes of biology and ecology, Academia Sinica, University of aviation and space in China. In the meantime, an organisation of BSRG/BS&PC (Birdstrike Research Group, Ornithology Branch, China Zoology Society/Birdstrike & Prevention Committee, Yunnan Zoology Society) was established.

At the Symposium, 11 delegates gave presentations including:

- Bird strike accidents of Civil Aviation and Airforce during 1992-1994 in China;
- Recent advances on researches of bird strike and prevention in the world;
- Designing of bird strike resistance and approaches on improving of levels of bird strike resistance of windshield and cabin of aircraft;
- Projects on bird strike resistance of wing, tailplane of aircraft and transparent material in China;
- Ecological distribution of certain species of bird and bird migration in relation to bird strikes in China.

Afterwards, some proposals were discussed which might be used in the future:

- Identification and analysis of remains of bird strikes;
- Proposals on bird strike education for pilots, airport managers, aviation administration staff and other relevant personnel;
- Proposals on appointing certain airports which encounter serious bird strikes to implement comprehensive control projects in airport environment (especially to wildlife);
- Projects on improving bird strike resistance of structure of aircraft, measure of impact test and on research and exploiting new material for bird strike resistance of transparencies and high stress areas.

I had provided a list of BSCE22 papers and a copy of 'Bird Hazard Check List' (WP68).

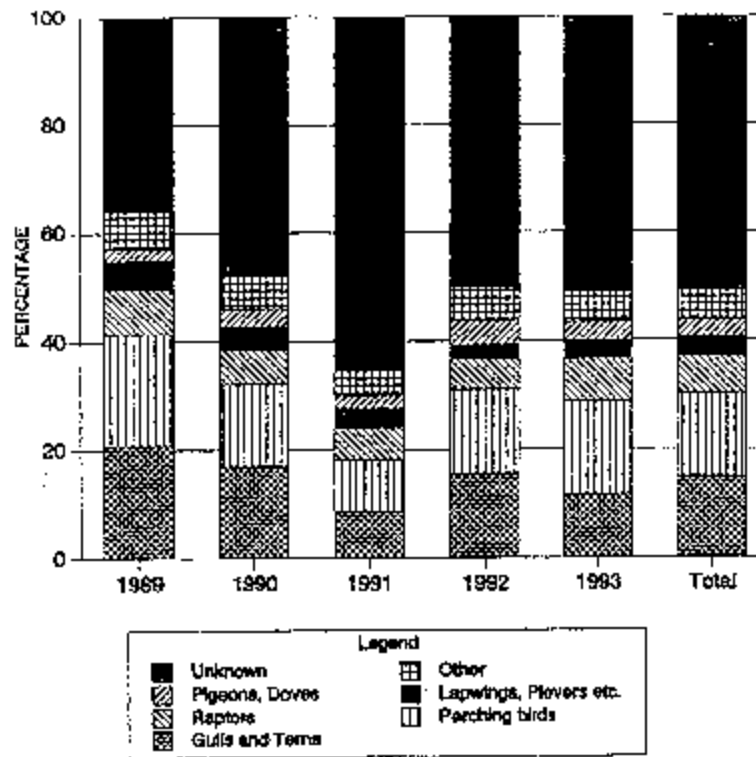
10 Bird Strike Statistics from VARIG

It is unusual to get much bird strike data from South America, thus I felt it worth summarising the 1993 VARIG data. This covers 120 strikes combined with 309,000 movements, the rate works out at 3.9 per 10,000 movements, very similar to many European countries. The months with the best rate were March and November, the worst July. The highest number of strikes were at Rio-de Janeiro and Sao Paulo, not surprising as this would be where most VARIG movements would take place. Most of the strikes were to B737 - 96 strikes. The engine was struck in 43% of incidents. Only 40% of strikes were during take-off and climb, whilst 60% were during approach and landing, European airlines report nearly equal percentages. The effects were surprisingly minor, 2 engine shutdowns, 5 precautionary landings and 2 abandoned take-offs. 39% of strikes were at night. Bird species most frequently identified were Vultures and Quero quero. In 42.5% of strikes, the reporter stated the number of birds was over 100.

11 ICAO IBIS System Data

I have received two items:

- A statistical study, dated 14 July 1995, using bar charts of data from 1989 to 1993 covering over 24,000 strikes. The species reported show considerable variation from year to year, while not surprisingly the part struck hardly varies (giving confidence in the reporting). It also shows 2220 engines damaged, the trend being upward.



- Analysis (dated 12 May 1995) of 1993 data sent by 41 states, including brief details of all serious bird strikes.

12 FAA Proposals on Landfills

The FAA have requested comments from the public on a draft report (4 pages) on 'The potential hazards to aircraft by locating waste disposal sites in the vicinity of airports'. This request was in the Federal Register (Vol 60, No 101) of Thursday 25 May, it got to me early June when I was on holiday, any comment had to be in Washington by 26 June. I was therefore unable to respond on behalf of BSCE. The FAA believes that landfills constitute a potential hazard to aviation if located within 5 miles of an airport.

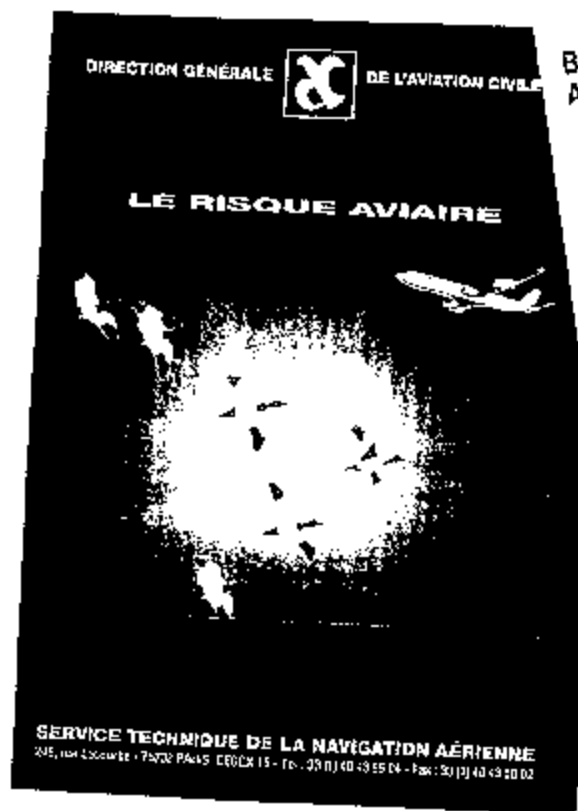
13 Contact with International Air Transport Association IATA etc

The Chairman of the IATA Safety Committee has been in contact with me and details of the 1996 meeting will be publicised via their Information Exchange Committee. This will hopefully produce more airline participation. I provided a 5 page article 'Conflict of Wings' summarising the main aspects of the bird strike problem for the UK Flight Safety Committee's quarterly publication FOCUS which has a wide national and international distribution. This has already produced some airline response.

14 Posters, Leaflets and Videos

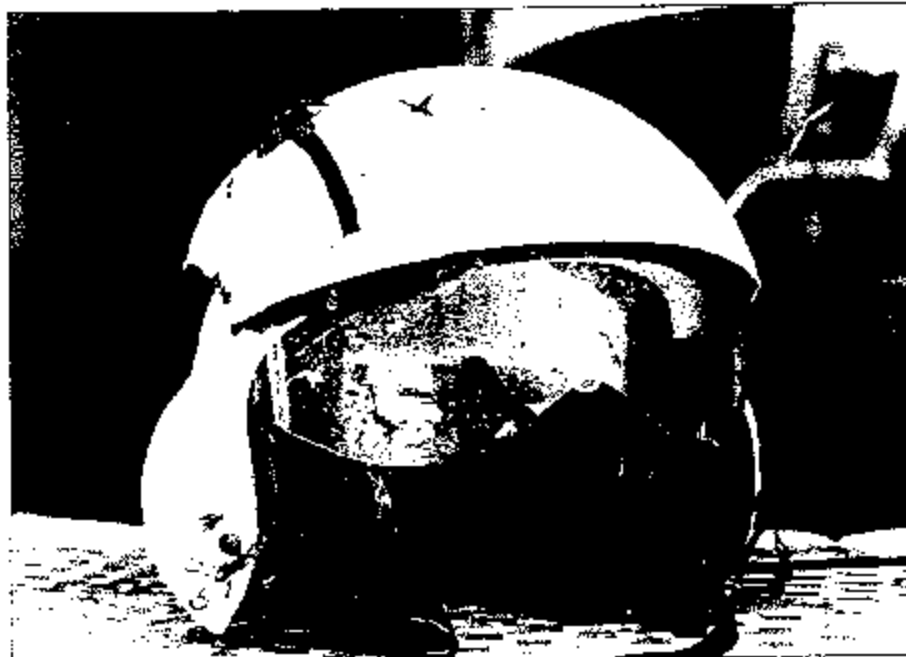
Canada has produced a bird Avoidance Leaflet (ref TP12422) based on the UK one aimed at helping pilots avoid strikes. It is in English and French. They also have two colourful posters, the theme being $E=MV^2$. There is also an excellent 17 minute video 'Bird Strike - Sharing the Skies' which covers the main aspects of the problem. The contact for these items is Bruce MacKinnon, Manager Wildlife Control, AKPP Airports Group, Transport Canada, 18 Tower C, Place de Ville, Ottawa, Ontario, Canada, K1A 0N8, Fax: 613 957 4260.

From France there is an excellent 5 page leaflet in French 'Le Risque Aviaire' that summarises statistics, engine certification, aerodrome measures and research. It has been produced by Service Technique de la Navigation Aérienne, fax +33 40 435802.



15 Low Flying in a Bird Environment

The July 1995 Transport Canada Aviation Safety Vortex included the photo below under a heading 'Do Helmets Really Save Lives?'



Remains of a Western Grebe (*Aechmophorus occidentalis*) after it hit a Bell 206, and then this helmet and visor.

16 Serious Bird Strike Accidents/Incidents

On 28 September 94 at 01.30 am El Al 3747 was taking off from Tel Aviv with 420 passengers. At 150 kts, collided with four Partridges and a Barn owl. Take-off was continued, fuel jettisoned over the sea and returned. Engine 3 was completely lost and engine 4 was struck but not damaged.

On 20 January 1995 there was a fatal accident to a Jet Falcon at Paris Le Bourget due to birds. On take-off, just after rotation, engine 1 ingested Lapwings (*Vanellus vanellus*, wt 260g). Some of the CF700 fan blades were broken and the fan oversped, the power was not reduced, the fan disc departing from the aircraft. Some compressor blades entered a fuel tank. The pilot attempted to return on one engine, but landed heavily and the aircraft caught fire. All 10 occupants died. The accident was at 17.37 hours, at dusk, just after a cumulonimbus storm.

A Canadian Accident Report has recently reached me:

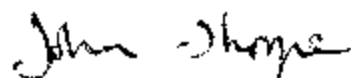
24 February 1994, Piper PA28-160, Lake Ontario, Canada, 1 killed. The pilot was on a flight to Hamilton Airport, Ontario when he reported to the Hamilton Tower controller that something had come through his windshield, that he could hardly see, could not see the instruments and was dis-oriented. Six minutes later he made his last radio call and the aircraft was observed on radar to fly an 'S' pattern east-bound over Lake Ontario before it disappeared from radar at 13.45 hour 14 miles NE of Hamilton airport. The pilot, who had over 17,000 hours much of it on low level pipeline patrols, and the aircraft are still missing. An aviation witness on the ground saw the aircraft and reported the weather as sunny, visibility unlimited, cloud base approximately 5,000 ft.

In June, while on the approach to Kennedy Airport, New York, an Air France Concorde ingested Canada geese (*Branta canadensis*, wt 3.6kg) causing fires in engines 3 and 4. The aircraft landed safely.

In the UK there was considerable newspaper coverage of an incident where the singer Rod Stewart was on board a BAe 125 taking off on 8 July from Gothenburg, Sweden when one engine was knocked out by a Canada goose which was seen by the crew on the runway. There was a smell of cooked flesh and the plane was wobbling all over the place. Just 3 days earlier the pilot had completed single engined recency training. A footnote added that *"the Canada goose is loathed by aviation chiefs and environmentalists alike. Its population has exploded in recent years and it set to double this year due to climate changes and a decline in hunting"*. When the bird remains were examined in the UK Bird Strike Prevention Unit laboratory, it was found that a gull, probably Herring gull (*Larus argentatus*, wt 1020g) was the cause.

Sadly, I have just heard that on 10 August 1995 the Israeli Air Force lost an F15 over the Negev Desert. The two crew were killed. The collision was with a flock of storks (probably *Ciconia ciconia*, wt 3.4kg), 4 were found dead, nearby, others struck the fuselage and one engine causing a fire. The collision was at 1000 ft agl and 500+ kts. The accident was 4 days before the comprehensive Autumn Avoidance Measures were activated.

This I think brings you up to date with some of the things that have happened in the bird strike world. Please let us have your **Registration Forms** early, your papers in good time and your **reservations to the hotel by 1 January**. We hope you have an enjoyable summer vacation, a Happy Christmas and a pleasant flight to London and look forward to meeting you in the Brunel Bar of the Great Western Royal Hotel on Sunday evening 12 May 1996.



John Thorpe
Chairman, BSCE

PS I will be away from the office from Thursday 26 October until Monday 11 December, Julie will deal with most things in my absence.

Chairman: John Thorpe
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Safety Promotion Section
Aviation House
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West Sussex, RH6 0YR, UK

Personal Assistant: Julie James
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Telex: 878753
Office Hours: 09.00 - 17.00 local



APPENDIX 21

Bird Strike Prevention in China

bsusa.ws

Mr. Chaitman

Ladies and gentlemen:

I feel greatly honor to attend this grand meeting. At first, I thank heartily Chairman of meeting, Dr. James Forbes and Dr. Richard Dolbeer for their satisfying arrangement.

Here, my presentation is THE SITUATION ON AIRCRAFT BIRD STRIKE AND THE PREVENTION IN CHINA.

BIRD STRIKE PREVENTION IN CHINA

Wei Tianhao, Kunming Institute of Ecology, Academia Sinica, 25 Jiaochang East Road, Kunming 650223, China

ABSTRACT The statistic and some accidents of bird strike in China were described. In Airforce, during 1957-1982, there were 50 accidents posed by birds, which were analyzed in this paper. Then, in September, 1994 there were 5 accidents at an Airforce Training Base, one of which was a serious event, and a new pilot was killed. However, in Civil Aviation, in duration of 1982-1994, there were 34 accidents posed by birds, one of which was happened at Chongqing Airport, Sichuan Province, when two flocks of Gray Heron collided with a Boeing 757 at the time of taxing before taking off. The event costs 2.8 millions dollars.

First Symposium on Bird Strike to Aircraft of China(1st SBSAC) was held 25-28 October 1994 in Kunming. 32 delegates from 20 organizations of civil aviation, military, aircraft industry companies and biological institutes of China Academy of Science, universities and colleges attended. Meanwhile, Bird Strike Research Group, Ornithology Branch, China Zoology Society / Bird Strike Prevention Committee, Yunnan Zoology Society (BSRG/BS&PC) were established simultaneously.

Then, a project on feasibility of bird strike prevention signed at Chongqing Airport with Civil Aviation Administration of China, and it shall be initiated this September. Emphasis of the project is a fundamental ecological investigation in or near airport.

As appendixes, some figures on analysis of Bird Strikes and a figure on Distribution of Bird Strike in China were provided.

I. Statistics of Bird Strike in China

First accident of bird strike of China was recorded in 1952. Thereafter, it was happened more or less in Civil Aviation and Airforce. Depended on the analysis, the damage by bird were 21% of total damages of aircraft of China.

Recent years, the accidents by bird are dramatically increasing, particularly, at seven major airports by coast and large rivers. Furthermore, Swedish airplanes were struck by bird during 1988-

1990 at Beijing Airport.

(1) In Airforce

During 1992-1994, there were 5 serious accidents posed by birds, 5 aircraft crashed, 3 pilots was killed. It is worth that 5 accidents happened from 12-27 September 1994, in which one aircraft crashed, a new pilot was killed. Because of lack of proper report system, all accidents was reported only just after the serious accident.

Depended on a statistic of 50 accidents happened from 1957 to 1982, the features of the accident are as following:

1.A. At different speeds

26% were at 300-399km/h, 20% at 200-299km/h, 18% at 500-599km/h, only 4% were above 700km/h and below 100km/h(Figure 1 a);

1.B. At different altitudes

18% were at 100-199m asl, 16% below 100m asl, 12% at 2000-3000m asl, 10% at 300-399m asl(Figure 1 b);

1.C. In different phases

26% were in normal flight, 22% in landing and taking-off, 8% in climbing(Figure 1 c);

1.D. in different months

18% happened in April, 16% in May, 14% in June, 12% in November(Figure 1 d);

1.E. By the species of bird

42% were unknown bird species, geese, eagle and small bird each and every was 14%(Figure 1 e);

1.F. By the numbers of bird struck

48% were struck by single bird, 24% by flock, 26% were unknown(figure 1 f);

1.G. In different times of a day

24% were in 19:00-21:00 and before 12:00, 18% in 12:00-18:59, 16% after 21:00(Figure 1 g);

1.H. The damages of aircraft struck

The damage of aircraft occupied 42%, slightly damage 32%, injury of pilot - 6%, 20% no any damage(Figure 1 h);

1.I. At the different parts

26% were windshield, 22% nose, 16% engine, 10% wing(Figure 1 1).

(II) In Civil Aviation

8 February 1995, in Chongqing Airport, a B-757 taxiing before take-off encountered two flocks of Gray Heron(*Ardea cinerea*), and ingested some into right engine. At the time of a danger, the pilot had to cease the take-off procedure. As results, 4 blades of the engine were damaged, 6 tyres of gear automatically flattened.... Finally, it costs 2.80 million dollars.

During 1986-1995, there were 34 serious accidents in Civil Aviation posed by birds in or near airports in China. The features are as following:

A. In different years

There were 9 accidents in 1994, 6 in 1988, 4 in 1990, 1986, and 3 in 1989(see Fig. a):

B. At the different phases

The most of bird strike took place during take-off(Fig. b);

C. At the different types

The most of aircraft struck were B-737(Fig. c);

D. At the different parts

The most parts of aircraft collided were engine(Fig. d);

E. In different months of a year

21% appeared in August, each and every 12% in May, July and October...(Fig. e).

F. By species and numbers of bird

The species of bird were Lapwing, Gray Heron, Swallow, Eagle, Duck and Pheasant, but there were 25 accidents do not known by which species. However, the most of accidents were struck by flocks;

At present, there are no a proper report system of bird strike in China yet, and no one devotes to identify the remains. So, there were public names only, for example, "birds", "large bird", "small bird", or "ducks", "waterbird", "eagle", "heron", and so on.

G. At the airports

The airports that bird strike took place were Beijing, Tianjing, Nanjing, Shanghai, Hangzhou, Nantong, Xiamen, Loyang, Wuhan, Guilin, Chengdu, Chongqing, Kunming and Jinghong. Others were happened before(Fig. g).

II. On First Symposium of Bird Strike To Aircraft in China

Contacted and negotiated with related personnel and the authorities, First symposium on bird strike of China was held during 25-28 October 1994, in Kunming. 32 delegates attended, including officers from Civil Aviation Administration of China, engineering from Institute of Airforce, companies of China Aviation Industry, professors from institutes of biology and ecology, Academia Sinica and colleges.

On the Symposium, following titles were reported in thesis, pictures and videos:

1. Bird strike accidents of Civil Aviation and Airforce during 1992-1994;
2. Recent Advances on researches of birdstrike and the prevention the world over;
3. Designing of birdstrike resistance and approaches on improving of levels of birdstrike resistance of windshield and cabin of aircraft;
4. Projects on birdstrike resistance of wing, tailplane of aircraft and transparent material in China;
5. Ecological distribution of certain species of bird and bird migration relation to birdstrike in China.

Afterwards, following projects and some proposals were discussed which might be conducted in recent:

- a. remain identification and analysis of bird strike;
- b. Proposals on learning about basic knowledge of bird in pilot, airport manager, aviation administration staff and other members related;
- c. Proposals on appointing certain airports encountered serious birdstrike to proceed comprehensive control projects in airport environment (especially to wildlife);
- d. Projects on improving birdstrike resistance of structure of aircraft, measure of impact test, and on researching and exploiting new material of birdstrike resistance of transparent and high intensity.

In the end of the symposium, the first organization of Birdstrike Research Group, Ornithology Branch, China Zoology Society/Birdstrike & Prevention Committee, Yunnan Zoology Society(BSRG/BS&PC) was established.

Professor Zheng Zuoxing(Cheng Tso-Hsin), famous ornithologist, congratulated the symposium and the establishment of BSRG/BS&PC through telephone from Beijing. A Deputy Director, Kunming Branch, Academia Sinica, a Vice Chairman of Yunnan Science & Technology Association, a Director of Yunnan Zoology Society, and delegates from China Ecology Association, and from Ornithology Branch, China Zoology Association, Attended, too.

Dr. John Thorpe, Chairman of BSCE, congratulated in letter from UK, and provided a list of thesis at 22 meeting of BSCE and "Bird hazard check list", ICAO.

After the Symposium, the Secretary Group edited a newsletter "AVIATION AND BIRDS NEW", two issues a year. An English edition, we think, will be edited in 1996.

III. A planning project on bird strike prevention in airport.

After the accident occurred 8 February this year at Chongqing Airport, invited by Civil Aviation Administration of China, I have been Beijing and Chongqing Airport twice to negotiate a project on bird strike prevention at the airport.

Based on experiences of bird strike prevention the world over, a primary ecological investigation will be conducted at Chongqing Airport from this September, the duration is a year. The emphases include soils, vegetations, soil animals, insects, amphibian, reptilian, rodents, birds and their habits. Then, depending on the results above, the feasibility of bird strike prevention at the airport shall be developed.

In the meantime, Professor Yu, Shanghai Normal University, is observing an avifauna in Pudong Airport, east of Shanghai, which is a new designing international airport to come.

IV. Exchange the Information and Co-operation

Mr. Chairman,
Ladies and Gentlemen:

You all known that bird strike reduction is a grand international program. Therefore, it requires close coordination and co-operation among countries and areas, especially among developed and developing countries. So, we hope that we, west and east, developed and developing countries and areas, could discuss a intensive cooperation program in every aspects of the bird strike reduction. So that, such countries, as China, could takes part in the international cooperation, undertakes the tasks of bird strike reduction, and can do all they could do.

Here and now, I would like to tell you that the Second Symposium of Bird Strike to Aircraft of China (2nd SBSAC), may be held next October in Chongqing Airport, Sichuan Province. We are discussing with related authority. On behalf of BSRG/BS&PC, China, at that time, we will welcome you all faithfully to attend the meeting for making lectures and devices or consultants, training related staffs, at same time, for visiting our country.

V. Acknowledgements

Recent years, as a scientist engaged bird strike reduction in China, I have obtained a number of helps from many countries.

At first, on behalf of BSRG/BS&PC, China, I thank heartily to Dr. James Forbes, Chairman of BSC-USA, Dr. Richard Dolbeer, Program Chair, BSC-USA, who given me a good opportunity to attend this meeting and to make this presentation here, as well as, to Dr. Bruce MacKinnon, Chairman of BSC-Canada, let me known the experts

above and you all.

I owe it, also, to Dr. Hans Dahl, BSCE retired Chairman, to Dr. John Thorpe, present Chairman of BSCE, and to Dr. Jochen Hild, Chairman of BSC-German, who have provided us much more information and valuable consultations.

It is worth, as well as, to say thanks to Mr. Hans Elokpoel, Canadian Wildlife Service. His book "Bird Hazards to Aircraft"(1976) let me saw overall picture of bird strike reduction the world over, which was given by Professor Brian Chapman, Corpus Christi State University. Since then, according to the outline provided, my colleagues and I translated and updated much new information from 17-20 Working Papers of BSCE and some brochures into a Chinese manuscript "Bird Collision with Aircraft and The Prevention". At the movement, the manuscript is enlarging and updating from 22 Proceedings and Working Papers of BSCE, Minutes of 21 Meeting of BSC-Canada and other articles. We wish, of course, it would be pressed in future.

Finally, by this chance, I beg faithfully and thank sincerely all related authors for a permission of translating and citing your works, articles and brochures; Of course, an adequate acknowledgement will be given.

That's all

Thank you all!

BIRD STRIKE PREVENTION IN CHINA

By Wei Tianhao
Kunming Institute of Ecology, Academia Sinica
25 Jiaochang East Road
Kunming 650223, China

I. Statistics of Bird Strike in China

(I) IN AIRFORCE

DURING 1957-1982, THERE WERE 50 ACCIDENTS HAPPENED.

IN SEPTEMBER 1994, THERE WERE 5 ACCIDENTS HAPPENED AT A TRAINING FORCE BASE, ONE OF WHICH WERE A SERIOUS EVENT.

1. A. AT THE DIFFERENT SPEEDS
1. B. AT THE DIFFERENT ALTITUDES
1. C. IN THE DIFFERENT PHASES
1. D. IN THE DIFFERENT MONTHS
1. E. BY THE SPECIES OF BIRD
1. F. BY THE NUMBERS OF BIRD
1. G. IN THE DIFFERENT TIMES IN A DAY
1. H. THE KINDS OF THE DAMAGES
1. I. AT THE DIFFERENT PARTS OF AIRCRAFT STRUCK

(II) IN CIVIL AVIATION

Chongqing Airport, Sichuan Province,
along the Changjiang (Yangtze River)

Gray Heron (*Ardea cinerea*)

- A. in different years;
- B. At different phases of flight of aircraft;
- C. Different types of aircraft;
- D. Different parts of aircraft damaged;
- E. In different months;
- F. Bird species;
- G. Airports.

II. On First Symposium of Bird Strike To Aircraft in China

The titles discussed:

1. Bird strike accidents of Civil Aviation and Airforce during 1992-1994;
2. Recent Advances on researches of bird strike and the prevention the world over;

3. Designing of birdstrike resistance and approaches on improving of levels of birdstrike resistance of windshield and cabin of aircraft;
4. Projects on birdstrike resistance of wing, tailplane of aircraft and transparent material in China;
5. Ecological distribution of certain species of bird and bird migration relation to bird strike in China.

The proposals provided at the Symposium:

- a. Identification and analysis of remains of bird strike;
- b. Proposals on learning about basic knowledge of bird in staffs related;
- c. Proposals on appointing certain airport to proceed comprehensive control projects;
- d. Projects on improving birdstrike resistance of structure of aircraft, measure of impact test, and on researching and exploiting new material of birdstrike resistance of transparent and high intensity.

- III. The planning project on bird strike prevention in airport, the investigation includes soil, vegetation, bird and other animals.

IV. Acknowledgements

Dr. James Forbes, Chairman of BSC-USA
 Dr. Richard Dolbeer, Program Chair, BSC-USA
 Dr. Bruce MacKinnon, Chairman of BSC-Canada

Dr. Hans Dahl, retired Chairman of BSCE
 Dr. John Thorpe, Chairman of BSCE
 Dr. Jochen Hild, Chairman of BSC-German

Dr. Hans Blokpoel, Canadian Wildlife Service

Dr. Brian Chapman, Corpus Cristi State University

A Chinese manuscript:

"Bird Collision with Aircraft and the Prevention"

q. civil Action

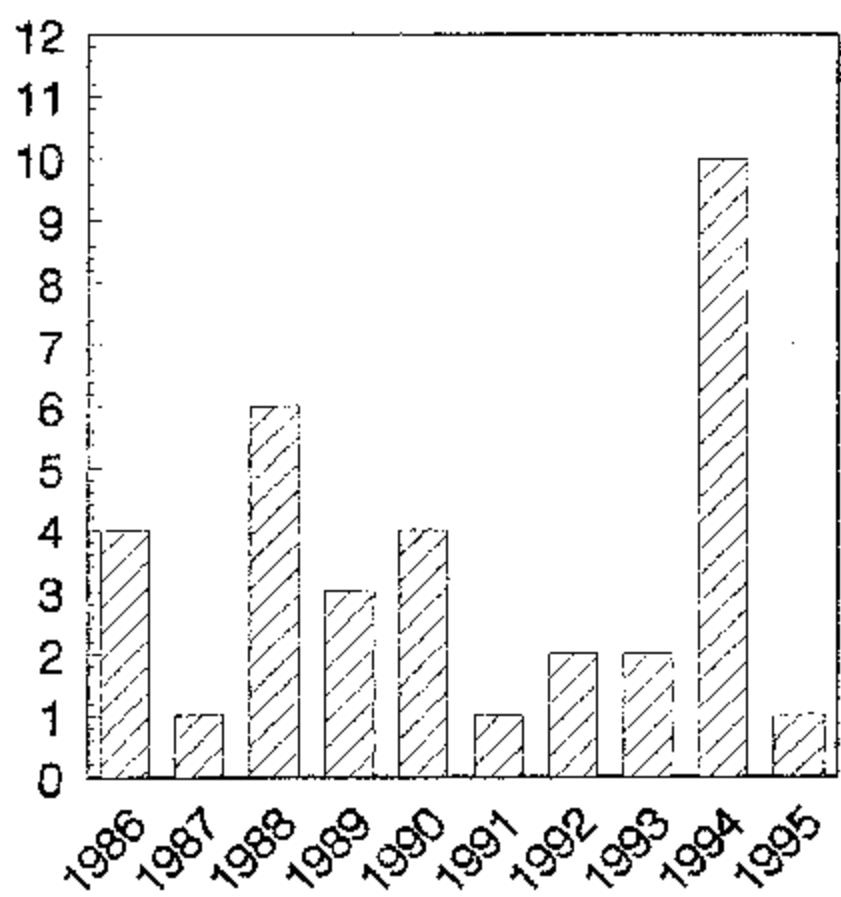


Fig. A. Distribution in different years.

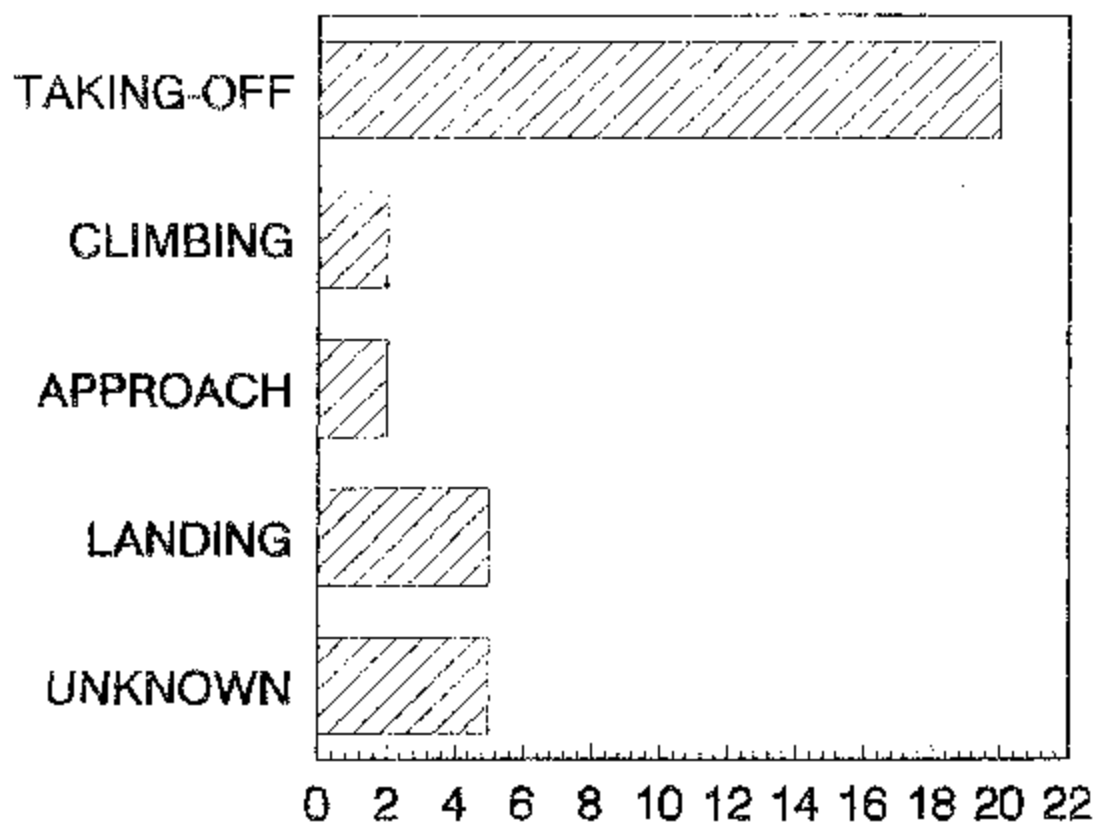


Fig. B. Different phases of flight.

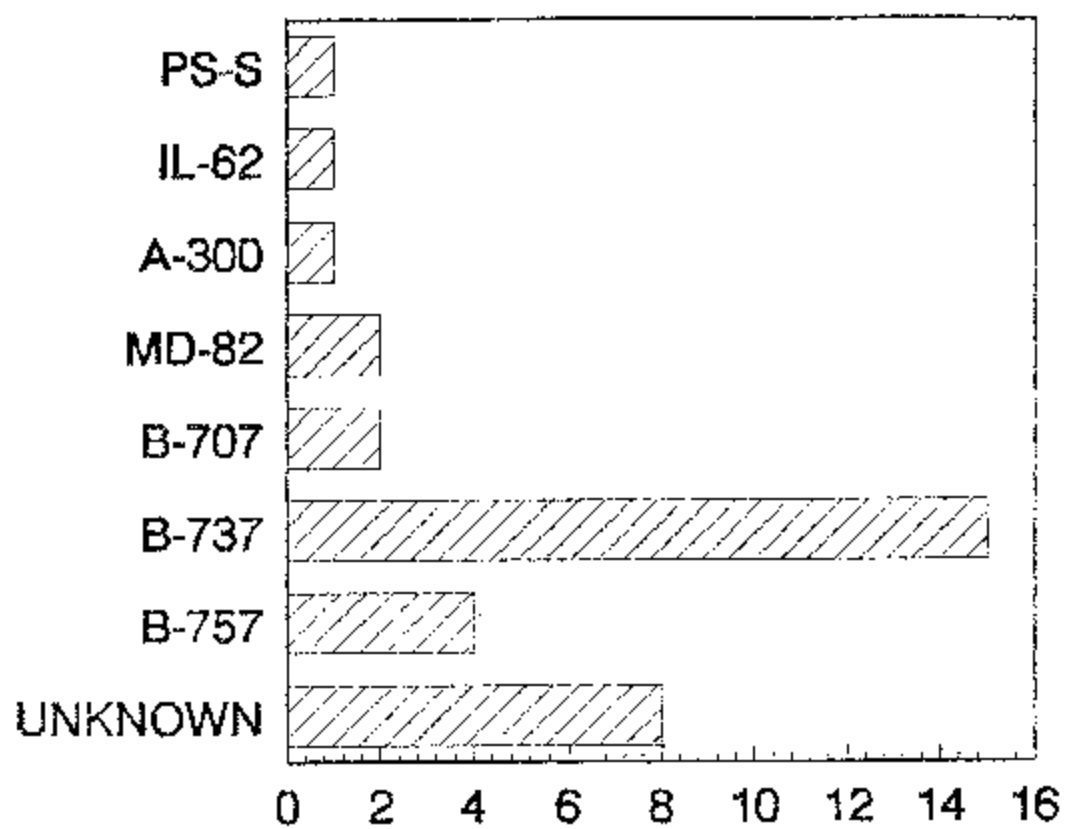


Fig. C. Different types of aircraft.

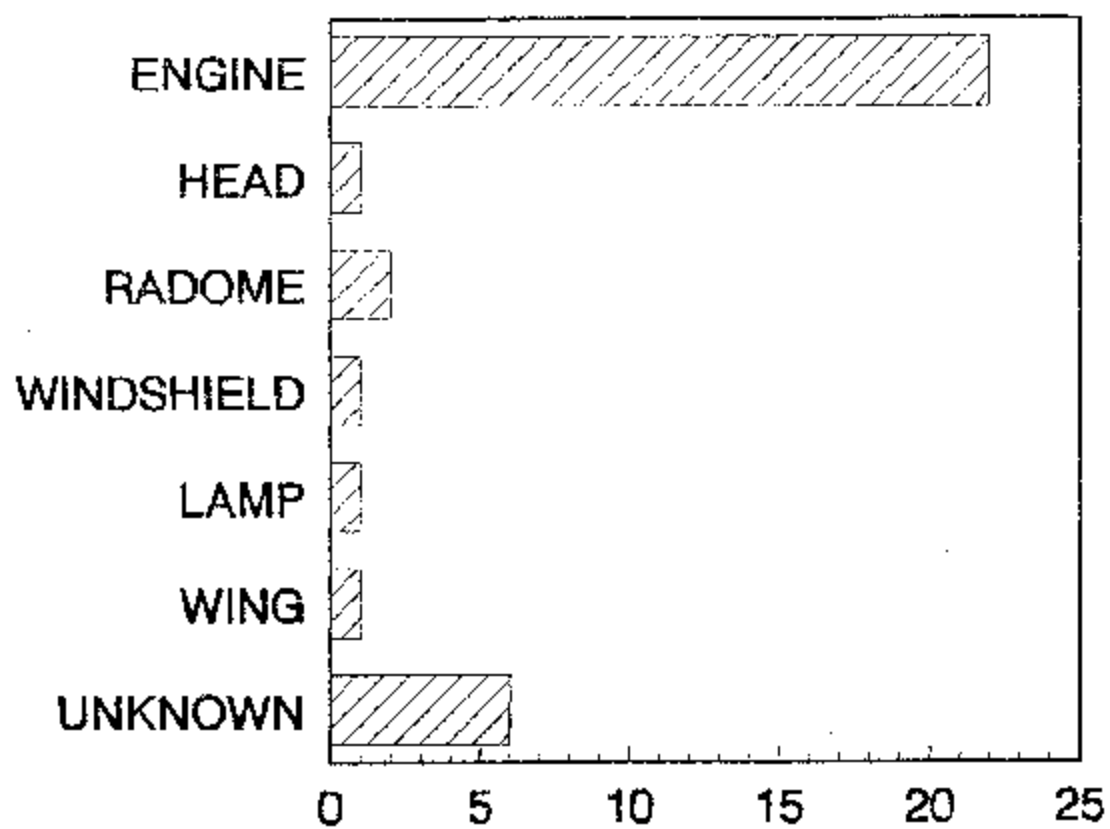


Fig. D. Different parts of aircraft.

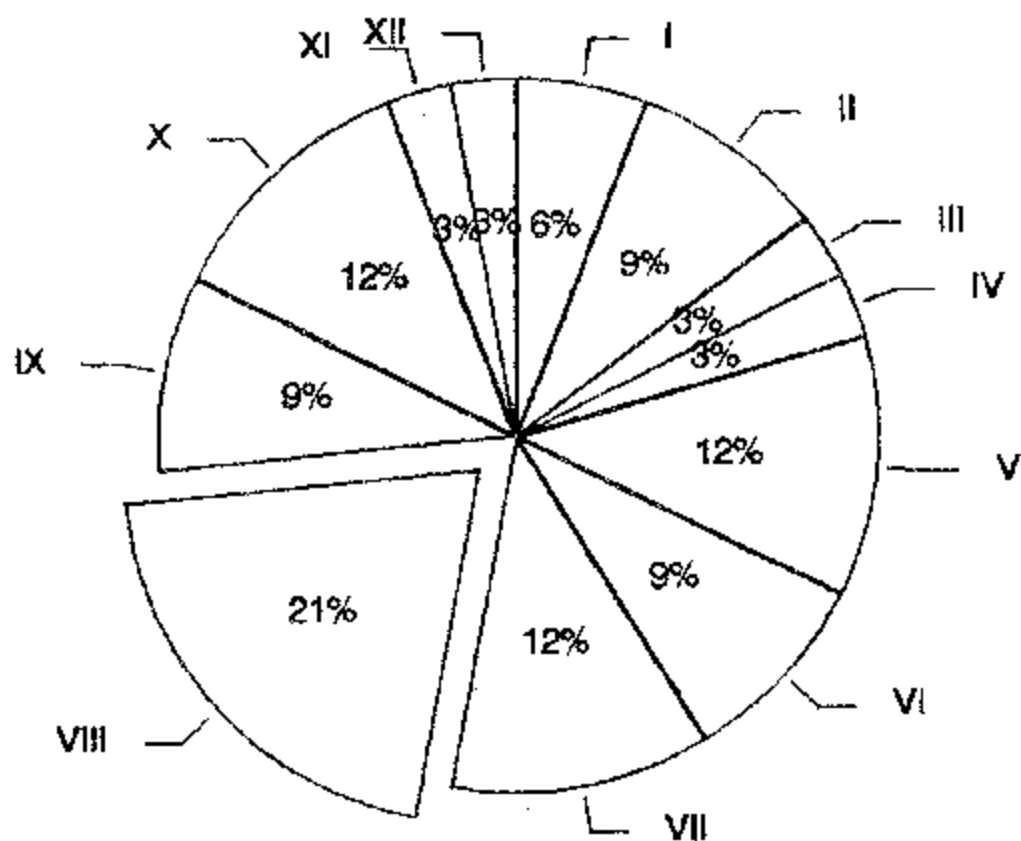


Fig. E. Distribution in different months.

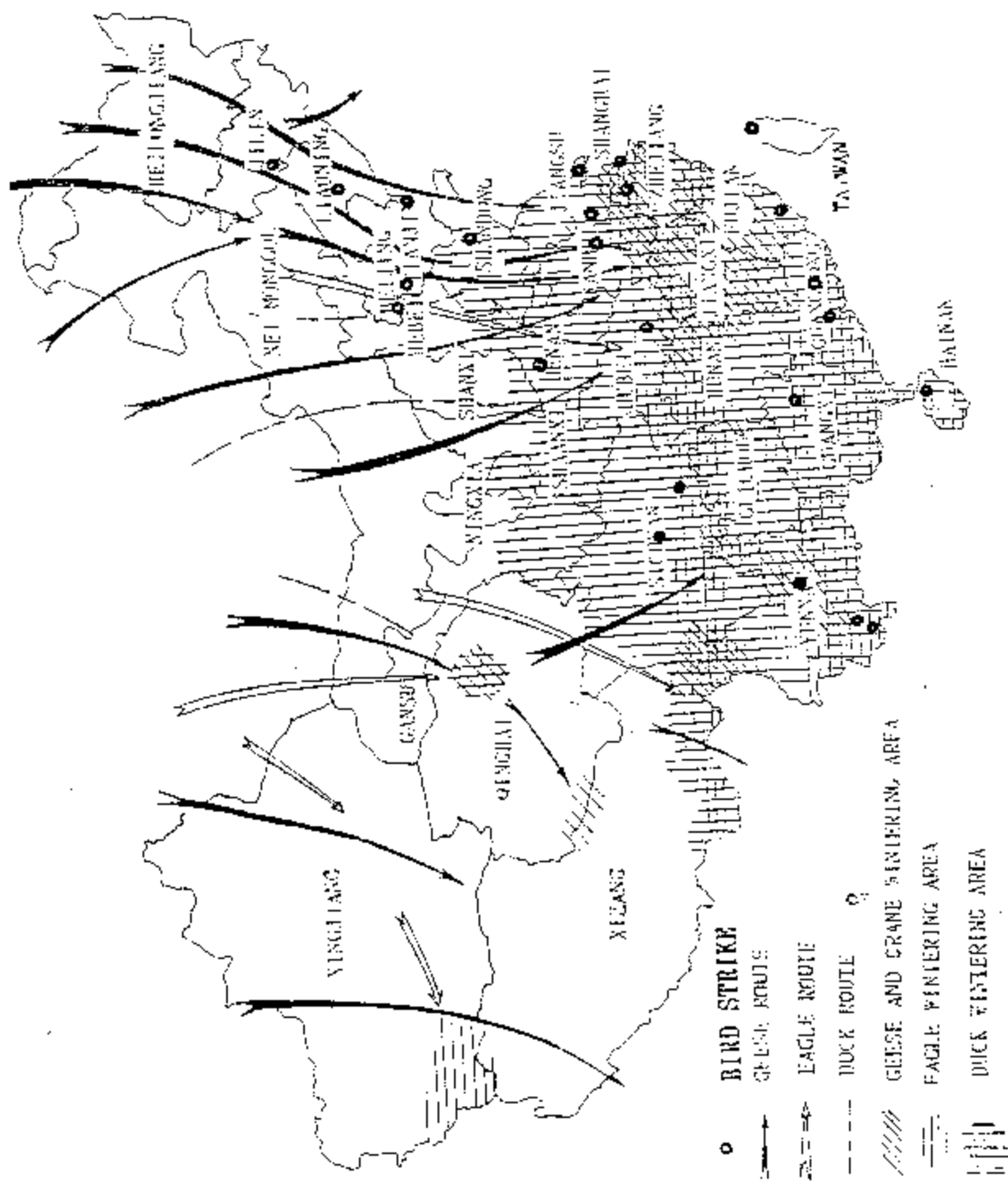
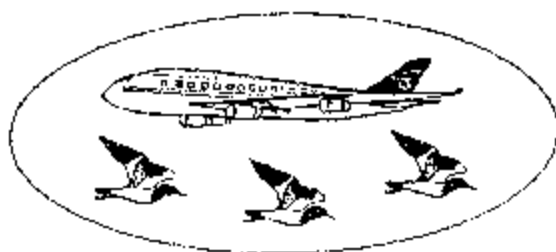


**Figure 9. THE MIGRATORY ROUTE AND DISTRIBUTION
OF BIRD STRIKE IN CHINA**

航空与鸟类通讯

Aviation And Birds News



1994年
试刊

中国动物学会鸟类学分会鸟撞研究专业组
/ 云南省动物学会鸟撞及防治专业委员会
秘书组

鸟类与飞机相撞及其防治

BIRD COLLISION WITH AIRCRAFT AND THE PREVENTION

魏天昊 周加良

编著

愿将此书献给航空界、鸟类学界，
以及各条战线上曾经给予我们各种关心
和帮助的师长、同行，以及对此有兴趣
的同志们！

1994 · 昆明

7 Airforce

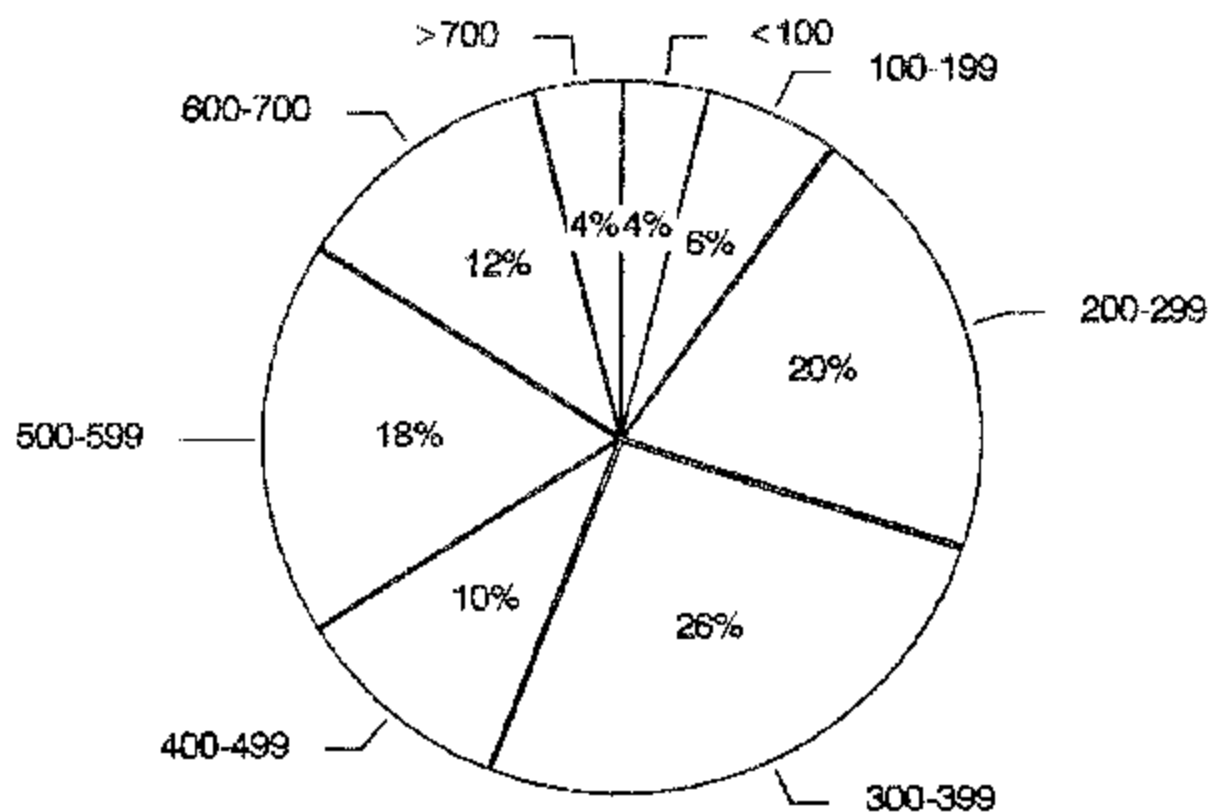


Fig 1 a. The bird strike rate in different speed.
(km/h)

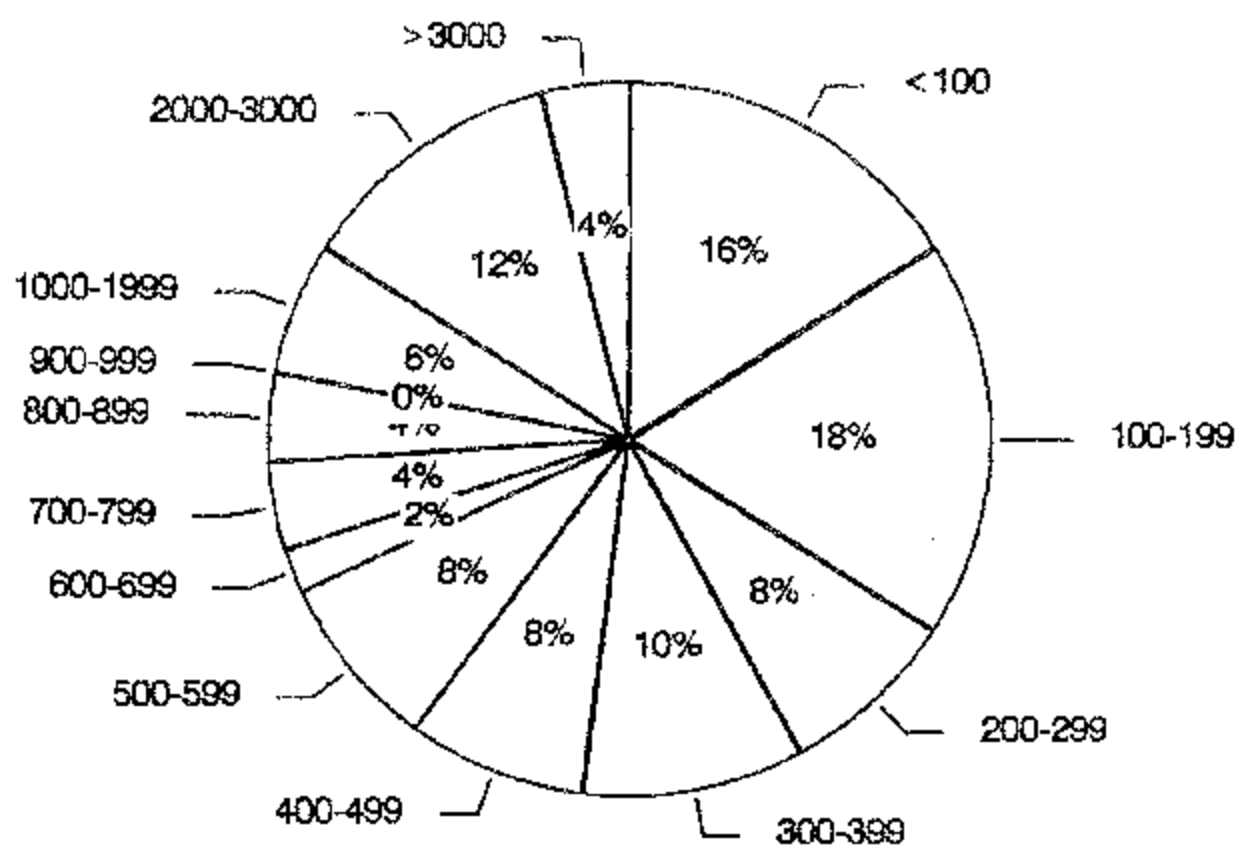


Fig 1 b. Bird strike rate at different altitudes (m).

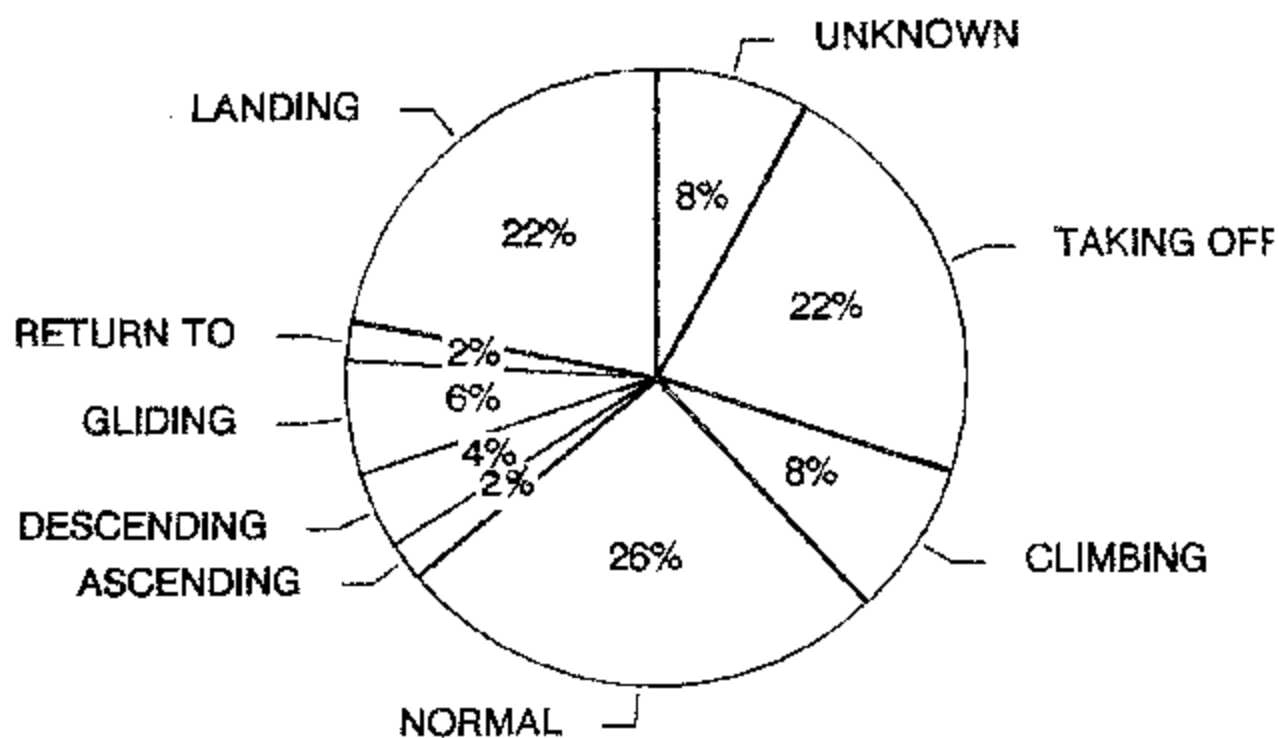


Fig 1 c. Different phases of aircraft.

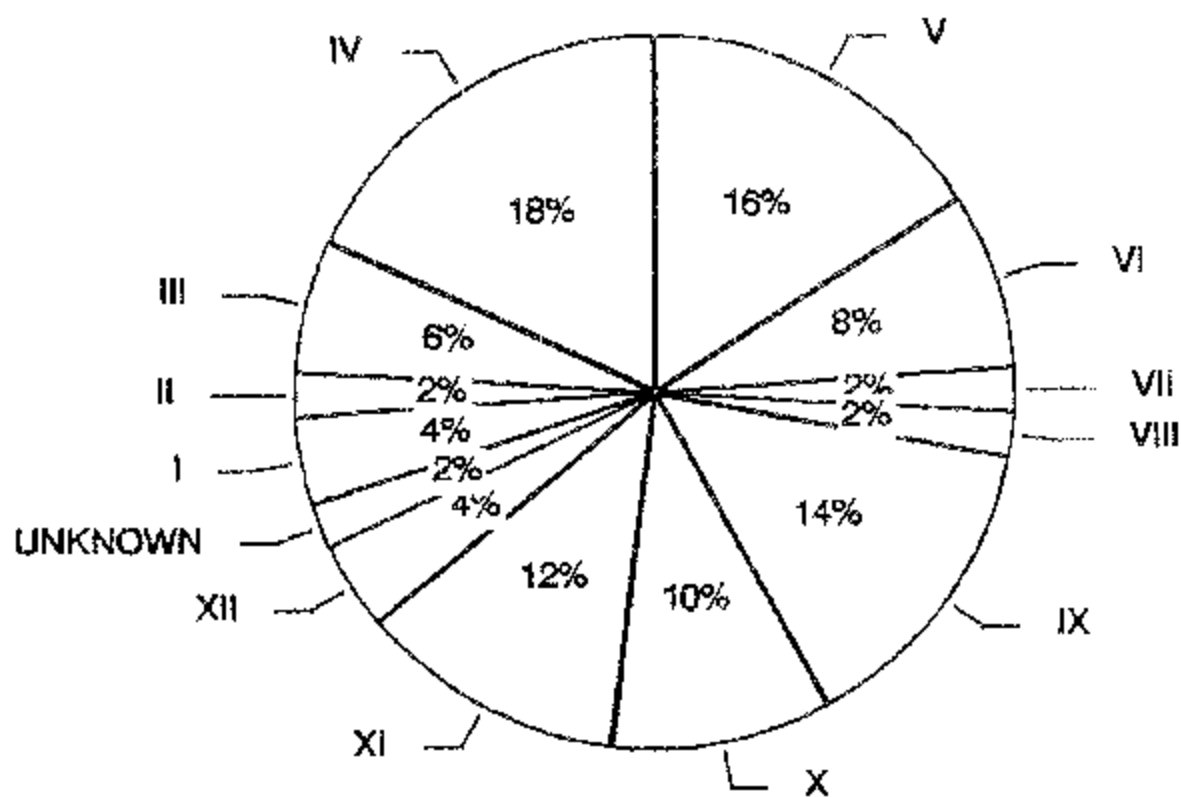


Fig 1 d. Distributions in different month.

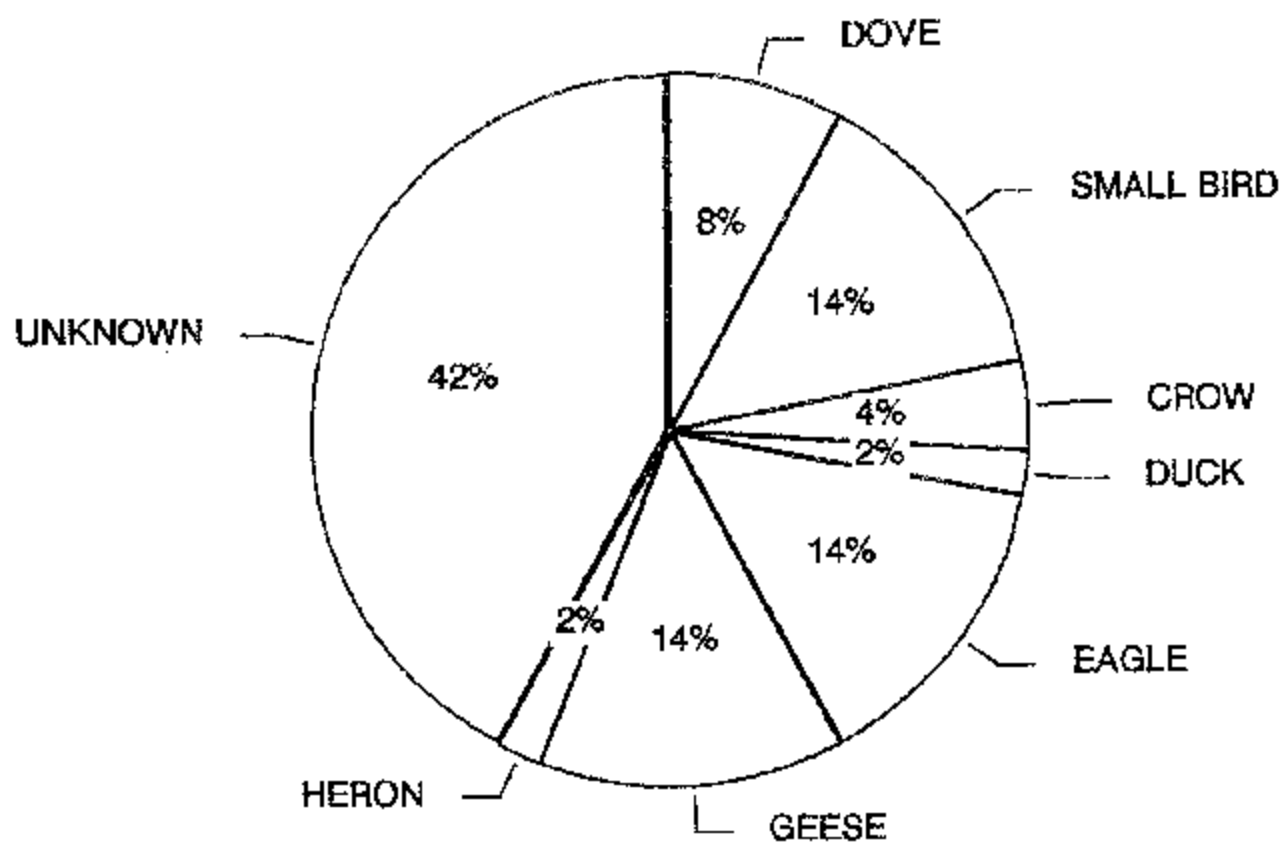


Fig 1 e. Different species of bird struck.

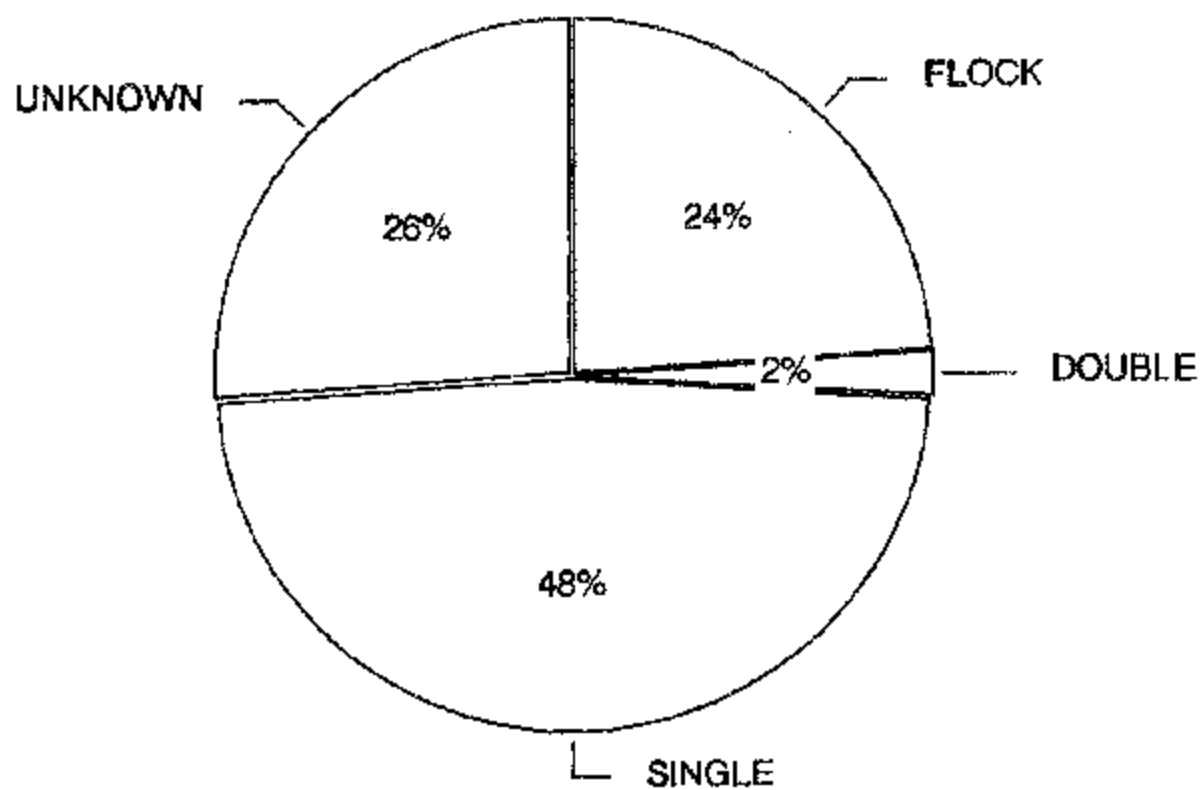


Fig 1 f. The number of bird struck.

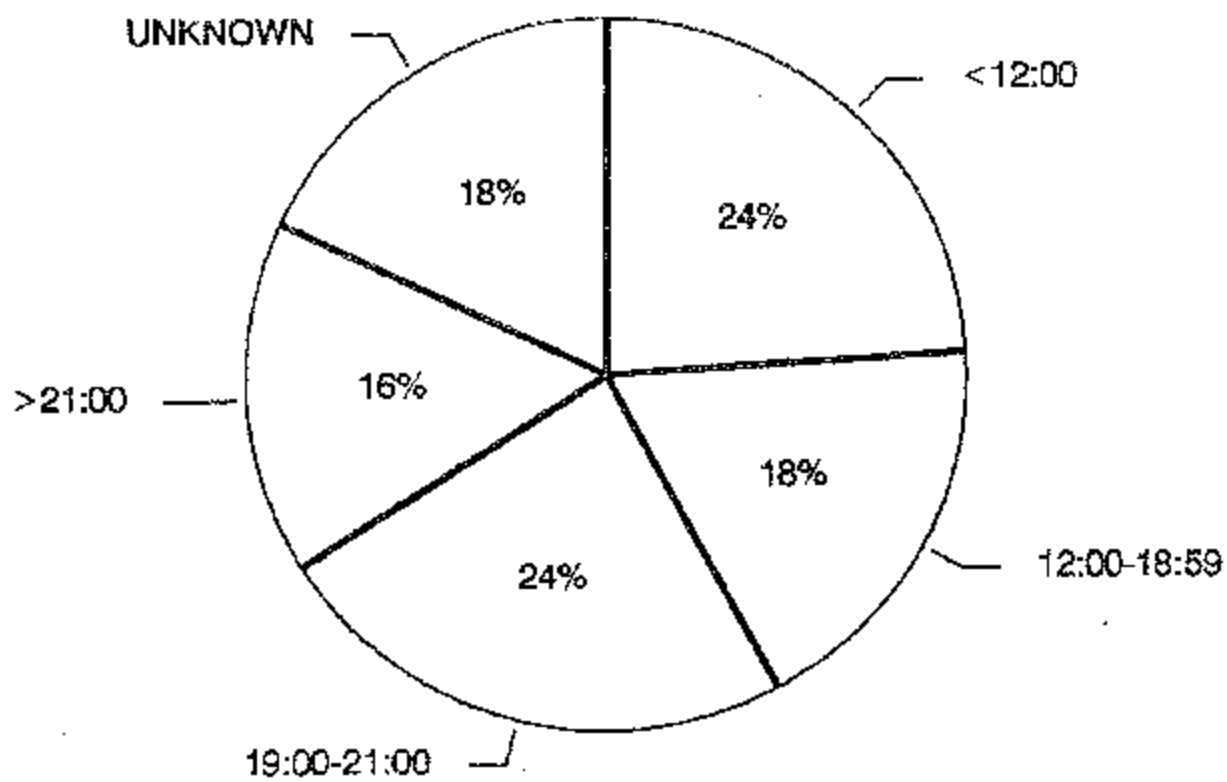


Fig 1 g. Different times in a day.

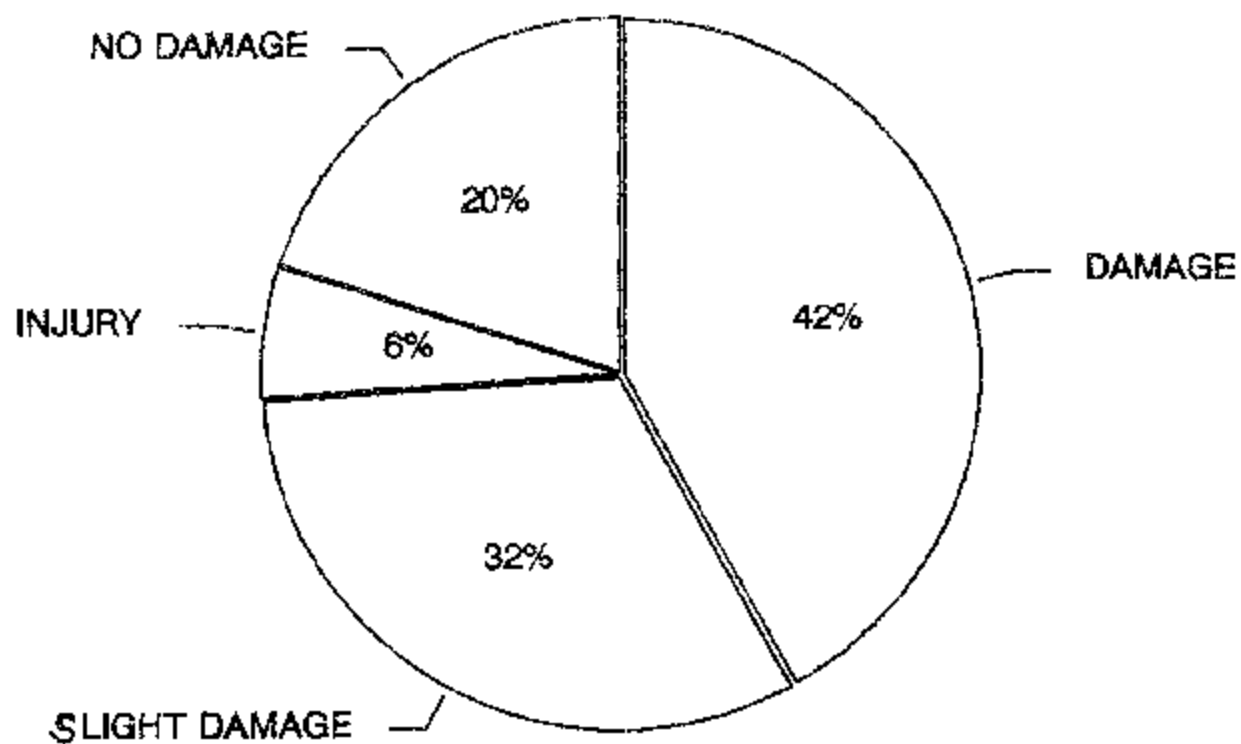


Fig 1 h. Damages of aircraft struck.

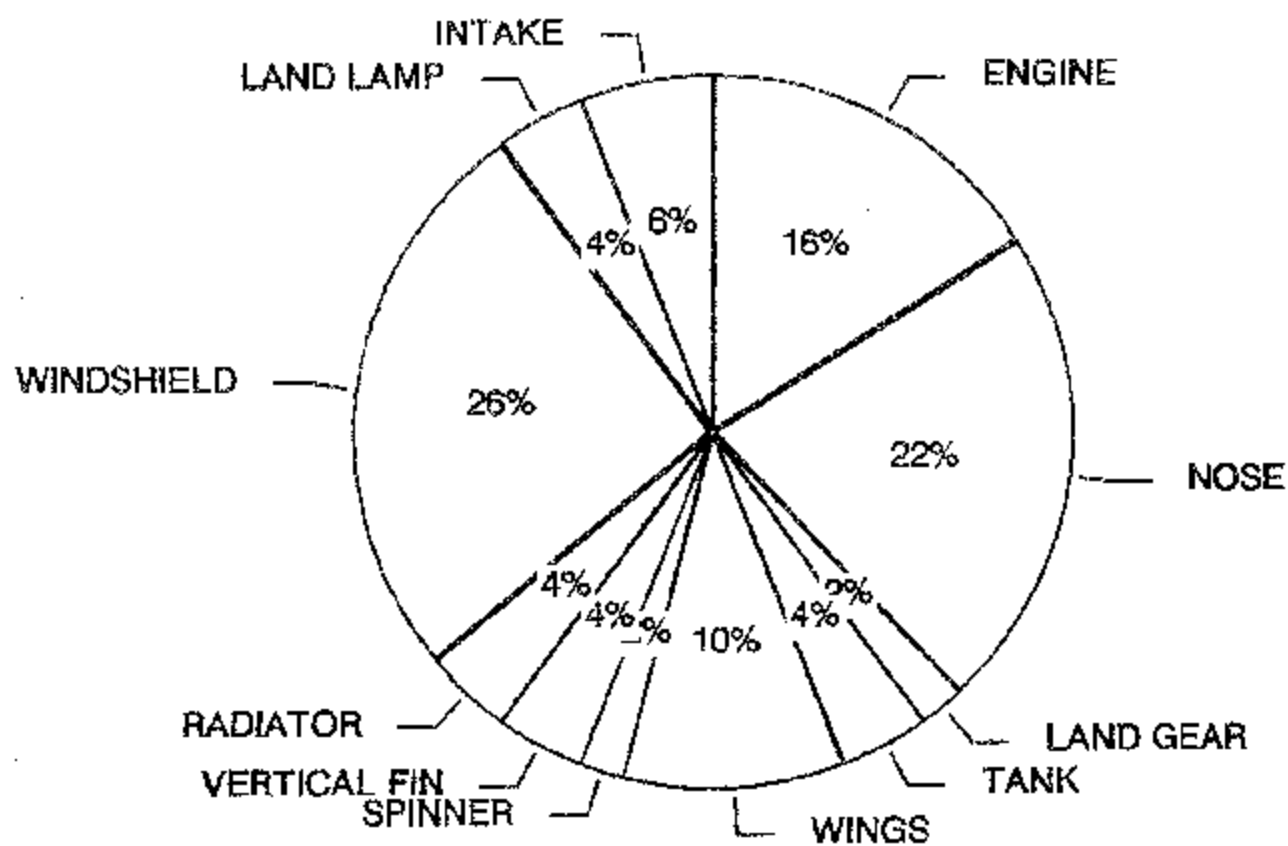


Fig 1 i. The parts of aircraft damaged.

APPENDIX 22

The Role of NIMBY Groups in 22 Sanitary Landfill Sitings in Illinois

THE ROLE OF NIMBY GROUPS IN 22 SANITARY LANDFILL SITINGS IN ILLINOIS

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Abstract. Illinois Senate Bill 172 (SB172), enacted in 1981, made it possible for city or county governments to approve or deny proposed sanitary landfill sites in their jurisdiction. Each of the 22 new sanitary landfill siting decisions (12 approvals, 10 denials) made under SB172 was used in a discriminant analysis to identify factors that make local political resistance to a proposed landfill site effective. It was found that county- and city-wide activist, or NIMBY, groups were able to influence local jurisdictions to deny sites, particularly in relatively populous jurisdictions, largely on the basis of groundwater quality concerns or plans for waste incineration. The discriminant analysis shows that 6 of the 10 denials can be attributed to these groups, and 6 of the 12 approvals would have been denied had NIMBY groups been formed. Interests of residents that live within one mile of the proposed site, however, played an unimportant role.

INTRODUCTION

Sanitary landfills are the means of disposal for 67 percent of municipal solid waste in the United States, even though the recent limited success of source reduction, incineration, and recycling programs has reduced this percentage from 83 percent in 1985 (Curlee et al., 1994). New municipal landfills are often needed because of population growth and increases in waste streams per capita, combined with the closure of landfills due to capacity constraints and environmental regulation. However, siting new landfills is difficult. Communities often do not desire them because of perceived negative impacts on the local environment, including increased levels of noise, dust, litter, rodents, odors, and traffic; aesthetic concerns; public water supply risks; and, in some cases, reduced property values.

When a new landfill is to be sited, a marked difference in perception often occurs between waste management professionals, who generally view landfill siting in terms of technical design issues and meeting regulatory requirements, and local residents, who view siting in terms of potential health issues, loss of amenities, and equitable allocation of environmental risk (Burdge et al., 1991). In Illinois, Burdge and Venning (1990) found an intense concern on the part of local government officials and the public toward the hazards

associated with sanitary landfills. In fact, the primary barrier to successful siting of needed waste facilities is often local opposition that derives from a mistrust of the data presented in support of the disposal site (Greenberg and Anderson, 1984). Much the same could also be said of siting waste incineration facilities (Curlee et al., 1994).

Foremost among the fears of residents is contamination of public groundwater supplies (Usselman et al., 1984). Former landfills (primarily unregulated dumps) codisposed of industrial and municipal waste and were major contributors to groundwater contamination in 130 of 138 landfills in a widely published report of the National Superfund Priorities List (Franklin Associates, 1986). Hence, locational conflicts arise over the siting of new sanitary landfills, typifying the phenomenon popularly known as NIMBY ("not in my backyard") (O'Hare, 1977).

In this paper, discriminant analysis is applied to 22 landfill sitings (12 approved, 10 denied) in Illinois under Senate Bill 172 (SB172) to test the hypothesis that locally formed groups opposed to landfill siting can effectively prevent such siting. It is shown that they can and do, but that this result is dependent upon the legal procedure through which locational decisionmaking is made, which in this case is mandated by SB172, a law that was designed to strengthen local control over landfill siting.

ILLINOIS SENATE BILL 172 AND THE NIMBY RESPONSE

SB172 emerged as a compromise following five years of legislative activity. Twelve bills were introduced into the Illinois legislature between 1976 and 1981 to formulate a

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workable process for including substantial local input into sanitary landfill siting decisions while maintaining oversight of technical and design criteria in the hands of the Illinois Pollution Control Board (IPCB) and also protecting landfill developers from arbitrary denial of landfill applications (Gergits, 1987). Illinois Senate Bill 172 (Public Act 82-682, Illinois revised statutes, Ch. 111-1/2) was finally enacted on November 12, 1981, and grants Illinois counties and incorporated cities the power to approve or deny developers' proposals for new landfill sites in their jurisdiction.

Under SB172, landfill developers make initial application to the local government. A notice of the application must be posted in a local newspaper, and a public hearing must be held within 60 days of the application. Local boards are to base their decisions on the law's specified criteria (Table 1) and not on the operating record of the landfill developer, the

potential need for increased fire protection and road maintenance, or the applicant's financial stability (Gergits, 1987), although these legitimate factors can be difficult for boards to ignore.

SB172 has succeeded in enhancing citizen input into and increasing local control over the landfill siting process, a factor that Zeiss (1991) and Curlee et al. (1994) have found to be critical to facility acceptance. SB172 has also focused public awareness on solid waste problems (Burdge et al., 1991). Vining (1988), however, points out that public hearings were unrepresentative of local communities, and the siting process could have been improved through use of public surveys, community-appointed advisory boards, or nominal group processes. Burdge et al. (1991) found that 66 percent of respondents to a survey (including activists, associations, local government officials and employees, major

Table 1. Illinois Senate Bill 172 Siting Criteria and Their Use in Denying Proposals

Criterion Description	Criterion Used for Denial (Number of Cases)
1. The facility is necessary to accommodate the waste needs of the area it is intended to serve.	1
2. The facility is so designed, located, and proposed to be operated that the public health, safety, and welfare will be protected.	1
3. The facility is located so as to minimize incompatibility with the character of the surrounding area and to minimize the effect on the value of the surrounding property.	0
4. The facility is located outside the boundary of the 100-year floodplain or is floodproofed.	0
5. The plan of operations for the facility is designed to minimize the danger to the surrounding area from fire, spills, or other operational accidents.	0
6. The traffic patterns to or from the facility are so designed as to minimize the impact on existing traffic flows.	0
7. In the case of a hazardous waste facility, an emergency response plan exists.	0
8. If the facility will be located within a regulated recharge area, any applicable requirements specified by the board for such areas have been met.	0
9. If the facility is to be located in a county where the county board has adopted a solid waste management plan, the facility is consistent with that plan.	0
Denials Based on Multiple Criteria	
1,5	See criteria above. 1
2,3,6	See criteria above. 1
1,2,3,5,6	See criteria above. 2
1,2,3,4,5,6	See criteria above. 1

Source: Environmental Protection Act, Ill. Rev. Stat., Ch. 111-1/2.1039.2, 1989; Sherrill, 1990.

waste generators, and the waste industry) expressed concern that the siting decision process created by SB172 "plays into the hands" of small opposition groups that oppose landfill sitings (Table 2).

Conversely, the law may also have further solidified the solid waste management community as an interest group. Burdge et al. (1991: 29) conclude that SB172 has resulted in an "emergence and further solidifying of a 'citizens versus the waste management industry' polarity." Respondents also indicate (with the exception of the waste industry) that SB172 has been helpful in allowing a fuller consideration of safety issues in landfill siting decisions (Table 2, statement 1).

In effect, SB172 has increased cities' and counties' ability to prevent nearby metropolitan areas such as St. Louis and Chicago from exporting their solid waste to them (Gergits, 1987), thus creating conditions for locational conflict in

which waste-exporting jurisdictions are set in opposition to waste-importing jurisdictions. The law fostered the development of county- and city-wide interest groups that oppose waste importation. These jurisdiction-wide citizen-activist groups are normally instigated and organized by environmental activists, peak in membership and activity level during the critical decisionmaking period, and disappear as a group shortly thereafter. Among the cases studied here, only in McHenry County, where the McHenry County Land Savers defeated three successive landfill proposals, did a NIMBY group remain as an effective entity much beyond the final siting decision.

However, residents directly adjacent to the proposed site were found to be effective in opposing the site only by gaining county- or city-wide support through a NIMBY group which results in a denial of the proposal by local government. "Not in my backyard" becomes "not in my hometown."

Table 2. Summary of Survey Results Identifying Attitudes Toward Illinois Senate Bill 172 Among Six Interest Groups

Statement	Percentage Agreeing in Each Group						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1. Overall, I think SB172 has been helpful in dealing with solid waste issues.	92	85	70	55	73	35	68
2. Illinois counties should be allowed to ban waste from other counties.	84	79	64	51	52	37	61
3. SB172 needlessly complicates the landfill siting process.	8	28	45	47	41	72	40
4. SB172 made the solid waste crisis in Illinois worse by making it almost impossible to site new landfills.	23	39	61	39	69	83	56
5. Under SB172, disposal facilities are most likely to be sited in rural areas because they have fewer resources to take advantage of SB172 safeguards.	69	57	38	46	79	54	57
6. SB172 has been especially helpful in preventing outside solid waste from being brought into my community.	55	44	34	28	42	35	40
7. SB172 allows citizens to have more say in local solid waste issues than they did before.	98	100	91	98	90	93	95
8. SB172 plays into the hands of small citizens' opposition groups which block proposed landfill sites.	22	48	68	83	92	85	66

Groups: (1) Citizen activists; (2) association members; (3) elected officials; (4) government employees; (5) waste generators; (6) waste industry; (7) mean of six groups

Source: Burdge et al., 1991

METHODS

This study investigates each of the 22 local siting decisions for new sanitary landfills made after passage of Illinois Senate Bill 172 in the period 1982-1990 (Figure 1) in order to test the hypothesis that locally formed groups opposed to landfill siting (NIMBY groups) can effectively block such siting under the decisionmaking process that law mandates. Two criteria were used to define a local siting decision: (1) Sequential applications submitted to the same local siting authority for the same location were considered one siting attempt, with the last siting decision considered; and (2) the siting decision was based on the decision at the local level regardless if it was later reversed by either the IPCB or the courts. In this manner, local interests were targeted for analysis.

Data on each of these 22 decisions were collected during the summer of 1990 by examining the proposed sites and conducting interviews with county and city clerks, county board

personnel, and regional Illinois Environmental Protection Agency (IEPA) officials; by attending public meetings; and by reviewing public records and local newspapers. Four cities and eight counties approved sites; one city and nine counties denied proposed landfill sites.

Discriminant analysis was used to build an explanatory model of the 22 decisions. This form of multivariate analysis identifies those variables that best discriminate between states of a dichotomous variable, in this case landfill application denial (0) or approval (1). Nine explanatory variables (Table 3) were chosen to represent independent considerations potentially determining the outcome of the decisions with reference to the SB172 criteria (Table 1) and key statutory and nonstatutory factors as informed by Sabatier and Mazmanian (1981).

SB172 Criteria

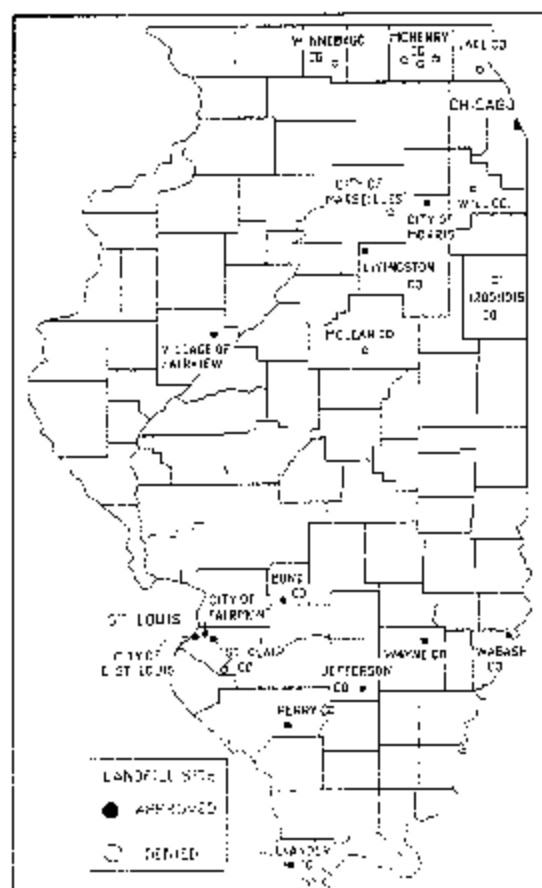
Need for landfill space (Criterion 1) is represented by the remaining lifetime in years of existing available solid waste facilities for the area to be served by the proposed landfill. These data were drawn from the minutes of the siting hearings and published IEPA reports.

Local impacts (Criteria 2 and 3) are represented by the residential population within an impact field of one mile from the proposed landfill site. Zeiss and Atwater (1991) estimate 2 km as the impact field for landfills, whereas Massey (1978) found that 70 percent of residents surveyed felt that proposed landfills should be established at least one mile from residences. Stevens (1974) found in a study of eight operating landfills that residents living as near as two miles from the site did not know the landfill existed or felt it had no effect. We chose to use population within one mile to reflect the potential for noxious effects and reduction in property values.

Protection of regulated recharge areas (Criterion 8) is represented by the percentage of public water supplies that the jurisdiction acquires from groundwater. In fact, Illinois regulated recharge areas and setback zones of up to 1,000 feet from a wellhead have had no legal effect on any of the siting decisions (Marlin, 1989), but the perception of groundwater contamination remained a critical issue in the landfill siting hearings despite developers' assurances that leachate gathering and other techniques to prevent groundwater pollution would be used. In some Illinois counties, rural households meet their water supply needs from private wells that could also potentially be contaminated by landfills. Sherrill (1990) found that the percentage of water supplies met by groundwater is a more accurate measure of reliance on groundwater than the total number of domestic wells in a county.

The remaining criteria in Table 1 (4, 5, 6, 7, 9) had no effect on the siting decisions because of the limited variance in these factors among the 22 cases. All landfill applicants met floodplain, emergency response, and solid waste management plan criteria. Landfill operations and traffic concerns were

Figure 1. Location of Local Approvals and Denials for Proposed Sanitary Landfills Under Illinois Senate Bill 172, 1981-1990



minimally discussed in the siting hearings. Design features regulated by the IPCB were also minimally discussed and do not apply directly to local decisions (Sherrill, 1990).

Landfill size was also included as a design variable and is measured as the acreage of the landfill site rather than acreage of fill, since surplus acreage is often used for future landfill expansion.

Political Factors

Sabatier and Mazmanian (1981) identify a number of factors beyond the structure of a statute that influence its implementation, including socioeconomic conditions and technology, media attention, public support, attitudes and resources of constituency groups, support from sovereigns, and commitment and leadership skill of implementing officials. While each of these concepts is not directly measurable in the context of landfill siting in Illinois, we were able to derive indirect measures of a number of these political variables.

The presence of an active NIMBY group, the discriminating variable of primary interest, was defined as a single-issue oriented citizens' group of ten or more members opposed to the landfill site. While not representative of broad-based public opinion, the presence of such a group is indicative of the attitudes and resources of the local populace who take the initiative necessary to play a role in local political decisions. Moreover, in each of the cases where a NIMBY group emerged, coverage in local news media also occurred, whereas it occurred in only two of eight cases where a NIMBY group was absent.

Socioeconomic conditions and the resources of constituency groups were further represented by assessed real estate value per household and the jurisdiction's population size.

Plans for waste importation and associated compensation are also critical in establishing the conflict of interest between jurisdictions that prompts the NIMBY response (O'Hare,

Table 3. Explanatory Variables Used in Discriminant Analysis

Variable	Approvals (Mean)	Denials (Mean)	Overall (Mean)
NIMBY group (0/1)	0.5	1.0	0.72
Jurisdiction population (1,000's)	41	197	112
Households within one mile of site	338	20	194
Groundwater use (%)	27	77	50
Compensation offered (0/1)	0.25	0.4	0.27
Landfill site (acres)*	329	135	242
Assessed real estate value/capita (\$1,000's)	12.4	17.8	14.9
Existing landfill capacity (yrs)	22	58	38
Waste importations planned (0/1)	0.42	0.7	0.55

Sources: Illinois, 1980; Kirk et al., 1984; Wiley, 1985; IEPA, 1988, 1989; Sherrill, 1990.

*The Fairview landfill site is 2,800 acres, larger than the other 21 proposals combined. Excluding this observation, the mean for approvals is 114 acres, and the overall mean is 120 acres.

Table 4. Factors Discriminating Between Local Approval and Denial of Landfill Siting Proposals

Discriminating Variable	Coefficient	Standardized Coefficient
Constant	11.278	
NIMBY group (0/1)	-3.158	-1.155
Population size (ln)	-0.743	-1.083
Population within one mile of site (ln)	0.537	0.997
Percent groundwater- supply (ln)	-0.576 *	-0.841
Compensation offered (1=yes, 0=no)	-1.556 *	-0.750
Landfill size (acreage of site)	0.0005	0.288
Assessed value per household (\$1,000's)	-0.030	-0.180
Lifetime of existing landfills (ln yrs)	0.103	-0.176 *
Imported waste planned (0/1)	-0.044	-0.024

Canonical Correlation .946 Squared .895 Wilks's Lambda .1059
Eigenvalue 8.443 Chi-Square 34.80 Significance .00000

Classification: Correct 22, Incorrect 0

1977; Lake, 1987). These dichotomous variables were measured by reviewing the landfill developer's proposal as presented in the county or city meeting minutes.

Lifetime of existing landfill space, population within one mile of the proposed site, percent groundwater supply, and population size were transformed to natural log form to better achieve the normal distribution required by the discriminant analysis technique.

RESULTS AND DISCUSSION

A discriminant analysis using the nine variables defined to explain approvals and denials obtained a chi-square of 34.80 (0.00005), explained 89.5 percent of the variance in decisions, and correctly classified each of the 22 decisions (Table 4). Five explanatory variables were strongly related to approvals. In order of greatest to lowest influence as measured by standardized coefficients, these relationships are: the presence of a NIMBY group (negative), population size (negative), the population within one mile of a site (positive), percentage of water supplied by groundwater (negative), and an offer of compensation (negative).

One would expect all of these relationships to be negative except compensation: thus, population within one mile and compensation had the opposite of the expected effect on approvals. Compensation, offered in 7 of the 22 cases, has a negative effect on approvals. Three cities that were offered compensation approved sites, but one city and three counties offered compensation denied sites. Thus, compensation is not borne out here as a remedy for NIMBY. Rather, key actors viewed compensation packages not as an equilibrating trade-off, but as a bribe to gain their acquiescence (Sherrill, 1990). These results are consistent with Zeiss (1991), who found that impact prevention, control, and mitigation, respectively, were consistently preferred over compensation as a remedy for locational inequities associated with waste facilities. Zeiss also found that people demand that mitigation be performed on the actual problem being caused; thus, money or a new park is not considered to be suitable compensation for potential health risks due to groundwater contamination.

The positive relationship between population within one mile of the proposed site and approvals is most puzzling; however, population of the county or city is negatively and more strongly related to approvals. Clearly, it is the human resources of the jurisdiction, not the neighborhood, in which

Table 5. Discriminant Scores for Each of the 12 Approvals and 10 Denials With and Without NIMBY Groups Opposing the Landfill Siting

Community	Approvals		Community	Denials	
	Discriminant Score With	Discriminant Score Without		Discriminant Score With	Discriminant Score Without
East St. Louis	2.67	5.83	Marxelles	-1.88	1.28*
Fairmont	-0.20*	2.96	Iroquois	-2.86	0.30*
Fairview	2.79	5.95	Lake	-4.42	-1.26
Morris	-0.92*	1.24	McLean	-2.17	0.99*
Alexander	0.44	3.60	McHenry	-1.45	1.71*
Bond	1.39	4.55	McHenry	3.20	-0.04
Jefferson	1.06	4.22	McHenry	-4.50	-1.34
Livingston	-0.04*	2.12	St. Clair	-2.30	0.86*
Perry	-1.26*	1.90	Will	-4.41	-1.25
St. Clair	-0.88*	2.28	Winnebago	-3.14	0.02*
Wabasa	-0.83*	2.35			
Wayne	0.86	4.02			

* Outcome reversed by presence or absence of NIMBY group.

Note: For cases where NIMBY groups formed, discriminant scores were adjusted by 1/161 to estimate the discriminant score without the group. For cases in which no NIMBY group formed, discriminant scores were adjusted by 1/3,161 to estimate the discriminant score had a group formed. Positive discriminant scores are approvals, negative scores denials.

landfills are proposed that is critical in generating opposition. This is further supported by the absence of instances in which a neighborhood group instigated the creation of a jurisdictional group that successfully denied a landfill proposal.

Assessed real estate value per household, landfill size, and waste importation had little effect on siting decisions. With regard to importation, however, three McHenry County sites were the only sites lacking formal proposals for waste importation that were denied. Yet the public hearings clearly indicated that a substantial portion of the public distrusted the developer's denials that importations from Chicago would be involved because of the large size of the sites (113, 119, and 159 acres). Also, the approved Fairview site, at 2,800 acres, is much larger than the other sites, and this may have obscured a small negative effect of landfill size on approvals (see Table 3 footnote).

Discriminant scores from this model for each of the 22 siting decisions are shown in Table 5: a positive score represents approval, a negative score denial. By adjusting this score by the coefficient on NIMBY groups of 3.16, a prediction can be made as to the outcome had the presence of a NIMBY group been reversed. This procedure shows that 6 of the 12 approvals (cities of Fairmont and Morris, and Livingston, Perry, St. Clair, and Wabash counties) would have been denied had opposition groups been formed. Conversely, 6 of the 10 denials (city of Marseilles and Iroquois, McLean, St. Clair, and Winnebago counties, and the first proposal in McHenry County) would have been approved were it not for the efforts of NIMBY groups in those jurisdictions. In this sense, the findings of Burdge et al. (1991) that 66 percent of respondents felt that SB172 "plays into the hands of small citizens' groups" is supported. The law clearly places siting of sanitary landfills in the realm of local politics and empowers communities, if not neighborhoods, to have an influence on decisions affecting their local environment.

Anecdotal evidence from some of the 22 cases further illustrates these local political dynamics. The most typical cases of successful jurisdiction-wide opposition to a landfill proposal occurred in the city of Marseilles and McHenry County. But the failure of neighborhood-level opposition groups can also be illustrated by the cases of Bond and Wabash counties and the city of East St. Louis.

The city of Marseilles (population 5,020), located 75 miles southwest of Cook County on the Illinois River, denied a large (400-acre) facility. A NIMBY group was formed (Area Residents for Environmental Safety) which was primarily concerned with the environmental consequences to a tributary of the Illinois River and large-scale waste importation. The city of Chicago has long disposed of its sewage into the Chicago Sanitary and Ship Canal, wherein drainage of the Chicago River was reversed from Lake Michigan to the Illinois River, to the great displeasure of downstream communities such as Marseilles. Despite an eight-million-dollar

incentive package, the public was strongly opposed to the developer's intent to haul municipal waste from Cook County by rail. The public hearings were moved from city hall to the local high school because of overflow crowds. The locational conflict centered on the policy concerns of accepting large quantities of additional waste generated by the Chicago metropolitan area.

McHenry County, an affluent, populous county northwest of Chicago that relies totally on groundwater, denied three different remote landfill sites on votes of 23-1, 23-1, and 22-2, despite existing landfill capacities of only two years. Three different developers filed site applications, but all three sites met organized, community-wide resistance from the NIMBY groups McHenry County Land Savers and Heartland Families United, despite the county government's support of the applications, which included a full-time waste manager who was actively supporting a new facility.

But where there was only neighborhood-level support, landfills were not successfully blocked whether or not a named group was formed. For example, a Wabash County citizen was perhaps the most hard-working opponent to a site located immediately across a small rural road from his farm. However, no community-wide NIMBY group marshaled sufficient influence, and the County Board approved this site. In the Bond County decision approving a site on a vote of 4-1, approximately 65 households were located within one mile of the site. These residents formed the Bond County Concerned Citizens, but despite its name, the organization lacked county-wide membership and support. In the only instance of a close vote, East St. Louis approved a site within one mile of 3,500 households, but the proposed landfill would partly solve a financial crisis the city was experiencing with refuse in the streets and waste storage at the local high school.

CONCLUSIONS

By using the complete population of locational decisions concerning sanitary landfill applications made under Illinois Senate Bill 172, this study was able to provide an explanatory model of landfill application approval/denial decisions under SB172 and to confirm the hypothesis that NIMBY groups can and do influence siting decisions. Protection of community groundwater supplies and/or opposition to waste importation was generally the motivation for formation of these groups. Population size apparently plays a role in providing a pool of potential activists and the necessary market for a local newspaper or to attract attention from metropolitan news media. Residents within the one-mile externality field for sanitary landfills, however, could make their opposition to the proposed landfill effective only if a larger jurisdiction-wide NIMBY group was organized on their behalf. Compensation packages were either ineffective or counterproductive in attempting to overcome local opposition. These factors resulted in denials for landfill proposals to import wastes from the Chicago metropolitan area to relatively populous counties that rely upon groundwater for public water supplies.

These conclusions provide useful information for both policymakers and local environmental professionals. First, they show that local residential interests are important players in facility siting, and therefore their views must be taken into consideration if agreement is to be reached. End runs around the political process are likely to be counterproductive, as are unrelated compensation packages. Curlee et al (1994), in their in-depth study of waste-to-energy siting difficulties, also reach this conclusion.

But the results also show that the structure for locational decisionmaking mandated by statute, as defined here by SB172, is central in determining just how effective local opposition can be (after Sabatier and Mazmanian, 1981). For example, if the law governing sanitary landfill siting were written differently (e.g., by providing locational decisionmaking power to a statewide siting board), the NIMBY responses reported here would also be different, and the effectiveness of local citizen-activist groups would likely be much diminished. To the extent that they place locational decisionmaking power in a different political forum, states with different legal mechanisms for landfill siting should yield different patterns of effective resistance to new sanitary landfill sites. This is a hypothesis that future research on facility siting and NIMBY should test.

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APPENDIX 23

Update on the Raptor Relocation Program at Pearson International Airport, 1989-1993

UPDATE ON THE RAPTOR RELOCATION PROGRAM AT PEARSON INTERNATIONAL AIRPORT, 1989-1993

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INTRODUCTION

There is a well-known, significant hazard to aircraft from birds [6]. The hazard is especially important in the vicinity of airports because of the high concentration of aircraft in those areas, the higher density of birds near ground level, and the fact that aircraft pilots have limited time to respond to strikes because their relatively low altitude. Considerable effort has been expended in reducing the potential for aircraft strikes by birds and other forms of wildlife [5].

The Pearson International Airport at Toronto is the busiest airport in Canada and is therefore in need of the greatest effort to minimize bird strikes. The numbers of reported aircraft strikes at Pearson is presented in Table 1. In recent years, there have been about 80 bird strikes per year at this airport. The composition of bird species involved in strikes at Pearson is substantially different from other airports across Canada (Table 2). Unfortunately, the annual reports on bird strikes have not been presented in a consistent manner each year so certain data were not available for the summary table. Approximately 17% of the strikes at Pearson involve raptors whereas the national average is only about 3% raptors. In contrast, Pearson has almost no strikes of swallows or humpbacks which nationally rank second and third to gull strikes.

The program to control birds around Pearson involves both a contract with a licensed falconer to frighten birds from the area and trapping and removing problem birds. The latter includes transporting the birds to the Mountsberg Wildlife Centre where they are banded and released. Occasionally, birds require rehabilitation before release and this service is available at Mountsberg. The 1991 report [1] from Transport Canada noted that less than 2% of hawks return to Pearson while there has been a 75% decrease in gull numbers at Pearson in response to the falconry.

Results for the first five years of the raptor relocation program have been published previously [7]. The present report covers the subsequent five-year period from 1989 through 1993 and extends the information about recovered birds.

BIRDS BANDED AND RELEASED

The banding operation from 1989 through 1993 was conducted in essentially the same manner as for the preceding period. One significant change was the greater distribution of release points. This change was necessary to reduce the potential for birds returning to Pearson as well as to more evenly distribute the numbers of raptors across the area. Continued release of so many birds in one area has the potential for depleting the prey supply so that few of the birds will be able to obtain all of their dietary requirements.

A total of 1350 birds of 11 species have been banded over the ten-year period 1984-1993 (Table 3). From 1989 through 1993, the number of birds trapped was 846 which is about an 67.9% increase over the totals of the previous five-year period (504).

As previously reported [7], the most frequently trapped species was Red-Tailed Hawk. It represents 71.8% of all birds banded. The Snowy Owl was the second most commonly banded species. Four species were represented by only one or two birds.

RECOVERIES OF BANDED BIRDS

A number of birds were retrapped at Pearson Airport or were recovered at other locations in Canada and the United States. The following is a summary of the available information

R.R. #1, Acton, Ontario, L7J 2L7

R.R. #2, Campbellville, Ontario, L0P 1B0

R.R. #1, Puslinch, Ontario, N0B 2J0

Table 1. Summary* of annual aircraft strikes by birds at Pearson International Airport

Year	Flights	Strikes	Strikes/ 10000 Flights
1980	254900	51	2.00
1981	250308	61	2.44
1982	246659	47	1.91
1983	245531	46	1.87
1984	258263	30	1.16
1985	298411	50	1.68
1986	308265	58	1.88
1987	323150	57	1.76
1988	346666	25	0.72
1989	349745	32	0.91
1990	N/A	N/A	N/A
1991	354260	79	2.23
1992	421053	80	1.90
1993	327526	85	2.60

*Data compiled from annual aircraft strike statistics published by Transport Canada [1,2,3,4,6]

Table 2. Summary* of bird species involved with aircraft strikes at Pearson International Airport in comparison to other airports in Canada.

Species	Toronto				Canada
	1984-88	1991	1992	1993	1984-88
Gull	38	12	8	11	387
Swallow	0	0	2	2	117
Hunting	0	0	0	0	112
Sparrow	6	0	2	5	97
Hawk	22	6	3	5	67
Owl	7	5	13	4	24
Kestrel	6	5	0	3	9
Eagle	0	0	0	0	2
Falcon	1	0	0	0	1
Other Species	152	50	52	55	2618
Total	232	79	80	85	3434

*Data compiled from annual aircraft strike statistics published by Transport Canada [1,2,3,4,6]

Table 3. Species composition of raptors trapped at Pearson Airport, 1984-1993

Species	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	Total	1989-1993
COHA									1		1	1
NOGO							1	1			2	2
RTHA	63	120	56	83	22	61	132	123	142	167	969	625
RLHA	1	10	9	5	1	20	15	7	11	3	82	56
BAEA		1									1	0
AMKE		1		1	1	2	7	5	14	9	40	27
LEOW		21	6			6					33	6
SEOW	1	2	5	21	1	6		1			37	7
NSWO									1		2	2
GHOW	3	11	8	2	1	10	1	2	2		42	17
SNOW	6	3	12	12	15	3	2	13	44	31	141	93
Total	74	169	96	124	41	109	160	152	215	210	1350	846
Non RTHA	11	49	40	41	19	48	28	29	73	43	381	

Birds Returning to Pearson Airport

Only three species (Red-tailed Hawk, Great Horned Owl, and Snowy Owl) were found returning to Pearson Airport (Table 5). Some birds returned to the airport two or more times (Table 4). Thirty-three Red-tailed Hawks (2.4% of species banded) returned one or more times. Three birds returned twice while one bird was recaptured on three occasions. Two Great Horned Owls returned to the airport once each representing 4.2% of this species. Snowy Owls showed the greatest rate of return (11.3%) to the airport. Sixteen birds returned once while one was recaptured a second time. Other species were not recaptured at Pearson Airport subsequent to banding but this probably reflects the lower numbers banded for of these species.

Ten of the 48 Red-tailed Hawks that returned to Pearson Airport did so within 50 days of capture (Table 5). Numbers returning at other time intervals was surprisingly uniform. This suggests that their reappearance at the airport was entirely at random and there was no specific attempt for the birds to return to Pearson.

Great Horned Owls did not return to the airport for more than one year after release. Snowy Owls that returned to Pearson Airport after release mostly returned (14 out of 17) there within 3 months of release. The others returned one or two years later.

Table 4. Numbers of birds returning to Pearson International Airport, 1984-1993.

Species	Banded	Times Returned			% of Encounters Returns
		1	2	3	
RTHA	969	32	4	1	3.4%
GROW	42	2	0	0	4.8%
SNOW	141	16	1	0	11.3%

Birds Recovered at Other Locations

Four species of birds were recovered at locations other than at the Airport (Table 7). One Red-tailed Hawk (1387-29215) was encountered twice. This bird was originally banded as a SY in late April, 1992. It was subsequently caught at the Holiday Beach banding station in late fall of 1992, then taken near Markham almost a year later. One Snowy Owl was recaptured at Pearson Airport exactly one year after banding (Nov. 8, 1989) then moved on to Windsor where it was encountered in March of the same winter (1993).

Table 5. Days elapsed between release and return to Pearson International Airport, 1984-1993.

Days Elapsed	RTHA	GROW	SNOW
<1000	1	0	0
500-1000	3	1	0
300-500	5	1	2
200-300	6	0	1
150-200	5	0	0
100-150	5	0	1
50-100	4	0	5
1-50	10	0	8
Mean	330	480	108
Min	17	389	9
Max	1349	570	461

Table 6. Summary of recaptures of raptors at Pearson International Airport, 1984-1993.

Band Number	Banding Date	Age	Sex	Recovery Date	Days
Great Horned Owl					
59942539	1989 10 14	HY	U	1990 11 08	389
59942541	1990 03 31	AHY	U	1991 10 26	570
Snowy Owl					
59942504	1987 12 01	HY	F	1988 02 28	92
59942505	1987 12 01	HY	F	1989 03 02	461
59942539	1989 11 08	AHY	U	1990 11 08	363
59944205	1991 01 12	AHY	M	1991 05 11	51
59944221	1992 01 24	SY	M	1992 02 14	20
59944234	1992 01 24	SY	M	1992 02 27	33
				1992 03 23	26
59944225	1992 01 25	SY	F	1992 02 04	9
59941251	1992 01 27	SY	M	1992 03 08	41
59944243	1992 03 08	AHY	F	1992 03 24	16
59944259	1992 12 26	AHY	U	1993 03 24	93
59944260	1992 12 26	HY	F	1993 02 10	49
59944261	1992 12 26	F	F	1993 02 02	41
59944263	1993 00 01	SY	F	1993 02 26	85
59944264	1993 03 01	AHY	M	1993 02 26	55
59944271	1993 02 19	AHY	F	1993 06 10	111
59944281	1993 03 24	AHY	F	1993 12 01	247

Days = time elapsed between encounter

The majority of recovered birds were taken in Ontario as might be expected (Table 8). Ontario recoveries were obtained in nearly all compass

Table 6: (Cont.) Summary of recaptures or captures at Pearson International Airport, 1984-1993

Band Number	Banding Date	Age	Sex	Recovers Date	Days*
Red-tailed Hawk					
87746415	1991 05 24	SY	U	1991 08 12	48
A7746416	1991 07 24	HY	(M)	1991 08 25	31
				1991 11 15	84
				1992 04 16	156
87746435	1991 10 04	HY	U	1992 03 08	159
87746471	1992 02 22	SY	U	1993 04 12	413
87746479	1992 03 06	SY	U	1992 04 16	40
98746773	1989 06 02	SY	U	1990 03 28	301
120714173	1987 03 24	SY	U	1989 02 19	695
120714192	1987 09 29	HY	U	1987 11 05	26
120714230	1991 07 24	ASY	U	1992 04 16	267
120714334	1991 09 18	HY	U	1992 04 23	220
120714244	1992 04 13	SY	F	1992 09 02	139
				1993 06 10	283
120745131	1990 03 28	ASY	U	1992 03 24	747
120745134	1990 03 06	ASY	U	1990 03 26	17
120745135	1990 04 18	SY	U	1990 11 16	208
120745141	1990 07 20	ASY	U	1990 08 29	39
120745148	1991 03 14	SY	U	1991 04 09	25
				1991 09 18	159
138711333	1989 09 29	HY	U	1990 03 28	184
138711334	1989 10 22	HY	U	1990 03 02	135
				1990 12 06	274
138711335	1989 10 26	HY	U	1990 10 26	355
138711345	1989 12 02	HY	U	1990 04 25	148
138711357	1989 12 14	ASY	U	1990 02 25	76
138711395	1990 03 02	SY	(F)	1992 03 13	741
138711958	1991 02 12	SY	U	1991 03 23	41
138714907	1990 03 26	SY	U	1993 12 10	1349
138714939	1990 05 03	SY	U	1990 08 13	100
138714949	1990 08 13	HY	U	1990 10 26	73
				1991 03 22	151
138714956	1990 09 10	ASY	U	1991 07 13	308
138714984	1991 03 22	SY	U	1991 07 13	111
138729214	1992 04 29	ASY	U	1993 06 10	41
138729268	1992 12 19	HY	U	1993 04 30	136
180708203	1990 03 21	SY	U	1990 04 10	19
180708223	1990 04 25	SY	U	1990 12 11	226
180708271	1992 04 16	SY	M	1993 06 10	419

Days = time elapsed between encounter

directions and mostly within 100 km of Mountsberg (Fig. 1). Single Rough-legs were taken in Wisconsin, Pennsylvania and Indiana in comparison with two birds that were recovered in Ontario. This indicates a more westerly distribution than Red-tailed Hawks. The latter were taken in Ohio (2), Michigan (2), Pennsylvania, Kentucky (2) and Georgia. All four Great Horned Owls recoveries were from Ontario but two of these were not far distant from Mountsberg. The single Snowy Owl not recovered in Ontario was obtained in Quebec four years after it was banded and at about the same time of year.

Although the number of recovered birds is somewhat limited, it is possible to discern a pattern of dispersal that relates to the age of the Red-tailed Hawks. Age frequency pattern for birds recovered fairly close to Mountsberg is very similar to the age frequency noted for the whole banded population (Table 9). By contrast, the birds travelling west along the shore of Lake Erie or taken in the United States are predominantly hatch year birds when banded. This suggests that the younger birds are migrating further south while the older birds tend to remain in Ontario. Additional recoveries are required to confirm this initial observation.

SUMMARY AND DISCUSSION

A total of 1350 birds were captured as part of the safety program at Pearson International Airport. Birds were banded and relocated at Mountsberg and several other locations in southern Ontario. The banded birds represent 11 different species of hawks and owls but the Red-tailed Hawk is the most prevalent species. Some birds do return to the airport (3.4% for Red-tailed Hawk, 4.2% for Great Horned Owl and 11 for Snowy Owl). The returns to the airport appear to be the result of random wandering in the case of Red-tails whereas Snowy Owls may make a more direct return. Released birds show a general dispersal (all directions) from the point of release. A number of birds do migrate west along the shore of Lake Erie and enter the United States. The latter group of birds appear to be predominantly hatch year birds. The relocation program at Pearson Airport is considered to be an overall success in that a large number of birds were saved through relocation. No major strikes have occurred although the number of minor strikes remains high. An additional benefit of the program is the additional data relating to longevity, migration and dispersal of the birds.

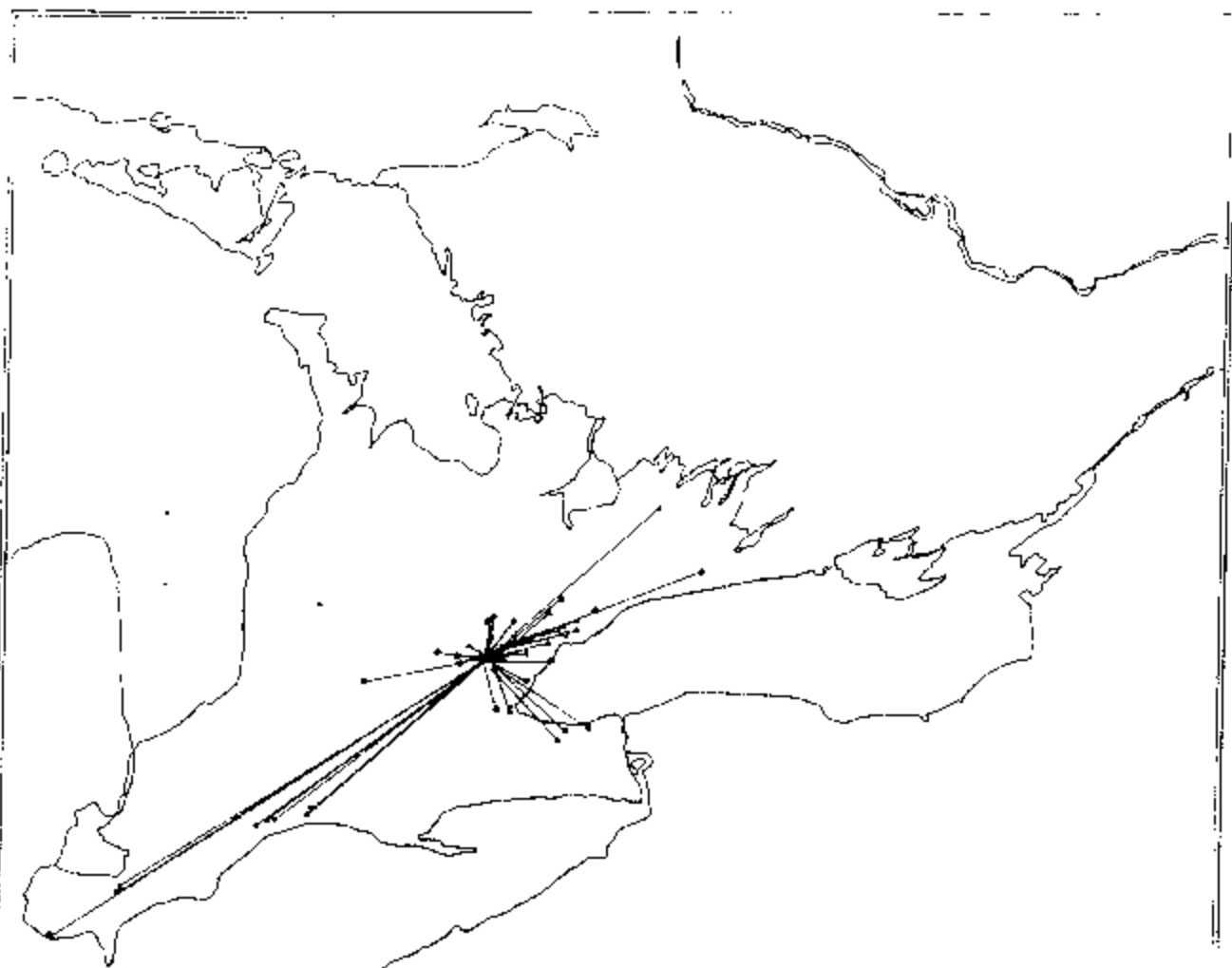


Figure 1. Distribution of recoveries of Red-tailed hawks originally trapped at Pearson Airport, Toronto, 1984-1993 and banded at Mountsberg

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Table 7. Summary of foreign recoveries of raptors originally banded at Pearson International Airport, 1984-1993.

Band Number	Banding Date	Age	Sex	Region	Contd.	Location	Recovery Date	Lat	Long	Name	How	Days
Red-tailed Hawk												
87704567	1985 12 04	HY	L	668	6110	Nr Hamilton, Ont	1986 04 27	431	795	Leona Jakob	00	156
87728353	1984 11 27	HY	F	668	6110	Nr Hamilton, Ont	1985 05 05	431	794	Richard Frost	45	159
87728354	1984 11 27	HY	M	668	6110	Hammer Bay, Ont	1984 12 26	433	792	Leonard Prior	00	29
87728364	1984 12 13	ASY	M	668	6110	7 W Milton, Ont	1984 12 31	433	795	Robert McCaw	28	18
87728397	1985 04 19	SY	L	668	6110	Enn, Ont	1990 10 09	434	793	Lynn Asbee	00	2083
87746421	1991 09 11	HY	U	668	2000	Elders Mills, Ont	1994 02 18	434	793	R. T. Cubitt	89	892
87746423	1991 09 11	HY	U	668	6110	Nr Tilbury, Ont	1992 03 06	421	822	Ken Snowden	00	180
87746431	1991 09 26	SY	U	668	6110	Nr Smiths Bk, Ont	1991 12 31	430	793	Brian Young	45	95
87746461	1992 01 27	ASY	F	668	1033	Toronto, Ont	1992 04 04	434	793	Red Mason	39	67
87746496	1992 03 22	SY	U	668	2000	Beaconsfield, Ont	1992 12 14	430	792	Kip Parker	57	262
87764222	1984 04 20	ASY	U	668	6850	Don Mills, Ont	1992 06 20	434	792	Unknown	70	60
87764240	1984 06 27	SY	M	668	6850	Nr Acton, Ont	1984 09 28	433	800	Ralph Knowles	28	91
87771901	1985 10 12	HY	U	127	6110	5 N Milton, GA	1986 07 06	325	813	Howard Hensley	14	268
87771921	1985 12 14	HY	U	668	6110	Dundas, Ont	1986 06 28	421	795	P. Atwood	00	189
87771923	1985 12 14	HY	U	668	6110	Caledon East, Ont	1985 12 20	433	793	Don Anselme	28	6
87771968	1986 09 27	HY	U	668	6110	Woodhaven, MI	1986 11 01	420	821	Robert Ritz	00	24
87771995	1987 03 11	SY	U	668	6110	Marpesa Twp, Ont	1988 04 01	442	755	Ken Glasford	00	399
87772000	1987 03 24	ASY	U	668	6110	Nr Guelph, Ont	1989 04 05	433	801	Terry Martin	50	745
98725351	1986 12 28	HY	U	172	6110	Nr Warner Run, PA	1990 02 03	411	755	Barbara Reish	45	1155
98740780	1989 11 25	HY	U	668	6110	West Lorne, Ont	1989 12 13	423	813	Philip Pyatt	45	18
98740784	1989 12 03	HY	U	668	6110	Lake Ontario, Ont	1990 01 09	431	794	M. Cutler	00	41
120714121	1985 10 06	HY	U	668	6110	Weaver, KY	1987 01 30	375	862	D. Chapman	03	484
120714127	1985 10 06	HY	U	668	6110	Richland Twp, OH	1985 12 07	411	841	Richard Diemer	50	61
120714135	1985 10 06	HY	U	668	6110	Cambridge, Ont	1987 02 12	432	803	Daryl Coulson	45	483
120714196	1987 11 18	ASY	U	668	6110	Woolwich Twp, Ont	1988 04 08	433	803	Robert Reist	00	145
120714237	1992 02 27	SY	U	668	2000	Nr Searched, Ont	1992 08 30	432	805	Bob Wex	3	183
120714242	1992 04 13	SY	F	668	2000	Mississauga, Ont	1993 05 25	431	793	Martin Wernaart	54	407
120715036	1993 09 13	HY	U	266	2000	Elyria, OH	1994 05 24	412	820	Susan MacGillivray	03	256
120745108	1988 05 03	SY	F	668	6110	Toronto, Ont	1989 05 11	434	793	Carl Heam	00	283
120745111	1988 09 30	HY	U	668	6110	5 NE Dutton, Ont	1988 11 09	424	812	Mrs N. Cook	45	45
138711318	1989 04 21	ASY	U	668	2000	King City, Ont	1992 07 29	435	793	Derrick Hind	00	1183
138711337	1989 11 06	HY	U	668	6110	Maple Dist MNR, Ont	1989 11 14	435	793	MNR, Maple	54	8
138711343	1989 11 25	HY	U	668	6110	St Catharines, Ont	1990 01 10	431	791	Jeff Derksen	00	50
138711361	1989 12 19	HY	U	668	6110	Burlington, Ont	1989 12 23	431	794	Sara Hall	00	4
138711362	1989 12 19	HY	U	668	3000	Hawk Cliff, Ont	1990 10 26	424	810	Don Fowler	89	312
138711391	1990 02 25	SY	U	668	6110	9 km E of Milton	1990 03 06	433	794	Terry Kelly	14	11
138712226	1987 04 12	SY	U	239	6110	Louisville, KY	1988 02 16	381	854	Toby Preston	03	309
138712228	1987 04 12	SY	U	668	6110	Waterloo, Ont	1989 01 12	432	803	Martin Fischer	00	640
138712258	1989 11 18	ASY	U	668	6110	Haldimand Twp, Ont	1991 03 30	440	780	A. Edwardson	54	493
138712274	1988 09 07	HY	U	668	6110	Nr Toronto, Ont	1990 05 21	434	793	F.C. Ferguson	00	624
138714930	1990 04 23	SY	U	668	6110	Hawk Cliff, Ont	1990 11 18	424	810	Don Fowler	89	203
38714042	1990 05 27	SY	U	668	6110	Tilbury, Ont	1990 11 21	421	822	Joan Hanson	14	174
138714958	1990 10 06	HY	U	668	6110	Nr Dutton, Ont	1991 02 23	423	813	Carl McLeod	14	141
138729215	1992 04 23	SY	L	668	2000	Holiday Beach, Ont	1992 11 01	420	830	Tom Carpenter	39	188
				668	2000	Markham Twp, Ont	1993 09 42	435	791	R.T. Cubitt	45	310

Table 7. Summary of known recoveries of raptors originally banded at Pearson International Airport, 1984-1993.

Band Number	Banding Date	Age	Sex	Region	Cont.	Location	Recovery Date	Lat	Long	Name	How	* Days
138729233	1992-07-12	SY	F	668	2000	N. Atherholt, Ont.	1992-07-18	43.2	803	Brian Wyatt	45	6
138729289	1993-05-27	ASY	F	291	2000	Ne Depere, WI	1994-01-24	44	880	Joseph Amersbach	100	242
138729360	1993-09-18	HY	U	668	2000	Unknown, MI	1994-01-03	43	810	Thomas Cholewicki	130	138
138729372	1989-10-31	HY	U	668	2000	N. Milton, Ont.	1993-11-29	43.5	798	J.R. Moser	100	34
Rough-legged Hawk												
87728383	1985-02-18	ASY	U	668	6110	N. of Hamilton, Ont.	1985-03-23	43.2	794	John Amersbach	100	2
87746465	1992-02-12	SY	M	235	2000	Laboran, IN	1992-12-07	40.0	862	Tony Mann	100	294
138712317	1989-03-16	SY	U	668	6110	Milton, Ont.	1989-03-26	43.5	791	Jeff Bannow	34	10
Great Horned Owl												
59906057	1985-03-28	ASY	U	668	6110	Milton, Ont.	1985-07-31	43.3	795	Nancy Tilt	104	133
59928156	1986-01-23	ASY	U	668	6110	Penetanguishene, Ont.	1989-04-07	44.4	795	David Hawke	100	1169
59938156	1986-01-23	ASY	U	668	2000	London, Ont.	1993-07-06	42.5	811	Chris Taylor	45	2718
60800585	1984-10-12	U	U	668	6560	Burlington, Ont.	1985-02-06	43.1	794	Ronald Clark	34	119
Snowy Owl												
59942508	1988-01-22	ASY	M	668	6110	Campbellville, Ont.	1988-01-25	43.2	795	Daryl Chulisan	45	3
59942509	1988-01-22	ASY	F	668	6110	Geethph, Ont.	1988-02-18	43.1	801	Aaron Zimmerman	14	36
59942510	1988-01-22	ASY	M	668	6110	Mississauga, Ont.	1988-01-31	48.1	830	D. Rose	100	9
59942530	1989-01-06	HY	F	676	2000	4 km S Chesapeake, Ont.	1993-01-03	51.4	798	George Lombeck	100	1469
59942539	1989-11-08	ASY	U	668	2000	Pearson Airport, Ont.	1990-11-08	43.4	793	PLA	100	365
				664	6110	Windsor, Ont.	1991-03-06	42.1	820	Brian Ballingston	100	123
59944214	1991-12-10	HY	F	668	2000	Vanessa, Ont.	1992-11-07	42.5	802	James Potts	45	332

* Days elapsed between encounters

Table 8. Geographic distribution of Red-tailed Hawk recoveries of Red-tailed Hawks banded at Pearson Airport, 1984-1993.

Location	RTHA	RLHA	GHOW	SNOW
Ontario	40 (162)	2	4	5 (182)
Quebec	-	-	-	1
Wisconsin	-	1	-	-
Indiana	-	1	-	-
Pennsylvania	1	1	-	-
Ohio	2	-	-	-
Michigan	2	-	-	-
Kentucky	2	-	-	-
Georgia	1	-	-	-
Total	48	5	4	6

Table 9. Comparison of dispersal patterns with age for Red-tailed Hawks banded at Pearson Airport, 1984-1993.

Dispersal Direction	HY	SY	ASY
Overall Population*	35.9	36.0	20.6
Local, north and east**	43.3	36.7	29.0
West and south***	70.6	36.0	5.9

* Overall population includes all Red-tailed Hawks trapped at Pearson Airport.

** Local includes birds recovered north and east of Mississauga and short distances to south and west.

*** West and south includes birds recovered along north shore of Lake Erie and in the United States.

APPENDIX 24

Technical and Air Safety: Close Encounters of the Bird Kind

TECHNICAL & AIR SAFETY

Close Encounters of the Bird Kind

by F/O Richard Sowden
Chairman, Bird Hazards STC

This is not the title of a late night movie re-run! As pilots, the very first day that we sit in an aircraft we are taught many procedures to minimize the risk of aircraft colliding. We are also taught that in the event of a near collision between aircraft, the incident must be reported in order to determine if there is a need to modify procedures to prevent the same situation occurring in the future. The same type of logic must be applied to encounters with birds or other wildlife.

Before you think I have really lost my mind, let me give you a little background on the extremely difficult task of managing wildlife at an airport. Airport wildlife management is much like guerrilla warfare, with wildlife control personnel on one side and wildlife on the other. The battle, like any other form of guerrilla warfare, relies on intimate knowledge of the environment and your enemy. Wildlife control officers rely on training, personal experience, keen observation and reports of wildlife sightings to develop and implement ever changing plans to control wildlife. Once all the intelligence is gathered, the job of outwitting the enemy can begin.

Wildlife control officers are trained to use many different techniques to control wildlife (though they are often limited in what techniques can be applied by legislation, economics and pressure from environmental and wildlife activists). These techniques are divided into two distinct categories, active and passive. Passive control techniques generally lead to a long term solution to a wildlife problem, while active control techniques are used to control an acute problem immediately.

Passive control methods rely on habitat management to control bird species by reducing the attractiveness of an area. An example of this would be the filling in of small ponds near runways to discourage waterfowl from the vicinity. Another example is the adjustment of grass height near runways. Birds such as gulls and dunlins like short grass; if the grass is kept slightly lower these birds will not loaf in the grassy

areas adjacent to the runway, thereby reducing the risk of a bird strike. However, if the grass is allowed to become too long, different bird species may be attracted, such as birds of prey searching for rodents hiding in the long grass. As you can see, this is somewhat like mother nature's version of Newton's third law: For every action there is a reaction. When undertaking habitat modification careful thought must be given to the consequences. What may drive one bird species away may be an ideal habitat for another equally dangerous bird.

Active wildlife control methods consist of various "scaring" devices that startle the birds and when selectively applied are used to progressively move the birds away from the vicinity of runways. The primary devices used are various pyrotechnic shells fired from a shotgun, which emit loud bangs or screaming sounds. This technique must be used carefully to ensure that the birds are not being scared into the flight path of arriving and departing aircraft.

Now that we understand the nature of the problem we can return to the opening paragraph of this article. As pilots, we have a much more extensive view of the airport environment, as well as vastly outnumbering the number of wildlife control personnel. Typically, an airport will have only one or two people controlling wildlife at any given time. This, coupled with the fact that airports cover many hundreds of acres, means that only small areas can be actively observed and controlled at any given time. This is usually accomplished by using routine patrols following established routes based on experience with the local terrain and bird species.

Any acute wildlife problems that occur must be communicated immediately to the wildlife control personnel to ensure prompt action. This is where pilots can assist. As we arrive and depart airports we cover large areas in short periods of time. If we happen to see a potential wildlife problem, such as a flock of birds in the vicinity of the runway or in the approach or departure path, informing air traffic control of the

occurrence is essential. ATC will ensure that other pilots are informed of the potential danger and that the wildlife control personnel are informed so that appropriate measures can be taken.

Should you happen to have a close call with a flock of birds while arriving or departing an airport, it is also important that you take the time to fill out a birdstrike report form. The new birdstrike report forms from Transport Canada are also meant to be used to report a "near miss". You might ask "If I didn't hit the bird why fill out the form?". The primary use of birdstrike information is to assist wildlife control personnel in identifying problem bird species at an airport. If, by chance, you just missed hitting a bird or flock of birds there was a very real risk of an accident or an incident had the path of the flock changed.

This leads us back to the concept of airplane near collisions and their significance. If we only reported airplane collisions then we would be doing little to increase the level of safety. It has been through the diligent reporting of near collisions that problem areas have been identified and improvements to procedures and equipment developed. The same theory applies to birdstrikes. By establishing a sound base of knowledge, through reports of occurrences, problem areas can be identified and solutions generated.

It is very difficult to identify wildlife problems without supporting data. Anecdotal evidence, while useful, is often not strong enough to convince the appropriate agencies that action is needed to mitigate a potential birdstrike problem. This is particularly true when the source of the birdstrike hazard may be related to a problem not located on airport property. An example of this is a poorly managed landfill which can attract thousands of gulls that may choose the airport as a convenient resting site on the way to and from the landfill site. Scaring the birds away from the airport will deal with the problem in the short term, but will not address the root cause of

the problem. In this situation, appropriate data - when available from pilot reports and others - can be used by authorities to force the landfill operator to control birds at the landfill site.

I hope that you are able to see the importance of reporting wildlife problems at airports. Our observations are important sources of data for those who manage wildlife at the airports we fly in and out of. Failure to inform the appropriate authorities of a wildlife problem can lead to dis-

astrous consequences.

I will leave you with one tragic example. Of what can happen when wildlife is ignored. This year, on January 20, a Falcon 20 was taxiing out at Paris Le Bourget Airport. The crew remarked that there were numerous birds (later identified as lapwings, which weigh approximately 215 grams) in the area of the runway. The crew did not notify ATC of the problem. On takeoff the aircraft struck a flock of these birds and a number were ingested into one

of the engines, which subsequently experienced an uncontained failure. The crew were unable to return for a landing and the aircraft crashed. All ten occupants on board were killed. While hindsight is twenty-twenty perhaps if a little more time and effort had been made by the flight crew to inform ATC, the birds could have been dispersed from the area of the runway before takeoff.

U.S./Canada/Japan Investment Overview

by Alan Morris P.Eng.

The Financial Planning Group, Mississauga

Interest rates and the U.S. economy

With the U.S. economy showing signs of weakness, on July 6/95 the Federal Reserve cut interest rates by 1/4%, to provide some stimulus. A further interest rate reduction is probable in the near term, albeit small. Lower interest rates will benefit the U.S. economy and will boost President Clinton's popularity in the third year of his term.

U.S. equities remain attractive despite the large run-up of the Dow, bearing in mind that large cap mutual funds will weather a market correction better than small caps.

On the fixed income side, although the long term bond market still has some life, bondholders might consider moving some of their assets into cash over the next quarter. Holders of strip coupons purchased when rates were higher should consider taking some profits now.

Canada

Prospects for resource rich Canada are at least as good and probably better than any place in the world today.

- Current reining in of both Federal and Provincial Government expenditures will result in better quality debt attracting lower long term interest rates.
- Expected U.S. interest rate reduction/stability will provide additional impetus for lower Canadian rates, that will favour growth.
- Over the last three years Canadian industry has radically streamlined itself cutting the "fat" out of production costs.
- The threat of Quebec separation is declining.
- The low Canadian dollar makes our exports very competitive. To cap it all,

the huge demand for infrastructure by the emerging Asian giants and the developing countries in Europe and South America means profits for nickel, copper, pulp, newsprint, lumber and oil producers.

Canadian resource companies in these areas are poised for a boom. The expected fall in Canadian interest rates will precipitate a rush of "GIC refugees" back into mutual funds in the 1996 RSP season. Those with the foresight to reposition themselves now will reap benefits.

Japan

Sir John Templeton's sage advice to "Buy at the point of maximum pessimism" is being touted by many media sources as the justification for buying into Japan today. Major banks hold huge real estate portfolios, as yet to be revalued to reflect

lower values. The high Yen has created a shambles out of competitive export pricing. Latest estimates of the cost of the Kobe earthquake disaster exceed \$100 billion. Nobody is buying Japan at present, and those who hold it are probably regretting past purchases.

Acknowledging that Japan has relocated the production of most consumer goods previously produced in Japan, to lower cost Asian rim neighbours, (Even Honda Accords produced in Kentucky are now being exported to Japan), as well as the huge Asian growth potential, taking a major position in Japan is still premature, with a devaluation of the Yen a distinct prospect.

A conservative strategy of using Global equity funds for Japan and Asian exposure offers less risk than exclusive country positions.

Flight arrivals & financial independence have nothing to do with luck...

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Alan Morris (P.Eng.)



**THE
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APPENDIX 25

Where the Birds Are

Where the birds are

Although they often share common airspace, feathered birds and metal birds can be a dangerous combination. There have been numerous aircraft/bird collisions over the years, some with calamitous results.

In this instance, the pilot of a U.S.-registered Cessna 441 Conquest escaped unhurt and his six passengers suffered minor injuries when the aircraft and seagulls came together at Fort Frances, Ontario, at 0445 on 18 June 1994. The aircraft was substantially damaged.

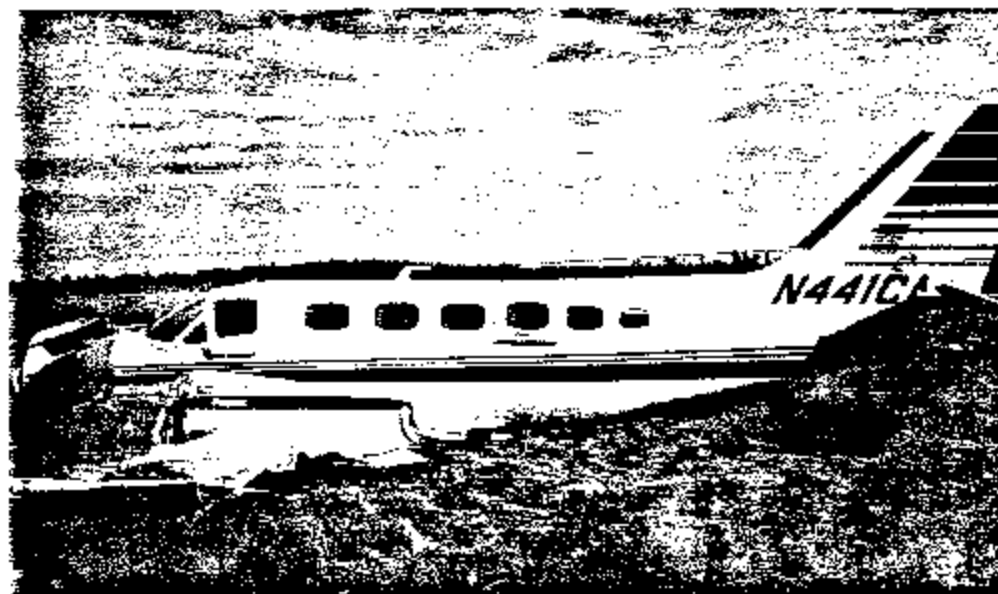
Report No. A940105

The pilot lost control of the aircraft during take-off when the left engine lost power as a result of bird ingestion. Contributing to the loss of aircraft control were a take-off weight

in excess of the maximum allowable, and a centre of gravity aft of the centre of gravity limit.

The company Flight Manifest/Weight and Balance Form for the occurrence flight indicated a take-off gross weight of 9,850 lb and flight centre of gravity 177.5 inches aft of reference datum. After the occurrence, the baggage was weighed and each passenger was asked to confirm his actual weight. Using these revised weights, the take-off gross weight and flight centre of gravity were calculated to be 10,471 lb and 180 inches aft of the reference datum.

Based on the bird remains on the runway, the bird ingestion occurred after 1,600 feet of ground run. The skid marks on the runway are the first indications of left yaw developing at about 1,800 feet of ground run. The main wheel tire marks on the runway were probably caused by the pilot inadvertently applying toe pressure to the brakes as he



The Cessna Conquest after an encounter with seagulls during take-off from Fort Frances, Ontario.

pushed the right rudder pedal forward to correct for the left yaw that was developing. The negative torque sensor on the left engine reduced the amount of left yaw that was developing.

Because of the aircraft's high power-to-weight ratio, the rotation speed of 98 knots was attained. After rotation, the pilot realized that the yaw was pronounced, and confirmed the power loss in the left engine by reference to the torque gauge. At this point, he also noticed a gull pass in close proximity to the left of the aircraft.

The pilot had the option of aborting the take-off or continuing. He had achieved rotation speed and elected to continue the take-off.

The aircraft was now airborne and heading for the side of the runway. The pilot could not maintain control of the aircraft and it crashed off the left side of the runway with the landing gear down. When the aircraft came to rest, the pilot assisted in the evacuation of passengers and then ran to the passenger terminal for assistance.

The pilot's inability to control the aircraft was likely contributed to by the over-gross take-off weight and the out-of-limits aft centre of gravity.

THE DUMP

Transport Canada recommends that garbage dumps not be located within five miles of an airport and describes garbage dumps within this distance as "extremely hazardous." The



The town dump and its population of seagulls are about 1 mile from the airport.

Fort Frances garbage dump is located approximately one mile to the south of the airport. Hundreds of gulls were observed at the dump site on the day after the occurrence which would tend to substantiate the conclusion that an extremely hazardous bird site exists within one mile of the airport. There is no warning of the potential bird hazard at Fort Frances in the Canada Flight Supplement (CFS).

The TSB issued an Aviation Safety Advisory Letter to Transport Canada (TC), asking that the CFS entry for Fort Frances include a warning of the bird hazard.

TC responded that it does not plan to publish such a warning in the CFS; however, it will direct the Regional aerodromes inspection staff to monitor the wildlife control procedures at the Fort Frances airport.

REFLEXION

While the aircraft's landing lights did not prevent this occurrence, they are still one of the best anti-collision tools available.

The pilot's inability to control the aircraft was likely contributed to by the over-gross take-off weight and the out-of-limits aft centre of gravity.

APPENDIX 26

Aviation Safety Vortex: Issues 3/95 and 4/95



Do Helmets Really Save Lives?

You can bet your sweet (expletive) they do. They have in the past, and will continue to save lives and serious injury in accidents yet to happen. Give them whatever name you wish — electric hat, bone dome, brain bucket, hero hat or, that old standby, flying helmet — they work as advertised.

Throw your trusty helicopter at the ground or some other hard object (for whatever reason), and more often than not you're in for a very interesting ride before all the parts stop. Even with your body secured by a seat belt (we hope) and shoulder harness, the head gets to move around on its own. This mobile part very often comes in contact with less-than-forgiving items like door posts and even parts of the ground like rocks and trees. The main rotor has been known to enter the cockpit area, contacting occupants. The question is, if you're going to be hit in the head by a main rotor, would you like to be wearing a bone dome or a baseball cap? I know an individual (he's still with us) who was hit in the helmet by a blade as it came through the cockpit, but I don't know of any ball cap users who have had the same experience and remained to talk about it.

The helmet will not save everyone, but the statistical evidence is there: they do help, not only in saving lives, but also in preventing serious brain injuries. It doesn't take much of an injury to reduce your brain power from smart (most helicopter pilots) to radish-equivalent. It's your choice.



Remains of a Western Grebe (*Aechmophorus occidentalis*) after it hit a Bell 206, and then this helmet and visor.

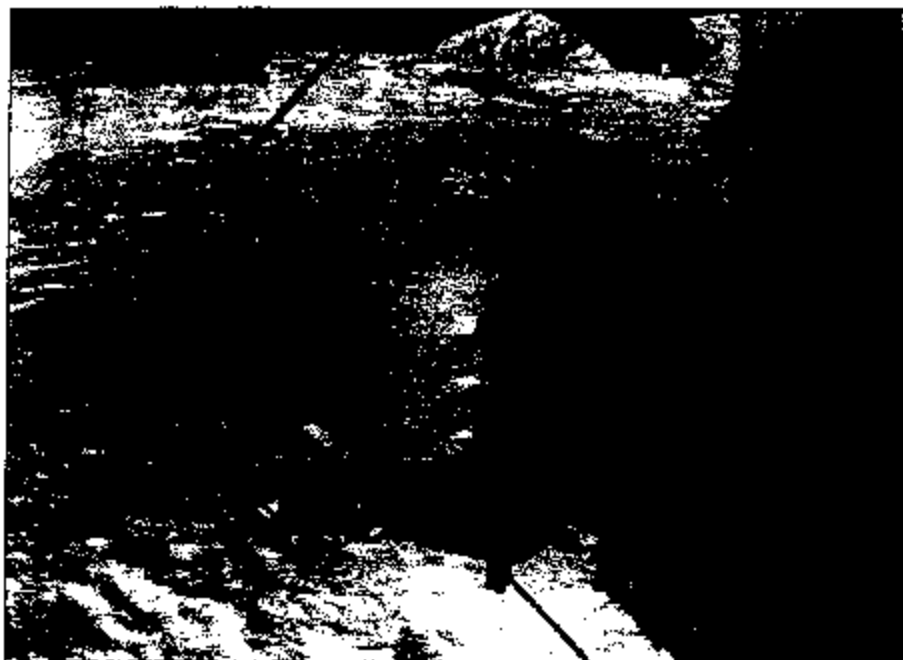
Early in its development (during WW I), the parachute was banned from a number of military cockpits. "Bad for morale, take away from our boys' aggressive attitude." Sounds wild, but it actually happened. Nowadays for "parachute", read "helmet".

From the community that feels a ball cap will provide adequate protection, we get a variety of reasons why they don't, won't, wear a hard hat. A while back we asked you, the readers, a few basic questions on helmets, and the returns were generally very positive for the use of helmets. Eighty-five percent of the responses were in favour of helmets for crew members on most jobs (the notable exception was airline operations).

Here are the questions and a cross-section of the responses. We'll let you be the judge.

Do you wear a helmet?

- No, they cost too much, are uncomfortable and look wimpy.



Helmet from Bell 206 accident showing impact scars.

- Sometimes, it depends on the job and if I have passengers.
- Not yet, but I'm thinking about it.
- Not yet, but I will.
- Always.
- No, because I spend a lot of time flying vertical reference and my neck gets stiff.
- I have a helmet, but I don't wear it because of a previous injury.
- Only when I am at greater risk.
- Yes. Yes. Yes. Yes.
- I don't, because they're uncomfortable and not practical.
- Yes, you're crazy not to.
- I fly corporate so nobody wears one.
- I have for 20 years and I don't intend to stop.
- Yes, unless asked not to by the customer.
- No, but I did in the military.
- No, but I should.
- No, the front seats have shoulder harness.

Why do/doesn't you wear a helmet?

- I don't, because of company policy.
- I do, as it is our company policy.
- It's a military requirement, but

- I still think it's a good idea.
- I feel that it could save my life. I know of a number of pilots who would be here today if they had only worn a helmet.
- I don't, because it's expensive and uncomfortable.
- I don't, because of the extra weight, reduced freedom, electrical problems and ridiculously high cost.
- I used to, but I don't anymore because it's uncomfortable and I feel trapped.
- I do because I have a strong desire to retire as a pilot and not a vegetable.
- For crash survivability, I wear one.
- I don't because of the lack of available headroom.
- All pilots wear one, they're supplied by the company and, besides, it could save my life.
- The company supplies them, along with nomex suits and gloves.
- I do because of safety, statistics and hearing protection offered by a good fit.
- I don't because they're not required.
- I don't because there is no requirement in our ops

manual.

- I find it hard to believe how senseless it is not to wear one at all times. All it takes is one accident/incident to put yourself down and out for the rest of your life, whether as vegetable or deceased.
- I do because I would like to know my own name when I stop flying, and I would like the end of my career to be my choice.
- I never thought about why I don't. I guess it's because nobody in our company does.
- You bet I do, mine saved me from serious injury, perhaps death.
- I don't like them, they're too hot.
- They might offer head protection but they do not offer hearing protection.
- No, cost and comfort.
- Yes, it's more comfortable than a headset when it's adjusted correctly. I love the sun visor, and it provides head protection.
- I do, for the same reason that I wear seat belts and shoulder harness, to enhance safety.
- I wore one in training, and I believe in the accident statistics.
- I tested one to its full extent, and it works.
- I don't because all I fly are sightseeing trips.
- I don't because the helmet blocks out the sound of the engines as well as other sounds.
- It adds weight to the head in case of sudden deceleration.
- I can't afford it.
- It's cheap health insurance. I wear it on all flights.
- I don't because of cost, peer pressure, management pressure, but I would if permitted.
- The helmet increases the likelihood of staying conscious in a crash.
- Yes, I'd like to stack as many things in my favour as I can.
- Common sense.

made by somebody who has been trained by the helmet manufacturer. Just tightening the straps is not the way to go.

Quite often helmets are passed from pilot to pilot and this too causes problems. You may get a deal at a reduced price, but you may also end up with the wrong size or a helmet that's been damaged.

If you own an old Canadian military-type helmet (method of acquisition not important), you should note that the manufacturer is no longer making parts for them (the Canadian military has purchased a new helmet for their helicopter crews).

Take it from someone who's worn a helmet for a long time: a proper fit is very comfortable, a bad fit is absolute hell.

If you're concerned about the weight, perhaps neck-strengthening exercises would help. If you've tried an old helmet, remember that the new, state-of-the-art helmets, are made from composite materials. They provide a much greater degree of protection from a substantial reduction in weight.

Those who complained about comfort also complained about not being able to hear properly. If the earphones aren't over the ears, they're not going to work very well, are they? A little-known fact is that a number of people have

one ear higher or lower, forward or back, from the other.

Helmets are expensive

Can't argue with cost, but what value do you place on life? A good helmet will probably cost a bit more than double the cost of a good headset and a baseball hat. If you don't think your life is worth the added cost, stay with the ball cap.

A good helmet can be purchased for about the price of four new tires and a brake job on your performance car. Would you permit your wife/girlfriend to drive your car with bald tires and poor brakes?

The helmet won't work in our helicopter

Sorry, we don't agree at all. All it takes is a minor fix by an avionics technician in less than an hour. This is a poor excuse.

Peer pressure

If you don't wear a helmet because none of the other drivers do, and you're afraid they will call you a wimp, well, maybe you are a wimp. Just remember, self-preservation is very much "macho". It against our company policy to wear a helmet

This is hard to believe, but very true. Some operators have gone so far as to say, "Wear one and you're fired". If the passengers are intimidated by pilots wearing helmets, they must really become anxious when briefed about ELTs,

life rafts, emergency exits, crash axes, fire extinguishers, first-aid kits, how to prepare for a crash, and duties after a crash. For those operators who insist on prohibiting the use of helmets, please see first remark under **"Do you think that the wearing of helmets should be mandatory by law?"**.

On the positive side, hats off to those companies who are taking an active role in assisting pilots in the purchase of helmets and other types of personal flight equipment. The Vortex congratulates them for their pro-active approach toward flight safety.

On the passenger side, an ever-increasing number of companies who are frequent users of helicopters are providing their employees with helmets for personal safety.

Now that the Vortex has had another shot at the helmet issue, we would like to hear again from you the readers. If you have any first-hand knowledge of accidents where helmets saved lives or prevented injury, write them down and send them to the Vortex. We'll print them in upcoming issues.

The choice should be yours. "To wear or not to wear, that is the question."

Robinson Safety Awareness Program

Robinson Helicopter Co. has produced an "Awareness Training" kit to alert pilots of potential fatal hazards when flying helicopters. The kit includes an approximately two-hour video of excerpts from the Robinson safety course along with other training material. The kit is designed to be used by helicopter flight instructors giving an "Awareness Training"

course to their students and other pilots.

While they last, the kits are available from the factory by sending US \$30.00 to:

Robinson Helicopter Company
2901 Airport Drive
Torrance CA
90505

- I don't because they cause neck and spinal pains — also they are too hot in the summer.

Does your company have a policy on the wearing of helmets?

- They feel that helmets worn by the pilots will frighten the passengers.
- They suggest that pilots wear helmets, but it's not mandatory.
- No official policy, but unofficially their use is discouraged because they say their use frightens the passengers.
- Our company policy is that it's not mandatory, but it's encouraged. They will pay 50 percent of the cost of a helmet.
- No policy and no support — wear one if you wish.
- Our owner approved a purchase subsidy program and repayment of the balance over 12 months to encourage the use of helmets.
- Our company policy used to be, you can wear one when no one is on board to see the damn thing. Thanks to pressure from outside and from within, we now have a policy of, "There are certain jobs we would wish you didn't wear one on."
- They will pay for it, but then you must wear it.
- Our company requires all pilots to wear a helmet.
- Of my last three companies, two made helmet use mandatory.
- Our company has no policy, but our base manager prefers no helmet.
- The policy is no helmets when carrying passengers. They feel the passengers will get the idea that flying in a helicopter is dangerous.
- There is no policy, but their use is frowned on.
- Our company strongly recommends the use of helmets. In all my years flying I have never

had a passenger object to my flying with a helmet on, and yet this is one of the main reasons used by those who choose not to wear one. It should be noted that 95 percent of my passengers are corporate leaders in suits and ties and, again, no complaints.

- Unofficial policy — they intimidate the passengers.
- All front seat occupants must wear a helmet.

Do you feel that customers should wear helmets?

- It would be nice, but who would pay for them?
- Yes, either all or none.
- For some types of operations like photo, SAR, construction, mountain.
- Yes, if they do a lot of flying.
- They should be available, at least for frequent flyers.
- Yes, the laws of physics do not differentiate between pilots and passengers.
- We have spare helmets in the hanger. If they want one they can have one — their choice.
- I have seen ground accidents where people lost their life and might have been only injured if they had been wearing helmets.
- It's a good idea for frequent flyers. Most of the companies we fly for provide helmets for their people — I think it's an insurance requirement.
- I spend a lot of time in the back of a helicopter and was very pleased when our company started supplying helmets.
- No, not practical.
- The problem is fit. A poorly fitting helmet is of no value.

Do you think that the wearing of helmets should be mandatory by law?

- Probably not by law, but prohibiting their use as a company policy should be punishable by death.

- Definitely not. The government has no right to regulate every thing — it's a free country.
- Instead of making them mandatory, how about the insurance companies giving the companies who write helmet requirements into their Operations Manuals a premium reduction. Make it incentive, not penalty.
- No, but perhaps a Workman's Compensation Board directive or something from the insurance community.
- Helmets definitely have their place in the helicopter world, but to legislate their use would be a step backwards in educating the public.
- Not a chance. We're over-regulated now. Let the industry decide.
- If it becomes mandatory, the cost should be picked up by the government, perhaps as a tax deduction.
- A law should address the subject with common sense.
- You are required to wear a helmet on a motorcycle, but do you wear one in your car? High-risk jobs, mandatory; airline operations, never.

Before we go any further, thanks to all those who took the time to send in their comments on the helmet issue. In favour or against, your input is valued.

Here is the *Vortex* response to a few of the more popular negative comments:

Helmets are uncomfortable

Very true, if it doesn't fit properly (poor adjustment or wrong size). Anything you wear that doesn't fit properly will be uncomfortable (shoes, helmets, undershorts, and even baseball caps). The secret is having the helmet adjusted properly and making sure that you have the correct size in the first place. Unfortunately, these adjustments should be

Aviation Safety

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TP 202E
ISSN 0823-6354

Learn from the mistakes of others; you'll not live long enough to make them all yourself...

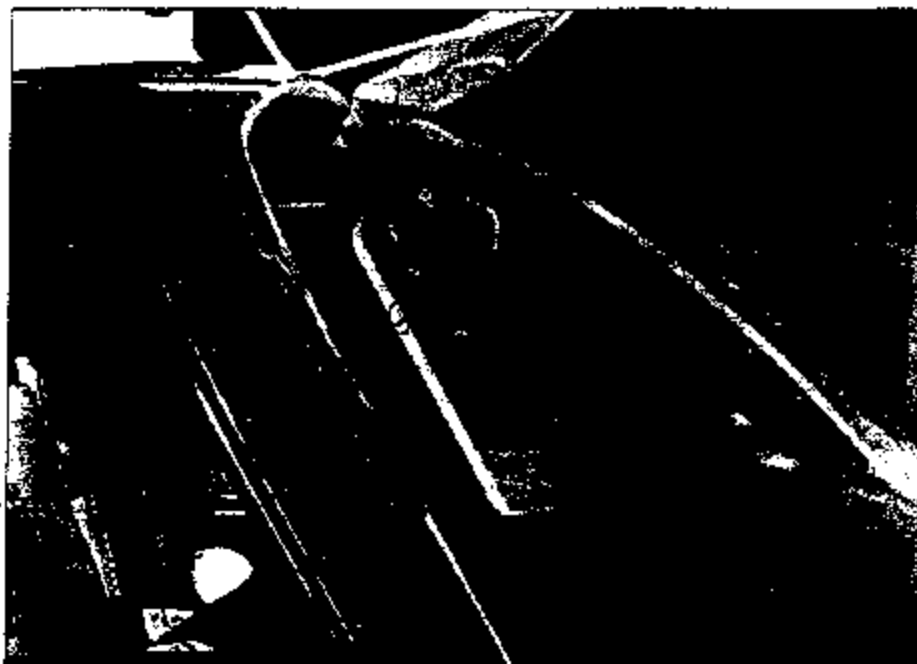
Issue 4/95

An Ounce of Prevention is Worth...

The pilot had just completed a night search mission and was heading back to the airport when all hell broke loose. There was an explosion-like noise followed by a severe blow to his head and face. Though cut about the face and almost knocked unconscious, the pilot managed to land successfully at the nearby airport.

The Bell 206 had impacted a bird, more specifically a western grebe (*Aechmophorus occidentalis*), which is approximately 63 centimetres long, has a wing span of about 88 centimetres and weighs one to two kilograms. Had the pilot not been wearing a helmet (with the visor down), the mid-air would probably have ended in tragedy.

The bird strike took place at night, over a heavily populated part of Kelowna, British Columbia. The helicopter had, just moments before, levelled off from a left climbing turn at 1200 feet above ground level and at a speed of about 80 knots. The navigation and position lights were on, and the pilot had just turned off the Night Sun search light. A dark object (probably another bird) passed on the left side, and a split-second later, impact.



Broken windscreen.

The grebe impacted the right side door and window frame about 30 centimetres down from the top of the door, bending the frame and tearing off a door hinge. The bird then smashed through the windscreen, into the cockpit, where it crashed into the right side of the pilot's face with tremendous force. His head was snapped backward into the headrest, and he was very nearly knocked unconscious. He was wearing a helmet (see also *Vortex 3/95*) and, by his own words, "Due to force of habit from military flying days, I had my clear visor down. Had I not been wearing my helmet with the visor down, I certainly would have been incapacitated, with most likely a fatal result. At the very least I would have lost my right eye." The helmet

Canada



Broken door hinge.

and visor both received structural damage from impact with the bird and broken windshield. The pilot's injuries included facial cuts (below the visor) from the grebe and pieces of plexiglas, a major contusion to the jaw,

and a severely strained neck. The bird came to rest (in many pieces) in the back-seat hatrack.

Editor: There are a number of birds, native to Canada, that are larger and heavier than the western grebe. Take, for example, a Canada goose, or a turkey vulture, and fire them at the same spot on a 206 windshield. The force of impact would be considerably greater in a collision with a larger bird. In 1994 there were two documented collisions between helicopters in Canada and Canada geese, but fortunately at different points of impact than in the grebe collision over Kelowna.

The key issue to the Kelowna occurrence is the degree of self-protection (preservation) that the pilot gave himself by wearing a helmet (with the visor down). What kind of protection would YOU get from your shades and a baseball hat??? 

So You Thought You Couldn't Say No...

Bush pilots used to be encouraged, if not actually taught, to carry out the customer's wishes whatever they were, as long as the safety of the helicopter (and the bodies on board) was not jeopardized.

On one major contract, predominantly flown by Bell 47s, one of the resident helicopter's important duties was to keep the fly-camps supplied. The loads carried were mainly food, but also items of equipment of all shapes and sizes: lumber, clothing, mail, spares for vehicles, drills, tools and suchlike.

Preparation for these routine trips was rather like putting together a pannier-laden Eskimo dog team. The external cargo racks were often piled up as high as the fuel tanks, long loads overhung the ends of the racks, and the inside of the bubble was crammed until there was just enough room for the pilot.

albeit with his all-round visibility drastically reduced. A sharp eye had to be kept on how all the stuff was loaded and on the weight of it all. Once in a while, by accident or intent, machines became overloaded - this fact being learned the hard way shortly afterwards! Unless the engineer/mechanic was on hand to supervise the loading, the pilot had to do it himself, including the tying down, just to make sure. In this way, exciting takeoffs with fully-forward or fully-aft centre of gravity locations were kept to the minimum. The odd heavy-vehicle mechanic arriving at the helicopter had been known to take off his parka and casually put it in the chin of the bubble, and by some oversight would neglect to say that in its pockets languished more than 80 pounds of bolts and other spares for a lame bulldozer.

APPENDIX 27

**Transport Canada: Atlanta Georgia - Lear Transcript,
November 20, 1995**

TRANSPORT CANADA

Atlanta Georgia - Lear Transcript

November 20, 1995

...history of famous last words, in many cases had been very safe. Over two hundred years ago Madame De Pompadour, the favorite mistress of King Louis the fifteenth, lay dying in her bed, the priest had given her last rights, and was preparing to leave the room. The Madame said, one moment Monsieur Le(?), and I'll go with you, ...(inaudible) she passed away. A hundred and twenty years ago, Stonewall Jackson lay at the foot of a tree, dying, wanted by accident by his own men. He looked across, and said, let us cross over the river, and rest in the shade of the trees. A hundred and twenty years later, a pilot took off in a Lear 23, and (inaudible) tree, and his last words were, "we have hit some birds, we're not going to make it". That was a sad day.

The (?) a large generally used to relieve (?) for Atlanta harvesting were over five hundred based aircraft, and our highest number of operations per year of about two hundred and seventy thousand. We're the second busiest airport as far as takeoffs and landings are concerned, in the States, second only to (inaudible).

Atlanta is a hilly area and were located about a thousand feet above sea level. I have no information on gulls, we're about three hundred miles from the Gulf and the same distance from the Atlantic. The only time I've seen

seagulls is after a hurricane in the Gulf or hurricane near the Georgia coast.

So I have to stick to the three types that I hit most.

The day before yesterday, at the pre-conference meeting, Al (?) said something that disturbed me. He says airport managers don't give a damn about birds. I started to argue with him, but I stopped to think. Okay, my accident happened ten years ago. I had (inaudible) Boston - Logan accident, at that time I don't didn't know what a starling looked like. I had heard about the accident the Viscount in Maryland. I didn't worry too much about that. We have no swans flying around north of Georgia that I know of. And I didn't know they could whistle. (laughter) But today and certainly during the last ten years, and even more recently, I think airport managers do give a damn. I think if they don't, they'd better. Because what happened to me, could happen to any airport in this country. Only the names of the birds would be changed.

About eleven years ago, politics raised its ugly head in Decalb County, Georgia. Up until that point, no commissioner had ever been re-elected. Always, they were ready to vote him out of office for something. At this time the garbage situation in the county stank. The man that was running against the incumbent promised to do something about the garbage pick up. This was not a contract pick-up, this was done by county employees as a

department of sanitation of the county. Sure enough, he got elected. Up until that time, they been burning at a very large incinerator most of the refuse. And burying the rest in an uninhabited area of South Decalb PTA closed the incinerator, and that's when the garbage situation went from bad to worse. So our politicians looked around, and this is an old story, we've heard it here, today and yesterday, they looked for another site. We've got one on the south side, let's get one on the north side. Where do we put it? Let's put it on the airport. We already own the land. There's an area, a depressed area we use to, there's a (?) , to build a new parallel run-way, we'd like to take one more minute to

(coughing)

SPEAKER IS AWAY FROM MICROPHONE - TOO LOW TO DISTINGUISH
this is a six, seven lane highway, and(inaudible) this would be an area (inaudible) this area is about fifty feet below the of the runway industrial park, ... I must say

BACK TO MIC

On the twenty seventh of February, nineteen seventy three, the Lear was cleared for take off, took off on the longest runway 20 left and two minutes later in went into oblivion. The plane came down in an apartment complex, which probably was under construction, and it hit the unoccupied part of the apartment structure. Aboard were two couples, two married couples, and another individual, the pilot and co-pilot. Seven people. They

were on their way to Florida, the plane was furnished to them by a real estate company. It was flying them to Florida to look at some real estate they hoped to purchase. Of course, we lost all of the occupants of the aircraft. And one man on the ground was burned by fuel after the plane crashed. He survived, very fortunately.

Although, I hadn't been able to get much help in doing away with the birds, which had started coming into the dumps, as soon as the dump was opened. Right after the accident, I seemed to have a lot of help. It was sort of too late by then. But all of a sudden we had off duty policemen, deputy sheriffs, and anybody else that had a shot gun, out between the dump and the runway. It sounded like the battle of the bulge, and I'm very surprised that we didn't lose more people to shot gun pellets, than we did in the aircraft.

That didn't last very long. We got a little bit better organized, and started the, again, the roving patrols. These things we did, the first thing we did was to call on some professional help. We called on the state, we called on the feds, we called on the extinction service, we called on private enterprise, we called Dr. Sid Verto,, >?) came down to give us a hand, to see what we could do about it. Surprisingly enough, the commissioners we not about to close the dump. As a matter of fact one was overheard to say, "we'll close the airport before we close the dump" That's a sad situation. We tried

the (?) canons, we tried to twin shot made by (?) , I don't think they make them any more. We tried the shotguns with seven and half shot, we tried just about everything. We tried chemicals. We start with (abotrol), using the pawn shop type.? That worked fair, but not near good enough. We experimented with a product called curb, c-u-r-b. The only trouble with that was you go out and spray it on the grass, early in the morning before the dew left. Well it's awfully hard to spray five or six hundred acres before the dew dries. So that was a total waste of time. At that time the FAA closed the airport for all turbine pilot aircraft. That really did hurt the FBO's, the aviation services on the airport. We were, that was completely closed to that aircraft. And then we were able allow them to let us come in after dark and before sunrise. Then, they gave in a little bit more and the turbo props were allowed to come back. But the Lear jets, the straight jets were still banked. So we had to do something. So we, again with the help of the experts, we came up with a plan that worked fairly well. It worked well because we certainly had no more strikes, ...(inaudible,). We calculated how long it would take a starling to fly from the dump to the runway. We positioned a security officer between the dump and the edge of the runway, which helped. At the time a jet would get in the takeoff position and the security officer would call up to tower and tell them that the runway remained open, actually made a sweep of the runway, and then positioned himself at the center. Now this dump was different. Decalb Country wanted to do it differently. It was not in the

approach or departure. It was not off to the end of the runway, it was a little to the side. So we computed that the aircraft relative pass the central portion, where the birds would touch first, before the birds could get there for a collision. And the FAA bought it. And it worked fairly well, as a matter of fact were talking (?) County, we () that information, published everywhere we could possibly think of and tried (inaudible) jet pilots. And each one would come in and request plane . So it took some time, but it did work.

Right after the accident, I got lots of mail from all, from people I that didn't know, all over the country, and I guess, I guess they felt sorry for me. It was advice on how to get rid of..... (CASSETTE WAS TAPED OVER) on how to get rid of birds. One lady from Arkansas said she spread ice cream salt all over the airport. Another said use rubbing candles (?) snakes. One said you use dynamite, put dynamite out there, when they come back, blow 'em up. Another one said put wires out there, electric wires, when they light, electrocute 'em. I like those letters too. "Blow 'em up, "Electrocute 'em" , that all for capital punishment of starlings, (?) , and cow birds. Some of them were a little less ridiculous. One was, mix corn meal with water and put in alot of salt, spread that around. Another one was mix twenty five pounds of chicken feed with (?) , that'll keep them. (coughing). The other thing that I did not try, would've liked to have , but I couldn't find a falcon,

closer than (?), England, we did not, were not able to try falcons, and with the record of the Atlanta Falcons, I guess probably it's just as well too.

(laughter)

I'd like to close with some recommendations for particular airport managers. I'm sorry there're not more of us here. Don't do just one or two things. Do every single thing that you can think of and that the experts recommend. Even on an experimental basis, everything you do is going to help some. So let's push the engineers to design airports better. Let's get them to design where we don't have to have built in retention pockets. And that's (?) for both (?) areas. And to keep up the bird patrols. Keep them active and alert. As long as you don't have a bird strike, your people are doing a good job. So keep them out there for all the time that you possibly can. Insist that dumps not be allowed to be built closer than five miles to an airport. Insist that they're not to be built on any straight line between a pond, lake and a airport, or between two existing dumps. The FAA is trying to help us on that, but I think five thousand feet and ten thousand feet is too close. The last recommendation that I have is to call for help. You can get help from the fish and wildlife service, your state (?), If you've having political problems with it, get the ALPA, your air carrier or to the ALPA that you generally airport to help you. Get you FBO's, your airport tenants, and their pilots, let their voice be heard. Last but not least is independent

consultants. You know, commissioners and politicians, airport directors can tell them the same things that the consultants do, but they'll listen to consultants because they're from out of town. I have enjoyed being here and I'll be around if

END OF SPEAKER

(SPEAKER ANSWERING QUESTIONS)

APPENDIX 28

In the News: News Clippings and Comics

IN THE NEWS...

Toronto Star July 9 1995

Rod Stewart's jet forced down

GOTHENBURG, Sweden (Reuter) — A private jet carrying pop star Rod Stewart was forced to make an emergency landing shortly after takeoff early yesterday after a goose was sucked into one of its two engines, police said.

"It was bloody scary. We hadn't a clue what happened," the 50-year-old singer told Britain's News of the World tabloid.

Police said none of the nine people on board was hurt when the plane touched down with one of the engines shut down. It had been bound from Gothenburg for Luton, England.

THE LAST WORD

Radar system for the birds

A Canada goose, a really big one, can weigh in at nine to 10 kilograms and fly as fast as 80 kilometres an hour. An airplane, however, is a lot bigger and a lot faster.

Yet the computers that operate the radar systems at some American airports along bird migration routes can't tell the difference between feathers and metal. And when they try to process the geese as if they were airplanes, the computers crash, leaving air traffic controllers blind.

This happened last week at three U.S. airports in the Midwest and the details are a reminder that even the fanciest technology can be humbled by nature.

The computer boffins, you see, thought they had licked the problem of distinguishing between a Boeing 767 and

Branta canadensis maximus. Sure, radar signals echo from birds just as they do from planes but the experts dreamed up a special computer program to filter out the bird blips. But it failed and the radar systems at Des Moines, Omaha and Kansas City were knocked out. For hours.

Like computer people everywhere, the Americans have explanations.

Try this one — strong tailwinds meant the geese moved so fast they tricked the software. Or this — there were an awful lot of birds.

Usually are, during the fall. Geese fly a long way in a day too, hundreds of kilometres in a honking, V formation. Most people can tell them apart from airplanes, just by looking. Guess we're still smarter than computers.

Wing and a prayer

SAN FRANCISCO — A passenger alerted the crew of a football-sized hole in the wing of an American Airlines jet. The aircraft turned around and returned to San Francisco yesterday, an airline spokesman said.

Dave Wilson said the Boeing 767 aircraft, with 161 passengers on board, took off from San Francisco and was bound for Chicago. When a passenger noticed a hole, "a little bigger than a football" in the left wing.

He brought this to the crew's attention and the plane was turned around. Fire engines were on hand when it landed at San Francisco International Airport about 30 minutes after takeoff but there were no problems and no one was hurt, Mr. Wilson said.

He said technicians did not know what had caused the hole and were investigating. A hole in the wing is "very unusual," he added.

— Reuters

Poisoned pigeons may doom our urban peregrines

The best thing about the fact that endangered peregrine falcons are now nesting in downtown Toronto and Hamilton may be that the birds may not survive.

One young bird has already crashed into a building and later fell down an unused chimney but, then, young peregrines do tend to have low survival potential.

And, since you know I don't want to see endangered birds die, why would I suggest it's a good thing? Because, frankly, I don't know what else it would take to make us wake up to the threat and futility of pigeon poisoning.

In 1977, the Ontario Ministry of Natural Resources began re-

Nature Trail

HARRY KENT MACKAY



leasing peregrines into the environment in a variety of settings and locations, including ledges of tall buildings. In historic times, peregrines have chosen such nest sites.

Americans also released peregrines, although they were apparently less scrupulous than

Ontario about selecting birds as close as possible to the race that was the endangered form native to most of North America.

But, while the placement of baby peregrines into surrogate nests high on city skyscrapers was great for promoting the program and sponsoring non-governmental organizations, some of us were concerned about just how unsafe the city was for such birds.

Few summers go by without some local news story about poisoned pigeons. Avitrol (4-aminopyridine) is usually the agent used and we are almost invariably reassured that it's intended only to make pigeons a little ill, thereby chasing them away from where they're not

wanted.

In fact, Avitrol was developed to make blackbirds and starlings flop about and utter distress calls that chase the rest of the flock from croplands. Avitrol also causes pigeons to flop about and be disoriented (not unlike the falcon who crashed into the building) but pigeons simply don't have a distress call to utter.

Although Avitrol is apparently not licensed to kill birds, killing is the only way it can remove pigeons. Dosed birds can't make distress calls and thereby chase their companions. Overdoses are fatal and there's no way of controlling how much of the chemical the birds consume.

On June 27, the Ministry of

Natural Resources issued a "Pesticides Memorandum" asking that both Avitrol and Rid-a-bird (strychnine or fenthion) not be used near the peregrine nests in Toronto and Hamilton. The ministry's request has no authority.

The ministry is concerned about secondary poisoning, either indirectly, from consuming contaminated prey, or directly, by swallowing treated food within a captured pigeon's crop.

It's a concern I've been expressing for years, not only because I worry about endangered species, but I worry about all species. Many species of predator, and even people, eat city pigeons. We ought not to be poisoning those birds.

The greatest irony is that poisoning is only a cruel, stopgap solution, as well as a misuse of Avitrol. Pigeons removed leave space for more pigeons. That may guarantee future business for the pest control companies but progressive companies avoid poisons altogether and favor exclusion technology.

It's time for the federal government to ban strychnine and crack down on Boensing companies misusing Avitrol, although it will be a shame if it takes the deaths of peregrines to make that happen. Or will even that be enough to trigger action?

Nature Trail appears on Sundays.

No scarecrows

But A.C. airport does use weeds to help keep birds away

■ Birds are a threat to fliers' safety in that they can seriously damage planes in the air.

By DONALD WITTKOWSKI
Staff Writer

EGG HARBOR TOWNSHIP — Atlantic City International Airport appears to be in desperate need of some good gardening these days.

The airport grounds are dominated by towering weeds and grass that would choke even the best lawn tractor.

No, the maintenance crew hasn't been fired.

Airport officials are allowing the weeds to grow to discourage gulls and other birds from foraging for the Japanese beetles that are in abundant supply this time of year.

Each summer, flocks of birds congregate at the airport and present a danger to aircraft.

But the combination of high weeds, harassment tactics and shotgun blasts from government marksmen seems to be keeping the problem in check, airport officials say.

"In the last two years, we've had no gull strikes. And we've had only about 12 strikes a year involving smaller birds," said Thomas H. Hupf, environmental manager for the Federal Aviation Administration.

Midair collisions between birds and planes were more frequent here in previous years. That was before the FAA employed a broad bird-deterrent strategy.

"I don't think that it will ever be a complete success, because there are just too many variables. But I'm pleased with the results," said Richard Battaglia, FAA assistant airport manager.

Despite their relatively small size, birds can do great damage to aircraft — at times with deadly consequences.

Since 1972, 30 people have been killed nationwide in civil aviation accidents attributed to bird strikes, according to figures compiled by the National Transportation Safety Board.

A Concorde jet narrowly averted disaster in June when Canada geese were sucked into two

Birds:

Weeds serve in fowl fight

(Continued from Page B1)

engines and caused them to catch fire while the aircraft was landing at John F. Kennedy International Airport in New York.

Earlier this year, an F-16 fighter jet landing at the Atlantic City airport sustained \$2 million in damage when its engine was destroyed by a bird, Hupf said.

Bits of feather recovered from inside the engine were sent to an ornithologist at the Smithsonian Institution in Washington, D.C., and identified as those belonging to a black-bellied plover, a quail-sized shore bird.

Gulls and other birds come to the Atlantic City airport from their breeding grounds in the salt marshes of the Edwin B. Forsythe National Wildlife Refuge about five miles away in Galloway Township.

The birds are attracted by the huge summer population of Japanese beetles on the airport's sprawling grounds. Beetles are a tasty morsel for the adult gulls and their chicks waiting to be fed back at the nests.

Airport officials will not use insecticides to control the beetles for fear of contaminating an airport reservoir that is used as a secondary water supply for Atlantic City.

So instead, they have concentrated their efforts on making the airport as inhospitable as possible for the birds, particularly the aggressive laughing gulls that appear in large numbers.

"As the gulls have learned, this is not a nice place for them to be," Hupf said.

Sharpshooters from the U.S. Department of Agriculture have killed about 100 gulls so far this year for the FAA. Hupf said the figure is down significantly from the high of more than 800 birds killed in 1991 and 1992.

Battaglia said nonlethal harassment measures such as setting off fireworks are first used to try to scare the birds. He said they are killed only when there is no other alternative.

been approved by the U.S. Department of the Interior's Fish and Wildlife Service and the New Jersey Department of Environmental Protection's Division of Fish, Game and Wildlife.

No animal-rights or conservation groups have raised objections or filed lawsuits in an attempt to prevent birds from being shot at the Atlantic City airport, Hupf said.

Environmentalists have criticized the Port Authority of New York and New Jersey for killing thousands of gulls at the Kennedy airport, which is adjacent to breeding grounds in the Jamaica Bay Wildlife Refuge.

Pete Dunne, director of natural

history information for the New Jersey Audubon Society office in Cape May, expressed confidence that the FAA would not shoot birds unnecessarily.

"When other recourses are exhausted and human life is endangered, it seems sanctionable to me," Dunne said. "I'm sure this is being done judiciously."

The FAA has an awful lot of experience in this area."

Hupf noted that the Atlantic City airport has been the site of research programs exploring nonlethal ways to discourage birds from congregating here and at other airports.

Among the findings, researchers learned that birds generally

don't like to feed or settle in tall grass or weeds.

Armed with that knowledge, airport officials have allowed the grass and weeds to grow tall in large sections of the airport property. Cutting will not be done until the migratory birds begin leaving the area in September.



Peregrine falcons feed a pigeon to one of their chicks in a nest high above the Toronto office tower. They are the first peregrines to mate successfully in Ontario in more than 40 years. (BARRY BANFORD)

Peregrine falcons make city comeback

First chicks born in Ontario since 1950s

BY PETER WHELAN
Special to The Globe and Mail
Angered peregrine falcons raising chicks on office building ledges high over downtown Toronto and Hamilton, nesting in Southern Ontario for the first time in more than 40

Wildlife officials are to announce the nestings today after a month of protecting the birds with secrecy.

Missing peregrines disappeared from Ontario and much of the rest of North America in the

1950s and 1960s, after DDT and other pesticides building up in the environment disrupted their nesting. Infertility spread, and thinned egg shells broke under brooding females.

Since 1977, the Ontario Ministry of Natural Resources and the Canadian Wildlife Service have released more than 400 young peregrines in the province as part of a national recovery program. Up till now, the program has shown no apparent success.

Please see *Falcons* / A5

Falcons returning to urban cliffs

• From Page A1

Officials are exuberant. "The prognosis for peregrine falcons in Ontario appears promising," one environment official said. "There is now a small but expanding population that is producing young in acceptable numbers."

Office worker Mark Nash discovered the Toronto nesting in early May.

"I thought the usual pigeons and gulls were zooming around a lot outside. Then I looked up from my desk and... wow!"

Mr. Nash, once a falconer, recognized a peregrine circling office towers opposite the King Edward Hotel, just east of Toronto's old business centre at King and Yonge Streets.

Years ago, Mr. Nash was licensed to fly a red-tailed hawk — a family sedan of a bird compared to the lanky racer of the peregrine, the fastest creature in the world. It has been timed at more than 300 kilometres an hour in a dive on prey.

The falcons nested on a rooftop next to Mr. Nash's office. In fact, it was their second try. They had already laid an egg high on the Sheraton Centre Hotel opposite Toronto's City Hall, then deserted it when disturbed.

Biologist Peter Ewins of the Canadian Wildlife Service had monitored that aborted nesting, and followed them to the new site.

The sleek crow-sized, blue-backed birds with pointed wings and a black "mustache" mark usually nest on wild cliffs but adapt to the "cliffs" of city office towers with aplomb. The Toronto pair bred while a building across the street was being gutted and rebuilt into condominiums, and with a television pilot being filmed on the busy street below.

Peregrines live mainly on air. They chase and seize in flight. On a rooftop one afternoon, the darker male laid before his mate five dead and plucked birds and a black squirrel. He brought her city pigeon mourning doves and a duck as it brooded their eggs for five weeks on a metre deep ledge 20 floors over Bank of Montreal branch.

After the white-fluffed chicks hatched, the female increased her own hunting to help feed them. She perched on the green spire of nearby St. James Cathedral, flashing out to seize passing pigeons in puffs of feathers.

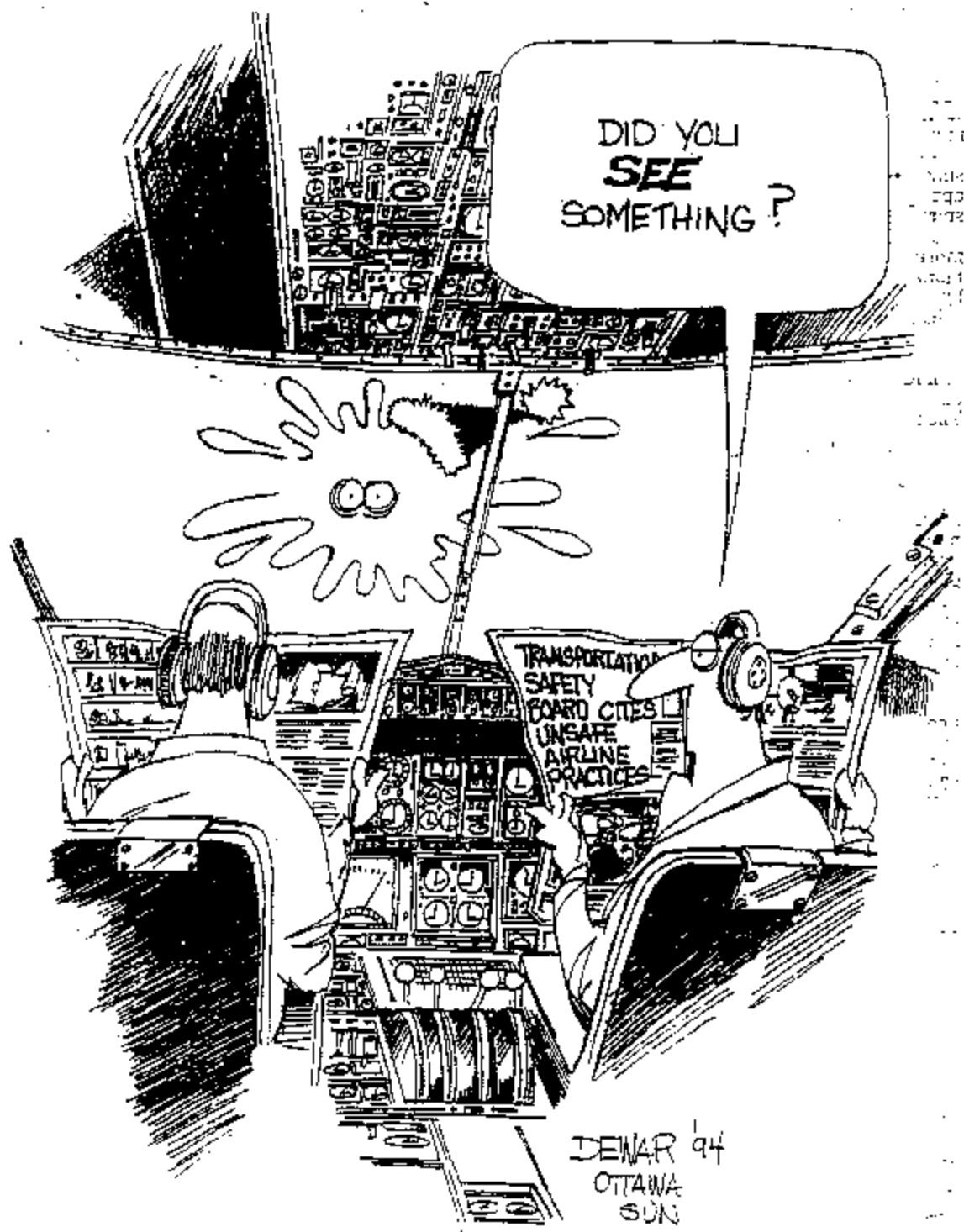
Mr. Nash and his office colleagues were enthralled, even though they could see only swooping and poaching falcons and not the nest.

"This is the experience of a lifetime — and right outside my window," he said. The chicks should first fly about July 5, after five weeks as fledglings.

The Toronto female, identified from the number on her leg band, came from one of three eggs laid on a river bridge in Philadelphia. U.S. wildlife officials hatched the egg in an incubator, and launched the chick from an artificial nest on a city building. This approach was adopted after early bridge-reared chicks drowned on their first shaky flights. A brother died last August colliding with an airplane at New York's La Guardia Airport.

The Hamilton nesters laid two eggs and are feeding chicks high on the Sheraton Connaught Hotel.

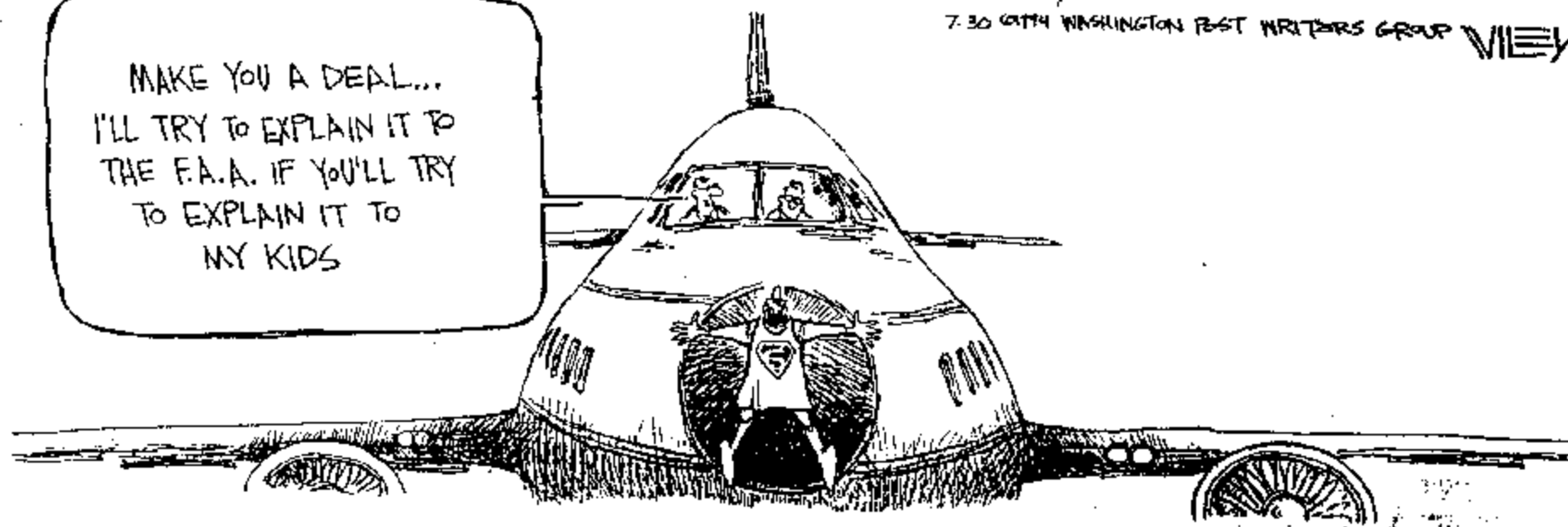
Peregrines are site-faithful. If they survive winter migration, they should return next spring to nest near the same spots.



Non Sequitur

MAKE YOU A DEAL...
I'LL TRY TO EXPLAIN IT TO
THE F.A.A. IF YOU'LL TRY
TO EXPLAIN IT TO
MY KIDS

7.30 WITH WASHINGTON POST WRITERS GROUP **VILEY**



BEATTIE BLVD.



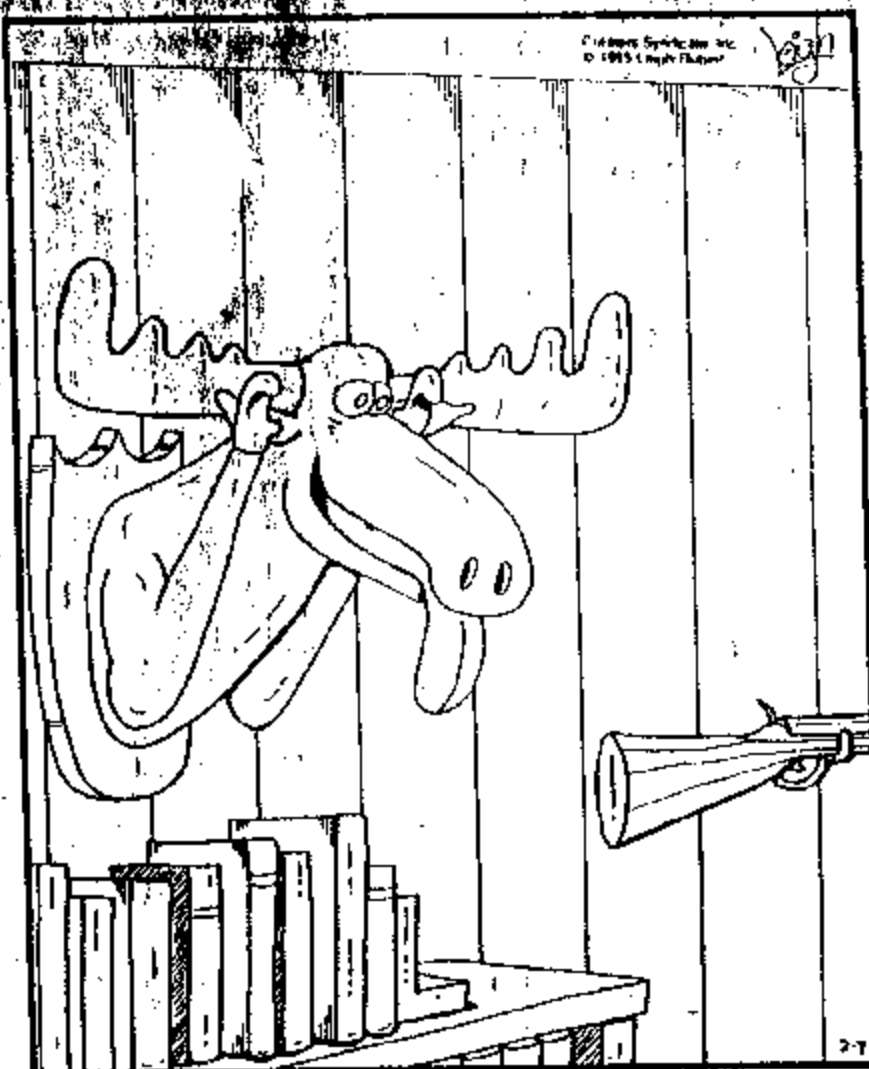
"Letting him land without the glove is
a mistake you make only once."

In The Bleachers



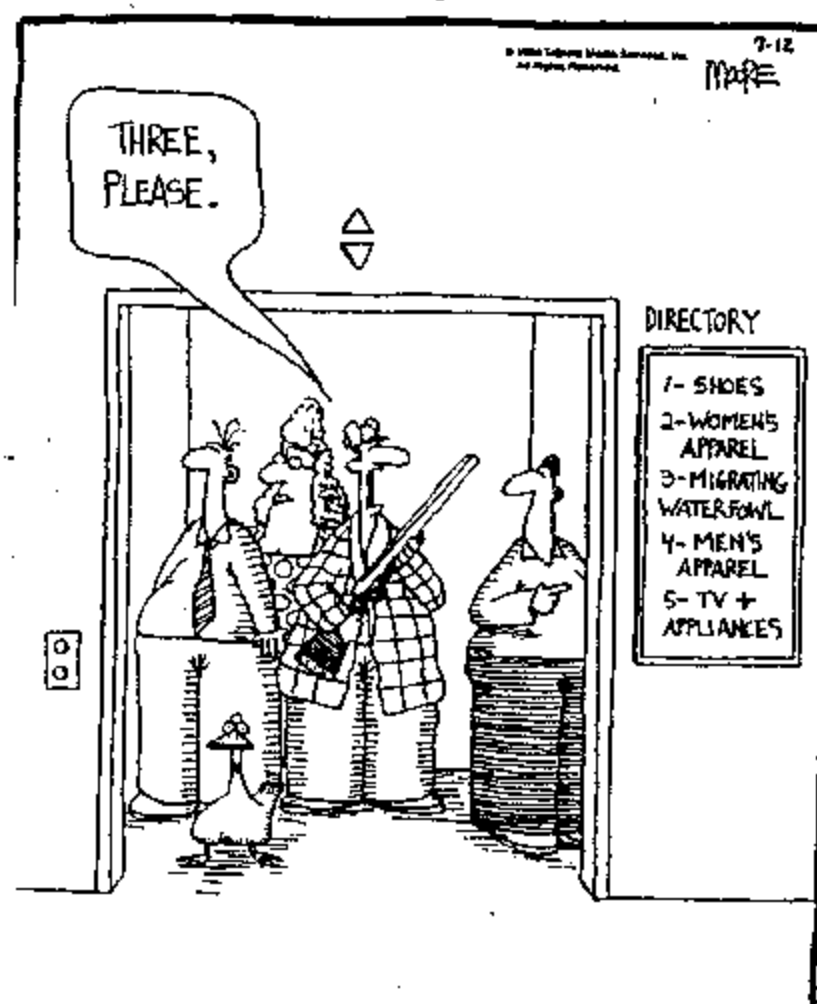
"The other arrows! The other arrows!!"

Rubes



As the end of hunting season approached,
Bernie's cockiness got the best of him.

In The Bleachers



Farcus

by David Waisglass.
Gordon Coulthart



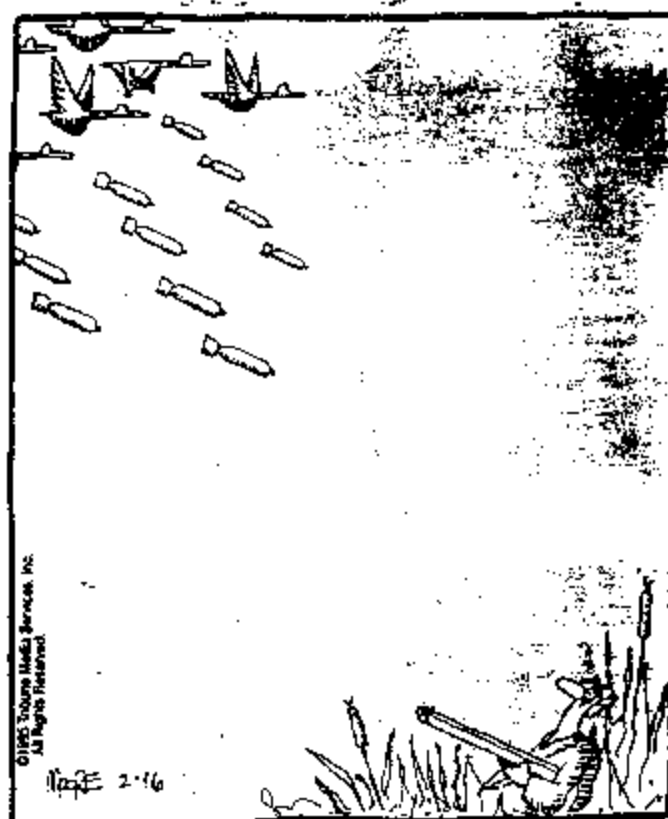
"I don't like it either, but
we have to evolve as a
species."

The Far Side



"It's a buzzard picnic, son — and you best remember to nary take a look inside one of them baskets."

In The Bleachers



BY GARY LARSON



"It's just a miracle you pulled through, George. ... Why, it was only a few hours ago the whole family was deliberating on whether or not to wring your neck."

In The Bleachers



"I hate this place...it always smells like something crawled in a locker and died."

The Far Side



"That's just not impressive, Doris. ... The brain! Hold up the big brain!"

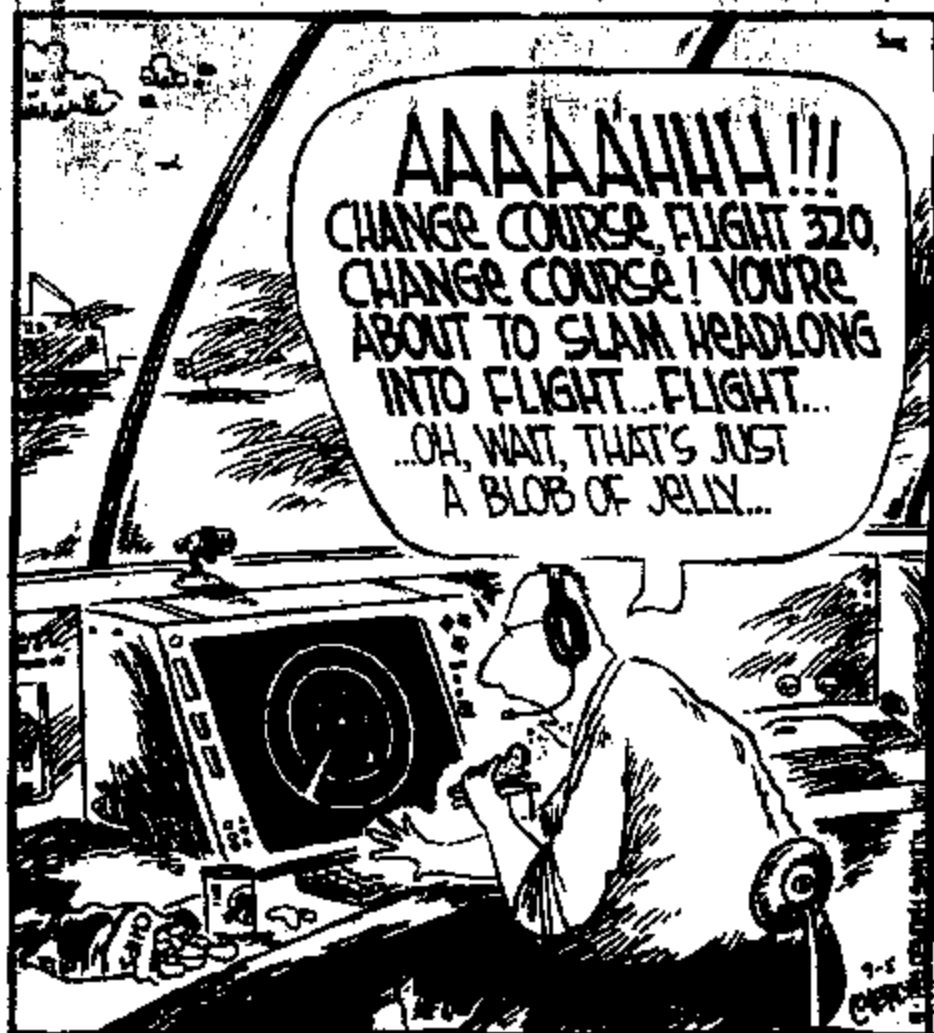
In The Bleachers



"That was fabulous. ... It's hard to believe we used to be vegetarians."

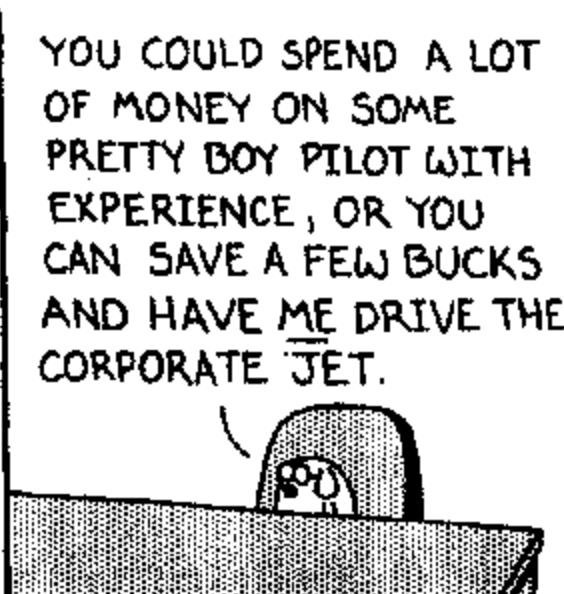
SPEED BUMP

By Dave Coverly

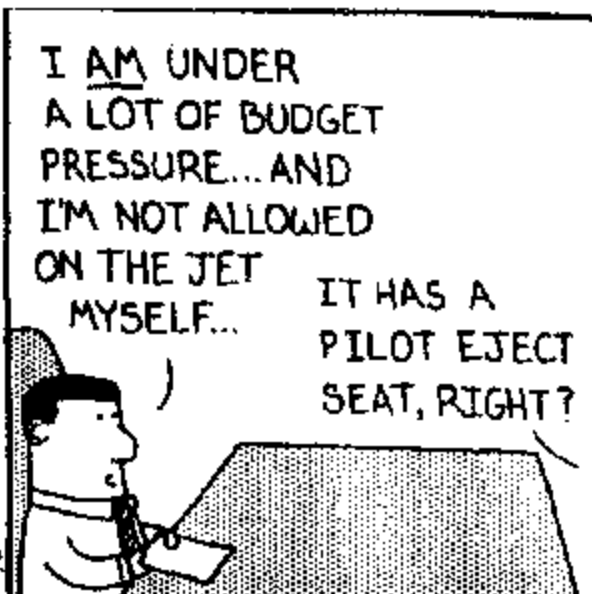




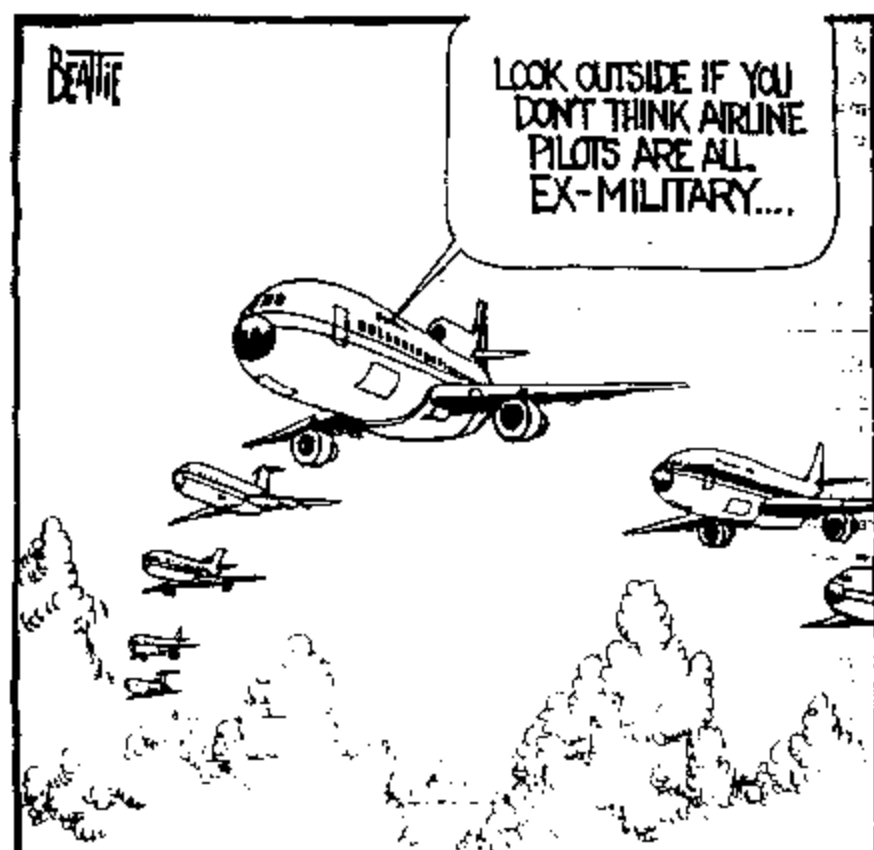
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BEATTIE BLVD.



APPENDIX 29

Bird Away

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BIRD-AWAY

OBJECTIVE:

Called "Bird-Away", this unique remote-controlled, air operated, semi-automatic firing mechanism discharges magnesium explosive blanks which emanates a loud blast for the purpose of clearing landing strips of birds and other menaces to permit safe aircraft landings.

DESIGN:

This firing mechanism (attached to a drone) is a unique piece of machinery in that it can be loaded and discharged while in flight by a remote control operator. The operator can direct the drone in the general direction of the unwanted birds then activates "Bird-Away" to propel the explosives out of the mechanism to explode at approximately 100-150 feet ahead of the drone. This action will emanate a gunshot blast which will in turn scare the birds away from the unwanted area without harm.

The main body of the unit measures 19 1/2" (49 1/2 cm) in length and 5" (12 1/2 cm) in height without the clip magazine. "Bird-Away" is comprised of the main body, a compressed air canister, piston, air release valve and a detachable clip magazine. The clips vary from 10 to 30 rounds of shells. "Bird-Away" can be attached to any remote control drone, rotating heat sensor, movement sensor or time-delay mechanisms.

PURPOSE:

The main purpose of "Bird-Away" is to clear airstrips for safe aircraft landings. By mounting "Bird-Away" on a drone, the operator can sweep festered airstrips while at a safe distance from the airstrips. The explosives are projected in a wide range direction of the birds or menaces to scare them "away" from the airstrip in order to permit safe aircraft landings, preventing costly damages to aircraft and unnecessary deaths.

- 2 -

"Bird Away" can complement any motion and heat-seeking movement sensor devices. In areas where bears, wolves, raccoons, etc... are unwanted, these devices can activate "Bird Away" to propel magnesium explosives to scare away unwanted pests without harm.

"Bird Away" can also be used for other unwanted farmer's pests such as deer, geese, fox etc., who damage spring seeds. "Bird Away" can be placed in an infested field and commanded by a timer to discharge magnesium explosive at specific time intervals.

Other useful purposes are combat war games for military practice where "Bird Away" can be amended to discharge colourful magnesium.

APPENDIX 30

Product Reviews, Summer 1995

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PRODUCT REVIEWS

To receive more information about a product, write the number at the end of its review on the reader service card in this issue, complete the card and mail to Airports North America.

RAMP RAT Dispenses Fuel



Ramp Rat is a modular self-contained fuel storage and dispensing system for fixed base operations. It consists of a 2,000 gal. UL 142 double-wall tank, skid mounted with integral pump, hose, nozzle, filter, meter and grounding reel.

Designed and built by refueling experts to meet industry standards, Ramp Rat has a lower installed cost than site built systems and is suitable for new and replacement systems.

Both surface and underground versions are available.

Tate Engineering Systems Inc.

Reader Service Card No. 265

GCA RADAR Improves Safety

GCA-2000 ground controlled approach radar has been developed to meet the needs of emerging low-intensity airport requirements for higher safety standards.

GCA 2000 is a cost effective way to meet present and future performance requirements. One portable system is ICAO compliant for both terminal area surveillance and precision controlled approach and offers superior height finding capability.



ties.

Proven, modern active array architecture simplifies operation and increases reliability and availability by an order of magnitude.

GCA-2000 involves very low life cycle costs, and all system components are backed by ITT's worldwide support network.

ITT Gilfillan

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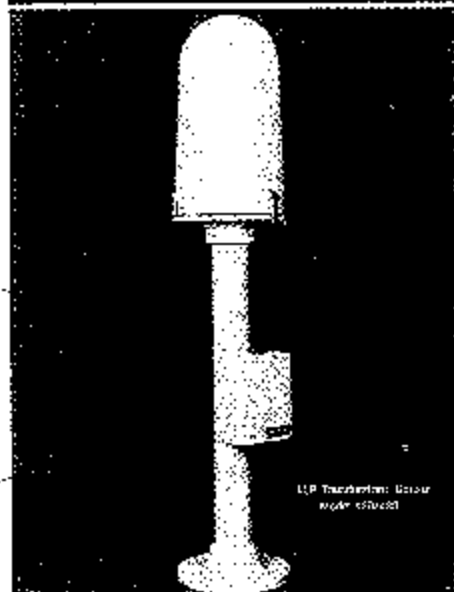
warble rate are adjustable for virtually any situation, making it difficult for birds to acclimate.

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Deltic Group

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PRODUCT REVIEWS

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APPENDIX 31

The Contents of Chinese Volumes...
from Bird Damage Control and Reduction in Aviation, China

bscc95.04

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November 15, 1995

Dear Dr. MacKinnon:

Thank you very much for your videos sent at 5 Meeting of BSC-USA, your letter dated August 18 and the Minutes of 22 Meeting of BSCC.

I apologize for replying you too late and could not attend the 23 Meeting of BSCC in November, but I congratulate the Meeting success and wish receive the minutes in the future.

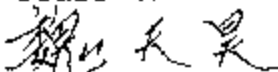
After the meeting I am dropping into a lots of public affairs and preparing for the project on Feasibility of Bird Strike Prevention at Chongqing Airport.

We are planing to translate or cite from English material into Chinese and edit a series of volume named BIRD DAMAGE CONTROL AND REDUCTION IN AVIATION. Right now, the first volume was completed and should be printed by Civil Aviation Administration of China. So, I write to you and through you to all relative authors for permissions to translate or cite from them.

Enclosed are contents of the Chinese volumes.

With best regards.

Yours sincerely



Wei, Tian-hao
Associate Professor
Secretary General of
Bird Strike And Prevention Committee,
China Ornithology Society

The Contents of Chinese Volumes into which translate or cite from English material:

Volume One:

1. J. Hild, 1984. Landscape Management on Airport for Reduction of Bird Populations (a leaflet from the author);
2. J. Hild, 1985. Suggestions for Provisions Against Birdstrikes on Some Asian Airports (a leaflet from the author);
3. J. Hild, 1985. Biotope Management for Bird Strike Control, Airport Forum, 1985, No.6 (a leaflet from the author);
4. C. Thomas, 1990. Bird Hazard Management At Manchester Airport, BSCE, 1990(20):549-552(a leaflet from author);
5. R. Kull, 1994. Staff Assistance to Bases for Bird Hazards, Minutes of 21 Meeting of BSCE, 1994:annex.24;
6. Transport Canada, 1995. Bird Avoidance (a brochure);
7. Allian, 1990. The Impact of a Lumbricide Treatment on Airfield Grassland, BSCE, 1990(20):531-542.

Volume two:

Bird Collision with Aircraft and the Prevention, which was as sample as Bird Hazards to Aircraft (Blokpoel, 1975), Clarke Irwin, enlarged and updated from working papers, proceedings, minutes, brochures and leaflets of BSCE, BSCE, BSCE BSCE-U and others.

Volume three:

Transport Canada Airports Group, 1994. Wildlife Control Procedure Manual (TP11500E, third edition).

APPENDIX 32

**John F. Kennedy International Airport Wildlife Management Plan
—December 19, 1995**

John F. Kennedy International Airport
Wildlife Management Plan

by Steven D. Garber, Ph.D.

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

December 19, 1995

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EXECUTIVE SUMMARY

JFK International Airport Wildlife Management Plan

Steven D. Garber, Ph.D.

The primary goals of the John F. Kennedy International Airport Wildlife Management Plan are to improve safety for everyone flying in and out of this airport. We are committed to accomplishing these goals in an ecologically sound manner, in such a way that enables us to have a net positive affect on the environment. In some cases, this will require the cooperation of other agencies, groups, and individuals. In particular, the National Park Service must take a stronger, more positive, regional approach to their stewardship ethic, and modify their policies so they benefit more people and birds than their current approach, that is often criticized as environmentally insensitive.

This premier airport is operated by the Port Authority of New York and New Jersey. It has 350,000 aircraft movements (landings and take-offs) per year. JFK is the fourth busiest cargo-handling airport in the world; it receives and ships 1.5 million tons of cargo per year. The airport was built in the most biologically productive environment in the New York-New Jersey-Connecticut region. As a significant part of the Hudson-Raritan estuary, annually the Jamaica Bay ecosystem receives millions of birds of approximately 300 species, many of which migrate through JFK's 10 square miles of airspace. With so many birds flying through the same airspace being used by hundreds of thousands of aircraft, the potential for collisions between birds and planes can and has led to aviation disasters.

Because bird strikes pose a significant threat to the flying public, the aviation industry has long been keenly aware of the dangers from just one bird being able to cause a jet crash. Congress passed laws requiring the Federal Aviation Administration to insure the proper management of airports so the better interests of the flying public are maintained. Included in the federal laws are provisions outlining what airports need to do to manage their bird strike problems. Because JFK is adjacent to a National Park, and because the Department of the Interior manages their property much differently than do airports, to date, the FAA has chosen work with both parties in an effort to help resolve the conflict.

The Port Authority complies with the laws, and has been the leader in creating techniques and technologies that insure the safety of its passengers. Being part of such a biologically rich sanctuary for wildlife provides many challenges to airport managers. The Port Authority officials have worked for decades with the National Park personnel to cooperatively manage the shared. The unique urban ecosystem that thrives under the National Park Service's stewardship is protected by their vigorous advocacy for the wildlife and habitats they oversee. This advocacy has led to many improvements: the number of species utilizing the Jamaica Bay area has increased since the National Park Service began managing the area and the number of breeding birds has been increasing through these decades spanning the 1970s, 1980s, and 1990s.

This advocacy has also led to many problems that create serious hazards for the flying public. Thousands of pairs of gulls nest on islands in the Jamaica Bay Wildlife Refuge. Three of these islands are immediately adjacent to JFK's runways, and located on these islands is the only breeding colony of laughing gulls (*Larus atricilla*) in all of New York State. This colony is a protected resource, which is valued both by the National Park Service and the State of New York's Department of Environmental Conservation. The protection of this colony has come at a very high cost, and ultimately, if this colony causes a plane crash, then the price will increase to the point where the colony becomes intolerable. Due to the colony's location, an unusually high number of laughing gulls has been involved in bird strikes, or collisions with aircraft, a reality that needs to be managed because bird strikes cause plane crashes.

As the direct result of the establishment of the laughing gull colony next to the airport less than 20 years ago (in 1979), the number of bird strikes at JFK doubled, which gave JFK the dubious distinction of being, with respect to bird-related hazards, the most likely to be the most dangerous airport in North America, if wildlife management procedures were not immediately initiated. JFK deployed rapidly to remedy the situation with increased emphasis on its wildlife management program. With the wildlife management procedures in place, 90% of the laughing gull strikes were eliminated. However, JFK has many bird-related hazards, so the airport continues to rank as North America's #1 airport, with respect to the number of bird strikes that occur as a percent of the number of plane movements. While JFK has been at the forefront of establishing bird hazard management procedures for airports around the world, it continues its all-out effort to minimize bird-related hazards. In fact, the Port Authority recently hired a full-time wildlife biologist in an effort to continue to improve the Port Authority's wildlife management initiatives. In particular, a great deal of effort has been devoted to dealing with the laughing gull situation which continues to represent a significant hazard to airport operations. However, the many biological and political issues that involve both nature and man, make a rapid solution unlikely. The issues involved require both short-term and long-term approaches if we are ever to solve the problems. To ameliorate the laughing gull situation, as well as manage all the other wildlife hazards at JFK, requires many simultaneous approaches, which are described below.

This wildlife management plan was prepared with the intent of using it in a comprehensive ecosystem management plan. This wildlife management plan continues to be written as we learn more about the JFK ecosystem. As new procedures are initiated, they will be added to this management plan which will be a matter of public record. We hope this document will assist wildlife managers, especially those working with bird-related hazards at JFK and other airports. The policies developed here and the issues that are being managed, are certainly to be of interest to a much wider audience. Many of us in the environmental community realize that problems such as those at JFK are being encountered to one extent or another by other agencies across the country and throughout the world. How we solve these problems here and now has bearing on more than just the natural resources we pass onto our children, but the solutions provided by us now will have bearing on how we choose to solve problems in the future. Rather than being locked into a perpetual series of conflicts with the many parties who represent say they are pro-nature and pro-environment, we challenge these citizens' and advocacy groups, public and private agencies, and federal, state, and city regulatory agencies to work with us to move the process forward so we can accomplish our goals. The issues are complex, but with care we can find solutions that follow sound policies

CHAPTER ONE

Wildlife Management Plan

Introduction

1994 marked another major episode in what has been decades of wildlife management challenges at JFK. In 1994 this environmental impact statement established the legal framework for a new series of initiatives regarding JFK's gull hazard reduction program. The primary gull hazard management activities requiring attention that were specified in the environmental impact statement's record of decision, were: 1) vegetation management, 2) insect control, 3.) solid waste management, 4) water retention management, 5) and other on-airport issues that address bird hazard management. When these initiatives are complied with to the satisfaction of the United States Fish and Wildlife Service, then JFK will receive an operational permit that will enable the airport personnel to use wildlife management techniques 12 months a year, as opposed to being constrained as we presently are.

This wildlife management plan has been prepared in an ongoing effort to improve our bird hazard management procedures at all of the airports we operate. In addition, full compliance with the National Environmental Policy Act requires documenting our management plan in accordance with the requirements of the environmental impact statement. When the Fish and Wildlife Service states in writing that we are in full compliance with the initiatives in the record of decision (for background related to records of decision we recommend Part 1505 of the National Environmental Policy Act which is cited in the references under Council on Environmental Quality), then we can

move forward toward our next series of goals involving relocating the laughing gull colony that is next to the airport.

This ecosystem management plan has been prepared as a document that continually receives additions and amendments, so our plans and documentation will benefit from countless modifications and improvements. We hope to learn from our efforts in creating this wildlife management plan, and fully intend to make the best use of the individual sections of this document. Each section will be based on initiatives taken at the airport, or will help shape initiatives we plan to take. In addition, if this management plan assists other wildlife managers, especially those working with bird-related hazards at JFK and other airports, that would be so much the better. The issues analyzed and policies that were developed and presented on these pages, will enable us to continually improve all management procedures at the airport that affect the ecosystem, which includes how we work with our human resources.

Problems analogous to ours at JFK are encountered by agencies throughout North America and in other countries around the world. How we solve these problems at JFK has bearing on more than just the natural resources we pass onto our children, but the solutions provided by us have bearing on how we choose to solve other environmentally sensitive safety-related problems in the future. It is our hope that we can work together to move beyond the current stalemate where all parties are locked in perpetual conflict. We at the Port Authority are totally committed to working with all the different publics represented by citizens and advocacy groups, public and private agencies, and by federal, state, and city regulatory agencies, to find sensible solutions that benefit all of us so we can move forward and continue to make progress with wildlife management issues.

This document was written to help us evaluate issues, establish policies, set plans into place, and effect changes that improve the overall quality of JFK's bird hazard management program. Each of the earlier dated versions of this document has been well-received by the people who work on ecosystem management issues at the Port Authority of New York and New Jersey's airports. In addition, this document has been reviewed by many representatives from federal, state, and city agencies who advise the Port Authority of New York and New Jersey on issues regarding our wildlife management program. Because this document states much of our program, it has proven to be very useful in our continuing dialogue. For the members of the Bird Hazard Task Force, this document will help shape decisions that continually need to be made. JFK's 10 square miles are all in the Borough of Queens, and adjacent to both Nassau County and the United States Department of the Interior National Park Service's Gateway National Recreation Area.

We manage one of the busiest airports in the world, where both planes and birds continue to fly safely. What we do affects one of the most important remaining wildlife habitats in the region. Few wild areas of the magnitude of the Jamaica Bay ecosystem survive in any urban environment the size of New York City. To properly manage the safety issues in concert with the many other considerations, involves working with many

parties, each of which weighs in throughout the continued process that have taken us to this point, and we hope to continue developing and improving our relationships with each of the members of the activist community who volunteer their time and effort toward the betterment of this airport and surrounding ecosystem. The governmental mandate we are putting in effect is complex, and much is at stake, however, and the progress we make toward this end benefits all of us, in that the airport will be a safer place, and its operations will be more environmentally sensitive, in that advice is being heeded and consensus achieved.

Others have said the wildlife management issues that have to be resolved here are the most complex and difficult in the world, and that solutions will not always be instantaneous, nor will consensus always be unanimous, but we are totally committed to the continued effort of always working toward achieving all our shared goals. This management plan is designed in part, to help anyone interested in mastering the complexity of issues, so they can become a responsible contributor, helping JFK achieve its goals. Internally, many people are involved in the day to day activities of bird hazard management, and for them, this document is a resource. It pulls together information that to date has been in many different locations, and it allows us, in an organized manner, to build on our cumulative knowledge so we can improve our ecosystem management techniques. In addition, the added value of this document is that it helps us respond to requests from the regulatory governmental agencies and members of the community who often request current status reports and updates concerning our wildlife management procedures. Now, we will be able to show what we are doing to anyone interested by submitting a current, accurate, and comprehensive wildlife management plan.

Port Authority of New York and New Jersey

The Port Authority of New York and New Jersey is the largest and oldest public planning agency in the United States (Walsh 1978). Its mission is to identify and meet the critical transportation infrastructure needs of the bistate region's businesses. Its functions encompass many tasks, but it is primarily a company involved in transportation-related issues affecting the greater New York metropolitan area, with its goal being to strengthen the economic competitiveness of the New York-New Jersey metropolitan region by providing links and access throughout the region to the rest of the world. The Port Authority operates the largest air terminal system in the world, which includes John F. Kennedy International Airport, LaGuardia Airport, and Newark International Airport; the most heavily used tunnels and bridges on earth which include the two Hudson River tunnels, Lincoln Tunnel and Holland Tunnel, and the George Washington Bridge; Manhattan's premier bus terminal named eponymously the Port Authority Bus Terminal, and the United States' largest containership port facility. It also operates the world's largest office complex, the World Trade Center, and it runs the Port Authority Trans-Hudson (PATH) system.

The Port Authority's facilities comprise 10 billion dollars in assets, most of which are located on thousands of acres of land that have been developed by the Port Authority. Many of these holdings comprise some of the most valuable urban wilds surviving in the New York metropolitan region. Port Authority also has considerable influence on the ocean habitats, nearby bays, rivers, estuarine environments, and adjacent areas in the region. These properties span the gamut from developed, partially natural, and in many cases, about as natural as you can get in this metropolitan area. In part, because of their vastness, and their biological richness, each contributes, affects, and interacts with New York and New Jersey's biological resources that comprise the basis of the region's economy. These resources also significantly contribute to the region's beauty and uniqueness. The Hudson River, New York Harbor, the New York Bight, and Jamaica Bay are just four of the biologically diverse and important features of the region with which the Port Authority interacts. The estuaries in the region are breeding grounds for a multimillion dollar fishing industry, as well as sport fishery. Boaters enjoy the regions waterways which are much cleaner now than just a few decades ago. Great strides have been made toward improvement of the region's air quality. With all this said, our airports are in the business of moving large numbers of aircraft, people, and tons of cargo. The New York metropolitan area depends on the efficient operation of their airport facilities, of which, JFK is the #1 revenue producer of all of the Port Authority's facilities thanks in part to its efficient and effective management (Kelly 1995).

More than one million aircraft movements are handled annually by the Port Authority's airports. In addition to operating the largest air terminal system in the world which moves approximately 80 million people a year. All this is done without taxing the public; Port Authority has financed the services and infrastructure it provides through revenues and profits it generates, unlike other government entities. The Port Authority operates within an enormous urban area, the greater New York metropolitan region, with roughly 20 million inhabitants. Within this conurbation is a complex web of governments and public agencies, including nearly two dozen counties, 500 municipalities, and thousands of special districts (Warf 1988). No governmental unit except the Port Authority has a jurisdictional encompassing the entire New York metropolitan region. The Regional Plan Association reviews policies for the region but lacks sufficient money and power to enforce them. The Urban Development Corporation in New York and the Economic Development Administration in New Jersey are confined to jurisdictions within their respective states, but the Port Authority alone deals with regional issues and it has the resources to shape the local developmental patterns. In fact, this is one of the reasons the Port Authority was formed in 1921. The compact that was originally signed entrusted the Port Authority with the development of the transportation facilities around the port of New York and with the promotion of trade within the 3,900 square mile area within a 25 mile radius of the Statue of Liberty in New York Harbor.

In its 74 years, Port Authority has been one of the major contributors to the vitality and economy of the New York metropolitan area. Port Authority has creatively responded to the many needs of the governors of New York and New Jersey, as well as to the mayor of New York City, the city's five borough presidents, and approximately 30 million

residents of the region. The needs have largely been related to the Port of New York and to transportation issues, although Port Authority has been flexible and responded as a master builder of huge complex undertakings when the need existed. In all, Port Authority has oversight over more of the natural environment in the New York City region than any other private or public entity. More and more the Port Authority's environmental stewardship has been in step with the public's changing attitudes. Increasingly, attempts to solve certain environmental problems are being approached with the same foresight, vision, and sensitivity that the company has shown through its nearly eight decades of problem solving.

Port Authority Airports

The economic impact of the aviation industry on the New York/New Jersey region was analyzed and reported by the former Economic Impacts Division and the Customer and Marketing Services Division of the Port Authority of New York and New Jersey (as reported in September/October 1995 Customer and Marketing Services Report of the Port Authority of New York and New Jersey). Aviation operations, airport construction, and tourism account for 380,270 jobs, \$11.8 billion in wages, \$36.4 billion in sales, \$1.1 billion in taxes, and about 4.2% of the gross regional product.

In addition to Teterboro Airport in New Jersey that handles most of the private plane traffic in the New York City metropolitan area, Port Authority also operates the three major commercial airports in the area: John F. Kennedy International (JFK), LaGuardia (LGA), and Newark International (EWR) airports. Passenger traffic at these three airports during 1994 increased to 77.6 million, of which 57 million were domestic passengers and 20.8 million were international. JFK's share was 28.8 million passengers, EWR was 28 million, and LGA was 20.7 million passengers. Total cargo tonnage also increased to 2.4 million tons. The relatively slow growth of the New York region is benefiting from the more rapid growth of Port Authority's traffic. Henry Raimondo, Port Authority's chief economist, predicted the overall economic growth rate of the New York metropolitan region in 1995 will be 0.6 percent, and the annual growth rates over the next few years will range from 0.6 to 1.0 percent (Abrams 1995). Yet, domestic traffic at Port Authority's airports have grown at a rate of 4 percent in the first quarter of 1995 and by 2 percent in the second quarter, and international traffic at the Port Authority airports continued to grow by almost 8% during both quarters.

New York City's John F. Kennedy International Airport is one of the busiest airports in the world. Of the over 1.1 million planes that land and take-off at JFK, LGA, and EWR each year, approximately one-third, depart and land at JFK. JFK's on-site businesses generate 77,400 jobs, and almost \$2.1 billion in wages and salaries each year. Off-airport activities generate another \$8.6 billion in sales, \$2.7 billion in wages and salaries, and 96,000 jobs (Pita 1994).

JFK comprises more than 5,000 acres, an area equivalent in size to all of Manhattan from 42nd Street south to the Battery. EWR comprises 2,000 acres, and additional acquisitions are being made. LGA is the smallest of the three airports, which is why it cannot handle the big bodies, the largest planes that comprise much of the international traffic, such as Boeing 747s. LGA is small, very busy, and its traffic is dependable and predictable, which allows it to be run very efficiently. Newark and JFK are the two airports that continue to accommodate the increasing traffic in the region.

Our rapidly increasing volume of air traffic means we will have to do even more to manage what would otherwise be translated into a greater risk from bird strikes. The bird strike risk has been compounded by growing numbers of certain species. In 1995 the number of waterfowl migrating south increased by 17 percent from one year earlier, and this is an increase of 39 percent from two years earlier. The Fish and Wildlife Service places the 1995 waterfowl migration from the middle part of North America at 83,000,000 ducks, most of which move south, many by way of the coasts, just as soon as the ponds in the heartland freeze over. This is 12,000,000 more ducks than 1994, and 23,000,000 more than 1993 (Stevens 1995). Just for comparison, since there are not many current estimates of the number of migrating birds passing through a given area, and there are even fewer estimates made with the specified purpose of predicting bird strike risks, 500,000,000 birds of over 100 species pass through Israel during their annual migration to Africa from Europe and Asia. As recently as August 10, 1995 Israel lost a jet and those aboard due to a stork that was ingested into an engine (Lewis 1995).

Commercial airports are usually located near cities and the increasing number of gulls around many cities has caused problems at nearby airports. Flocks of gulls and other birds endanger aircraft, causing from \$25 to \$40 million in damage to commercial aircraft in the United States each year (Garber 1987). The most serious accidents occur when the birds get sucked into a jet's turbine engines, choking the turbine and ruining the engine. The problem is so serious that at about 25 airports, full-time bird control units have been hired to harass the birds on the runway and nearby to reduce the number of bird-plane collisions (Garber 1987). Of these three airports, only JFK is next to a National Park. It is immediately adjacent to the United States Department of the Interior's National Park Service's Gateway National Recreation Area. The Unit of this National Park that is next to JFK is the Jamaica Bay Wildlife Refuge. Within the refuge are 650 acres of salt marsh immediately adjacent to one of JFK's runways. Thousands of gulls nest on this saltmarsh, and this has led to many bird-related problems at the airport. JFK has always been in the forefront of the aviation industry when dealing with bird problems. But as is the case with many public issues, JFK has not always been able to avoid controversy. Controversy generates feedback, and we at JFK have improved our operations as we continue to evaluate our performance, as well as the feedback we receive about our performance.

Bird-Related Crashes

Performance at an airport is evaluated many ways. For those of us involved with ecosystem management at airports, our successes are not always easy to evaluate. It has been almost 50 years since April 17, 1947, when the Port Authority of New York and New Jersey began to operate JFK. During this time thousands of bird-strikes have occurred. From the records we have kept and analyzed, we have been able to determine what wildlife management strategies work, and which ones are not as effective. We have generated the most complete bird strike data set from any airport in the world. This airport is the fourth busiest cargo carrying, general aviation, and commercial airlines servicing airport in the world. We have unique problems, being located on a rich estuary that is protected as a wildlife sanctuary by the National Park Service. But these problems are issues that we have worked to manage. Overall, the aviation industry has recognized the fact that JFK has effectively decreased the risk from bird strikes. We had three landfills surrounding the airport shut down, we support a well-trained, professional Bird Control Unit that keeps birds off the runways. Our track record speaks for itself, however many people, who do not see the danger from bird strikes, need proof. Therefore, we have been working to document more than just the risk from bird strikes at JFK, but the risk to anyone who flies, and we hope to show that our combined efforts are making flying safer for all of us.

To my knowledge there is not a current, comprehensive listing documenting bird strike incidents and accidents that have occurred worldwide, nor is there a more local listing for just the United States and Canada. Also, to my knowledge there is not a comprehensive listing of airports showing the number of bird strikes per 10,000 aircraft movements, which would be useful when evaluating the relative risk of bird strikes at each airport. Nor is there a listing of airports with the equivalent of a bird control unit, and those without. All of the above, tabulated and kept current on an annual basis, would be very helpful to those of us in the industry who are working to improve our methods.

The involvement of general aviation, military, and commercial aircraft in the considerable number of incidents justifies the continued efforts of the aviation industry to reduce the risks involved. The aircraft industry, engine manufacturers, commercial carriers, the FAA, Transport Canada, and the airports all work to minimize the risks attributed to bird hazards. In the United States the Federal Aviation Administration requires airports, whenever necessary, to manage their bird strike problems. Many airports operate full-time bird control units who are responsible for keeping birds off the runways and out of harm's way. The extent to which these efforts are effective has not been analyzed, so utilizing data provided by All Nippon Airways (1992) that compared bird strike frequencies at airports with the equivalent of JFK's Bird Control Unit to airports without bird patrols, I found a statistically significant difference between the two samples. Airports that engage in measures to reduce the number of bird strikes, such as the efforts taken at JFK, substantially reduce the risk of bird strikes.

In addition to requiring airports with bird problems to develop plans to reduce bird hazards, the FAA has required engine manufacturers producing engines to have them all certified under stringent airworthiness standards (i.e. those of Change 1 of October 31, 1974, or Change 5 of March 26, 1984, to Part 33 of the Federal Aviation Regulations). Both contain the requirement that an engine having inlet area greater than 3900 square inches continue to operate with 75 percent power and under specified conditions of safety upon the ingestion of a flock of eight 1.5 pound birds. Recently, the Federal Aviation Administration has considered new standards that would include birds heavier than 1.5 pounds in this "medium bird" certification test (Banilower 1995). Pratt and Whitney engines models JF9D-7Q, JT9D-59A, JF9D-70A, JF9D-7R4, PW2000, and PW4000 have inlet throat areas larger than 3900 square inches and therefore require an eight-bird "medium bird" certification test. Two engines produced by General Electric that also fit this category include: General Electric's CF6-80A and CF6-80C2, and the following four engines produced by Rolls Royce also fit this category: RB211-5335C, RB211-535E4, RB211-524G, and RB211-524H. Because both International Aero Engine's V2500 and CFM International's CFM56 have inlet areas that are smaller than 3900 square inches, the standards by which they were determined to pass involve seven 1.5 pound birds, and International Aero Engine's V2500-A1 requires six 1.6 pound birds (Banilower 1995).

Certification standards, although not yet finalized, have been distributed to the Boeing 777 engine manufacturers, which include Pratt and Whitney, General Electric, and Rolls Royce. Unlike the Boeing 747, that has four engines, each with a six foot inlet throat diameter, the Boeing 777 has two engines, each with a 12 foot diameter. Partially because aircraft with two engines are more vulnerable to bird strike hazards than four engine aircraft, it is expected that the specifications for the Boeing 777 aircraft will be more demanding than that for the Boeing 747 engines. Pratt and Whitney, has been building PW4098 engines for the Boeing 777 that can survive the ingestion of either an eight pound bird or four two pound birds (for flock simulation) (Hexter 1995). However, one needs to remember that many jets being flown today were designed with engines that did not have to meet the eight bird minimum. Even an eight bird minimum is not a guarantee, but it is a tremendous improvement. Eight gulls, which are medium-sized birds, rarely, if ever, are simultaneously ingested into a single engine; the number is usually less. But the possibility always exists, especially in areas where large numbers of gulls regularly fly near or over an airport. Many species exceed the medium-sized bird category, such as swans, geese, eagles, and vultures, and no engine has ever been designed to withstand such bird-strikes. It should also be emphasized that herring gulls, which are one of the most common birds to be ingested into aircraft engines at JFK, routinely weigh 2.5 pounds and over, and as recently as October 21, 1995, a Boeing 747 taking off at JFK ingested one or more herring gulls into a single engine, which caused sufficient damage to cause that plane to dump 35,000 pounds of fuel over the water before returning to JFK to land. However, not all aircraft have enough thrust after ingesting birds to return to an airport safely.

On October 4, 1960, when a Lockheed Electra was taking off from Boston's Logan International Airport, it passed through a flock of starlings and an engine ingested a

sufficient number of birds to cause the plane to crash; 62 of the 72 passengers on board died. In addition there were 9 serious injuries. July 13, 1962 a Douglas DC3 hit a vulture over Lahore, Pennsylvania. The windscreen was the point of impact, and the plane went down. Three people were on board, one of the passengers died in the crash. November 23, 1962 a Vickers Viscount over Ellicott City, Maryland struck two whistling swans; the plane crashed and all 17 people aboard died. The swans hit the tailplane. In 1963 a Beechcraft hit a loon near Bakersfield, California; two men died. July 28, 1968 a Falcon 20 over Lake Erie ingested gulls into its engines and the plane went down. Three people were aboard, and luckily they survived. February 26, 1969 a Douglas DC3 at Khar, Ambadu struck cranes (*Grus* sp.). The plane crashed and the four people aboard survived. February 26, 1973 a Lear 24 at Atlanta, Georgia struck cowbirds, which were ingested into the engines. All seven people aboard died. December 12, 1973 a Falcon 20 in Norwich, United Kingdom ingested gulls into its engines and the plane crashed; no one was hurt. In 1974 a police helicopter in Mineola, New York hit gulls and one man died, three others were critically injured. October 16, 1974 a Cessna Citation in New Haven, Connecticut ingested gulls into its engines and the plane crashed; no one was hurt. June 14, 1975 an NA265 Sabreliner in Watertown, Wisconsin ingested a Franklin's gull into an engine and it crashed; of the 6 people aboard, everyone lived, however, 3 were seriously injured. November 12, 1975 a DC10 taking off at John F. Kennedy International Airport in New York City struck great black-backed, ring-billed, and herring gulls. The plane caught fire and burned for several days; of the 139 people aboard, everyone got out alive and only 2 were seriously injured. November 20, 1975 an HS125 in Dunsfold, United Kingdom ingested lapwings into its engines. Because of the crash, there were 6 third party deaths. February 6, 1976 a Lear 24 in Bari, Italy ingested gulls into its engines. The plane crashed, everyone got out alive. November 12, 1976 a Falcon 20 in Naples, Florida ingested ring-billed gulls into its engines and of the 11 people aboard, all were seriously injured.

Bird Strikes

Bird strike data are kept in two subcategories at JFK. There are: 1) reported bird strikes and 2) unreported bird strikes. Reported bird strikes are those reported by either the pilot or the tower. It's a fine line that determines whether the pilot or the tower reports the strike. Sometimes the pilot reports the strike to airport operations, other times the pilot reports the bird strike to the tower and the tower reports the strike to operations. Regardless of who it is who gets the report to operations, the strike goes into the log as a reported bird strike. We then look for the bird on the airfield. Sometimes the entire bird or just some remains are found on or near the runway. If the plane landed at JFK, we also go to where the plane went when it landed, to see if any of the bird's remains are left either on the plane, or in an engine. These are collected, reported, and logged. If the remains are questionable or unidentifiable, we send the feathers to Carla Dove at the Smithsonian Institution, where they are identified. If the Smithsonian is unable to identify the feathers, Henri Ouellet, and independent contractor, will do it with electrophoresis.

Unreported bird strikes are those that go unreported by both the pilot and the tower, but are logged. We know about these birds because their remains are found within 250 feet of the centerline of the runway. A runway is 150 wide from the centerline to the runway lights on either side. Any dead bird found either on the runway or along its edge is also recorded. This helps provide a long-term data set which is used as part of an index, telling wildlife managers much about the habits of the birds on the airport. Most of these dead birds, it is assumed, died as a direct result of being injured from an aircraft or turbulence.

Recent Bird Strike Incidents (adapted from MacKinnon 1995):

June 17, 1993 a Boeing 737 Canadian Flight 661, departing from Calgary for Alberta, carrying 110 passengers and 6 crew, struck a large number of gulls on runway 34. Number 1 engine was destroyed and number 2 engine was severely damaged, requiring the aircraft's pilot to make an emergency landing; there were no injuries.

November 18, 1993 a Piper Navajo on approach to YVR struck a snow goose and penetrated the windshield, incapacitating the pilot. The copilot landed the aircraft safely.

January 20, 1994 a Falcon 20 departing Le Bourget, struck lapwings. Uncontained engine failure resulted in a fire and the aircraft crashed short of runway; 10 people were killed.

February 24, 1994 a Piper PA-28-140 crashed in Lake Ontario causing one fatality. It was thought that the cause was a gull penetrating the windshield and incapacitating the pilot.

May 7, 1994, Canadian Airlines Boeing 737-200 struck a barn owl at Palm Springs, California, damaging one engine. The pilot safely landed, the engine had to be replaced, and passengers had to be housed while a replacement aircraft was located.

June 18, 1994 a Cessna Conquest departing from Fort Frances, Ontario struck gulls and damaged left engine, requiring a crash landing near the end of the runway; there were no injuries.

June 23, 1994 a Sandspit B.C.-DeHavilland Beaver crashed, causing two fatalities. TSB report identified possible bird avoidance by pilot caused the crash.

November 3, 1994 an E120 struck what was termed a possible Canada goose at Washington Dulles International Airport at night; the airline reported damage.

November 18, 1994 a Cessna 441 on approach to Inverness struck four geese, and landed safely.

November 1994 a Jetstream 31 departing Peterborough, Ontario struck a large number of gulls, requiring the pilot to abort takeoff after the aircraft departed from the end of the runway; no one was injured.

December 22, 1994 a TWA Boeing 727 struck a goose, destroyed its nose cone, and safely landed in Tampa, Florida; there were no injuries.

April 16, 1995 a Bell 222 Helicopter in London, Ontario struck a bird at 1,000 feet. The bird penetrated the windshield, and the pilot, who was wearing a helmet with his visor, had obscured vision, but was able to land safely.

May 6, 1995 a Bell 206 Jet Ranger helicopter RCMP struck a western grebe at 1,200 feet. The bird penetrated the windscreen, struck the pilot in the face. The pilot, who was wearing a helmet with a visor, was disoriented, but able to safely land the helicopter.

June 3, 1995 an Air France Concorde landing at JFK struck Canada geese, destroying engines 3 and 4, which caught fire and were shut down. The aircraft landed safely, no one was injured.

July 1995 a corporate jet carrying Rod Steward in Gothenburg, Sweden struck a goose, causing damage to one engine. An emergency landing was required, there were no injuries.

September 14, 1995 a Boeing 757 landing at Washington Dulles International Airport in Herndon, Virginia struck 10 Canada geese at 7:30PM. The multiple strike damaged both engines, both wings, and the radome; no one was hurt.

September 15, 1995 a Boeing 707 AWACS aircraft crashed shortly after taking off from Elmendorf Air Force Base in Alaska. It struck Canada geese at the end of the runway as the plane was taking off. 31 dead geese were found at the end of the runway, microscopic samples of Canada goose feathers were identified from both left engines, which were destroyed. All 24 people in the plane died.

September 25, 1995 a corporate jet carrying Newt Gingrich struck 2 Canada geese when departing from Mackinac Island, Michigan. The pilot aborted takeoff, the aircraft came to a halt 30 feet past the end of the runway, and no one was injured.

October 23, 1995 an Evergreen Boeing 747 was departing from JFK at 8:00AM on runway 13R when the pilot saw several gulls fly across the front of the aircraft, then he heard and felt a thump; the aircraft struck a herring gull, damaging the #2 engine, which was then shut down. Before returning to JFK to land, the plane dropped 35,000 pounds of jet fuel over the water. No one was hurt and the engine had to be replaced.

November 6, 1995 at 4:52AM a China Air Boeing 747 departed from JFK enroute to Anchorage, Alaska. The plane was carrying 100,000 pounds of fuel. The #4 engine developed a problem shortly after take-off; the engine was shut down, fuel was dumped, and the aircraft returned to JFK. We are currently investigating this incident to determine if birds were involved.

Bird Strike History at JFK

It was not long after people started to fly in aircraft using the same skies that birds had been safely using for millions of years, that humans first began to suffer from in-air collisions with birds. In 1912 the national hero, Galbraith P. Rogers, who had just completed a record breaking transcontinental flight across the United States, and who had probably flown more miles than any other person of his time, was demonstrating his flying expertise in Long Beach, California in front of a crowd in a Model EX Wright Pusher when his plane collided with a gull. His plane crashed in the ocean and Rogers died (Federal Aviation Administration 1989). Planes and birds have continued to collide ever since, and due to the high speeds involved, and the intricacies of modern jet engines, birds as small as cowbirds or starlings are sufficient to bring down aircraft. Most bird strikes cause little to no damage, but they all have the capacity to cause major disasters, and for this reason the problem needs to be addressed very seriously.

The airport discussed in this document, which was Idlewild and since has become John F. Kennedy International Airport, became the responsibility of the Port Authority of New York and New Jersey on April 17, 1947 when, with the consent of Congress, New York City and the Port Authority of New York and New Jersey agreed that Port Authority of New York and New Jersey would improve JFK, LaGuardia Airport, and Floyd Bennett Field, at its own expense (City of New York and The Port of New York Authority, 1947). The aviation system that this bistate authority created was to be developed, operated, and maintained by Port Authority and at the expense of Port Authority. At the time of this agreement, the United States Government had just turned over certain military properties to the City of New York. Idlewild and Floyd Bennett Field were both United States airfields, and the properties between them that were also owned by the United States Military, were turned over to New York City. New York City in turn entered into the above agreement with the Port Authority with the airfields, and the City intended to turn the rest of the property into a park.

With the advent of modern jet-propelled aircraft, it didn't take long for Port Authority to realize that both Idlewild and Floyd Bennett Field could not be developed properly so nearby one another. The decision was made to turn Floyd Bennett Field back to New York City, and then in the early 1970s New York City turned their parklands in the Jamaica Bay region over the National Park Service. It has always been the intention of the City to maximize benefit from its public properties at the least cost. This way, New York City taxpayers got a park, but the federal government operated and maintained it at

their own expense. Likewise, New York City got all the benefits of a major airport, while it was the Port Authority that developed, operated, and maintained it, without ever levying a single tax on the citizens of either New York or New Jersey (Smith 1969). Connecticut was invited to be part of the Port Authority; some people believe that their having declined explains why Connecticut never built the expensive infrastructure that would have given them the benefits of world class ports, bridges, and tunnels.

JFK had bird-related problems from the beginning (United States Department of the Interior, 1976). The airport, which is surrounded by water on three sides (Jamaica Bay, Thurston Basin, and Bergen Basin) was built from dredge spoils that were taken from Jamaica Bay and placed on salt marshes. Although the habitat was altered, it wasn't destroyed. If anything, the new habitats were more useful to some species that could no longer find adequate foraging and nesting areas in the highly urbanized surroundings. When the airport was first built it was located approximately 15 miles from downtown Manhattan, far from civilization. Without many people nearby to object to an airport, it was easy to locate landfills and sewage treatment plants in the vicinity as well. Such land uses might have been appropriate at the time, but it soon became apparent that the large numbers of birds attracted to the landfills were creating a hazard at the airport. This was a disaster just waiting to happen. With so many gulls in the area it was a matter of time before a plane struck birds in just the wrong way, creating sufficient damage to the engines that lives were going to be lost. Luckily, no one was hurt in the disaster that got everyone's attention, and since then the bird problem has been taken with the highest level of seriousness.

This bird-related incident occurred on November 12, 1975 when an Overseas National Airways (ONA) DC-10 was taking off at JFK. Before becoming airborne the plane struck gulls which led to an engine explosion and the take-off was aborted. The pilot stopped the plane at the end of the runway and where all the 139 people escaped unharmed. Everyone aboard the plane worked for the airline and had training to escape planes in the event of an incident. The plane burned for two days before it was finally put out.

The ONA accident was one of many bird-related near disasters at JFK, however, due to the fact that a plane burning for days made all the media, the severity of the problem needed to be dealt with. The situation was studied while the birds continued to fly over the airport, until the appropriate city agencies with important regulatory oversight helped solve certain related problems. None of these changes occurred instantaneously. First, the Federal Aviation Administration requested the United States Fish and Wildlife Service to conduct an ecological study of the bird hazards at JFK. That report contributed to the eventual shut down of both nearby landfills, which helped alleviate some bird-related problems at the airport.

CHAPTER TWO

Legal Environment

Congress Establishes Airport Requirements for Bird Hazard Reduction

The Act of Congress passed on March 2, 1931 (46 Stat. 1468; 7 United States Congressional Record 426-426B) authorized and directed the United States Fish and Wildlife Service to establish cooperative programs concerning bird hazards with federal agencies in an effort to improve passenger safety on aircraft. Congress passed the Federal Aviation Act of 1958 (49 United States Congressional Record 1429) which under Section 609 established specific requirements for airports with bird problems to create bird hazard reduction programs. Recognizing the need to provide technical assistance to many airports, the FWS began to do address the problem, particularly in response to increased air traffic and a number of incidents (Drury 1962; Abbott 1964; Bull 1965; United States Fish and Wildlife Service 1969, 1970, 1973, 1974, 1976).

In May 1973 the Federal Aviation Administration introduced Part 139 Section 67 which mandated airports to come into compliance with bird hazard reduction programs wherever necessary to meet with certification requirements. A 1976 FWS report made recommendations to JFK to alleviate bird hazards which contributed over the intervening

years to many improvements at JFK, but much occurred to further complicate the situation. Practically from the moment laughing gulls began to breed adjacent to JFK in 1979, the number of bird strikes due to laughing gulls increased dramatically. It was not long before the total number of bird strikes due to laughing gulls equaled one half of all the bird strikes incurred each year at JFK.

The May 1973 Part 139.67 Certification Requirement of the FAA which states that for an airport to be certified it must show that it has established instructions and procedures for the prevention or removal of factors on the airport that attract, or may attract, birds. However, the applicant need not show that it has established these instructions and procedure if the Administrator finds that a bird hazard does not exist and is not likely to exist. This was then amended with a new version as of January 1, 1988. Part 139 Section 337, titled Wildlife Hazard Management states more clearly what the responsibility of an airport is with regard to managing bird hazards. The precise language (United States Department of Transportation, Federal Aviation Administration 1988) states:

"(a) Each certificate holder shall provide for the conduct of an ecological study, acceptable to the Administrator, when any of the following events occurs on or near the airport:

- 1) An air carrier aircraft experiences a multiple bird strike or engine ingestion.
- 2) An air carrier aircraft experiences a damaging collision with wildlife other than birds.
- 3) Wildlife of a size or in numbers capable of causing an event described in paragraph

(a)(1) or (2) of this section is observed to have access to any airport flight pattern or movement area.

(b) The study required in paragraph (a) of this section shall contain at least the following:

- 1) Analysis of the events which prompted the study.
- 2) Identification of the species, numbers, locations, local movements, and daily and seasonal occurrences of wildlife observed.
- 3) Identification and location of features on and near the airport that attract wildlife.
- 4) Description of the wildlife hazard to air carrier operations.

(c) The study required by paragraph (a) of this section shall be submitted to the Administrator who determines whether or not there is a need to a wildlife hazard management plan. In reaching this determination, the Administrator considers-

- 1) The ecological study;
- 2) The aeronautical activity at the airport;
- 3) The views of the certificate holder;
- 4) The views of the airport users; and
- 5) Any other factors bearing on the matter of which the Administrator is aware.

(d) When the Administrator determines that a wildlife hazard management plan is needed, the certificate holder shall formulate and implement a plan using the ecological study as a basis. The plan shall-

- 1) Be submitted to, and approved by, the Administrator prior to implementation; and
- 2) Provide measures to alleviate or eliminate wildlife hazards to air carrier operational.

(e) The plan shall include at least the following:

- 1) The persons who have authority and responsibility for implementing the plan.
- 2) Priorities for needed habitat modification and changes in land use identified in the ecological study, with target dates for completion.
- 3) Requirements for and, where applicable, copies of local, state, and federal wildlife control permits.
- 4) Identification of resources to be provided by the certificate holder for implementation of the plan.
- 5) Procedures to be followed during air carrier operations, including at least-

(i) Assignment of personnel responsibilities for implementing the procedures;

(ii) Conduct of physical inspections of the movement area and other areas critical to wildlife hazard management sufficiently in advance of air carrier operations to allow time for wildlife controls to be effective;

(iii) Wildlife control measures; and

(iv) Communication between the wildlife control personnel and any air traffic control tower in operation at the airport.

6) Periodic evaluation and review of the wildlife hazard management plan for-

(i) Effectiveness in dealing with the wildlife hazard; and

(ii) Indications that the existence of the wildlife hazard, as previously described in the ecological study, should be reevaluated.

7) A training program to provide airport personnel with the knowledge and skills needed to carry out the wildlife hazard management plan required by (d) of this section.

(f) Notwithstanding the other requirements of this section, each certificate holder shall take immediate measures to alleviate wildlife hazards whenever they are detected.

(g) FAA Advisory Circulars in the 150 series contain standards and procedures for wildlife hazard management at airports which are acceptable to the Administrator.

Laughing Gull Management Legal Implications

While JFK was legally managing the bird hazards at the airport, many of the problems were continuing to be solved. Nature, however, being a fluid interaction of many variables, continued to throw surprises at the airport's managers. One surprise was laughing gulls. Previous to 1979, the number of laughing gulls flying through JFK airspace was negligible, and very few were ever struck by aircraft. However, beginning in 1979 15 pairs of laughing gulls began nesting on the saltmarsh at the end of Runway 4L. The number of nesting pairs increased markedly, so within 10 years the number was at nearly 10,000 nesting pairs on the marsh at the end of Runway 4L. As the number of nesting birds increased, the number of laughing gull bird strikes increased proportionally. The number went from 0 to nearly 200 laughing gull bird strikes per year, which doubled JFK's number of bird strikes annually, and most of the laughing gulls were struck during the summer months. Clearly there was a new species at the airport that presented a serious hazard, that JFK had a legal responsibility to manage properly.

The airport was continuing its efforts to manage the airport in an ongoing effort to reduce on-airport bird attractants. However, it was readily apparent that more was needed to reduce the number of laughing gulls being struck. Recognizing that an increase from less than 2 percent of the bird strikes being due to laughing gulls to 50 percent being due to laughing gulls in a span of ten years was a situation that had to be rectified. Working with the National Park Service, so the studies were credible and acceptable by the National Park Service, the Port Authority agreed to let the National Park Service choose the members of an international panel of scientists to evaluate the laughing gull situation at JFK and let them make the recommendations that would be followed by the Port Authority. This panel conducted their study, which they submitted to the National Park Service and to the Port Authority, and they presented these recommendations in the "Blue Ribbon Panel's Recommendations on Bird Hazards to Aircraft at JFK International

Airport" was held in July 1989 at the National Park Service's Gateway National Recreation Area. The panel recommended adopting an effective control program that included "oiling of all eggs in the laughing gull colony. This will ensure that the birds are tied to their nest and will not produce any offspring and thereby remove the need for repeated feeding flights across the airfield. We expect that this will reduce the sudden peak in bird strikes in June. The oiling of eggs would be the least hazardous approach to both aircraft and non target wildlife. If continued in successive years, oiling would be likely to result in the abandonment of the colony. Other control methods could be introduced in future years to speed up this process." The oiling was started, and after the first year the National Park Service abruptly brought this to an end. Because they control access to their property, there was nothing the Port Authority could do, except find alternative methods to control the laughing gull strike problem.

In addition, the Port Authority gave the National Park Service the money to hire their own scientists to conduct ecological studies at the airport to determine methods that would evaluate the laughing gull situation and let them make recommendations that needed to be followed. The Port Authority also expanded and improved its non-lethal harassment programs, as recommended by the National Park Service's experts.

In 1990, with the approval of the National Park Service, the Port Authority hired scientists to begin an egg oiling program on the laughing gull colony. The intention was to nonlethally reduce the number of laughing gulls in the area in an effort to reduce the number of laughing gulls being struck by aircraft. However, after the 1990 field season, and after spending \$200,000 for the first year of work on what was planned to be a multi-year effort, the National Park Service abruptly withdrew its support of the program. Left with a rapidly approaching summer, during which the laughing gull hazards would have to be reduced, the airport opted for a lethal solution, one it preferred to avoid, but one which the National Park Service forced upon the Port Authority of New York and New Jersey. That is, with all the work to date that the airport was doing to reduce the on-airport bird attractants, still the number of laughing gulls flying over the airport and being struck by aircraft was increasing.

Because the National Park Service would not allow the Port Authority to move the birds, or to oil the eggs, or to alter the bird's nesting habitat, albeit temporarily, so the birds would not nest there, the airport had no choice other than using lethal means of management. The Department of Agriculture's Animal Damage Control people began a shooting program which immediately reduced the number of laughing gulls flying over the airport, it also reduced the number of laughing gulls being struck by 90 percent. The shooting program was very successful in this regard, but it was an imperfect solution.

The Port Authority was locked into an program that required far more shooting than would have been necessary if the National Park Service had followed through on the recommendations of the international panel of experts they had chosen to study the problem. Solutions that were far better than shooting were not available to the Port Authority because the National Park Service forced the Port Authority to shoot, because

they closed off any opportunity to solve the problems in a non-lethal manner. Then, the National Park Service began to fight the Port Authority's ability to use lethal means to manage the bird hazards.

The Park Service worked with the press and outside groups to stop the airport's shooting program. The court's required Port Authority to provide two Environmental Assessments to show that shooting the birds was not doing irreparable harm to the environment. Then, a lawsuit brought on by the Fund for Animals required an Environmental Impact Statement, which is a more involved process, that usually costs a minimum of several hundred thousand dollars, often millions of dollars, and can take years to complete. However, the airport could not take more than several months, if it was to keep the airport safe when the laughing gulls returned. In record time an Environmental Impact Statement was prepared and submitted before the 1994 breeding season, and the shooting program continued.

Environmental Impact Statement

If an action is determined to have potentially significant environmental impacts, an environmental impact statement is required. Applicants who seek project approval or funding may be responsible for preparing an environmental impact statement. It was the United States Fish and Wildlife Service that issued the permit to shoot laughing gulls. The Fish and Wildlife Service was being sued because it was felt they had allowed the United States Department of Agriculture, that was doing the shooting, to exceed the numbers inherent in the intent of the Migratory Bird Treaty Act. The suit required a hearing and due to the laws under the National Environmental Policy Act (NEPA) and New York's State Environmental Quality Review Act (SEQR) the judiciary decided an environmental impact statement was needed to have a proper public hearing about the issue so a more informed decision could be made. For more information about SEQR, I recommend a reading of both the State Environmental Quality Review Act and Article 8 of the Environmental Conservation Law. In addition, the statewide SEQR regulations, Part 617 of 6NYCRR (revised effective June 1, 1987).

An environmental impact statement concisely describes and analyzes a proposed action that may have a significant effect on the environment. The environmental impact statement is available to the public for information and comment. An environmental impact statement must include a: 1) description of the action, including the need for the action and benefits accrued from the action; 2) description of the environmental setting and areas to be affected; 3) analysis of all environmental impacts related to the action; 4) an analysis of reasonable alternatives to the action; and 5) identification of ways to reduce or avoid adverse environmental impacts. In 1994, as a direct result of the EIS process, federal, state, and city regulatory agencies required Port Authority to hire a full-time wildlife biologist to manage the bird hazards at the airport. One was hired December 27, 1994. In 1995 the New York State Department of Environmental Conservation required Port Authority to submit an annual status report that identified

specific activities undertaken to reduce bird attractants on and off the airport. An initial report prepared on June 30, 1995 outlined and identified the ecosystem approach that was going to be taken to manage the bird hazards, and this report identified the plan of action for the activities and estimated the time frames involved.

Record of Decision

In the Final Environmental Impact Statement that was completed in 1994 there was a Record of Decision that summarized the regulatory agencies' agreements regarding conclusions they had come to that were to be the guidelines that would either be adhered to, or modified, as time went on. Below are the main points that were stated in the Record of Decision, as they were interpreted by the Fish and Wildlife Service:

1. Enhance the professional capability of the Bird Control Unit

- a) The Port Authority of New York and New Jersey will hire a person trained in ornithology, or wildlife biology, or in a related field as the supervisor of the Bird Control Unit by August 1, 1994. This supervisor will be trained to the Master of Science level in either ornithology or wildlife biology and will be capable of developing and evaluating the bird hazard management program at JFK and developing monitoring programs for birds in the JFK area.
- b) The Port Authority of New York and New Jersey will increase staff size for the Bird Control Unit to 10 permanent, full-time members by November 1, 1994. All Bird Control Unit employees will be qualified to consistently and accurately collect biological field data and to conduct surveys and monitoring programs with the minimum professional training of a Bachelors of Science or equivalent substantive course work and field experience. The Bird Control Unit will include at least one person trained in entomology and pesticides.
- c) The Port Authority of New York and New Jersey will provide sufficient equipment and vehicles to support the improved Bird Control Unit by November 15, 1994. This includes equipment to disperse water following rain storms, pyrotechnics, speaker systems in all vehicles, firearms, and safety equipment.
- d) The Port Authority of New York and New Jersey will train and authorize all Bird Control Unit employees to conduct all harassment methods, including the firing of firearms for lethal and non-lethal harassment. This includes the development of a training plan for all employees.
- e) The Bird Control Unit staff requires 7 people to perform its bird harassment responsibilities (1 supervisor, 2 employees per shift, shifts per day, 7 days a

week). In order to increase the capability of the Bird Control Unit, the Fish and Wildlife Service has determined that three additional people are required, as well as improving the professional training and capabilities of the Bird Control Unit and assuring that the Bird Control Unit is adequately equipped to do its job.

2. Reorganize the Bird Hazard Task Force to assist as an independent review body.

a) The Port Authority of New York and New Jersey will reorganize the Bird Hazard Task Force to serve as an advisory committee to the Port Authority for the evaluation of the Bird Control Unit program and the gull shooting program. The Bird Hazard Task Force will suggest improvements to this program, recommend additional research and monitoring needs and establish criteria to be used for initiation of Category 2 measures. The agencies currently composing the Bird Hazard Task Force would remain. The chairmanship would be rotated on an annual basis; however, the Fish and Wildlife Service would chair the task force during this reorganization period.

3. Establish in-house capability with the Bird Control Unit to assess and monitor effectiveness of control programs on target species.

a) The Port Authority of New York and New Jersey will develop and implement monitoring programs to assess the following:

- i. evaluation of the effectiveness of the gull shooting program and JFK's bird hazard management program,
- ii. identification of criteria that could be used to determine when a gull shooting program should begin or end,
- iii. identification of criteria, with the involvement of the Bird Hazard Task Force, that could be used to determine when Category 1 elements have become ineffective,
- iv. evaluation of off-airport attractants that encourage gulls to fly through JFK's airspace, and
- v. continuing evaluation of potential on-airport attractants.

4. Prepare written plans for vegetation, insect control, solid waste, water management, and other on-airport issues that address bird hazard management

a) The Port Authority of New York and New Jersey will produce written management plans for vegetation, insect, water, and solid waste management at

JFK. These plans will document the existing programs and the overall management strategies for these programs.

Permits

Before harassing birds, destroying nests, oiling, addling, or destroying eggs, before stepping on or taking a rake or any other implement to nests, eggs, or chicks, and before disposing of the carcasses of animals, it is imperative that all our permits be current and valid for the procedures that are potentially anticipated. New York State provides regulatory protection to a variety of wildlife species that occur within New York through Article 11 of the Environmental Conservation Law, also known as the Fish and Wildlife Law (Environmental Conservation Law). Each year, if we are to shoot any birds we need permits from the New York State Department of Environmental Conservation and from the United States Fish and Wildlife Service. From New York we need a Depredation License issued pursuant to Environmental Conservation Law, Article 11-0521, and 6NYCRR Part 175, to allow for the take of state-protected birds for scientific investigations or to address human safety problems. The New York State Department of Environmental Conservation issues permits to JFK to conduct ongoing bird hazard reduction activities. Port Authority has always applied for these permits and received them in Port Authority's name, however, during 1994, due to changes initiated while completing the Environmental Impact Statement, the United States Department of Agriculture's Animal Damage Control applied for our permits in their name and received them. However, in 1995 the Port Authority applied for the permits in Port Authority's name and they were issued to us once again.

The permits issued to the Port Authority have had the following conditions:

- 1) During 1995 we could shoot gulls, but the Port Authority personnel or people working for the Port Authority, could take no more than 14,500 laughing gulls, 1,500 herring gulls, 200 great black-backed gulls, and 200 ring-billed gulls.
- 2) The State of New York required reports when more than 5 percent of the gulls shot during any given week are non-laughing gulls.
- 3) When targeting migratory species, we could not shoot endangered or threatened species, or eagles.
- 4) We were required to dispose of all specimens either through incineration, burial, or through donation to public or scientific organizations.
- 5) We were to maintain records.

New York State Department of Environmental Conservation Regulations

The State of New York provides regulatory protection to a variety of wildlife species within the state through Article 11 of the Environmental Conservation Law, also known as the Fish and Wildlife Law (Environmental Conservation Law 11-0535[1]-[2], 11-0536[2],[4], 11-0537). This section protects state-listed endangered and threatened species, species of special concern, and all game birds and birds protected under the federal Migratory Bird Treaty Act from the illegal "taking." The term "taking" has been broadly defined, as in federal law, to include pursuing, shooting, hunting, capturing, trapping, etc. Almost all of the bird species encountered at JFK receive some form of protection under this state law. Exceptions include the English or house sparrow, pigeons, European starling, and escaped, non-domesticated parakeets and parrots.

The state threatened and endangered bird species which you may encounter at JFK and which are protected under this law include the following:

Status:	Endangered	Threatened	Protected	Special Concern
	Piping Plover	Common Tern	Black Skimmer	Short-eared Owl
	Bald Eagle	Osprey	Common Barn Owl	
	Percegrine Falcon	Northern Harrier		

These species receive the highest level of protection. While members of the Bird Control Unit conduct their duties, it is important to be aware of the potential presence of these species. If one knowingly, or with wanton disregard, shoots, harasses, or kills one of these species, outside the conditions of your permit, you could possibly be held liable for your actions under state law.

Penalties

Under Article 71, Title 5 of the Environmental Conservation Law, civil penalties include not more than \$1,000 and additional penalty of not more than \$250 for each additional animal involved. The offense also carries a criminal penalty as a misdemeanor offense subject to imprisonment for not more than 15 days or a fine not to exceed \$250, or both.

For golden eagles and bald eagles, the offense is considered a misdemeanor punishable by a fine not to exceed \$5,000 or six months in jail, or both. The illegal taking of game birds and migratory birds protected under state Fish and Wildlife Law is punishable by civil penalties only. The civil penalties for the taking of these species, outside of permit conditions, include fines of \$60 for each violation and an additional penalty of \$25 per each bird.

In the past, the New York State Department of Environmental Conservation has issued a permit in accordance with 11-0521 of Environmental Conservation Law which has

allowed the "taking" of specific wildlife species that have been shown to be a threat to human welfare and destructive to property. The permit, as discussed later, allows for the "incidental" (or accidental) taking of protected species during the conduct of normal Bird Control Unit activities.

United States Fish and Wildlife Service/New York State Department of Environmental Conservation Permits

The United States Fish and Wildlife Service has been issuing permits to the Port Authority of New York and New Jersey to authorize JFK personnel to conduct ongoing bird control work, and to the Department of Agriculture to conduct operational gull control activities from May through August 1991 through 1995. The most recent permit issued to the Port Authority of New York and New Jersey was Special Purpose Permit #PRT-734800 under Statute 16 USC 703-712, Regulation 50 CFR Part 13, 50 CFR 21.27. It contained several basic conditions restricting the authorized JFK and Department of Agriculture personnel :

- 1) to kill only non-endangered and non-threatened species of migratory birds, except eagles and all species of gulls, when they are creating or are about to create, a hazard to aircraft;
- 2) all carcasses collected under the permit were to be donated to a public or scientific organization, or disposed of through incineration or burial;
- 3) maintain records as required by the regulations implementing the Migratory Bird Treaty Act.
- 4) The Port Authority's Special Purpose Permit restricts the taking of gulls as per the Department of Environmental Conservation's permit.
- 5) authorized ADC personnel to take no more than 14,500 laughing gulls, 1,500 herring gulls, 200 great black-backed gulls, and 200 ring-billed gulls.
- 6) required that all specimens collected under the permit be donated to a public or scientific organization, or disposed of through incineration or burial;
- 7) maintain records as required by the regulations implemented by the Migratory Bird Treaty Act.

Also, in 1995 the New York State Department of Environmental Conservation issued the Port Authority of New York and New Jersey Fish and Wildlife Depredation License #DWP95-023, under their Statutory Authority ECL 11-0521, 11-0505 (5), 6 NYCRR PART 175, to allow for the take of state-protected birds for scientific investigations or to address human safety problems. The state placed restrictions on the Port Authority of

New York and New Jersey, which were in accordance with Fish and Wildlife restrictions, and additional requirements included plans and reports which were submitted.

Organizational Changes

Port Authority has shown its commitment to ecosystem management and specifically to properly managing the bird-related problems by hiring a full-time wildlife biologist to oversee many of the different aspects of the gull hazard reduction program. The biologist was hired in 1994 and since then the Port Authority has reorganized the Bird Hazard Task Force (BHTF).

The BHTF is an organization of federal, state, and city agencies with shared concerns, duties, and responsibilities to work together to find a solution to the safety problems at JFK that are the result of bird hazards. The group is advisory; its members include the United States Fish and Wildlife Service, United States National Park Service, United States Animal Damage Control Program of the Animal and Plant Health Inspection Service of the United States Department of Agriculture, Federal Aviation Administration, New York State Department of Environmental Conservation, New York City Department of Environmental Protection, and the Port Authority of New York and New Jersey.

The mission of the group is to exchange ideas and information about bird management, bird populations, and bird strikes, to help agencies communicate and shape their positions relative to bird strike issues, to regularly review the JFK bird hazard control program, to provide technical recommendations to the Port Authority about issues affecting bird strikes, to help with the design, implementation, monitoring, and analysis of data gathered in JFK's wildlife management programs, and to assist the Port Authority with the development of a long-term bird hazard reduction program by creating informed policies and decisions among the cooperating agencies.

Categories One and Two

To move from Category 1 procedures, those that involve dealing primarily with on-airport bird attractants, to Category 2 procedures, those that involve working directly with the colony of laughing gulls breeding next to JFK, the United States Fish and Wildlife Service must find that JFK has been complying with the terms of the record of decision. It must also be determined that in spite of all the work done at JFK, that the number of laughing gulls flying over the airport still constitutes a danger that must be dealt with through the integrated management plan which states that procedures to manage the laughing gulls nesting on the laughing gull colony. We feel we have

complied with the record of decision and it is just a matter of time before the Fish and Wildlife Service either acknowledges this, or specifies what additional modifications have to be made before they will find us in complete compliance. We also feel that due to the surveys conducted at JFK, we have shown that thousands of laughing gulls are found over the airport each summer. No laughing gulls are attracted to land on the airport to feed on insects any longer, and the associated resting on the airport nearby pools of freshwater has also been eliminated.

CHAPTER THREE

Vegetation Management

This chapter provides the required documentation stated in the Final Environmental Impact Statement's Record of Decision as areas that required better documentation so the airport could be reissued its operational permit:

1. vegetation management
2. insect control
3. water retention management
4. solid waste management
5. other on-airport issues that address bird hazard management

Vegetation Management

Recommendations and Suggested Studies

A summary of the landscape management methods that are policy at JFK:

1. Incorporate habitat manipulation strategies in landscape plans

- Select plant material that does not serve as an attraction for feeding or roosting by birds and is tolerant of stressful urban conditions
- Avoid planting conifers except as widely spaced individuals
- Select trees with open growth forms
- Maintain open canopies with routine pruning
- Select low-growing shrubs and do not use as an understory
- Plant vegetation in linear configurations versus circular clusters
- Use staggered rows of trees spaced so their canopies do not interlock
- Avoid rows of trees encircling parking lots if the parking lots are heavily planted
- Minimize large expanses of lawn
- Research the use of long grasses and alternative groundcovers such as gravel in place of lawn

Design new buildings, signs, and lighting fixtures so they do not provide roosting or breeding habitats for birds. Work to modify existing buildings, signs, and lighting fixtures so they do not provide roosting or breeding habitats for birds.

Landscape Architecture

JFK has been in the forefront of airport landscape architecture. We generated the Federal Aviation Administration's list of plant species that do not attract birds, which has become the industry standard. We are currently reevaluating the list, in an effort to determine which species might be dropped from, or added to, the list. Measures are being taken to guarantee our recommendations are adhered to. We avoid planting monocultures, so entire plantings are not susceptible to discase or widespread insect infestations. We also avoid planting species that stand a chance of becoming problems in the future. Plant species that might attract birds, particularly birds that roost in large numbers, such as large numbers of starlings in the fall and winter, are to be avoided, or if present, thinned, or cut down. We also avoid planting species that provide food and cover, preferring plants that are attractive to humans, but not attractants to other species. When we find that certain species are particularly susceptible to disease or insect infestations, these species are managed to the best of our ability, or culled (Garber 1995a, 1995b).

Planting Management Plans

Landside Vegetation (vegetation on side of airport where no planes are allowed)

Tall Vegetation

Whether airside or landside, because obstructions near the approach or departure zones of runways present hazards to low flying aircraft, they need to be eliminated. Some of these locations are well-suited to trees which will seed in on their, so woody vegetation is continually cleared, and the tall trees are managed, generally by pruning, cropping, or removing them if they are too tall. Areas where large trees are felled usually do not require more maintenance for as long as ten years. The smaller species, such as the bayberries that grow in more widespread areas on the airport, are usually thinned or cleared when the maintenance crews are available during the summer months.

During 1995 the trees that had grown to a significant height at the 13R approach zone on the Lefferts Boulevard side of Bergen Basin were thinned significantly so they should not present a problem for another 10 years. They were cut on October 14, 1995; approximately 18 trees were cropped. This area has wetlands in it that JFK has agreed not to disturb, as part of a deal made when we built the long-term parking lots. However, we are allowed to clear trees as they grow.

The four tree species we culled were black cherry (Prunus serotina), white mulberry (Morus alba), the tree of heaven (Ailanthus altissima), and the eastern cottonwood (Populus deltoides). All are common weedy species in the area; two provide food for birds. The mulberries attract a wide range of species when in fruit in July, and the cherries are abundant when in fruit in August. The mulberries can be a real problem in July because laughing gulls are attracted to the tree tops and while on the wing, dip down and take the mulberries off the tree. This behavior brings gulls over the airport, and this is an additional reason that we work to control the growth of this species on the airport. Allowed to continue standing in the area were Norway maples (Acer platanoides), Sycamore maples (Acer pseudoplatanus), and a willow, probably a black (Salix fragilis) or crack willow (Salix nigra). These trees were spared because they were not in the direct flight path of the planes and because they are not considered major bird attractants at the airport.

Plants That Are Recommended

In newly constructed areas, planting are evaluated in terms of how they might enhance the overall landscaping design and beauty of the airport. Other reasons plants are appropriate in such areas is that in many cases they are needed to reduce erosion. Each

species is ultimately chosen for more than just its aesthetics that are appropriate for the particular location, it also must be physiologically well-adapted to the particular microhabitat being considered, to insure it's survival. However, at no time do we want to plant species that will attract more hazards to the airport. To minimize the bird attraction we have generated a list of species that is urban tolerant, can survive salt, wind, dust, ozone, compacted soils, and thrive on the sandy soils at the airport (Garber 1989a). To the extent that it is possible without tremendous cost, we always prefer to plant species that are both native to this region, and indigenous to this type of habitat. Our reasoning is that native species that grow in this habitat are mostly likely to thrive here without tremendous amounts of maintenance, and native species are better because there is less of a chance that they will spread in a manner that cannot be predicted, becoming weed species on the airport. We also prefer to use plants that are indigenous to this type of habitat for the same reason, and because philosophically we feel that native species, habitat-specific species, and communities of species that are found in the wild in this region are more beautiful when growing at JFK than are most non-native species growing in man-made communities. Such concepts are often difficult to explain effectively to the uninitiated, and for this reason, it is sometimes far more difficult than it should be to enforce native species preferences. But many ecosystem managers are making headway, as are we at JFK.

The species listed below are broken down according to woody vegetation (deciduous, trees, coniferous trees, and shrubs), groundcovers, and grasses. Species that are recommended are listed first, and there is a listing of species that are not recommended. Management regimens are also described, and a list of plant species found on the airport's airside is also provided

Deciduous Trees:

Trident Maple (Acer buergerianum)
Hedge Maple (Acer campestre)
Box Elder (Acer negundo)
Norway Maple (Acer platanoides)
European Hornbeam (Carpinus betulus)
Hackberry (Celtis occidentalis)
White Ash (Fraxinus americana)
Green Ash (Fraxinus pennsylvanica)
Thornless Honeylocust (Gleditsia triacanthos)
Golden Rain Tree (Koelreuteria paniculata)
Eastern Larch (Larix laricina)
Dawn Redwood (Metasequoia glyptostroboides)
Amur Corktree (Phellodendron amurense)
London Planetree (Platanus acerifolia)
Cottonwood (Populus deltoides)

Japanese Poplar (Populus maximowiczii)
 Callery Pear (Pyrus calleryana)
 Sawtooth Oak (Quercus acutissima)
 Scarlet Oak (Quercus coccinea)
 Bur Oak (Quercus macrocarpa)
 Willow Oak (Quercus phellos)
 English Oak (Quercus robur)
 Babylon Weeping Willow (Salix babylonica)
 Japanese Pagodatree (Sophora japonica)
 American Linden (Tilia americana)
 Littleleaf Linden (Tilia cordata)
 Crimean Linden (Tilia euchlora)
 Silver Linden (Tilia tomentosa)
 Elm (Ulmus hollandica)
 Chinese Elm (Ulmus parvifolia)
 Japanese Zelkova (Zelkova serrata)

Coniferous Trees

Although we prefer to plant native species at JFK for all the reasons that native species make more sense everywhere, we have inherited many plantings from previous years that are not native, and we are not going to remove them. Pitch pine and white pine are both native to the northeast, pitch pine more commonly occurs in Long Island's sandy soils, and for this reason, this is the preferred pine for on airport plantings. However, in the past, pitch pines have not been nearly as available as Austrian and black pines, which were also recommended pine trees for sandy, coastal regions. As a result, over 95 percent of the pine trees that have been planted on the airport over the years, are Austrian and black. Of the two, black is preferable for reasons stated below in the following two species accounts.

Austrian Pine (Pinus nigra)

The Austrian pine, a native of southern and eastern Europe, has dark green, 8 to 12 cm. long needles are in pairs. The rough bark is dark brown, often with a grayish hue. Winter buds are oval, oblong, or cylindrical. Young shoots are yellowish brown. Cones solitary or in clusters, ranging from oval to conic, 5 to 8 cm. long, with scales terminating in a small prickle. This species does well in a wide range of soils, and thrives near the ocean. Of all the pines, it seems to do the best in chalky soils, and it tolerates exposed, windy areas quite well.

JFK's Austrian pines are subject to the fungal disease Diplodia pinea, which is controlled at JFK with a mixture of Bordeaux and cupric sulfide, which is sprayed onto the trees. Most of the Austrian pine trees that were planted on the airport's landside property are

from years ago, before this list of recommended species and those that are not to be planted on the airport was written. Many of the Austrian pines were subsequently cut down or thinned, because many evergreen trees closely planted with thick vegetation were attractants to flocks of overwintering birds, in particular, starlings. The Austrian pines still on the airport appear to suffer from Diplodia pini, but they survive with it.

Japanese Black Pine (Pinus thunbergii)

Like the Austrian pine, the Japanese black pine, a native of Japan and Korea, has paired needles, these are 7 to 18 cm. long, slightly longer than the Austrian pine's needles. Winter buds are pointed. Young shoots are light brown, oval to conic cones are 4 to 6 cm., and occur either singly and in clusters, and its branches are stout and twisted. Often planted near the coast, and does well as a wind break. It does well in poor, sandy soils. Even though the Black pine does not suffer from Diplodia pini like the Austrian pines, we do want to avoid a situation where they have to be cut down due to too many being planted too close together. As a matter of course, when pruning the trees on the airport, the pine trees are thinned so their otherwise dense, evergreen foliage never becomes an attractant to flocks of overwintering birds, in particular, starlings.

Shrubs

Five-Fingered Aralia (Acanthopanax sieboldianus)

Glossy Abelia (Abelia grandiflora)

False Indigo (Amorpha fruticosa)

Groundles Bush (Baccharis holmifolia)

Pea Shrub (Caragana arborescens)

Smoke Tree or Wig Tree (Cotinus coggyria)

Deutzia (Deutzia lempoia)

Burning Bush (Euonymus alatus)

Pearlbush (Exochorda racemosa)

Goldenbell (Forsythia sp.)

Rose of Sharon (Hibiscus syriacus)

Smooth Hydrangea (Hydrangea arborescens)

Shrubby St. Johnswort (Hypericum prolificum)

Creeping Juniper (Juniperus horizontalis)

Honeysuckle (Lonicera canadensis)

Sweet Syringa (Philadelphus coronarius)

Common Ninebark (Physocarpus opulifolius)

Bush Cinquefoil (Potentilla fruticosa)

Water Ash (Ptelea trifoliata)

Roseacacia Locust (Robinia hispida)

Pussy Willow (Salix discolor or Salix tristis)

Buffalo Berry (Sherperdia argentca)
Spiraea (Spirea spp.)
Lilac (Syringa vulgaris)
Frenech Tamarack (Tamarix gallica)
Yew (Taxus canadensis)
Weigela (Weigella spp.)

Groundcovers

English Ivy (Hedera helix 'Baltica')
Creeping Juniper (Juniperus horizontalis)
Pachysandra (Pachysandra spp.)
Periwinkle (Vinca minor)

Plants Not Recommended As Plantings On The Airport

Largely because of a plant's high food value to birds, certain plant species are listed as those that should not be planted on the airport. These species include:

Deciduous Trees and Shrubs

Silky Dogwood (Cornus amomum)
Eastern Flowering Dogwood (Cornus florida)
Gray Dogwood (Cornus racemosa)
Red Osier Dogwood (Cornus stolinifera)
Hawthorn (Crataegus spp.)
Eastern Red Cedar (Juniperus virginiana)
Amur Honeysuckle (Lonicera maackii)
Tatarian Honeysuckle (Lonicera tatarica)
Crab Apple (Malus spp.)
Cherry (Prunus spp.)
Firethorn (Pyracantha spp.)

Sumac (Rhus spp.)

The sumac species at JFK are Rhus glabra, Rhus copallinum, and Rhus radicans. They are low, woody species that are attractive in their own way, especially in autumn when their leaves add beautiful color to any landscape. However, these are species we are constantly fighting at JFK. Throughout the airport each seeds in on its own, and they

present a significant management challenge on airside habitats. It is primarily because of their berries that they have become staples in the diets of many birds species, including some of the overwintering species. We constantly thin and cut the sumacs, and have effectively eliminated them on landside, however airside is a more difficult area to control because it is so vast, and cutting regimens allow grasses to grow tall to keep certain bird species out. At the same time, this allows many plant species to germinate and take hold. We understand sumac species will probably remain an airside management problem that will always require a great deal of time to control, but we are proud that we have taken control of these three species on landside, and stag's-horn sumac (Rhus typhina), another common species in the area, has been entirely eliminated from both landside and airside

Mountain Ash (Sorbus americana)

Although mountain ash foliage is beautiful in autumn, and its berries also add considerable color to the landscape, it is because of the berries that we do not plant this species here. In addition, mountain ash looks out of place in this habitat.

Bradford Callery Pear (Pyrus calleryana "Bradford")

The Bradford callery pear was not on the list of species that were not recommended at JFK until 1995, and it is not on the FAA's list either, however, we at JFK have recently recognized this to be a problem tree. Its flowers, which usually appear in spring, but some that were planted at JFK bloom in the autumn, are beautiful, and its summer and autumn foliage are also admired. Nevertheless, the small pear fruits will stay on the trees all winter, creating a ready food source for, in particular, starlings. Because we are managing attractants suitable to overwintering starlings in an effort to eliminate the threat from flocks of starlings, we have added this species to the trees not recommended list (Garber 1989b).

White Mulberry (Morus alba)

White mulberry trees on JFK property now represent plants that probably seeded in on their own. Although this species is no longer popular as an ornamental, because many horticulturists consider it a weed, we are making the point to our ground crews that mulberries are to be avoided at all costs. When in fruit, here that is in the middle of July, they provide massive amounts of food to a range of bird species, including laughing gulls.

Red Mulberry (Morus rubra)

Even though the red mulberry is not planted very often as an ornamental, we placed it on the list because we want to stress that any mulberry species that has mulberry fruits is to be avoided. The species seed in on their own, and when in fruit, provide a significant food source to a wide range of species, including laughing gulls.

Vines

Bittersweet (Celastrus spp.)

This aggressive alien will climb over shrubs and trees wherever management practices allow it to stay two steps ahead of you. At an airport, that is practically everywhere. Although some people like the wild appearance of vines growing over the woody foliage, we feel it does not look clean, and because these vines bear fruit, and because the leaves stay green during much of the winter and therefore provide cover for some bird species, we do not plant this anywhere on the airport, and we remove it wherever it is growing.

Virginia Creeper (Parthenocissus quinquefolia)

Virginia creeper is a very attractive vine that is native to the area and to this specific region.

Herbs

American Cranberry (Viburnum trilobum)

Airside Vegetation

(restricted areas where the runways, taxiways, and aircraft are)

August 7, 1995 Dr. Robert Zaremba, a botanist with The Nature Conservancy, and I conducted a survey of the airside habitats quickly documenting as many plant species as possible. Below each of the species is listed. If there is an * after a species name, that designates that this is a New York State rare species. Any plant followed by (watch) indicates that this species is on the New York State rare plant watch list. Should anyone be interested in the exact locations of the rare or watch species, both Zaremba and Garber

have marked maps in their files. Instead of presenting these in phylogenetic order, for our purposes, we have chosen to alphabetize them:

List of Airside Plant Species

Achillea millefolium
Agrostis scabra
Ailanthus altissima
Ambrosia artemisiifolia
Ammophila breviligulata
Ampelopsis sp.
Apocynum cannabinum
Aristida sp.
Artemisia caudata
Artemisia vulgaris
Asclepias syriaca
Atriplex patula
Baccaris halimifolia
Cakile edentula
Celastrus orbiculatus
Cenchrus tribuloides *
Centaurea maculosa
Cirsium canadensis
Cyperus sp.
Cyperus schweinitzii *
Dactylis glomerata
Daucus carota
Desmodium sp.
Dianthus armeria
Diodia teres
Distichlis spicata
Epilobium sp.
Epilobium hirsuta
Erigeron annuus
Eupatorium album var. subvenosum (watch)
Eupatorium hyssopifolium
Eupatorium hyssopifolium var. laciniatum
Eupatorium perfoliatum
Eupatorium fistulosum
Euphorbia sp.
Euthamia tenuifolia
Euthamia graminifolia
Festuca ovina
Gnaphalium obtusifolium

Heterotheca subaxillaris
Hibiscus palustris
Hieracium sp.
Hudsonia tomentosa
Hypericum gentianoides
Hypericum cf. boreale
Impatiens capensis
Juncus effusus
Juncus gerardi
Juncus sp.
Lactuca sp.
Lechea maritima
Lepidium virginicum
Limonium nashii
Linaria canadensis
Lonicera morrowii
Ludwigia palustris
Lycopus sp.
Lythrum salicaria
Malus sp.
Melilotus officinalis
Melilotus alba
Mikania scandens
Myrica pensylvanica
Onoclea sensibilis
Panicum sp.
Panicum virgatum
Panicum amarum (watch)
Parthenocissus sp.
Phragmites australis
Phytolacca americana
Pityopsis falcata
Plantago lanceolata
Pluchea odorata
Polygonella articulata
Polygonum opelousanum *
Potentilla erecta
Prunus serotina
Rhus glabra
Rhus copallinum
Rhus radicans
Rosa rugosa
Rosa multiflora
Rubus flagerllaris
Rumex acetosella

Rumex crispus
Salicornia europaea
Salsola kali
Saponaria officinalis
Schizachyrium scoparium
Scirpus americanus
Scirpus cyperinus
Scutellaria galericulata
Setaria sp.
Solanum dulcamara
Solanum nigrum
Solidago canadensis
Solidago juncea
Solidago sumpervirens
Sparina alterniflora
Spartina patens
Sporobolus vaginiflorus
Strophostylis helvula
Suaeda linearis
Thelypteris palustris
Typha angustifolia
Verbascum thapsus
Verbena hastata

Vegetation of Airside Habitats

Based on field surveys that I conducted with Dr. Andrew Greller of Queens College, eleven different habitat types are described. Much of this work is based on Greller's earlier work at Dubos Point (Greller 1992). Each of the habitats is listed: beach herbland, sand, sand shrubland, grassland, mixed shrubland, Phragmites, Phragmites thatch, saltmarsh, salt shrubland, tall mixed woodland, and short mixed woodland. Nearby JFK's airside habitat is Dubos Point, which is a wildlife preserve. The soils, weather, habitats, and species are very similar in many respects to those here. One of the primary differences between the two localities is our ecosystem management, part of an ongoing effort to maintain a safe airport. If the habitats were all allowed to grow wild, they would rapidly become similar to those at Dubos. Because JFK's habitats will become like many of those at Dubos, without constant management, it is worthwhile to describe the habitats that occur at both JFK and Dubos. This way, all the airside habitats will be described here, with a short list of associated plant species:

Sand

The similar habitats to the bare sand habitats at Dubos, that occur at JFK, are primarily found along the edge of Thurston Basin, although some also exist along Bergen Basin and Jamaica Bay. This habitat occurs along the shore, as well as landside of stands of tall cordgrass (*Spartina alterniflora*) that border the shoreline. At Dubos, Greller believes the bare sand that occurs landward of tall cordgrass, is the result of erosion of peat. At JFK, the *Spartina* recently colonized, and the sand is both due to vast deposits of dredge spoils used to create JFK, and some of the sand is also the result of tidal action and storm tides. many races or subspecies Associated species found at the edges of storm-piled sand, are:

Distichlis spicata

Phragmites australis

Solidago sempervirens

Spartina patens

Suaeda linearis

Sand Shrubland

Sand shrubland is dominated primarily by the following native woody species: bayberry (*Myrica pennsylvanica*) and sumac (*Rhus copallinum*). These are usually shrubby, relatively low (1 to 3 meters high), and wide-branching. In the center of the larger clumps of *Myrica* and *Rhus* is often cherry (*Prunus serotina*), and these sometimes are small trees. Larger concentrations of shrubs are usually those with the taller shrubs, and these usually have vines such as *Parthenocissus quinquefolia* (this is the species described from Dubos, although at JFK the *Parthenocissus* is not definitely *quinquefolia*) and *Toxicodendron radicans*. *Rubus flagellaris* often grows as a mat covering the ground. Species associated with sand shrubland found in the area are:

Aronia melanocarpa

Baccharis halimifolia

Morus Alba

Myrica pennsylvanica

Panicum virgatum

Parthenocissus quinquefolia

Phytolacca americana

Prunus serotina

Rosa rugosa

Rubus allegheniensis

Rubus flagellaris

Solidago sempervirens

Toxicodendron radicans

Grassland

The prairie-like vegetation of the sand grassland is dominated by native grasses and forbs. Dredge spoils here are primarily well-drained, level, sandy soils. Because JFK is built on a marsh, there is constant settling, so interspersed within these grasslands are lower areas where water collects during parts of some years. We are vigorously pursuing an ongoing effort to fill all these in. The sand was originally placed on the marsh so the airport would be built on level sand that was six feet above high tide. These grasslands are all well above the influence of normal tidal cycles. The dominant grass species is Panicum virgatum; in addition Andropogon spp. are usually present, as are a number of Compositae, especially Solidago spp. Many of the associated species found in this sand grassland are:

Agrostis perennans?

Andropogon (Schizachyrium) scoparius

Andropogon virginicus

Eragrostis spectabilis

Eupatorium verticillatum

Panicum virgatum

Phragmites australis

Rhus copallinum (seedlings)

Solidago sempervirens

Solidago (Euthamia) graminifolia

Solidago (Euthamia) tenuifolia

Mixed Shrubland

This shrubland develops on sand, it is very disturbed, and although it is dominated by the native shrubs Myrica and Rhus as well as by such exotic vines as Lonicera japonica and Celastrus orbiculatus, and this habitat includes considerable amounts of Artemesia vulgaris. Species that occur in this mixed shrubland are:

Agrostis hiemalis?

Artemesia vulgaris

Aster novae-angliae

Celastrus orbiculatus

Lonicera japonica

Myrica pennsylvanica

Phragmites australis

Prunus serotina

Rhus copallinum

Phragmites

This tall grassland community (1 to 3 meters) is dominated by the common reed (Phragmites australis). Phragmites is usually a sign of wet soils or recent disturbance. In the reed's understory are many species. Species that occur here include:

Agalinus (Gerardia) purpureus?

Artemisia vulgaris

Bidens aristosa

Convolvulus sepium

Daucus carota

Scirpus juncoides?

Lycopus sp.

Phragmites australis

Polygonum cupidatum

Rack Thatch

This habitat is really just the rack composed of dead stems of both the common reed, Phragmites australis, and tall cordgrass, Spartina alterniflora, that are deposited by the tides along the high tide line of salt marshes, as well as next to some of the beaches along the periphery of the airport. The rack is most apparent and in the best shape during the winter.

Phragmites australis

Spartina alterniflora

Salt Marsh

The salt marsh habitats on and adjacent to JFK are a complex of grass- and forb-dominated communities that developed under the influence of daily tides. The three types of salt marsh communities present at JFK are (1) the tall cordgrass (Spartina alterniflora) type that often occurs on peat and is inundated for long periods by the tides. Some Spartina alterniflora localities at JFK were recently created with sandy dredge spoils, so the tall short grass can colonize an area much more rapidly than is required to create a deep peat salt marsh. These habitats usually occur along the edge of the land at the seaward edge. 2) The salt meadow type also occurs on peat, but is dominated by short grasses (Spartina patens and Distichlis spicata) and succulent forbs such as Limonium carolinianum, Aster tenuifolius, Salicornia europaea, and Suaeda. 3) A succulent forb community that usually develops on bare substrates such as sand or shells, and is dominated by a variable mixture of the following salt-tolerant succulent herbs:

Aster tenuifolius
Distichlis spicata
Juncus gerardi
Limonium carolinianum
Salicornia europaea
Spartina alterniflora
Spartina patens
Suaeda spp.

Salt Shrubland

A low community of widely branching, salt-tolerant, native woody plants that are inundated for short periods each day by the high tides. When this community is open there is often a dense ground layer which is dominated by the black grass (Juncus gerardi) which is a rush. Phragmites is frequently found mixed in with salt shrubland. The salt shrubland is often seen landward of the salt marshes in flat areas. Species found here include:

Baccharis halimifolia
Cyperus sp.
Juncus gerardi
Limonium carolinianum
Iva oraria var. frutescens
Phragmites australis
Solidago sempervirens

Tall Mixed Woodland

The tall mixed woodland is a community of tall woody plants with single trunks (boles) reaching heights of approximately 10 meters. The trees, which are mostly native, include Celtis occidentalis, a native species that is a dominant component of maritime forests at the southern tip of Staten Island. often have woody vines (lianas) climbing the bole and growing in the upper branches. This community's understory and fringes are dominated by shrub species, the majority of which are Myrica and. Also, this community has an important herbaceous component. Species found in the tall mixed woodland include:

Ailanthus altissima
Celtis occidentalis
Parthenocissus quinquefolia
Populus tremuloides
Prunus serotina

Short Mixed Woodland

The short mixed woodland community represents trees that reach 5 to 10 meters in height. This community has fewer species than the tall mixed woodland. Species found here include:

Celastrus orbiculatus

Pathenocissus quinquefolia

Prunus serotina

Salix fragilis?

Grass Management

Grass Management on the Aeronautical Side (Airside)

Short grass has been determined to be a gull attractant, attracting laughing gulls in particular (Blockpoel 1976; Brough and Bridgman 1980; Buckley and McCarthy 1994). The extent to which short grass at JFK was an actual gull attractant has tested in 1985 and 1986 (Buckley and Gurien 1986), however the conclusions have never been put into context, and the arthropodan prey species and the stages in their life history also needs to be put into the proper context. During the summers of 1985 and 1986 36 experimental plots were sampled between runways 4L/22R and 4R/22L using two levels of grass height. Each plot was a .4 hectare square separated by a 50 meter buffer zone. Laughing gull abundance and distribution were recorded and analyzed as a response to grass height as were the abundance and distribution of both larvae and adults of potential arthropodan prey. Each summer initial mowing of plots began on May 22. Short grass plots were cut first. Upon completion of all short grass plots the grass cutters were modified for the long grass cut. Mowing of long grass was completed by June 3. To maintain treatment heights, all plots were recut between July 8-12 and again between August 14-16.

The data confirmed that the experimental plots with short grass had significantly greater abundances of laughing gulls, but lower abundances of adult insects. Grass height had no effect on numbers of beetle larvae. However the presence of laughing gulls was positively correlated with the presence of oriental beetle larvae, which were emerging in large concentrations in areas where laughing gulls were concentrated, but laughing gulls only ate oriental beetles in short. Laughing gulls were most abundant in grass during late June and July, corresponding to beetle emergence periods. Stomach analyses of airport gulls showed significant proportions of adult beetles, particularly oriental and green

beetles, while bolus samples from laughing gull chicks on the Joco Marsh colony immediately adjacent to JFK revealed the almost complete absence of beetles. The primary diet of the chicks was fish and crustacea.

From this study the authors concluded that the major attractive features of JFK with regard to gulls was the existence of short grass, large concentrations of emerging oriental beetles, and the presence of freshwater ponds on the taxiways and runways. Based on these findings, recommendations for laughing gull control were to increase the length of grass in key aeronautical areas, elimination of freshwater ponding, and maintenance of current levels of the JFK bird patrol. Gurien (now McCarthy) said JFK stated making the recommended changes in grass height would not be possible because of fire safety, visibility, and aesthetics (personal communication 1995). However, since then we at the Port Authority have assessed the grass height situation with regard to the fire hazard potential, and determined many of the laughing gulls are gone by mid August and the grass has not dried out until then, therefore tall grass does not constitute quite as significant of a fire hazard during the summer months as was believed.

With regard to visibility, we purchased vehicles that drive higher so we can see over the grasses. Wherever the high grasses interfere with the FAA equipment, we cut the grass low. Aesthetics is the easiest, and sometimes the most difficult issue to deal with. It is easy because aesthetics do not constitute a safety hazard, so it is possible to do things that impinge on aesthetics without increasing any risk or danger to the flying public. It is very difficult to change people's perceptions, mores, and procedures. We at JFK work hard to create an aesthetically pleasing airport, both airside and landside. Many people feel that short grass is clean and attractive, and long grass is messy and unkempt. Therefore, regardless of a potential safety hazard, it is difficult to change procedures to manage previously short grass areas as long grass areas. Even though Buckley and Gurien could not mobilize sufficient persuasive, diplomatic, or managerial skills to enact such changes, it has since been possible through internal mechanisms to make all of the above changes. JFK and everyone flying in and out of the airport are the direct beneficiaries.

We now manage the grassy areas where laughing gulls had proven to be a problem in a manner that is consistent with the recommendations of the Buckley and Gurien study. Airside grassy areas were found to attract laughing gulls when certain insects emerged, and for this reason we do not cut these grassy areas from May 1 through August 1, except around approach lighting, FAA equipment, propane cannons, and signs. In 1995, after ceasing grass cutting on the airside, we did not have any complaints from the Bird Control Unit that the laughing gulls were resting and feeding on insects in the grassy areas, and it may well be that the grass management had also eliminated the gulls that had once been attracted to freshwater ponding on taxiways and runways.

In 1995, although we planned to resume cutting the grass short on airside at the beginning of August, we extended this date until August 15 because there were still large numbers of laughing gulls in the area, it was warm and there were many insects available

in the tall grass, and we were afraid that when we cut the grass large numbers of starlings, cowbirds, and other "blackbirds" might begin using airside habitats for feeding.

The extension to the middle of August worked well for everyone and it kept the number of birds over the airport low, perhaps in part due to this management decision. As soon as grass cutting resumed, I began surveying the cut areas and compared them to the areas that were not cut, to determine if there was a statistically significant difference in the number of birds utilizing these two habitats. We concluded, for the first month of cutting there was not much of a difference. The reason there is a first month of cutting, as opposed to say all the grass being cut in one week, is because grass cutting takes place over a very long period of time, considering how much area needs to be cut. The blades are set at the lowest rung so the cutters will not have to return before the snow arrives. The grass should be as low as possible by the time the snow arrives so the snow has somewhere to blow, otherwise we can end up with high drifts up against the high grass. This keeps snow blowing around on the runways and taxiways, creating a more dangerous airport. It is our preference to get the grass as low as possible by the time the winter sets in so the snow will blow off the runways and taxiways and disperse over the vegetated areas.

On areas of the airport where we have not had problems with laughing gulls feeding on the ground where grass grows, we have a cutting regimen that continues during the summer. At present these regimens are proving to coincide with our overall ecosystem management needs. We are monitoring the Van Wyck entrance to Federal Circle, the Van Wyck from Federal Circle to Building 269, 150th Street to North Boundary Road, the cargo areas, Central Terminal Area, areas west of Building 141, and the North Boundary Road. Currently the cutting regimens at each of these locations are controlled, monitored, and are proving effective.

Even though 97% of the laughing gulls observed in the Buckley and Gurien study were recorded in short grass, it needs to be pointed out that in 1985 the cumulative number of laughing gulls recorded on the airport in this study area totaled 482, and during 1985 there were 2,741 pairs of laughing gulls nesting on Joco Marsh; the number of laughing gulls on their airport reflected repeat individuals and were only a small percent of the breeding population. In 1986 the cumulative number of laughing gulls observed on the airport in the study area was 548. All the laughing gulls observed in the study area were juveniles and non-breeders. Of the carcasses collected at the airport, none appeared to be current breeders, strongly suggesting that laughing gulls using the airport were non-breeders. In 1995 no juvenile laughing gulls were observed feeding at JFK. Apparently, this stage in the bird's life history is now spent elsewhere. During the summer of 1995 we observed thousands of juvenile laughing gulls in Staten Island at the Fresh Kills Landfill. Apparently the Fresh Kills site has become the dominant resting, feeding, and drinking area of choice since JFK has no juveniles resting, feeding, or drinking here any longer, and thousands inhabiting this region spend their time elsewhere. Therefore, we have succeeded in eliminating the entire problem recognized by Buckley and Gurien in their 1985 and 1986 study. It needs to be pointed out here that the Buckley and Gurien

study was designed, conducted, analyzed, and written by National Park Service personnel. However it is the National Park Service which has continued for the next 10 years at harping about the grass, insects, and standing water problems at JFK with respect to all the laughing gulls they are attracting from Joco Marsh.

In 1985 and 1986 JFK was not attracting laughing gulls from Joco Marsh. The laughing gulls resting, feeding, and drinking here were juveniles, therefore they were not breeding birds, and therefore they were just spending part of their year at the airport because this habitat satisfied some of their requirements. Now that the airport is managed differently, no juvenile laughing gulls are ever observed feeding on insects or loafing on the taxiways or runways. We conclude that it is time for both the National Park Service and the United States Fish and Wildlife Service to recognize that the grass management, insect management, and freshwater management problems as identified in the Buckley and Gurien study have all been eliminated. Since these constituted the focus of Category 1 problems that needed to be eliminated before JFK could commence Category 2 procedures (see record of decision), we feel it is time to move on to Category 2. But first, in the interests of those who would like to see that JFK really has considered all the problems at the airport with a tremendous amount of care that goes far beyond the required scope of the record of decision, we recommend that you read the remaining sections of this wildlife management plan. We are doing all that is possible at JFK to continue being the Harvard of Airports, with respect to our bird hazard management, ecosystem management, and wildlife management procedures. There isn't another airport in the world that has created the years of data showing the plants and animals at the airport and how they are managed. We continue to use this data set in conjunction with our bird strike record to find short term and long-term trends that reflect successes and areas that require additional attention.

Grass Species on the Aeronautical Side

Although the airside habitats referred to as short grass or tall grass actually have many more species beyond the grass species, which are identified in the above list of airside species

Fescue Grass

There are about a dozen *Festucas* in the eastern United States. *Festuca ovina* is common at JFK where its seeds are eaten by many bird species, including sparrows, buntings, finches, and larks. This grass species is also important to cottontail rabbits and various species of rodents.

Panic Grass

Panic grasses, commonly called switchgrass, occur in a wide variety of habitats and species. There are at least 160 species in the United States, and their identification can be difficult, therefore, most of the species we have at JFK are tentatively called Panicum sp., which just means they are here, but we have not identified them. One very common panic grass, Panicum virgatum, is very widespread on the airside. Another, Panicum amarum, is on the watch list of New York State. This species is uncommon throughout the state, and having a population here at the airport is significant.

The genus is an important food source to a wide range of bird species, including upland gamebirds, marsh and shore birds, and water fowl. At JFK Panicum virgatum is more important than any of the fescue grasses. It does very well on disturbed soils where it is an important primary species.

Common Reed

Phragmites australis is the tall grass with conspicuous seed plumes on top that flourishes along the shores and disturbed soils in low lying areas. This grass can tolerate high salinities and therefore does well both along freshwater, saltwater, and brackish habitats. This species often grows in habitats that attract waterfowl and bird species that need to be managed at an airport. We use Phragmites as an indicator species, one that helps us identify areas that need more habitat management. In addition, Phragmites is a fire hazard and can bring ground visibility to zero where it grows high. In wet areas we have used mowing, better drainage, and fill to affect the habitats and change the species composition from being dominated by Phragmites to its being just one of many species, one that doesn't do particularly well in the altered habitat.

Bristlegrass

Setaria sp. are the bristlegrasses, of which there are about 13 in the United States, and most live in the eastern states. It is very high on the list of important grass species for wildlife, particularly birds. The bristlegrasses on JFK's airside are not as common as Panicum virgatum.

Grass Management on Landside

Grassy areas next to roadways are maintained on the airport with grasses regularly mowed to a short length. In particular, the mowed grass adjoining the roadways at the two main entrances to the airport are maintained as short grass because they do not attract significant numbers of laughing gulls. It is only long grass areas on airside that are

occasionally mowed, that attract laughing gulls during the summer right after the mowing. We conducted surveys during the summer of 1995 on landside habitats and found the short grass areas do not present a laughing gull attractant.

Grass Species That Grow As Weeds

Digitaria spp.

Digitaria is the crabgrass genus, which contains a number of common weeds that grow in lawns on JFK's landside. The common Digitaria sp. at JFK is hardy and competes well with the planted grasses and other weeds. It provides excellent food for mourning doves, sparrow species, cowbirds, larks, and juncos. It is also eaten by rabbits.

Grass Species Planted

Big Blue Stem (Andropogon gerardi)

Little Blue Stem (Andropogon scoparius)

Sand Love Grass (Eriogrostis trichodes)

Indian Grass (Sorghastrum avenaceum)

CHAPTER FOUR

Insect Control

Insects Provide Food for Birds

Many urban birds eat insects (Garber 1987, 1989c) and many bird species that migrate through urban areas eat insects, as do many bird species not usually thought of as urban tolerant species, but nevertheless are found on JFK's property, largely because airport habitats provide opportunities for these birds. Insect control is important at an airport if insects are attracting birds that increase the risk to safe operations.

Regulated Airports

Problems are compounded at international airports when insects are not controlled because this increases the risk of becoming regulated by the United States Department of Agriculture increases. At regulated airports all aircraft must be sprayed with insecticides before departing on international flights (for the precise list of nations, times of year, and types and amounts of pesticides to be used, contact the United States Department of Agriculture). In particular, because of the non-native Japanese beetle (Popillia japonica) (Garber 1990a) at JFK, in 1982 JFK was about to become a regulated airport. Were this to happen, departing flights would have to be sprayed, which would mean it would cost the airlines down time, and would expose passengers to potentially dangerous chemicals. To avoid these possibilities, JFK investigated ways to prevent the Japanese beetles from

being a problem at the airport so the aircraft would not have to be sprayed. Different insecticides were investigated, as well as milky spore. Because it takes years for milky spore to become effective, pesticides were used. In addition, neighboring communities like JFK to spray because of the mosquitoes. It was also felt that employees of the Port Authority preferred pesticides because they improve working conditions.

Because researchers hired by JFK to quantify the on-airport attractants found certain species of insects that provide food for bird species that otherwise might not be attracted to the airport, JFK has made significant efforts to control these insects species. The most important arthropodan attractants on the airport and adjacent areas are now controlled through a variety of means and habitat manipulations. Most of our methods do not involve chemicals, but rather are based on: 1) plant species that are recommended and not recommended for the airport, 2) grassland management, and 3) freshwater availability.

Pesticides

It has also been determined that spraying pesticides is an important method that should be continued. For this reason, JFK hired National Helicopter to spray pesticides every other Sunday from May 21, 1995 until the insects no longer appeared to present an attractant to the birds. In 1995, National Helicopter sprayed the following 6 times: May 21, June 4, June 18, July 2, July 16, and July 30. The spray applied first was Abate 4E (Lavacide), 1.0 to 1.5 ounces of material was used. Subsequent applications involved Nine (9) Dibrom 14 (Adulticide). 1.0 ounces of the material was mixed with 24 ounces of pre-mix solution and 6.0 to 8.0 ounces of kerosene. The above solution was mixed with water and applied to wetlands adjacent to Runway 4R-22L, to the grassy areas between 4R and 4L, as well as to adjacent areas next to the airport where insects appeared to be an attractant; these were at Howard Beach and at the Waxman Property.

Applications target mosquitoes, as well as the species known to be taken by laughing gulls, which include flying ants, green June beetles (*Cotinus nitida*), dogday cicadas (*Tibicen chloromera*), Oriental beetles (*Anomala orientalis*), Asiatic garden beetles (*Maladera castanea*), Japanese beetles (*Popillia japonica*), ground beetles, dung beetles, stink bugs, European chafers (*Amphimallon majalis*), American cockroaches (*Periplaneta americana*), crickets, and grasshoppers. Of the ant species reported, there are carpenter and field ants (Sweet 1993; Garber, unpublished data). The smaller of the two, field ants, were in a winged phase flying over JFK from about 5:00 PM until 7:00 PM on October 2, 1995. The ants flew over JFK from the sewage treatment plant area in the direction of the bay runway. Associated with them were mostly immature laughing gulls that were insecting. When the birds got near the runway they were harassed with pyrotechnics and successfully kept away from the runway and far from the flight path of the aircraft. Four families of beetles were observed: Scarabidae, Carabidae, Tenebrionidae, and Cicindelidae. Fly species, in addition to mosquitoes, include

greenhead horseflies, which are found during the summer in abundance on airside. Green darner and amberwing dragonflies are seen at the airport, although many more species are seen in New York City (Garber 1988a, 1989d). To date we have yet to begin a full accounting of the insects found at JFK, but we are in the planning stage so we can establish baseline data.

CHAPTER FIVE

Water Management at John F. Kennedy International Airport

Water Retention Management

History

Because standing water appeared to be a bird attractant, the Port Authority of New York and New Jersey funded research that addressed questions including whether standing water at the airport might act as a bird attractant (Buckley and Gurien 1985; Griffin and Hoopes 1991). The final reports from these studies led JFK to recognize that standing water can act as an attractant to birds, and ever since, JFK has made a concerted and continued effort to eliminate areas where water retention is a problem. Because the airport is built on dredge spoils that were deposited on wetlands, there is constant settling throughout the airport. This continually creates new low areas where water collects after it rains. As a result, low areas are identified and contracts assigned to eliminate the water-related problems.

Contracts to Eliminate Standing Water

To eliminate standing fresh water on JFK, 25 contracts have been completed from 1992 until present that eliminated areas of standing water by either creating or improving drainage (Garber 1995b). Many more contracts have been put out for bid or are currently under construction. Below are the completed contracts that greatly improved drainage in areas where there had been water retention problems:

- 1) Rehabilitation of taxiway "H" at the International Arrivals Building Ramp. JFK-690. Drainage. Completed 1992.
- 2) Taxiway "F" and "J" Modifications. JFK-220,073. Drainage. Completed 1992.
- 3) Rehabilitation of taxiways "I" and "O." JFK-630. Drainage. Completed 1992.
- 4) Rehabilitation of taxiway "P." JFK-660. Drainage. Completed 1992.
- 5) Rehabilitation of runway 4R-22L. JFK-663. Drainage. Completed 1992.
- 6) Rehabilitation of taxiways "R" and "S." JFK-672. Drainage. Completed 1992.
- 7) Rehabilitation of taxiways "KK" at the International Arrivals Building Ramp. JFK-677. Drainage. Completed 1992.
- 8) Installation of wick drains. JFK-220,070. Provide for installation of wick drains in grassy areas between runways 4L and 4R to improve drainage. Completed 1992.
- 9) Aeronautical improvements - phase IIIA. JFK-220,069. Construction of new taxiway sections "ZB", "MB", and "ZA," with provisions for better drainage. Completed 1993.
- 10) Relocation of taxiways "I" and "O." JFK-220,067. Drainage. Completed 1994.
- 11) Fibrous concrete rehabilitation of runway 13L. JFK702. Drainage. Completed by the end of 1995
- 12) Taxiway "QD" widening. JFK-804,101. Provides for drainage work. Completed 1993
- 13) Rehabilitation of runway 13L-31R. JFK-720. Provides for drainage work. Completed 1993.
- 14) Protect RC pipes JFK-220,076. Provides for drainage work. Completed 1993.

15) Aeronautical capacity improvements Phase III B. JFK-220.077. Provides for storm water pipe lines to Thurston Basin and Jamaica Bay. The drainage lines are for the newly constructed taxiway "ZB". Work includes installation of culverts and construction of outfalls. Completed 1994.

16) Rehabilitation of runway 13R-31L. JFK-736. Provides for drainage work. Completed 1994.

17) Aeronautical paving repairs. JFK-722. Provides for drainage work to taxiway "Z" from taxiway "H" to runway 31L, taxiway "L" from runway 31L to Building 54, taxiway "A" from runway 13L to taxiway "O." Completed 1993.

18) Rehabilitation of boat ramp south of runway 4R. JFK-711. Provides for drainage. Completed 1993.

19) Rehabilitation of boat ramp and adjacent outfall #13. JFK-730. Provides for drainage. Completed 1993.

20) Rehabilitation of erosion pavement. A3-900.103. Provides for drainage improvements between taxiway "I" and "O." Completed 1993.

21) Rehabilitation of International Arrivals Building apron pavement. JFK-721. Corrects ponding condition at various gate positions and hardstands, and provides much better drainage throughout the area. Completed 1993.

22) Rehabilitation of taxiway "G" at the International Arrivals Building ramp. JFK-725. Provides for drainage work. Completed 1993.

23) Rehabilitation of taxiway "E." JFK-746. Provides for drainage work. Completed 1994.

24) Rehabilitation of various taxiways. JFK-A. Provides for drainage work. Completed 1994.

25) Rehabilitation of eroding pavement. JFK-YYY. Provides for drainage work. Completed 1994.

Wetlands Delineation

In addition to standing water problems on the tarmac, JFK has worked to eliminate standing water problems between the taxiways and runways, and east of the 4s. Most recently, we prepared a report in which these wetlands were delineated (Malcolm Pirnie

1995). This final report delineates the wetlands between runways 4L and 4R and east of 4R. The purpose of the delineation is to provide the baseline information to be used by the regulatory agencies when determining the extent of filling allowed. The critical reasons for filling these areas is to reduce the on-airport bird attractant that has been identified in the areas where water accumulates. In addition, the wetlands delineation will contribute to the growing database of natural resources at the airport.

With these areas identified and delineated, we are in the process of applying for permits to fill them in. It needs to be stated that the majority of wetlands on the airport that were identified as bird attractants were filled in before the Final Environmental Impact Statement concerning the laughing gulls was completed in 1994. The Environmental Impact Statement was created by the National Park Service, Fish and Wildlife Service, and the Department of Agriculture. These governmental agencies agreed on a program to improve public safety through reducing the hazards to the flying public that result from laughing gull bird strikes. The agreed upon program presented in the EIS is termed the Integrated Management Program as the selected alternative to the shooting program. However, the National Park Service then adopted a policy that all applicable components of the Integrated Management Program must be employed off the National Park Service land and be determined as ineffective in reducing bird strikes at JFK, before any component of the Integrated Management Program could be pursued on the National Park Service property.

In the Environmental Impact Statement's Record of Decision, however, on airport bird attractants, components of "Category 1," were well under control by 1994. That is, Category 1 aspects of the Integrated Management Program, which are those off the National Park Service property, had to be dealt with to the satisfaction of the National Park Service before the National Park Service would allow the airport to start dealing with "Category 2" problems, those problems that occur on the National Park Service property. Because the Joco Marsh complex is where the laughing gulls breed, and because this property is managed by the National Park Service, the National Park Service has, in effect, found a way to allow thousands of their birds to be shot every year, and thousands more to die of starvation, just so the National Park Service can maintain a monopoly on breeding laughing gulls in New York State. Meanwhile, the Port Authority wants to pay to establish a new colony off Park Service property, and the National Park Service is doing everything possible to stall such an eventuality.

Because the Blue Ribbon Panel of International Experts who were chosen by the National Park Service all concurred that the breeding colony of laughing gulls would have to be moved from Joco Marsh, and because the Department of the Interior's Fish and Wildlife Service and the National Park Service also agreed in the Final Environmental Impact Statement, one might think the National Park Service would want to expedite such an eventuality as quickly as possible, so as few birds as possible die and to diminish any chance that there might be an aviation disaster during the interim. Over time it has become increasingly apparent that the longer we are forced to wait to move

the birds from Joco to a new site, the longer we have to tolerate what the experts have agreed is an intolerable situation.

With the governmental regulatory agencies' agreements as they currently stand, it could easily take another 15 years before the National Park Service begins to deal with the Port Authority's request to begin Category 2. In the intervening time another 100,000 birds will be shot, and easily that number of chicks will die on National Park Service property because the adult birds never return to them. This is not a good policy, yet this is the policy that the National Park Service has chosen. They feel it is best to force us to kill thousands of birds, to let thousands more die due to starvation, allowing birds to fly through JFK airspace that endanger the flying public.

To continue killing so many birds as a direct result of government inaction is in direct contravention of the governmental agencies' EIS. It is the mission of the National Park Service to protect the birds living on its property, however, with the policies currently in place, the National Park Service is causing massive death of its birds. The National Park Service needs to end their failed policy of inaction and stonewalling and allow the Port Authority to begin measures that will expedite the cessation of all unnecessary shooting. The Port Authority has repeatedly stated we could move the laughing gull colony in three years from the moment the National Park Service gives us the go-ahead.

Yet five years have already passed during which time the shooting has continued as a result of the National Park Service working to keep the shooting going. During these five years the Department of Agriculture has shot a total of 46,432 gulls at JFK. These include 42,389 laughing gulls, 3,014 herring gulls, 569 great black-backed gulls, and 460 ring-billed gulls. The Port Authority wants to stop the senseless killing, and the National Park Service continues to stand in our way. With the 1994 EIS, that was coauthored by the National Park Service, was written so they can hold up the only logical solution to this terrible situation for as many more years as they choose. In the meantime, thousands more birds will die senselessly, while the Port Authority continues to do practically everything stated in the EIS, word by word, in an ongoing effort to keep the airport safe from laughing gull-related bird strikes. It is true that there is a slight difference of opinion regarding the understanding of what the ROD requires, and the Port Authority has had many meetings with members of each of the regulatory agencies to solve these misunderstandings. Substantial progress has been made, but sometimes it seems like nothing will solve these slight disagreements.

It is for the above reasons that the Port Authority is going above and beyond the letter of the law, and is doing everything possible to satisfy the intent and meaning of each of the points in the ROD. Included in our overall water retention management is the need to fill in the remaining areas on the airport that still hold water during part of the year. The sites have been delineated and filling has been prioritized based on which areas are most critical with regard to being on-airport bird attractants. As of December 19, 1995 the wetlands prioritization listing included 21 designated areas. Based on the names of each of the wetlands designated in the 1995 JFKIA Wetlands Delineation Report, in

descending order from 1 to 21, 1 being the most important, the sites are: 1) AA, 2) A, 3) C, 4) DD, 5) RA, 6) B, 7) F, 8) G, 9) J, 10) D, 11) R, 12) Q, 13) H, 14) K, 15) L, 16) M, 17) RB, 18) RD, 19) EE, 20) FF, and 21) RC.

The first stages of the permitting process have begun, and when we have completed the permitting procedures for the designated areas, work will commence. This will further our compliance with the Record of Decision and should expedite efforts to reach Category 2. The cost is high, the time from start to completion will be over a year, and the benefits become less meaningful when considering that once the laughing gull colony is moved, on-airport attractants are no longer important with regard to laughing gulls. The problem is not that there are a few very dry, upland Phragmites habitats east of the 4s, the problem is that there is a huge colony of laughing gulls adjacent to a very busy airport. However, JFK will eliminate these wet areas to be in full compliance with the National Park Service's policy.

All areas being considered are not shoreline wetlands, rather they are either adjacent to shoreline, or more inland. New York State Department of Environmental Conservation regulates such wetlands when they are over 5 hectares (12.4 acres). If the wetlands are separated by non-wetlands within 50 meters, the two areas are automatically considered one unit. If two areas are hydrologically connected, even if they are over 50 meters from one another, they are considered one wetland unit. Permits must also be obtained from the United States Army Corps of Engineers regardless of size. The Corps looks at all wetlands under the Nationwide Maintenance" ruling. If the permitting goes through under "Filling Isolated Waters", the Nationwide permitting procedure is necessary when a unit exceeds one acre.

When the colony is relocated, the airport will be safer, the birds will be safer, and finally laughing gulls will be able to continue their recolonization of New York. Their recolonization efforts will, in effect, remain stalled as long as the only laughing gull colony in New York is one where the birds returning to nest each year find a colony with only 6,000 pairs of nesting birds. Once there are 40,000 nests, the birds will start establishing new colonies on their own, but as long as the Department of Agriculture's Animal Damage Control continues to shoot the laughing gulls, the colony will remain at a size that is too small to spawn major recolonization efforts.

Dispatching Ponding

After it rains we dispatch ponding on the airport with procedures that prevent this on-airport attraction. Water dispersal occurs during daylight hours after it rains, or upon daybreak if it rained during the previous night. It is the responsibility of the Airport Duty Manager to ensure that the Bird Supervisor has made the appropriate notifications. The Bird Supervisor "97" on duty is responsible for prioritizing the ponding areas and for contacting Port Authority Maintenance Crew that does the dispatching with the

Schorling brooms. At any given time during the summer we have between 12 to 15 operational Schorling brooms. Two have buckets installed to remove clam shells from the runways and taxiways, that are deposited in these locations by feeding herring gulls. The brooms without the buckets use the brushes to disperse standing water in an ongoing effort to insure it dissipates and evaporates more rapidly. The problem is taken seriously and the water is dispatched in a timely manner.

CHAPTER SIX

Solid Waste at John F. Kennedy International Airport

Solid Waste Management

Taxi Problem Solved

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

Now, all the holding areas have been centralized at the Central Taxi Hold which holds 350+ taxis. The Central Taxi Hold, located at 148th Street off the JFK Expressway, was opened May 9, 1995 and the T.U.C.S. Cleaning Service was awarded the contract to keep the area freed of garbage and all other possible bird attractants. We continue to monitor

the area and are pleased to report that it is clean, there is no garbage on the pavement, taxi drivers are no longer feeding the birds, in part because there is no garbage to attract birds to feeds, and because there are no birds in the area in the first place, and the garbage canisters have been designed to be bird proof. T.U.C.S. Cleaning Service continues to do an excellent job of keeping the area bird free, and should we ever have any complaints, Marianne Pellegrino, the Manager of Unit Terminal Buildings, will take care of the situation immediately.

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

Central Taxihold Expansion

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

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

Department of Sanitation

In Jamaica, Queens, north of JFK, not far from the airport, is a site where the Department of Sanitation Jamaica has a garbage truck staging site where they park many of their trucks. Material is moved there, a certain amount of loading and spillage, and the result has been that the area smells, is unattractive, and it was a significant bird attractant. As a result of observations made by JFK's Bird Control Unit, we determined that some of the birds flying over JFK were on route to this feeding area. JFK's General Manager, Robert Kelly, JFK's Manager of Security and Landside Services, Charles Seliga, and JFK's Maintenance Manager, Gennaro Spanpanato worked with the Port Authority's former Director of the Office of Environmental Policy and Management, Marcia Brystyn, who previously worked for New York City's Department of Sanitation, in an attempt to see if the Department of Sanitation might maintain their area in a manner that would not attract birds. JFK supplied certain materials, and Sanitation made some changes, and the net result has been that our combined efforts have been successful. The area is no longer a bird attractant, therefore we solved this solid waste management problem.

Open Dumpsters

It has become the policy of the Port Authority and all their tenants to place all organic matter in plastic garbage bags that then are stored in closed trash collection containers. The dumpsters are emptied 5 to 7 times per week. Three trucks police the airport to be sure garbage is removed in a timely manner. The Port Authority has recommended that all airport tenants continually review their trash containers' adequacy for handling trash, and if more removals are required, they should contact their contractor. The contractor for most trash removal at JFK is Baisley Carting of Jamaica, New York (718 656-5272).

Garbage Violations

To follow-up on our solid waste policies, we hand out environmental violations to anyone on the airport who is not complying with our procedures. If we find dumpsters that are not shut properly, with improperly pack material inside, with improper material inside, that have not been adequately maintained surrounding the dumpster, or if we find any illegal dumping, or other solid waste infractions, we write up the violation and request a written response telling us what corrective actions have been taken and within what time frame. These infractions must be addressed rapidly to avoid possible fines or other penalties. We keep records on all environmental violations at the airport and monitor the number of environmental violations. To date the number of dumpster violations has ranged from 0 to 10 a month, averaging less than 5 per month. The supervisor in charge is Richard Jarvis (718 244-3608).

CHAPTER SEVEN

Bird Management at John F. Kennedy International Airport

Bird Control Unit

Bird Control Unit Training Program

As part of Port Authority's overall plan to reduce bird attractants the Port Authority has been conducting a training program for all the people in the Bird Control Unit. On April 25, 1995 we kicked off JFK's new program with Wayne Peterson from the Massachusetts Audubon Society who presented an excellent program about the history of birds in the northeastern United States and their relationship to different, changing habitats. He also provided information on birds found at JFK, why these species are found here, and what types of monitoring can be done to develop useful management plans.

On May 31, 1995 the training program was held at the Jamaica Bay Wildlife Refuge during which time Janet Bucknall, Wildlife Biologist and State Director in the Pittstown,

New Jersey office of the United States Department of Agriculture Animal and Plant Health Inspection Service and Animal Damage Control, made an excellent presentation. Proper use of harassment and pyrotechnic devices and techniques was discussed and displayed. Steve Garber, Port Authority's Wildlife Biologist, explained data collection methods. Robert Kelly, JFK's General Manager, addressed the Bird Control Unit about the importance of wildlife management to the operation of a safe airport. Arthur Stewart, the Deputy General Superintendent of the National Park Service's Gateway National Recreation Area, and David Avrin, the Assistant Superintendent of the Jamaica Bay Wildlife Refuge each made presentations concerning the many resources offered by the National Park and the personnel. They generously made their experts available for the day and invited us to return for future sessions devoted to bird identification. Don Riepe, Jamaica Bay Wildlife Refuge's Operations Specialist, conducted a slide-assisted presentation about the birds of Jamaica Bay, their identification and behavior. Then everyone went out in the field with Nancy Corona and Kathy Krause, both of whom are Park Rangers and experts at bird identification, and together we provided practically a one-on-one instruction on bird identification for the entire Bird Control Unit. June 23, 1995 JFK's Bird Control Unit's training session was held at the airport. William Giezantanner of Massachusetts Audubon Society, who has taught at Harvard University for years, addressed the group about habitat management. This laid the ground work for the afternoon's presentation by Dr. Andrew Greller who spoke about JFK's grassland communities. Dr. Greller teaches at Queens College of the City University of New York. He was assisted by his postdoctoral fellow, another plant expert. The entire Bird Control Unit spent the afternoon in the field observing each of the primary grassland and shrubland habitats on the airport. The bird species that are attracted to each of these habitats was discussed, and reasons for these attractions were explained. We have training programs planned for the rest of this year, and have training programs planned for 1996, the first of which is scheduled for January 3 and 4. These two all day classes will comprise a bird identification course. We feel this it is useful to continue to teach bird identification because bird identification is something that you constantly build on.

Another part of our training program involves having bird experts spend time doing the Bird Control Unit's job one-on-one with a member of the Bird Control Unit. Once or twice a week we have been taking members of the Unit out for one-on-one training. This training is being spent while conducting the bird surveys. We emphasize that these surveys are not being conducted by other experts, rather experts are training our people.

The bird surveys will provide much valuable information: 1) the surveys will give us an additional index about the relative number of each bird species on the airport. From this we will have a better idea of how to assess the relative increase or decrease in numbers due to different management regimen. 2) Surveys also help us know how many birds of each species are flying over the airport per hour. This way, we will not have to wait for bird strikes to increase to know there has been an important shift in bird numbers, we will see the activity change as reflected in the weekly surveys. Below are the methods that the members of the Bird Control Unit should employ when conducting the surveys, and these are the methods that experts will use when coming here to assist in our field

training. We hope that the Bird Control Unit will comply with the methods that are listed below:

Bird Surveys Are To Be Conducted All Year Round

- During the daylight savings time each survey is to begin between 6:05AM to 7:05AM, and last until 7:50AM to 9:15AM. During eastern standard time each survey is to begin between 7:05AM and 8:05AM and last until 8:50AM to 10:15AM.
- Each supervisor should lead a minimum of one bird survey each week.
- A bird survey requires two people, a supervisor and either an agent or another supervisor, or the wildlife biologist, or an outside bird expert.
- The survey is to stop at stations A through M.
- Three minutes per station.
- Drive at 8 miles per hour between stations.
- Both the supervisor and the second person are to get out of the car at each stop, and stay out of the car throughout the 3 minutes.
- The vehicle is to be shut off while at the three minute stop.
- Each bird survey should not be interrupted, if at all possible.

Bird Control Unit Equipment

In the Bird Supervisor's office are bird identification guides, binoculars, supplies of pyrotechnics, shotguns, and ammunition. The Bird Control Unit is equipped with three vehicles. As a result of a survey in which the 25 members of the Bird Control Unit were questioned about the number and condition of their vehicles and the equipment available to them with regard to their effectiveness in the field, we have responded by upgrading the vehicles so now they are all new and each is four wheel drive. This is because the Bird Control Unit members felt that due to their lengthy patrols under all weather conditions, and the speed with which they had to respond to a wide range of possible contingencies, it was imperative that their vehicles be sturdy, dependable, and able to get over or through virtually everything.

The vehicles have a tape player with loudspeakers outside the vehicle to project the sounds of bird distress calls. Each vehicle is equipped with tapes of herring, ring-billed,

and great black-backed gulls, starlings, crows, and red-winged blackbirds. They also have shotgun mounts. 17 propane cannons are positioned between the runways and Jamaica Bay at approximately 300 yard intervals. They are kept in good working order by the Maintenance Department. Each of the shotguns is a 12 gauge, the flare pistols are 12 gauge, and the starter pistols are 6 mm. All are stored in a locked gun safe. In addition to 25 pairs of binoculars, the Bird Control Unit is equipped with two spotting scopes. The resource library in the Wildlife Biologist's office is modest in comparison to the rest of this resource that is the personal library of the Wildlife Biologist. This library is available and always being used; it amounts to over 3,000 volumes and in excess of 50,000 reprints. The library is devoted to wildlife-related topics, the subjects covered include ornithology, entomology, botany, and wildlife management.

On October 27, 1995 everyone in the Bird Control Unit was given rubber gloves for handling birds. This was because some birds have been known to carry diseases. As these gloves are used, there are more that Frank Heuer will dispense whenever they are requested.

Bird Control Unit Activities

It was not until the Overseas National Airways accident in November 1975 at JFK that we began to take the risk from bird strikes very seriously. An organized, full-time, bird control unit at JFK has existed here for more than 10 years which has given us time to improve the operation to the point where we are now very effective, knowledgeable, and efficient, but we are constantly working to improve our operation. We were not the first to establish a full-time bird control unit, although we were among the first in North America. Europe led the way in the mid-1960s, and we followed their lead, and quickly became an airport that was closely watched by others in the industry. Part of the reason was JFK had problems that were always in the news, partially because JFK is located in New York City, and New York is a media capitol where everything that happens locally becomes the center of attention everywhere else. But JFK also had problems that were bigger than everywhere else, and as soon as we solved one problem, another, even bigger one cropped up. That has been the way it is here, which is why we have had to work so hard to solve our problems. Solving problems in New York is not as easy as it might be elsewhere. America is a highly litigious society, with a vast complex of environmental laws. City, state, and federal regulations sometimes conspire against the flying public, and we at JFK have done our best to negotiate our way through the legal framework. In addition, working with nature does not lend itself to a single routine that is 100% effective, species are constantly changing in abundance, their feeding habits vary, and their use of the habitats in the JFK area are always in flux.

The success of JFK's Bird Control Unit can be measured quite easily. We had a disaster in 1975, responded quickly by organizing our Bird Control Unit, and with subsequent improvements we have effectively avoided any subsequent disasters. No one has ever

died at JFK due to a bird-related incident. This does not mean that we can ever rest, constant vigilance is the only way to manage the pervasive bird problems here. We are on the field keeping the runways clear 7 days a week, 52 weeks a year. Keeping the airways clear is more difficult, but we have established many measures that have improved safety at this airport. Our assignment is critical, which is why we expend so much time to understand the behavioral patterns and interactions of hundreds of species of plants and animals. The more we know about the ecology of this region, and specifically, of this airport, the more effective managers we can be of our bird-related hazards.

Bird Identification

It is very important for the members of the Bird Control Unit to be able to accurately identify the species of birds encountered. By knowing the species seen, it be possible to use the most effective control procedures for that species at that time of year. Through proper bird identification, and through increasing knowledge of the other species at and near the airport, such as mammals, insects, and plants, will it be possible for the Bird Control Unit to detect changes in the appearance and abundance of species, and to observe which species are using which habitats and food sources at any given time. Such observations become valuable when tabulated, analyzed, and monitored. It is then possible to make habitat management decisions that can be determined to be useful or not.

Bird control work is constantly changing, by virtue of the fact that you are interacting with natural systems that are complex and in flux. As people change the natural environment, the natural environment accommodates and adapts to the new opportunities that become available. When a marsh is filled or a channel dredged, or a woodland cut, or a grassland mowed, biological resources jockey for position. For instance, the moment a grassland is mowed insects that were hidden under several feet of vegetation become exposed, and avian opportunists may seize the moment by arriving in flocks to feed. If such opportunities are anticipated, through years of accumulated experience, then the management regimen of 10 square miles of differing habitats can be modified to reduce the on-airport bird attractants, and in the process make JFK a much safer airport to fly in and out of.

Over the months and years it is important to observe and anticipate the "normal" changes in these habitats, such as seasonal changes in species and their behaviors, and particularly those species that affect Bird Control Unit operations. It is also important for the Bird Control Unit to recognize the changes that require it to take action. Since 1979 62 bird species have been involved in bird strike incidents; of these, 19 species account for 81 percent of the bird strikes by aircraft, and four species of gulls account for 76.5 percent of the bird strikes. Waterfowl also pose a significant danger, and increased awareness of this group of species is of paramount importance. Even rock doves, more commonly

called pigeons, contribute to the total number of bird strikes at JFK, and this species needs to be observed and managed. We saw on June 3, 1995 when an Air France Concorde struck several Canada geese, and two engines caught fire and were turned off, that the unexpected can have dire consequences. In the last 20 years there had never been a Canada goose bird strike during the month of June. In June geese in Jamaica Bay prefer to be near East and West Ponds at the Jamaica Bay Wildlife Refuge (Burger et al. 1983).

Unique Species Responses

Each bird species has its own repertoire of responses to environmental conditions including fright response, escape response, and response to harassment. This is why it is so important for managers to learn how to identify all the different species that are found at the airport. It is only through correct species identification that we can solve each particular species-related problem.

Alarm Calls

Alarm calls alert and warn other birds of a potential danger in the area. Because alarm calls tend to have similar characteristics, most are not species specific and can be recognized by many other species. However, many alarm calls are species specific; some species have multiple alarms, each for a particular type of danger. For instance, a laughing gull has an alarm for an airborne predator that differs for those predators that approach on the ground. The net effect of the alarm call is to render the individual and the other birds nearby, less likely to be either located or consumed by a predator. Apparently, for an alarm call to be effective, it needs to be sounded when there indeed is an associated danger. Therefore, if an alarm call is used without any real danger to the birds, such as the way they are often used at airports, the birds may habituate, that is, get used to the alarm and no longer disperse when it is used. Therefore, to be effective, it is best to integrate alarm calls with real danger. Or, suitable alarm calls should be switched, so the birds never have the time to habituate to any one in particular. oversee. This advocacy has led to many improvements: the number of species has increased since the National Park Service began managing the area and the number of breeding birds has been increasing through these decades which have spanned the 1970s, 1980s, and 1990s.

This advocacy has also led to many problems that create serious hazards for the flying public. Thousands of pairs of gulls nest on islands in the Jamaica Bay Wildlife Refuge. Three of these island adjacent to JFK's runways, and located on these islands is the only breeding colony of laughing gulls (*Larus atricilla*) in all of New York State. This colony is a protected resource, which is valued both by the National Park Service and the State

of New York's Department of Environmental Conservation. The protection of this colony has come at a very high cost, and ultimately, if this colony causes a plane crash, then the price will increase to the point where the colony becomes intolerable

Egg Oiling

JFK rapidly went from no laughing gull strikes per year to nearly 200 strikes per year, which exceeded the total number of bird strikes of all other species all year round, even though most of the laughing gull strikes occurred during two peak months each summer. This additional 200 bird strikes a year, added to the nearly 200 non-laughing gull bird strikes, brought JFK to nearly 400 bird strikes a year, and the number was rising. This figure was equal to approximately 12 bird strikes per 10,000 aircraft movements, which was many times higher than the industry's average. JFK had to reduce the risk, and therefore was actively seeking reasonable methods in an effort to avoid a terrible accident. JFK agreed to an international panel of experts, selected by the National Park Service, who studied the laughing gull situation at JFK and presented their solutions. The "Blue Ribbon Panel's Recommendations on Bird Hazards to Aircraft at JFK International Airport" was held in July 1989 at the National Park Service's Gateway National Recreation Area. The panel recommended that an effective control program be adopted, that included "oiling of all eggs in the laughing gull colony. This will ensure that the birds are tied to their nest and will not produce any offspring and thereby remove the need for repeated feeding flights across the airfield. We expect that this will reduce the sudden peak in bird strikes in June. The oiling of eggs would be the least hazardous approach to both aircraft and non target wildlife. If continued in successive years, oiling would be likely to result in the abandonment of the colony. Other control methods could be introduced in future years to speed up this process."

In 1990, with the approval of the National Park Service, the Port Authority hired scientists to begin an egg oiling program on the laughing gull colony. The intention was to nonlethally reduce the number of laughing gulls in the area in an effort to reduce the number of laughing gulls being struck by aircraft. However, after the 1990 field season, and after spending \$200,000 for the first year of work on what was planned to be a multi-year effort, the National Park Service abruptly withdrew its support of the program. Left with a rapidly approaching summer, during which the laughing gull hazards would have to be reduced, the airport opted for a lethal solution, one it preferred to avoid, but one which the National Park Service forced upon the Port Authority of New York and New Jersey. That is, with all the work to date that the airport was doing to reduce the on-airport bird attractants, still the number of laughing gulls flying over the airport and being struck by aircraft was increasing.

Because the National Park Service would not allow the Port Authority to move the birds, or to oil the eggs, or to alter the bird's nesting habitat, albeit temporarily, so the birds would not nest there, the airport had no choice other than using lethal means of

management. The Department of Agriculture's Animal Damage Control people began a shooting program which immediately reduced the number of laughing gulls flying over the airport, it also reduced the number of laughing gulls being struck by 90 percent. The shooting program was very successful in this regard, but it was an imperfect solution.

The Port Authority was locked into an program that involved a great deal of killing when there were much better solutions available, but none were possible as long as the National Park Service blocked the Port Authority from pursuing any of them. Then, the National Park Service began to fight the Port Authority's ability to use lethal means to manage the bird hazards. The Park Service worked with the press and outside groups to stop the airport's shooting program. The court's required Port Authority to provide two Environmental Assessments to show that shooting the birds was not doing irreparable harm to the environment. Then, a lawsuit brought on by the Fund for Animals required an Environmental Impact Statement, which is a more involved process, that usually costs a minimum of several hundred thousand dollars, often millions of dollars, and can take years to complete. However, the airport could not take more than several months, if it was to keep the airport safe when the laughing gulls returned. In record time an Environmental Impact Statement was prepared and submitted before the 1994 breeding season, and the shooting program continued.

Additional Methods of Bird Hazard Management

Beginning in 1991 the Port Authority has worked in collaboration with the United States Department of Agriculture to effect an intensive gull program at JFK. In these 5 years approximately 50,000 gulls have been shot. The agencies involved in creating the policy to shoot this number of birds have included the United States Fish and Wildlife Service, United States National Park Service, United States Animal Damage Control Program of the Animal and Plant Health Inspection Service of the United States Department of Agriculture, the Federal Aviation Administration, New York State Department of Environmental Conservation, New York City Department of Environmental Protection, and the Port Authority of New York and New Jersey. All the above agencies agree that the bird shooting program is necessary to maintain safety at JFK. In addition, this policy is also due to the legal framework resulting from procedures adhered to when working through the National Environmental Policy Act's steps that involved an environmental impact statement. Many environmentalists and environmental groups were also part of the process that helped lock the Port Authority into this shooting program that we are working so hard to move beyond.

Progress is being made toward creating a situation where such an extensive shooting program will no longer be necessary. On May 30, 1995 Port Authority submitted a "Plan for the establishment of a new laughing gull (*Larus atricilla*) breeding colony in the State of New York" (Garber 1995d) to the New York State Department of Environmental Conservation.

Integrated Management Program to Reduce Bird Hazards

As a direct result of the environmental impact statement, we are now legally bound to use an integrated management program to reduce gull hazards at JFK. In particular, when the Fish and Wildlife Service states that JFK has conducted all the Category 1 procedures, then it will be up to the National Park Service to agree with its regulatory sister co-agency within the United States Department of the Interior. When the Fish and Wildlife Service determines that the Port Authority is in compliance, we will have to wait for the National Park Service to allow us to begin the next phase clearly delineated in the final environmental impact statement. In the EIS, it stated that when Category 1 has run its course, Category 2 is to begin. With this, the National Park Service must agree to an integrated management program that includes working on the laughing gull colony to reduce the gull hazard to JFK. The EIS states in legally binding language that was written in cooperation with the National Park Service, that the Port Authority will move the laughing gulls off the colony.

Therefore, the time is near that the federal agencies will agree that the Port Authority has been effectively using vegetation management, water management, and solid waste management use insect control, bird sweeps, loudspeakers, distress calls, propane canons, and pyrotechnics as airport bird hazard reduction techniques with success. There are many other bird hazard management methods that we utilize to reduce the bird-related hazards at the airport. In an ongoing effort to improve the product of providing a safe airport for the public to use, we are utilizing and testing many other possible methods that might enhance our wildlife management program. For instance, we are even working with the New York State Department of Environmental Conservation to move the laughing gull colony to a new site, away from airplanes.

In light of all the efforts taken by the Port Authority to reduce bird-related hazards, the regulatory agencies have to agree that the problem with laughing gulls persists. Even with all the integrated bird hazard management procedures operating simultaneously and successfully, accurate indices show that even the best airport wildlife management procedures in the industry have been unable to bring the number of laughing gulls attempting to fly through JFK's airspace to a level where shooting is no longer necessary.

This past summer laughing gulls were attempting to fly over the airport in record numbers, not to feed here, not to drink here, no longer because they are attracted to the airport, but rather because they are just flying over the airport because they are attracted to habitats within over 100 square miles in the vicinity of the Joco Marsh laughing gull breeding colony. Therefore, according to the EIS and the record of decision, it is time to move to Category 2. Although bird patrols and pyrotechnics are two of the most important bird control methods used by the Bird Control Unit that keep birds off the runways.

We use an integrated management program that involves a constantly changing, always improving, mix of ecologically sensitive methods (Garber 1990b). We are also constantly evaluating and testing the efficacy of new methods. We are evaluating using raptors and falcons and stakes with colored or scented streamers. We use the ecology of the area to reduce some species and increase the number of others. Fire can be used to modify a habitat, predators can change the species mix, and the value of human harassment should never be underestimated. We have evaluated and considered many options. Although we prefer to use as many natural methods as possible, there are artificial and chemical agents that might have merit. Some of the chemical agents that we have evaluated are listed below:

Falcons

Falconry has been used to improve safety at the following Canadian airports: Toronto, Montreal, and Vancouver, in France they have been used in Paris, in Spain at Torrejon, and in England at Mildenhall, Lakenheath, Alconbury, Upper Heyford, Fairford, Lossiemouth, Yeovil, Bentwater, Woodbridge, Gatwick, Driffield, and Coltshall. JFK has never used falconry, but it has investigated the option several times. In 1979 falcons were considered to control gulls at the Fountain Avenue Dump. Because it was felt that falcons cannot effectively remove thousands of gulls from a landfill, the idea was dropped. Instead of using falcons, or the chemical sterilant being considered, the landfill was shut down. Again in 1983 falcons were considered as a possible solution to help alleviate the bird problems at JFK, however, airport management decided not to exercise the option because falcons do not fly at night or work in the rain, they will not attack large groups of gulls, a significant number of falcons would be a hazard to air navigation, and a test with falcons in Staten Island demonstrated a falcon that instead of going after any of the available gulls, chose a pigeon.

The concept was reconsidered in 1992 when Tom Cullen (1992) sent JFK a proposal to establish a falconry program at the airport. He felt 10 large falcons were needed to address the gull problems at JFK. Training and housing on the airport would insure full acclimation to the conditions that exist. He recommended a minimum of two falconer positions from dawn to dusk, 365 days a year. Again the idea was not felt to have sufficient merit to pursue seriously.

In 1995 we spoke with Mark Adams of Falcon Environmental Services of Montreal who wanted to set up a falcon program at JFK. Peter Serwylo of Peter Serwylo Wildlife Control in Dartmouth, Nova Scotia was also interested in setting up a falcon program at JFK. Michael Givlin of M.G. Wildlife Control in Burlington, Ontario, was also interested in establishing a program at the airport, and his cost for a trial period lasting a couple of weeks to test the effectiveness of laughing gull control using birds of prey, (working with the consulting firm Louis Berger and Associates) was \$44,175.74; this was not considered further. However, M.G. Wildlife Control has offered to set up a program

guaranteed to reduce bird strikes at JFK by 75 percent or else we pay nothing other than the costs to operate the program. Most recently Mark Marrone of Parrots of the World has proposed setting up a falconry program at the airport, which we are in the process of discussing.

Model Airplanes

Due to the increasing number of geese at the Reno Cannon International Airport in Nevada, the Airport Authority of Washoe County worked with radio-controlled model airplanes in the Truckee Meadows area east of the airport to persuade the geese to move from the area. This experiment was coordinated with 22 other agencies, which comprised the Canada Goose Task Force. This was written up in the article "Airport uses model airplanes to reduce dangerous geese flight patterns" on page 4 of the February 5, 1990 issue of the newsletter entitled Airport Highlights (1990).

Avitrol

Before using the bird frightening agent (toxicant) Avitrol (4-Aminopyridine) at LaGuardia Airport (see rock doves below), we evaluated most of the alternatives. Avitrol is a chemical that is applied to food that when eaten causes a physiological response that is so unpleasant, it is felt that the birds are repelled from the area afterward, possibly due to a fright response. This material is therefore most useful when attempting to deter birds from either established feeding sites, or sites that are established first, before adding the Avitrol to the feed. Untreated bait is first strategically placed near the feeding sites, or in a new site that is to be turned into a feeding station. After the birds are trained to feed there, treated bait is added to the untreated bait for the desired effect. Usually just a small portion of treated bait, on the order of 1-3% is adequate. Applications are repeated as often as is necessary. Before choosing Avitrol, other alternatives were considered.

Methyl Anthranilate

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

Alpha Chloralose

Alpha chloralose is a stupefying agent that produces an anesthetic affect inducing a sleep-like stupor in affected animals. The material is administered on a bait and is most useful for situations where capture and transport of animals to other locations is the bird removal method of choice. The United States Government is completing its series of tests and approval mechanisms for this chemical. There is no current operational policy at JFK to regarding its future use.

Contact Poisons, Netting, Owls, Ultrasonic Devices, Bird Scare Eyes, Nixalite

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

We planned to conduct an Avitrol test in August 1995. We have certified Pesticide Applicators, certified by the New York City Health Department to purchase Avitrol and to use it. The New York State Department of Environmental Conservation said we could use Avitrol which is approved in the State of New York, and it is a registered pesticide under the Federal Insecticide, Fungicide, and Rodenticide Act. But we needed approval from the New York City Health Department for this specific application. The Deputy Commissioner gave us permission over the phone. They do not give it in writing. For two weeks we baited the area with 4 cups of corn per hundred birds on a daily basis. Because we were feeding 200 hundred birds, the 8 cups were consumed each time the food was laid out. Within a short number of days the birds were there to feed at feeding time. After feeding them for two weeks we applied 1 part Avitrol-treated corn to 9 parts untreated corn. 6 to 7 percent of the pigeons died, only 25 birds returned, the rest left the premises and did not return. The young called for several days after and then went silent. Apparently the young just remain in place and starve to death, which is unfortunate. Three months later the number of pigeons increased to the point that another treatment was necessary. This time, in November 1995, there were 100 pigeons. The birds were baited for two weeks with 4 cups of corn each day. Then instead of using Avitrol in a 1 to 9 ratio, we used 1 to 19 to avoid such a high mortality, however still 6 to 7 percent of

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

During the years from 1988 through 1990, the number of gull-related bird strikes averaged 134 per year (for the period June 20 through August 17, which was the duration of the shooting program this year). This was before the Department of Agriculture began their shooting program. During the same days in the summer of 1995 the number of gull-related bird strikes was 31, a decrease of 76 percent. In summer of 1995, counted all the laughing gulls nesting on the colony adjacent to JFK; the total was 5,830 nests, a 5 percent increase over 1994, when we counted the number of nests using the same method. Only as a last resort do we employ lethal methods, and still this is only for certain species that present special problems. The shooting program at JFK is one United States Department of Agriculture biologists shot 6,660 gulls flying over JFK airspace, compared to 3,981 during the same period in 1994. The number increased because the number of gulls in the area increased, and the number of birds flying over JFK increased.

In 1994 and again in 1995 we used the same censuring methods to count the number of laughing gulls flying over JFK runways. In 1995 the number increased 20 percent, from an average of 50.4 per hour to 60.7 per hour. We believe that this increase is due in part to more laughing gulls nesting on the colony, but it is also due to more birds in the area. This colony continues to attract laughing gulls from other colonies to the south, and despite the fact that we continue to shoot so many birds, the colony continues to increase in size. The number of laughing gulls in the area increased from an average of 57.7 per observation hour to 71.7 per hour.

These combined facts make the need to establish a new colony of laughing gulls elsewhere that much more pressing. We are not dealing with a static situation, but rather, with one where the birds are increasing continually and shooting them is not the best long-term solution, especially if we can find a more environmentally sensible, humane way to deal with the safety problem. Although we will probably continue the shooting program in some form after moving the colony, the number of laughing gulls flying over the airport will be greatly diminished and therefore the number of birds being shot, and the number of bird strikes will decrease significantly.

CHAPTER EIGHT

Evaluation of Effectiveness of Bird Hazard Management Program

Evaluation of Shooting Program

From 1991 through 1995 laughing gulls have been shot at JFK to reduce the risk to aviation at the airport by reducing the overall number of bird strikes and more specifically, by reducing the number of laughing gull bird strikes. Laughing gull strikes increased proportionately to the number nesting at Joco Marsh. By the late 1980s and early 1990s they accounted for 52 percent of the bird strikes at JFK (from 1988 through 1990; mean = 157 laughing gull strikes per year). Then a shooting program began, and during the next 5 years (1991 through 1995) 46,432 gulls were killed by the Department of Agriculture, whose biologists did the shooting. The number of laughing gulls struck at JFK declined statistically, by 80 percent, to a mean of 30 laughing gulls struck per year. Therefore, we conclude that the shooting program significantly reduces the number of bird strikes due to the target species at JFK. It is felt that a substantial reduction in laughing gull bird strikes also reduces the risk proportionately.

CHAPTER NINE

Birds At John F. Kennedy International Airport (1957-1995)

List of Species

JFK has a constant presence of trained professionals observing the activities of wildlife at John F. Kennedy International Airport since 1957. In addition to observing birds at the airport, we have created the most thorough record of bird strikes of any airport in the world. Our data set provides a valuable measure of bird activities at the airport both seasonally and over the years. This data set has enabled us to determine which species present a significant bird strike risk, and during which months they need to be managed. We can track the relative abundance of individual species, such as the Canada goose, which has been increasing in number recently. We know ospreys are only struck during fall migration, and the birds struck are neither the adults that nest at Jamaica Bay Wildlife Refuge, nor are their young involved in bird strikes. We know that snow buntings are involved in bird strikes in November, which is when they arrive here, but

are seldom involved in bird strikes during the rest of the winter, although they are here for several months each year. We know that our important population of upland sandpipers is seldom involved in bird strikes, and have never caused any damage to an aircraft.

The following is a list of the species that we have observed at and adjacent to JFK since 1957:

- % Species that have been observed at JFK are followed by %.
- * Species that have been involved in bird-strikes (bird-aircraft collisions) at JFK are followed by *.
- # Species known to have nested at JFK are followed by an #.
- & Species listed as breeding here, but absolutely positive verification was never obtained, to avoid disturbing the nest, as with endangered or threatened species, such as the northern harrier, are followed by &.
- ! Species that used to nest at JFK but no longer do are followed by !.
- @ Species followed by @ are those that have been seen adjacent to JFK on non Port Authority or National Park Service property.
- \$ Species that do not nest on the airport, but nest adjacent to JFK, at the Jamaica Bay Wildlife Refuge, are followed by \$.
- + Species observed at the Jamaica Bay Wildlife Refuge (Riepe and Villani 1994), which is immediately adjacent to JFK, are indicated by a +.

Loon

Red-throated Loon (Gavia stellata) +
Common Loon (Gavia immer) % * +

Grebe

Pied-billed Grebe +
Horned Grebe (Podiceps auritus) % * +
Red-necked Grebe +
Eared Grebe +

Cormorant

Great Cormorant +
Double-crested Cormorant (Phalacrocorax auritus) % * +

Bittern

American (Botaurus lentiginosus) % * +
Least Bittern +

Hérons and Egrets

Great Blue Heron (Ardea herodias) % * +
Great Egret (Casmerodius albus) % +
Snowy Egret (Leucophoyx thula) % * +
Little Blue Heron (Egretta caerulea) +
Tri-colored Heron (Egretta tricolor) +
Cattle Egret (Bububcus ibis) % * +

Green-backed Heron (Butorides virescens) % * +
 Black-crowned Night Heron (Nycticorax nycticorax) % * -
 Yellow-crowned Night Heron (Nycticorax violaceus) +
 Ibis
 Glossy Ibis (Plegadis falcinellus) % * +
 Swan
 Tundra Swan (Cygnus columbianus) % +
 Mute Swan (Cygnus olor) % +
 Goose
 Snow Goose (Chen hyperborea) % +
 Brant (Branta bernicla) % * # +
 Canada Goose (Branta canadensis) % * # +
 Wood Duck (Aix sponsa) % * +
 Green-winged Teal (Anas carolinensis) % +
 Black Duck (Anas rubripes) % * # +
 Mallard (Anas platyrhynchos) % * # +
 Pintail (Anas acuta) % +
 Blue-winged Teal (Anas discors) % * +
 Northern Shoveler (Anas clypeata) % +
 Gadwall (Anas strepera) % +
 Widgeon
 Eurasian + (Anas penelope) +
 American (Anas americana) % +
 Canvasback (Aythya valisineria) % -
 Redhead (Aythya americana) +
 Ring-Necked Duck (Aythya collaris) +
 Scaup
 Greater Scaup (Aythya marila) % +
 Lesser Scaup (Aythya affinis) % +
 Common Eider (Somateria mollissima) +
 King Eider (Somateria spectabilis) +
 Oldsquaw (Clangula hyemalis) % +
 Scoter
 Black Scoter (Melanitta nigra) % +
 Surf Scoter (Melanitta perspicillata) +
 White-winged Scoter (Melanitta deglandi) +
 Common Goldeneye (Bucephala clangula) % +
 Bufflehead (Bucephala albeola) % +
 Merganser
 Hooded Merganser (Lophodytes cucullatus) +
 Common Merganser (Mergus merganser) +
 Red-breasted Merganser (Mergus serrator) % +
 Ruddy Duck (Oxyura jamaicensis) % * +
 Turkey Vulture (Cathartes aura) +
 Osprey (Pandion haliaetus) % * +

Bald Eagle (Haliaeetus leucocephalus) +
Northern Harrier (Circus cyaneus) % * # & +
Hawk

Sharp-shinned Hawk (Accipiter striatus) % * ÷
Cooper's Hawk (Accipiter cooperii) +
Goshawk (Accipiter gentilis) % * +
Red-shouldered Hawk (Buteo lineatus) +
Broad-winged Hawk (Buteo platypterus) +
Red-tailed Hawk (Buteo jamaicensis) % * +
Rough-legged Hawk (Buteo lagopus) % * ÷

Falcons

American Kestrel (Falco sparverius) % * +
Merlin (Falco columbarius) % * +
Peregrine Falcon (Falco peregrinus) % * +
Gyr Falcon (Falco rusticolus) +

Ring-necked Pheasant (Phasianus colchicus) % * # +

Northern Bobwhite (Colinus virginianus) +

Chicken (Gallus gallus) @

Rail

Yellow Rail (Coturnicops noveboracensis) +
Black Rail (Laterallus jamaicensis) +
Clapper Rail (Rallus longirostris) % ÷
King Rail (Rallus elegans) +
Virginia Rail (Rallus limicola) % +
Sora Rail (Porzana carolina) % ÷
Common Moorhen (Gallinula chloropus) +
American Coot (Fulica americana) ÷

Plover

Black-bellied Plover (Pluvialis squatarola) % * ÷
Lesser Golden Plover (Pluvialis dominica) % * +
Semipalmated Plover (Charadrius semipalmatus) % +
Piping Plover (Charadrius melodus) % * # + !
Killdeer (Charadrius vociferus) % * # +

American Oystercatcher (Haematopus palliatus) % # ÷

Black-necked Stilt (Limantopus mexicanus) +

American Avocet (Recurvirostra americana) +

Lapwing (Vanellus vanellus) %

Yellowlegs

Greater Yellowlegs (Tringa melanoleucus) % * +
Lesser Yellowlegs (Tringa flavipes) % +

Solitary Sandpiper (Tringa solitaria) +

Willet (Catoptrophorus semipalmatus) % # +

Spotted Sandpiper (Actitis macularia) +

Upland Sandpiper (Bartamia longicauda) % * # ÷

Whimbrel (Numenius phaeopus) % +

Godwit

Hudsonian (*Limosa haemastica*) +

Marbled (*Limosa fedoa*) +

Ruddy Turnstone (*Arenaria interpres*) % +

Red Knot (*Calidris canutus*) % +

Sanderling (*Calidris alba*) % +

Sandpiper

Semipalmated Sandpiper (*Calidris pusillus*) % +

Western Sandpiper (*Ereunetes mauri*) +

Least Sandpiper (*Erolia minutilla*) +

White-rumped Sandpiper (*Erolia fusciollis*) +

Baird's Sandpiper (*Erolia bairdii*) +

Pectoral Sandpiper (*Erolia melanotos*) +

Dunlin (*Calidris alpina*) % +

Curlew Sandpiper (*Erolia ferruginea*) +

Stilt Sandpiper (*Micropalama himantopus*) +

Buff-breasted Sandpiper (*Tryngites subruficollis*) % -

Ruff (*Philomachus pugnax*) +

Dowitcher

Short-billed Dowitcher (*Limnodromus griseus*) % +

Long-billed Dowitcher (*Limnodromus scolopaceus*) +

Common Snipe (*Capella gallinago*) +

Woodcock (*Scolopax minor*) % * -

Phalarope

Wilson's Phalarope (*Steganopus tricolor*) +

Northern (*Lobipes lobatus*) +

Red (*Phalaropus fulicarius*) +

Gull

Laughing Gull (*Larus atricilla*) % * +

Little Gull (*Larus minutus*) +

Black-headed (*Larus ridibundus*) +

Bonaparte's Gull (*Larus philadelphia*) % * +

Ring-billed Gull (*Larus delawarensis*) % * +

Herring Gull (*Larus argentatus*) % * +

Iceland Gull (*Larus glaucoides*) +

Lesser Black-backed Gull (*Larus fuscus*) +

Glaucous Gull (*Larus glaucescens*) +

Great Black-backed Gull (*Larus marinus*) % * +

Tern

Gull-billed Tern (*Sterna nilotica*) +

Caspian Tern (*Sterna caspia*) +

Roseate Tern (*Sterna dougallii*) +

Common Tern (*Sterna hirundo*) % * +

Forster's Tern (*Sterna forsteri*) +

Least Tern (*Sterna albifrons*) % * +

Sooty Tern (Sterna fuscata) %
 Royal Tern (Thalasseus maximus) +
 Black Tern (Chlidonias niger) +
 Black Skimmer (Rhynchops nigra) % * +
 Dove
 Rock Dove (Columba livia) % * # +
 Mourning Dove (Zenaida macroura) % * # +
 Cuckoo
 Black-billed Cuckoo (Coccyzus erythrophthalmus) +
 Yellow-billed Cuckoo (Coccyzus americanus) +
 Owl
 Barn Owl (Eyto alba) % * +
 Snowy Owl (Nyctea scandiaca) % *
 Long-eared Owl (Asio otus) % +
 Short-eared Owl (Asio flammeus) % * +
 Burrowing Owl (Athene cunicularia) % *
 Saw-whet (Aegolius acadicus) +
 Common Nighthawk (Chordeiles minor) % * +
 Whip-poor-will (Caprimulgus vociferus) +
 Chimney Swift (Chaetura pelagica) +
 Ruby-throated Hummingbird (Archilochus colubris) +
 Belted Kingfisher (Megasceryle alcyon) % +
 Woodpecker
 Red-headed Woodpecker (Melanerpes erythrocephalus) +
 Red-bellied Woodpecker (Centurus carolinus) +
 Yellow-bellied Sapsucker (Sphyrapicus varius) +
 Downy Woodpecker (Dendrocopos pubescens) +
 Hairy Woodpecker (Dendrocopos villosus) +
 Common Flicker (Colaptes auratus) % +
 Olive-sided Flycatcher (Nuttallornis borealis) +
 Eastern Wood Pewee (Contopus virens) +
 Flycatcher
 Yellow-bellied Flycatcher (Empidonax flaviventris) +
 Acadian Flycatcher (Empidonax virescens) +
 Alder Flycatcher (Empidonax traillii) +
 Willow Flycatcher (Empidonax alnorum) +
 Least Flycatcher (Empidonax minimus) +
 Scissor-tailed Flycatcher (Tyrannus forficatus) %
 Eastern Phoebe (Sayornis phoebe) +
 Great Crested Flycatcher (Myiarchus crinitus) +
 Kingbird
 Western Kingbird (Tyrannus verticalis) +
 Eastern Kingbird (Tyrannus tyrannus) % +
 Horned Lark (Eremophila alpestris) % * # +
 Purple Martin (Progne subis) +

Swallow

- Tree Swallow (Iridoprocne bicolor) % * +
- Rough-winged Swallow (Stelgidopteryx ruficollis) +
- Bank Swallow (Riparia riparia) +
- Cliff Swallow (Petrochelidon pyrrhonota) -
- Barn Swallow (Hirundo rustica) % +

Blue Jay (Cyanocitta cristata) % +

Crow

- American Crow (Corvus brachyrhynchos) % * # +
- Fish Crow (Corvus ossifragus) +

Black-capped Chickadee (Parus atricapillus) -

Nuthatch

- Red-breasted (Sitta canadensis) +
- White-breasted (Sitta carolinensis) +

Brown Creeper (Certhia familiaris) +

Wren

- Carolina Wren (Thryothorus ludovicianus) -
- House Wren (Troglodytes aedon) +
- Winter Wren (Troglodytes troglodytes) +
- Sedge Wren (Cistothorus platensis) +
- Long-billed Marsh Wren (Telmatodytes palustris) % -

Kinglet

- Golden-crowned Kinglet (Regulus satrapa) +
- Ruby-crowned Kinglet (Regulus calendula) +

Blue-gray Gnatcatcher (Poliophtila caerulea) +

Thrush

- Eastern Bluebird (Sialia sialis) +
- Veery (Catharus fuscenscens) % * +
- Gray-cheeked Thrush (Hylocichla minima) +
- Swainson's Thrush (Hylocichla ustulata) +
- Hermit Thrush (Hylocichla guttata) +
- Wood Thrush (Hylocichla mustelina) +
- American Robin (Turdus migratorius) % +

Gray Catbird (Dumetella carolinensis) % *

Mockingbird (Mimus polyglottos) % #

Brown Thrasher (Toxostoma rufum) % *

Water Pipit (Anthus spinoletta) +

Cedar Waxwing (Bombycilla cedrorum) +

Shrike

- Northern Shrike (Lanius excubitor) +
- Loggerhead Shrike (Lanius ludovicianus) % +

Starling (Sturnus vulgaris) % * # -

Vireo

- White-eyed Vireo (Vireo griseus) +
- Solitary Vireo (Vireo solitarius) +

Yellow-throated Vireo (Vireo flavifrons) +
Warbling Vireo (Vireo gilvus) +
Philadelphia Vireo (Vireo philadelphicus) +
Red-eyed Vireo (Vireo olivaceus) +

Warbler

Blue-winged Warbler (Vermivora pinus) +
Golden-winged Warbler (Vermivora chrysoptera) +
Tennessee Warbler (Vermivora peregrina) +
Orange-crowned Warbler (Vermivora celata) -
Nashville Warbler (Vermivora ruficapilla) +
Northern Parula Warbler (Parula americana) !
Yellow Warbler (Dendroica petechia) +
Chestnut-sided Warbler (Dendroica pensylvanica) +
Magnolia Warbler (Dendroica magnolia) +
Cape May Warbler (Dendroica tigrina) +
Black-throated Blue Warbler (Dendroica caerulescens) !
Yellow-rumped Warbler (Dendroica coronata) % +
Black-throated Green Warbler (Dendroica virens) +
Blackburnian Warbler (Dendroica fusca) +
Yellow-throated Warbler (Dendroica dominica) -
Pine Warbler (Dendroica pinus) +
Prairie Warbler (Dendroica discolor) +
Palm Warbler (Dendroica palmarum) +
Bay-breasted Warbler (Dendroica castanea) +
Blackpoll Warbler (Dendroica striata) +
Cerulean Warbler (Dendroica cerulea) +
Black and White Warbler (Mniotilta varia) +
American Redstart (Setophaga ruticilla) +
Prothonotary Warbler (Protonotaria citrea) +
Worm-eating Warbler (Helmitheros vermivorus) +
Ovenbird (Seiurus aurocapillus) -
Northern Waterthrush (Seiurus noveboracensis) +
Louisiana Waterthrush (Seiurus motacilla) +
Kentucky Warbler (Oporornis formosus) +
Connecticut Warbler (Oporornis agilis) +
Mourning Warbler (Oporornis philadelphia) +
Common Yellowthroat (Geothlypis trichas) +
Hooded Warbler (Wilsonia citrina) -
Wilson's Warbler (Wilsonia pusilla) +
Canada Warbler (Wilsonia canadensis) +
Yellow-breasted Chat (Icteria virens) +

Tanager

Summer Tanager (Piranga rubra) !
Scarlet Tanager (Piranga olivacea) % +
Western Tanager (Piranga ludoviciana) +

Northern Cardinal (Richmondia cardinalis) % +

Grosbeak

Rose-breasted Grosbeak (Pheucticus ludovicianus) % * -

Blue Grosbeak (Guiraca caerulea) +

Indigo Bunting (Passerina cyanea) +

Dickcissel (Spiza americana) +

Rufous-sided Towhee (Pipilo erythrophthalmus) % -

Sparrow

Tree Sparrow (Spizella arborea) +

Chipping Sparrow (Spizella passerina) +

Clay-colored Sparrow (Spizella pallida) +

Field Sparrow (Spizella pusilla) % +

Song Sparrow (Melospiza melodia) % +

Vesper Sparrow (Pooecetes gramineus) +

Lark Sparrow (Chondestes grammacus) +

Savannah Sparrow (Passerculus sandwichensis) % # +

Grasshopper Sparrow (Ammodramus savannarum) % * # +

Henslow's Sparrow (Passerherbulus henslowii) +

Sharp-tailed Sparrow (Ammodramus caudatus) +

Seaside Sparrow (Ammodramus maritima) +

Fox Sparrow (Passerella iliaca) +

Swamp Sparrow (Melospiza georgiana) +

White-throated Sparrow (Zonotrichia albicollis) +

White-crowned Sparrow (Zonotrichia leucophrys) +

Slate-colored Junco (Junco hyemalis) % +

Snow Bunting (Plectrophenax nivalis) % * +

Lapland Longspur (Calcarius lapponicus) % +

Bobolink (Dolichonyx oryzivorus) +

Red-winged Blackbird (Agelaius phoeniceus) % * # +

Eastern Meadowlark (Sturnella magna) % * # +

Blackbird

Yellow-headed Blackbird (Xanthocephalus xanthocephalus) +

Rusty Blackbird (Euphagus carolinus) -

Grackle

Boat-tailed (Cassidix mexicanus) -

Common Grackle (Quiscalus quiscula) % # +

Brown-headed Cowbird (Molothrus ater) % * # +

Oriole

Orchard Oriole (Icterus spurius) +

Northern Oriole (Icterus glabula) +

Pine Grosbeak (Pinicola enucleator) +

Purple Finch (Carpodacus purpureus) -

House Finch (Carpodacus mexicanus) % +

Crossbill

Red Crossbill (Loxia curvirostra) % -

White-winged Crossbill (Loxia leucoptera) +
 Common Redpoll (Acanthis flammea) +
 Pine Siskin (Spinus pinus) % +
 American Goldfinch (Spinus tristis) % +
 Evening Grosbeak (Hesperiphona vespertina) +
 House Sparrow (Passer domesticus) % * # +
 Black-hooded Parakeet (Nandayus nenday) %
 Budgerigar (Melopsittacus undulatus) %

Accidentals

The following species have only been recorded once or twice at JFK and the immediate vicinity:

Sooty Shearwater +
 White Pelican +
 Brown Pelican +
 Wood Stork +
 White-faced Ibis +
 White Ibis +
 Greater White-fronted Goose +
 Fulvous Whistling Duck +
 Cinnamon Teal +
 Harlequin Duck +
 Swallow-tailed Kite +
 Golden Eagle +
 Purple Gallinule +
 Wilson's Plover +
 Sharp-tailed Sandpiper +
 Reddish Egret +
 Spotted Redshank
 Purple Sandpiper +
 Parasitic Jaeger +
 Pomarine Jaeger +
 Arctic Tern +
 Sooty Tern +
 Great Horned Owl +
 Tufted Titmouse +
 Sage Thrasher +
 Townsend's Warbler +
 Black-throated Gray Warbler +
 Lark Bunting (Calamospiza melanocorys) +
 Little Stint +
 Rufous-necked Stint +

Northern Gannet +
Cave Swallow +

Birds At John F. Kennedy International Airport

Species Accounts

The goal is to write about each of the above species, especially with regard to behavior and management plans, wherever applicable. Because there are so many species, and not all represent birds that pose a significant risk to passengers and aircraft at JFK, it will take time before each species has been addressed adequately to warrant its own account. Research continues, we have files on all of the species listed below, and over time we will write each species account, and add to it as we learn more. Members of the Bird Control Unit have banded birds over the years, which provides an added base of data from which to draw, which will be presented below. Most of the earliest banding was done under Cohen's permit, later the banding was done under Chevalier's, and now it is being done under the permit held by Garber. The species that have been banded at JFK include: snowy owl, short-eared owl, rough-legged hawk, northern harrier, red-tailed hawk, peregrine falcon, kestrel, piping plover, killdeer, upland sandpiper, mourning dove, laughing gull, American oystercatcher, horned lark, and red-winged blackbird. As the species accounts are written below, when appropriate, the data from the years of bird-banding at the airport will be incorporated. To date, we have written expanded accounts for some of the species, however they are all listed below, and as time permits, our intention is to write a management regimen for each, based on what we know about the species' behavior, both on and off the airport. The following is a list of the species that we have observed at and adjacent to JFK since 1957. The species identified at JFK are presented below in phylogenetic order. Below are the meanings of each of the symbols following the species names:

- % Species that have been observed at JFK are followed by %.
- * Species that have been involved in bird-strikes (bird-aircraft collisions) at JFK are followed by *.
- # Species known to have nested at JFK are followed by an #.
- & Species listed as breeding here, but absolutely positive verification was never obtained, to avoid disturbing the nest, as with endangered or threatened species, such as the northern harrier, are followed by &.
- ! Species that used to nest at JFK but no longer do are followed by !.

- @ Species followed by @ are those that have been seen adjacent to JFK on non Port Authority or National Park Service property.
- \$ Species that do not nest on the airport, but nest adjacent to JFK, at the Jamaica Bay Wildlife Refuge, are followed by \$.
- + Species observed at the Jamaica Bay Wildlife Refuge (Riepe and Villani 1994), which is immediately adjacent to JFK, are indicated by a +.
- ABCD Each four letter designation is the alpha code used by the American Ornithologists Union, the United States Department of the Interior Fish and Wildlife Service's Bird Banding Laboratory, and by the Canadian Wildlife Service.

Grebes and Loons

Horned Grebe (Podiceps auritus) HOGGR % +

Common migrant and summer visitor to coastal areas, Jamaica Bay included. There are no records of horned grebes ever being involved in a bird strikes at JFK.

Pied-billed Grebe (Podilymbus podiceps) PBGR +

Occur regularly in the Jamaica Bay area, but not in large numbers from April through November, but much more common from December through March. Since 1979, none has ever been involved in a bird strike at JFK.

Common Loon (Gavia immer) COLO % * +

In 1963 a Beechcraft hit a loon near Bakersfield, California; two men died. In the JFK region, loons are migrants along the Atlantic coast, and some are found in Jamaica Bay during migration seasons. On occasion one is involved in a bird strike. When common loons were more common, they posed a more serious threat, however, common loons are in decline throughout much of the northeast and eastern Canada, as a result, fewer are flying over JFK in recent years.

Red-Throated Loon (Gavia stellata) RTLO +

Common migrant and winter visitor to Jamaica Bay. Not a problem at JFK, however, since red-throated loons only fly over the airport on occasion, and none has ever been involved in a bird strike.

Cormorant

Great Cormorant (Phalacrocorax carbo) GRCO +

Some occur in the area in late fall and winter. None has ever been involved in a bird strike at JFK.

Double-Crested Cormorant (Phalacrocorax auritus) DCCO * +

Numbers have been increasing in recent years, as have the number of nesting double-crested cormorants in the region. We regularly have double-crested cormorants in the waters surrounding the airport throughout the warmer months, and when they are present they regularly fly over the airport. They are far less common throughout the winter. Double-crested cormorants are involved in approximately one quarter of one percent of all the bird strikes at JFK, based the total of 10 bird strikes from 1979 through 1995. They do not represent a significant risk to passengers or aircraft at JFK. 8 of the 10 occurred from July through October, and the other two occurred in January and March. A listing of the dates for each of the strikes is: one on January 16, 1979, one August 21, 1981, one September 11, 1984, one October 4, 1984, one September 2, 1985, one July 25, 1990, two on October 4, 1990, and one on April 27, 1993.

Waterfowl (Swans, Geese, and Ducks)

Tundra Swan (Cygnus columbianus) WHSW % +

The tundra swan, which is also called the whistling swan, is the smaller and more abundant of the two swan species native to North America. The other native swan is the trumpeter swan, whose range is confined to the western states. The tundra swan, winters along both the Atlantic and Pacific coasts. Along the Atlantic it overwinters as far south as far south as North Carolina. Its numbers are only a fraction of what they used to be, although they are slowly increasing in number. They pose a threat where they occur; in 1962 a plane that hit two whistling swans at Ellicott City, Maryland crashed and 17 people died. The migratory route of the tundra swan takes it overland to the coast and then south along the coast, but it usually hits the coast south of JFK, therefore, tundra swans are not common in the JFK area, and although they are observed on occasion, none has ever been struck. This is not a species of concern at JFK.

Mute Swan (Cygnus olor) MUSW % +

Although there is not a large number of mute swans in the immediate vicinity of the airport, they are big, dangerous, and it is not a rare occurrence to see them flying over the airport, and when they fly over the airport, they frequently occur in multiples. Since we have been keeping records, none has ever been struck at JFK, but their numbers are increasing in the region and this is a species that we have put energy into attempting to control their numbers in the vicinity of the airport.

Because the mute swan is an introduced species, the National Park Service does not have a mandate to protect it. Mute swans are bigger than vultures and eagles and they pose a significant hazard should they be ingested by a jet engine. Swans are rapidly increasing in numbers throughout the Northeast and their numbers have just begun to increase in the Jamaica Bay/John F. Kennedy International Airport area, where mute swans have begun to breed in large numbers. Their potential for turning into a major problem needs to be addressed. The Port Authority of New York and New Jersey has entered into a collaborative effort with the National Park Service to control this species. Together, we are conducting the Mute Swan Control Project which benefits native species while controlling the spread of a swan that was introduced to North America from Europe and has been spreading its range and number.

The Port Authority of New York and New Jersey wants to keep the swan numbers down for safety reasons, and the National Park Service wants to control this introduced aggressive invasive that is competing with native waterfowl species. I collaborated with Don Riepe and John Zuzworky during the summer of 1995 in an attempt to find all the

mute swans nesting in Jamaica Bay. They had begun this project during the summer of 1994, and we continued it with our field work in 1995. Based on our combined knowledge of the Bay and its surrounding properties, we knew that the area surrounding East Pond at the Jamaica Bay Wildlife Refuge was where nearly all the mute swans were nesting, therefore, that is where we concentrated our efforts. We worked to find all the nesting mute swans, and added the eggs so they would not hatch. We have plans to continue this project next year and beyond in a continued effort to control the number of swans.

Canada Goose (*Branta canadensis*) CAGO % * # -

Introduction

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

Canada geese used to fly through New York's airways during spring and fall, but they never spent the summer here. The Canada goose occurs in many races or subspecies, each identified by where it breeds, and there are slight differences, including their size; some range in size from three or four pounds, while others weigh about nine pounds. These subspecies nest in the northwestern United States and Canada, and winter in the United States, occurring in greatest numbers along the coasts. Migratory geese continue to breed to the north, however many geese remain further south all year round.

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

Strike Record at JFK

The Canada goose is a dangerous bird in several respects: 1) it is one of the heaviest and densest birds regularly flying through JFK airspace, 2) Canada goose bird strikes often involve flocks, making this species an even more significant risk to aircraft at JFK, and 3) this species is rapidly increasing in numbers in our area. During the period from 1979 through 1993, 31 Canada geese hit aircraft at JFK (Garber 1995h). This was less than 1 percent of the total number of bird strikes at JFK. Of these Canada goose strikes, no one was hurt, and two aircraft were either damaged or delayed, which was 2 percent of the total aircraft that were either damaged or delayed at JFK during that period. The trend in Canada goose related aircraft collisions has remained constant over this period, averaging 1.2 geese struck at JFK per year, with a range from 0 to 3.

Even before Canada geese were rapidly increasing in number, they were recognized as a hazard to aircraft at JFK; this was largely due to when an aircraft struck a Canada goose at JFK on December 14, 1965; the plane was left with an 8 inch (20.3 centimeter) diameter hole that was 10 inches (25.4 centimeters) deep in a horizontal stabilizer and there was also a 6 inch (15.2 centimeter) long indentation on the leading wing edge. At JFK, since 1979, three aircraft have been damaged or delayed due to Canada goose strike. There was the 1965 incident, two on November 8, 1979, one on November 9, 1991 when four Canada geese were struck, September 5, 1985 when 6 Canada geese were struck, two were struck on September 6, 1992, four on November 9, 1991, one on November 13, 1993, one on April 9, 1994, one on November 10, 1994, and the Air France Concorde incident on June 3, 1995.

Recent Strike Record at Other Airports

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

There was a major Canada goose-related incident at JFK on June 3, 1995 when an Air France Concorde was landing; several geese hit the fuselage, and geese were sucked through two engines which both caught fire and had to be shut off. Luckily no one was hurt, however the damage was an estimated at \$6 million. August 22, 1995 a Continental

Airlines Boeing 757 hit a flock of Canada geese just before touching down at Seattle-Tacoma International Airport. The 9 geese that were killed damaged the aircraft's nose cone, which contains the aircraft's radar. The plane landed safely and no passengers or crew were hurt.

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

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

On September 22, 1995 a Boeing 707 United States Air Force E-3B Advanced Warning and Control System, or AWACs, jet struck Canada geese when taking off at Elmendorf Air Force Base, just north of Anchorage, Alaska. Carla Dove of the Smithsonian Institution's Division of Birds examined the feather samples (personal communication) from two engines and made the positive identification. The \$180 million four-engine aircraft lost power in two engines, which was sufficient to cause it to crash two miles from the end of the runway. All 24 people aboard were killed (22 Americans, 2 Canadians).

In addition, another goose-related bird strike occurred September 25, 1995 when the jet House Speaker Newt Gingrich, the Republican from Georgia, and his wife, were flying in was taking off from a small resort island in Michigan. No one was hurt when the small jet ran off the runway on Mackinac Island, Michigan after striking four Canada geese. Their Cessna Citation aircraft hit a flock of geese that was on the runway which scattered as the plane approached. The aircraft had just begun its ascent when it hit the birds. The pilots were very shaken when at least two geese were sucked into the right engine, while two others hit the leading edge of the left wing. The collision caved in a 14 inch portion of the wing. No one was hurt when the plane aborted its take-off, skidding to a stop 30 feet off the end of the runway. Obviously, the plane should never have been cleared for take-off with geese on the runway. On October 2, 1995 a probable goose strike at LaGuardia Airport involved a U.S. Air Shuttle 727/225. It was a clear evening when the plane was taking off when one bird struck engine #2, which was

damaged. The engine instantly flamed out; there was internal damage that resulted in the engine having to be rebuilt. The Estimated cost of repairs was \$150,000 and an additional \$20,000 was the other cost due to lost revenues.

Growing Risk

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

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

Abundance

Not too long ago this abundant migrant and winter visitor along the coast was only relatively common in this area. And inland, most geese were just seen and heard during migration when flying overhead. With their changing habits over the past 30 years, Canada geese now commonly breed where they used to just spend the winter. And after breeding in areas where they used to just spend the winter, they remain through the winter. Jamaica Bay Wildlife Refuge has Canada geese present all year round.

Meanwhile, the northern breeding stocks are declining in number, perhaps due to bad weather in the north during the past several years, or in part due to the increasing competition they receive from their conspecifics when the northern breeders are on their overwintering grounds. Many people are upset with the burgeoning numbers of Canada geese; they are not appreciated by those golfers who don't like stepping in goose plop (which looks like a small dog's feces). Home owners might disapprove of geese grazing

in the backyard for the same reason. But we have only ourselves to blame. Canada geese were commonly raised in captivity and many escapes never went far from the roost. Instead of migrating north, after having been penned in and bred in these southern regions, their behavior was forever altered, and now their offspring are increasing in number like rabbits.

Canada geese have bred on the airport, and we are doing everything within our power to control this behavior. When we reported the first Canada goose nest on JFK to the United States Fish and Wildlife Service, we were informed we could not destroy the nest, harass the parents, addle or oil the eggs. It was not long afterward that an Air France Concorde hit several geese when landing at JFK. No one was hurt when two engines caught fire, however, a reported \$6 million dollars worth of damage was incurred, and Port Authority has been receiving inquiries from Air France's lawyers.

Management

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

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

Future Work

Considering the risk involved from Canada geese, this is not a problem that the aviation community can afford to overlook. We need to anticipate the informational needs we will require to effectively manage this growing problem. At present, our information is limited because this problem has only appeared to be a real problem for several months at most. It is too early to know whether this is a growing problem, or if this series of goose strikes was just an odd coincidence. Because we cannot afford to take any chances, we are working with the governmental agencies that oversee protected migratory species such as the Canada goose, to see if there is anything that can be done to manage the burgeoning populations nesting in our region, and those that fly through. In the meantime, we need to learn more about the habits of this species around our airports to determine if there are measures that can be taken to reduce the number of geese flying through the airspaces of JFK, LaGuardia, and Newark Airports.

Atlantic Brant (Branta bernicla) ATBR % * # +

The Atlantic brant is primarily a marine type of goose that occurs in our region in large numbers during the winter. When here, most are located from Long Island to the Chesapeake region, primarily on the ocean front and in the bays, as well as grazing on land nearby. The historic primary food source of brant during the breeding season was eel grass (Zostera marina). They also graze on nearby grasses and associated forbs and other weeds, and when breeding season is over, they switch their diet so they are largely terrestrial grazers. In 1931 eel grass populations were observed to be plummeting due to the parasite Labyrinthula (Salomonsen 1958), and brant populations declined sharply. Brant populations began to recover when more were found to be eating sea lettuce (Ulva lactuca and Enteromorpha sp.). By 1948 brant numbers had recovered. And since then, brant have increased in numbers; this species used to be far less common throughout this region.

Brant winter in large numbers in Jamaica Bay and fly over JFK with relative regularity. Brant cause a Mitsubishi MU-2G to crash at Bader Field in Atlantic City on April 16, 1972. The plane was taking off when at 800 feet (244 meters) it struck at least one brant and immediately the plane nose-dived into the ocean. All three people aboard were killed.

Snow Goose (Chen caerulescens) ISGO, BLGO, SBGI, GSGO % +

Abundant in the area, especially in Jamaica Bay, in spring, late fall, and winter. None of the different species or races, including the lesser snow goose (white phase, blue phase, and intermediate phase) and the greater snow goose, has ever been involved in a bird strike at JFK.

Ducks

Mallard (Anas platyrhynchos) MALL % * # +

A total of 50 mallards were struck from 1979 through 1995 at JFK, representing slightly more than 1 percent of the total number of birds struck during this period, resulting in no damage or delays to aircraft. 45 percent of the mallard strikes were evenly distributed throughout the non-breeding months of the year, July through March. 55 percent of the mallard strikes occurred during the breeding season which lasts from April through June. Mallards are common breeders in wetland habitats throughout New York State. They breed in virtually all types of wetlands, usually nesting on the ground among grasses. Their diet consists of seeds and sprouts of aquatic vegetation, as well as insects and other invertebrates, and even some fish. The regional population is increasing in size, but overall, they are decreasing in number in the United States.

Although mallards are large birds with some potential for year round problems to aircraft, at JFK the risk is greatest during the breeding season, and even then the risk is relatively low. Current grass and water management and harassment efforts have been proving effective at discouraging mallard use of the airport.

American Black Duck (Anas rubripes) ABDU % * # +

During the period of 1979 through 1995, 37 black ducks were involved in bird strikes at JFK, resulting in no damage or delays to aircraft. This accounts of 1 percent of the total number of birds struck during this period. The annual number of aircraft striking black ducks in 1979 through 1993 has ranged from 0 to 5, with an average of 2 per year. 70 percent of the black duck strikes occurred during winter (December through February) and in late spring to early summer (May and June). Their numbers appear to increase in number in the waters surrounding the airport in November, and increase until for several weeks, and then when their numbers are at their winter levels, the birds flying around the area are those that are struck on occasion.

Black ducks feed on insects, aquatic vegetation, and seeds. They breed throughout New York State, but are most abundant in coastal areas, particularly near salt marshes and fresh water wetlands in the eastern portion of the state. Inland black ducks usually nest in shallow depressions in wooded wetlands and wet thickets. Most of black ducks at JFK nest in dry fields, which may be because other suitable habitat has been filled in. While

black duck populations have been declining throughout much of their range, New York's salt marsh populations have remained relatively stable, however the inland populations have declined.

From our records, the risk from black ducks at JFK is seasonal and relatively low. No damage or delays to aircraft have occurred as a result of black duck-aircraft collisions since 1979. It is my opinion that current ecosystem management has been very effective in reducing the number of black ducks on the airport. Wetlands have been greatly reduced in number, and we continue to eliminate the last low-lying areas where water collects during certain times of the year. Woody vegetation is cut on a continual basis, thereby eliminating nesting habitat. Grassland management, although initially aimed at reducing gull hazards, has been watched and modified so we can reduce the greatest number of potential avian hazards simultaneously. In light of the small number of black ducks found on the airport, it is our opinion that current grassland management practices may also reduce the number of black ducks attracted to the airport. Because black ducks are much more wary of humans than mallards, whatever black ducks that do exist, can be easily eliminated with continued harassment. Currently, because we do not have a permit to shoot black ducks, and we cannot eliminate their nests or eggs, harassment with pyrotechnics another other scare tactics, has proven very effective.

Northern Pintail (Anas acuta) NOPI % =

Uncommon to rare all periods of the year except late fall when they are common in the area. When here they stay on the water nearly all the time, and seldom fly over the airport. This species has never been involved in a bird strike during the years we have been keeping strike records at JFK.

Gadwall (Anas strepera) GADW % +

Uncommon during winter, but common during all other times of the year in Jamaica Bay surrounding the airport. November 13, 1995 there were about a dozen gadwall at the mouth of Bergen Basin. This species has never been involved in a bird strike at the airport.

Eurasian Widgeon (Anas penelope) EUWI +

They occur, but infrequently, in the waters surrounding the airport. None has ever been involved in a bird strike.

American Widgeon (Anas americana) AMWI % +

In Jamaica Bay they are common to abundant all times of the year, except summer, when there are only a few individuals recorded all summer. They often occur in the winter months feeding with the brant west of the 4L extension. On November 13, 1995 there were about a dozen widgeon there mixed in with brant.

Northern Shoveler (Anas clypeata) NSHO % +

Blue-winged Teal (Anas discors) BWTE % * +

American Green-winged Teal (Anas carolinensis) AGWT % +

Wood Duck (Aix sponsa) WODU % * +

Canvasback (Aythya valisineria) CANV % +

Greater Scaup (Aythya marila) GRSC % +

Lesser Scaup (Aythya affinis) LESC % +

Common Goldeneye (Bucephala clangula) COGO % +

Bufflehead (Bucephala albeola) BUFF % +

November 13, 1995 bufflehead were back in Jamaica Bay, south of the bay runway.

Black Scoter (Melanitta nigra) BLSC % +

Surf Scoter (Melanitta perspicillata) SUSC +

White-winged Scoter (Melanitta deglandi) WWSC +

Oldsquaw (Clangula hyemalis) OLDS % +

Ruddy Duck (Oxyura jamaicensis) RUDU % * +

Mergansers

Hooded Merganser (Lophodytes cucullatus) HOME +

Uncommon to rare in the waters of Jamaica Bay surrounding the airport. Never been involved in a strike at JFK.

Common Merganser (Mergus merganser) COME +

Very rare in waters of Jamaica Bay surrounding JFK. Never been involved in a bird strike at the airport in the years that we have been keeping records.

Red-breasted Merganser (Mergus serrator) RBME % +

Common to abundant in late fall, winter, and spring in the waters surrounding JFK. None have ever been involved in a strike at the airport. November 13, 1995 red-breasted mergansers were in Thurston Basin adjacent to 4R.

Hawks, Osprey, Falcons

Northern Goshawk (Accipiter gentilis) NOGO % * +

No goshawks have been struck at JFK since 1979, but one was struck before then, when Sammy Chevalier (personal communication) worked on airside before we began keeping records.

Sharp-shinned Hawk (Accipiter striatus) SSHA % * +

No sharp-shinned hawks have been struck at JFK since 1979, but one was struck before then, when Sammy Chevalier (personal communication) worked on airside before we began keeping records. A sharp-shinned hawk was flying low over the area east of the 4s on November 13, 1995. They seem to move through during migration, but do not spend much time here.

Northern Harrier (Circus cyaneus) NOHA % * # & +

Although we have a fair number of harriers at JFK, particularly during the winter months, they seldom are involved in collisions with aircraft. 15 have been involved in strikes from 1979 through 1995. All these strikes occurred from July through April (one in July, one in August, one in September, one in November, one in December, one in January, two in February, six in March, and one in April). More northern harriers fly over the airside of JFK during the late summer, autumn, winter, and early spring, and then most leave presumably to breed elsewhere. Apparently those that stay during the summer are breeding here. From 1957 through 1992 Sammy Chevalier saw only one confirmed northern harrier nest on the airport. It was east of the 4s. Juveniles fledged. During the summer of 1995 a pair of harriers courted and stayed at the airport, and presumably bred here. I flushed one and then backed off because I did not want to disturb the nest. In the winter there are as many as five on the airport; the exact number could be determined if we organize several people to spread out over the airside to document harrier activity patterns.

The most recent harrier strike at JFK occurred on December 12, 1995. At 2:50PM an American Eagle Flight No. 808 (a SAAB 340 twin-engine aircraft) from Philadelphia, struck a harrier at 80 feet above the ground while landing on Runway 31L. There was no

damage to the aircraft. The carcass was wedged between the lower section of the windshield and the wiper.

Rough-legged Hawk (Buteo lagopus) RLHA % * +

Only two have been struck here from 1979 through 1995. One on February 12, 1985 and one on March 14, 1994.

Red-tailed Hawk (Buteo jamaicensis) RTHA % * +

We have struck two red-tailed hawks in the past 17 years, one 1986 and 1987. They were struck in January and March. On November 13, 1995 there were approximately 5 red-tailed hawks perched in trees near Thurston Basin, east of the 4s. Generally, the raptors on the airport have a net positive effect on aviation safety in that these birds keep others off the airport.

Red-shouldered Hawk (Buteo lineatus) RSHA +

No red-shouldered hawks have been struck at JFK since 1979. Only a few individuals are seen each year when they migrate through in spring and early fall.

Osprey (Pandion haliaetus) OSPR % * +

On average there is only one strike a year. 15 were struck from 1979 through 1995. 80 percent of the ospreys that are involved in bird strikes at JFK are hit during the months of July, August, September, and October. One was hit in June, two in July, 4 in August, two in September, four in October, none in November, one in December. From these data it appears that these strikes occur during migration when ospreys are working their way south. Many of the birds flying through JFK airspace in the summer and fall are naive to the operations at the airport, and in particular, it may be the young birds that do not have the ability to dodge planes. Ospreys coming through sometimes perch on the airport's FAA towers, giving the birds a commanding view of the area. One tower in particular, is near Thurston Basin, where the birds can see the water, which may give them information regarding the best fishing areas. Another tower, apparently helps bring the birds into harm's way.

Neither of the two birds that were struck this summer (1995) were from the nest where young were fledged adjacent to JFK, out on the Joco Marsh complex. There were two active osprey nests in the entire Jamaica Bay Wildlife Refuge in 1995, only two of these nests successfully fledged young. Several years ago there were no active nests in the

Refuge, but ever since DDT was banned, ospreys have been making a slow, but steady comeback throughout much of the Northeast.

Interestingly, the nest on the Joco Marsh complex is an enigma. An argument can be made that that platform should never have been erected there. The National Park Service put it up in direct contradiction to everything that one might expect. Why add fuel to the fire and encourage ospreys to nest near JFK? The National Park Service had a good reason. Ospreys had built a nest on a shoal marker near the marsh, but the nest was very precarious. Don Riepe, of the National Park Service, felt that the birds were going to fail there, people stopped and harassed the birds and the posts were tilting, so Riepe erected a nesting platform nearby, and the birds moved their nest almost immediately. That was in 1991.

This past summer (1995) while surveying the vegetation of Joco Marsh to determine what habitats were chosen for nest sites, I attempted to avoid the part of the marsh where the ospreys were nesting, so I would not disturb the birds.

Nesting Platforms

At the October 14, 1995 meeting of the Jamaica Bay Environmental Coalition held at Gateway National Recreation Area, I participated in a very constructive exchange of information and ideas regarding the laughing gull colony issue in Jamaica Bay. The Coalition supported erecting osprey platforms on the Joco Marsh complex in an effort to attract more ospreys to nest there, with the hope that these birds will keep laughing gulls from nesting near their platforms. It was felt that, with enough ospreys on the marsh, it might be possible to keep laughing gulls from nesting on parts of the marsh using a nonviolent, totally natural, and environmentally constructive method. At the October 21, 1995 meeting of the Board of Governance of the Atlantic Chapter of the Sierra Club in Poughkeepsie, New York, the Board unanimously passed a resolution stating that the Atlantic Chapter of the Sierra Club endorses erecting osprey platforms on the Joco Marsh complex in Jamaica Bay. Since then we spoke with both Don Riepe and Dave Avrin of the National Park Service who like the idea and have agreed to discuss the idea with others working in the National Park Service to find if we can get a definite go ahead. The hope is first to test the concept that ospreys keep laughing gulls from nesting nearby, by placing platforms where we know exactly how many laughing gulls have nested in the area in recent years. If it turns out that this method is effective, and does not lead to unforeseen detrimental side effects, such as the ospreys interfering with the nesting terns, then we hope to erect many more platforms and eventually establish a breeding colony of ospreys, similar to that on Great Island in Old Lyme, Connecticut. Ospreys might keep the gulls off the colony and therefore the laughing gulls would go nest elsewhere, and no longer present a hazard to aircraft arriving at and departing from JFK.

Osprey platforms have been used for decades. In the Chesapeake region Reese (1970) erected 100 platforms from 1964 through 1969 with excellent results. Rhodes (1977)

built osprey platforms at the Martin Refuge in Maryland to offset the lack of suitable nesting sites in the area and also had excellent results. Ospreys quickly adapted to the artificial nest structures and the total number of active osprey nests increased significantly. Many other wildlife managers, working to enhance the wildlife on the property where they work, have erected osprey platforms, and now most ospreys on the East Coast nest on these artificial structures.

The platforms constructed at the Martin Refuge were placed on top of 20 foot creosoted poles that were not more than a 5 inches in diameter. Poles of a wider diameter were not used because of the weight involved. The tops of the poles were notched on either side and two 2 x 4's were bolted horizontally in place. Additional 2 x 2 inch material was added on top of this to make a flat surface approximately 4 x 4 feet. Welded wire was placed on the platform to act as an adhesive base for the osprey nest. Because it is difficult to construct a platform based on a written description, I recommend looking at illustrations of many different platform designs that have been used with good success; one of the best compilations of illustrations appears in the book entitled Ospreys. A Natural and Unnatural History (Poole 1989).

Rhodes (1977) dug holes in the marsh with a hand-operated rotary post hole digger. The holes were dug approximately 5 feet deep, which left 15 feet of pole and nest platform above the ground. This height was believed to be adequate for osprey nesting and was thought to be a deterrent for predators. This height allowed visitors to observe from afar without letting their curiosity get the best of them by having a closer look. The poles were usually placed at the edge of the island where the ospreys could view the water, or along some tidal creek within the interior of the island. The platforms were spaced apart to give the birds adequate territorial areas. Each was placed where they could be easily reached under normal tidal conditions by boat. Nests could be checked with a mirror on a hand held pole. After 24 poles were erected, the final poles were reduced from 20 feet to 14 feet. I do not know how many refuge managers feel poles of this height are adequate. Many different methods have been used to dig the holes in the marsh.

Gateway National Recreation Area already has considerable experience erecting osprey platforms, and Jamaica Bay Wildlife Refuge has three platforms they already erected, two of which have active nests. So we feel it would be best to work with the National Park Service and benefit from their experience, possibly using the same exact methods they have settled on if they feel they are tried and true.

Peregrine (Falco peregrinus) PEFA % * +

On September 18, 1995 two peregrine falcons were struck by aircraft (probably by the same plane) at JFK. Both were found on the runway within five feet of one another. Each was banded; one was banded by Paul Castelli in New Jersey May 31, 1995 when it was too young to fly. Bruce MacKinnon of Transport Canada said he heard that a

peregrine that had been banded in Canada was recently struck at JFK, so it may be that the other peregrine struck on September 18, 1995 was a bird from Canada. I have written the United States Department of the Interior's Bird Banding Lab twice to find out where our bird was initially banded, and will provide this information just as soon as it is received.

November 13, 1995 I observed a peregrine falcon chasing through a flock of snow buntings between and east of the 4s. Then it landed on the FAA tower east of the 4s.

Merlin (Falco columbarius) MERL % * +

On September 14, 1983 a merlin was struck at JFK. That is the only one in the strike record from 1979 through 1995. The bird is rare in the area and not of concern as a potential management problem at the airport.

American Kestrel (Falco sparverius) AMKE % * +

A mean of 2.71 kestrels are involved in bird strikes at JFK each year. A total of 46 kestrels have been struck from 1979 through 1995. In an effort to determine whether kestrels need to be managed at JFK, we have found there are many on the airside. Whether the kestrels at JFK are all local birds, born and bred on or near the airport, or if they are migrants that are just moving through or birds that stay here for a while, we have begun to search banding data for some clues. One female American kestrel was banded by Fred Sibley at Lighthouse Point, Connecticut on October 6, 1983 and was recaptured by Sammy Chevalier at Breezy Point, New York on October 7, 1983.

Galliformes (Pheasants and Chickens)

Ring-Necked Pheasant (Phasianus colchicus) RNPH % * # +

Strike Record

During the period from 1979 through 1995, 12 pheasants were struck by aircraft, which was less than 1 percent of the total birds struck during that period. Of these strikes, one resulted in damage or delay to an aircraft. Most were struck during the months from May through July. The males stand on their territory and display in prominent areas during the first part of the breeding season. This is when the males are most conspicuous, and this may also be when they are most exposed and likely to be involved in a bird strike.

Management

When harassed, pheasants run and hide, although they usually remain nearby. Therefore, harassment techniques are not very useful when attempting to keep pheasants from living on the airport. Pheasants are insect and seed-eaters, so they do well in the grassland and old field habitats at JFK. In addition, the long grass management probably benefits these birds because it provides food, cover, and good nesting habitat during the summer months. Because there have been relatively few pheasant-related bird strikes at JFK, and these have only caused one damaged or delayed aircraft, this is not considered a high risk species at the airport. However, because the bird is a good size, and since their bodies are quite dense, when involved in a bird strike, they do pose a threat. In fact, in light of how few pheasants live at JFK, it is significant that 10 percent of all the pheasants struck at JFK have resulted in damage or delay to aircraft. This is a high percent. Although pheasants occur at JFK all year round, and are usually found alone, they are not particularly difficult to shoot from May through July when the males are displaying on their territories. Considering how conspicuous and not particularly difficult to shoot from May through July, we recommend that the small population of pheasants at JFK be made even smaller. This can be done by shooting the exposed birds when they present an appropriate opportunity, which is often during the month of May through July. This effort could eventually bring the number in the total pheasant population at the airport closer to zero.

Northern Bobwhite (Colinus virginianus) +

They are at the Jamaica Bay Wildlife Refuge and at Spring Creek, but none are at JFK as of this writing.

Chicken (Gallus gallus) @

During the summer of 1995, on the north side of the airport, just over the border, next to the sewage treatment plant, where the New York City Department of Sanitation parks their garbage trucks, I saw a chicken walking around! This is the only "wild" chicken I have ever seen in New York City, let alone at the airport. Because this species cannot survive our cold winters, without adequate protection this animal will die, so this surely does not pose a problem to aviation. In April 1990 Marc Marrone saw a female bantam or a female fighting hen with a brood of young at Spring Creek Pumping Station, which is on the northern side of Jamaica Bay, a couple of miles from the airport. For the record, I thought it was worthwhile to document the observation.

Herons, Egrets, and Ibis

Great Egret (Casmerodius albus) GREG % +

Snowy Egret (Leucophoyx thula) SNEG % * +

Two snowy egrets were struck at JFK from 1979 through 1995. The first was struck on June 29, 1981, and the second on May 9, 1985. Snowy egrets nest in New York City; most are nesting on islands in the Arthur Kill. There are many nesting in New Rochelle on Huckleberry Island (Garber 1988b). It is apparent that these nesting colonies, at least with regard to snowy egrets, present virtually no danger to aviation at JFK.

Cattle Egret (Bububcus ibis) CAEG % * +

At JFK 64 cattle egrets were struck by 64 aircraft from 1979 through 1995, resulting in no injuries to people, or damage or delays to aircraft. Each of these strikes was the result of a single bird strike; there were no multiple cattle egret strikes. The number of aircraft striking cattle egrets averaged 4 per year, with a range from none to 12 in any given year, with the exception of 1984, when 24 cattle egrets were involved in bird strikes. cattle egret strikes occur from May through September.

Their diet consists primarily of insects, mollusks, crustaceans, and annelids. They will even take rodents on occasion. They winter further south, and some go as far as South America, before returning the following spring. In New York, cattle egrets nest in association with wading birds. In all of New York State, cattle egrets are most common on Long Island, where the breeding population exceeds 350 pair in four colonies, and the number continues to grow. There is a potential for another colony forming near JFK, possibly on National Park Service property, such as on a woodlot on one of the islands in Jamaica Bay. Should this happen, then we could expect the number of cattle egret strikes to increase markedly.

There was a cattle egret problem at LaGuardia Airport in Flushing, New York that reached the point that in 1980 U. S. Fish and Wildlife experts considered the feasibility of using a grasshopper pathogen, spores of *Nosema locustae*, to control grasshoppers at the airport. It was thought that such a procedure would reduce the main food source and thereby eliminate the on-airport attractant that was luring in the cattle egrets. Officials at Port Authority were to consult with Environmental Protection Agency officials to

determine if they could obtain an experimental permit to use the spores. In addition, the possibility of an experimental study with the pesticide Sevin was going to be considered. Bird patrol personnel were to record the number of cattle egrets and their activity areas at the airport (Godin 1980).

The cattle egret threat at JFK is relatively low at the moment. This medium-sized bird rarely is involved in multiple strikes, although the potential for such a strike exists. To date, larger flocks of cattle egrets are more common further south. However, there are several cattle egrets that have been feeding on the lawn behind Aqueduct Racetrack, that might move in a flock on occasion. Until now, they have remained isolated at Aqueduct. We will watch this flock to be sure it does not start to pose a problem. If it does, harassment can be effective in deterring the species from the airport. Current habitat management at JFK that reduces gull attractants has also eliminated many potential cattle egret attractants.

Great Blue Heron (Ardea herodias) GTBH % * +

5 were struck at JFK from 1979 through 1995.

Little Blue Heron (Egretta caerulea) LBHE +

Tri-Colored Heron (Egretta tricolor) TRHE +

Green-Backed Heron (Butorides virescens) GNBH % * +

One was struck at JFK from 1979 through 1995.

Black-Crowned Night Heron (Nycticorax nycticorax) BCNH % * +

31 were struck at JFK from 1979 through 1995.

Yellow-Crowned Night Heron (Nycticorax violaceus) YCNH +

American Bittern (Botaurus lentiginosus) AMBI % * +

Sammy Chevalier (personal communication) said one was struck at JFK before we began keeping records in 1979. There have been no bitterns struck since 1979.

Least Bittern (Ixobrychus exilis) LEBI +

Glossy Ibis (Plegadis falcinellus) GLIB % * +

Three glossy ibis have been struck at JFK since 1979. One was struck on June 7, 1982, another on June 8, 1989, and the third on May 25, 1994. One should note that these strikes occurred during a two week period, although the three strikes occurred during three different years of a 13 year spread (1982 through 1994); none occurred during any of the other years from 1979 through 1995.

Rails

Yellow Rail (Coturnicops noveboracensis) YERA +

Black Rail (Laterallus jamaicensis) BLRA +

Clapper Rail (Rallus longirostris) CLRA % +

King Rail (Rallus elegans) KIRA +

Virginia Rail (Rallus limicola) VIRA % +

Sora Rail (Porzana carolina) SORA % +

Very few sora rails are seen here, mostly because they are secretive. But, sora rails are seen at JFK, and in the surrounding area. In fact, September 4, 1995 Joe Spano of the New York City Department of Parks and Recreation adjacent to JFK, on the other side of Rockaway Boulevard, just south of Springfield Park, which is next to Brookville Park. The precise location is just south of 150th Street, in Queens. In a fresh water creek, that was practically dry, they saw, and photographed, a sora rail feeding on the mud flat that walked into the Phragmites.

Common Moorhen (Gallinula chloropus) COMO +

American Coot (Fulica americana) AMCO +

Shorebirds

Plovers

Black-bellied Plover (Pluvialis squatarola) BBPL % * +

Black-bellied plovers are common to abundant from spring through early fall in the appropriate habitats along Jamaica Bay. However, they do not appear to constitute a threat to aviation in the area, from a review of JFK's strike record: from 1979 through 1995 three black-bellied plovers were struck: one in June 1983, another in August 1984, and the third in October 1991. What appeared to be a wounded black-bellied plover was hopping on one leg along the service road next to the bay runway on November 27, 1995. Although the bird was probably a casualty due to aircraft operations in the area, the bird was not added to our bird strike record because it does not fit the criteria used for bird strikes.

Lesser Golden Plover (Pluvialis dominica) LEGP % * +

Although lesser golden plovers are not nearly as common as black-bellied plovers in the Jamaica Bay area, more have been struck at JFK. Six were struck here from 1979 through 1995. Five were struck in September, one in October.

Semipalmated Plover (Charadrius semipalmatus) SEPL % +

Piping Plover (Charadrius melodus) PIPL % * # + !

Piping plovers are very rare in the area, several pair breed at Breezy Point, which is the westernmost tip of Long Island, and it is part of Gateway National Recreation Area. Although they are only rarely seen at JFK, they were seen here not too many years ago when they were still substantially more common than today. In fact, they bred here, and some were banded at the airport, which indicates they do not require pristine habitat, rather they key into specific characteristics and will choose them when their requirements are met. Chevalier trapped a female piping plover on its nest at JFK on May 20, 1970

that had already been trapped and banded on its nest on June 29, 1968 at Shinnecock Bay, Long Island, 62 miles away.

Killdeer (Charadrius vociferus) KILL % * # +

Killdeer are common at JFK, and they breed on the airport in relatively large numbers. To date they have never posed any threat to aircraft.

American Oystercatcher (Haematopus palliatus) AMOY % # +

Many oystercatchers nest at JFK, some nest very close to the runways and taxiways, all are on the ground. On June 10, 1995 I saw an adult oystercatcher with its young at the end of 4L, out in the salt marsh *Spartina* vegetation, where the *Spartina alterniflora* and the mud flats meet.

Black-Necked Stilt (Himantopus mexicanus) BNST +

American Avocet (Recurvirostra americana) ANAV +

Northern Lapwing (Vanellus vanellus) NOLA %

Lapwings are large ground-nesting plovers that often breed in semi-colonial aggregations on farmland (Berg 1994), but they do not breed anywhere near JFK. They are Eurasian in origin, although on occasion they are seen along the western Atlantic coast. Because they prefer sites with short or no vegetation, and because seems to be an important foraging habitat in some areas, these are the habitats in which they are most often seen when they are found in the New York area. One was seen at JFK during the winter of 1994-1995. It was here for several days and then a lapwing was seen out at the eastern tip of Long Island; it was presumed to be the same bird. No lapwing has ever been struck by an aircraft at JFK, but in Europe they do present a hazard on occasion.

Yellowlegs

Greater Yellowlegs (Tringa melanoleucus) GRYE % * +

Although greater yellowlegs have been struck at JFK prior to 1979, none were struck since 1979, during the period that we have kept records of our bird strikes.

Lesser Yellowlegs (Tringa flavipes) LEYE % +

Solitary Sandpiper (Tringa solitaria) SOSA +

Willet (Catoptrophorus semipalmatus) WILL % # +

Many willets nest at JFK. They nest on the ground in grassy vegetation. On June 10, 1995 I found a willet nest with eggs in it at the end of 4L, 15 feet in from where the black top ends and the vegetation begins, before the ground level gets low enough that it floods at high tide. It is significant that although these birds are quite common near the runways, none has ever been struck here since.

Spotted Sandpiper (Actitis macularia) SPSA +

Upland Sandpiper (Bartramia longicauda) UPSA % * # +

Although upland sandpipers are common at JFK, none has been struck here by any aircraft since 1979, when we began keeping bird strike records, although Sammy Chevalier has told me that we did strike at least one prior to 1979, and no damage was reported to the aircraft involved. The upland sandpiper is a grassy meadows and open plains species that occurs mostly in the prairie belt from Oklahoma to Alaska, although populations occur in suitable pastures as far west as Oregon and as far east as New Hampshire.

Many airports create large expanses of open grasslands that differ significantly from the lawns along highways, near homes, or in farm country, but airport grasslands may have characteristics in common with the grassy meadows, pastures, and open plains habitats in the prairie belt, because upland sandpipers nest in many such locations. Among the airports in the Northeast where upland sandpipers breed, are: Westover Air Reserve Base in Massachusetts, where there are approximately 100 pairs nesting on 1,600 acres of appropriate habitat; Atlantic City International Airport in New Jersey, Bradley International Airport in Connecticut, and JFK. JFK has airport grasslands and we have upland sandpipers in large numbers, one of the largest breeding populations in North America. We can safely conclude that airport grasslands differ from those found along roads and highways and near homes because upland sandpipers choose to nest at so many airports, while they do not choose the other options just listed.

Until recently, upland sandpipers in the region nested in many habitats other than just at airports. Although upland sandpipers were common summer residents throughout the region (Ailes 1979), they decreased in number during the nineteenth century, and were rare by the turn of the century (Cruickshank 1942). In 1923 Griscom wrote the upland sandpiper was "one of our rarest birds, and in most parts of the area is gone forever." The first record of upland sandpipers observed at JFK, to my knowledge, were the 25 reported on July 14, 1935, when JFK was still Idlewild (Urner 1936). They were common in New Jersey in the nineteenth century. Stone (1937) wrote Westcott shot hundreds in fields near Long Branch, New Jersey in the 1860s. Urner (1936) reported 55 upland sandpipers on August 11, 1934 and 45 on July 18, 1936 at Newark Meadows, New Jersey. Even though much of the Newark Meadows are wetland, the upland sandpipers nested on the dry portions of the Newark Meadows until the late 1930s; now the entire area where the birds used to nest is no longer suitable nesting habitat (Bull 1975). For a more recent account of their status see Mitchell (1967).

By 1900 upland sandpipers had disappeared from Morristown, none remained in Ridgewood by 1901, and Summit by 1904 (Cruickshank 1942). They were seen at Elizabeth, New Jersey in 1926 (Urner 1936). Upland sandpipers do not breed in

Westchester, Putnam, or Rockland Counties, New York. In Orange County they have bred at Goshen and Washingtonville. The single record for Fairfield County, Connecticut was a nest with eggs at Glenbrook in 1897 (Howes 1928). On Long Island they were seen on April 6, 1931 (Bull 1975), and at Heathcote, Westchester County on April 6, 1931 (Phillips 1928). They used to breed on eastern Long Island at Montauk, Shinnecock Hills, Orient, and Gardiner's Island, but none have bred in these locations for decades (Bull 1964). Elsewhere on Long Island upland sandpipers used to breed in Easthampton as recently as 1949, in Syosset in 1951, and Bohemia in 1958 (Bull 1975); none of these sites still have nesting pairs.

The Hempstead Plains on Long Island, which originally comprised approximately 60,000 acres, was one of the best remaining habitats for upland sandpipers in the area until the first part of the century. Nichols estimated at least 25 pairs bred there in the early 1920s (Bull 1975). By the early 1940s the Hempstead Plains population only had four to six remaining pairs (Cruickshank 1942); now the population has disappeared. JFK is very close to where the Hempstead Plains used to extend. Although much of JFK's habitat is artificially created from dredge spoils, the net effect has been to make upland meadow habitat where there used to be salt marsh, but near where there used to be natural upland meadows. Today upland sandpipers only breed at a relatively small number of discrete, local sites, and these sites usually have a small number of birds. It could be that the birds breeding at JFK as descendants of the birds that used to breed at Hempstead Plains, but the birds moved to JFK when the Hempstead Plains were fragmented and reduced in size, when simultaneously, JFK was increasing in size.

Throughout their entire range, which includes North and South America, the total number of breeding pairs is quite small. For this reason, and because JFK has one of the largest breeding populations, as well as one of the most significant long-term data bases on the species, we continue to monitor the species at the airport. In North America it breeds as far south as Virginia. It was formerly more common. Upland sandpipers only breed in a number of discrete, local sites. Although this species does not represent a hazard to aircraft, in light of the few that have been struck over the years, we are making every effort possible to record relevant information about the birds at the airport so others interested in this species' management might benefit from our experience.

The JFK population has been utilizing airside grassland habitats for many years. Studies of the species' breeding biology have been conducted (Higgins and Kirsch 1975; Kirsch and Higgins 1976; Ailes 1980), and their home range and daily movements were studied elsewhere (Ailes 1977). In addition, their coloniality, reproductive success, and habitat interactions have been studied in the Midwest (Bowen 1976). The upland sandpiper will not continue breeding in an area when its fragmentation reaches a certain critical threshold, therefore there is some concern that the continued divisions of the airside habitat with more taxiways and open blacktop areas, could lead to an eventual problem with this species at JFK. However, there is no indication that the numbers have decreased at all over the last several years.

Upland sandpipers overwinter each year in the South American pampas, (while it is winter here, it is summer there) and then they return to the New York and New Jersey region shortly after the snow melts. They often are back as early as the first week of April (Urner 1936), at which time they appear to already be paired (Ailes 1979). The earliest date one was banded at JFK was May 5. This bird was a bird that had already been banded, which indicates the eggs begin to hatch by the first week of May, because the banding season usually begins when the young have hatched out, because this is when you lure the adults close enough to capture them, and this is when you can chase down the young.

From 1969 through present bird banding has been conducted at JFK under the permits held by Jay Richard Cohen, Maurice (Sammy) Chevalier, and Steven D. Garber. 410 upland sandpipers were banded at JFK from 1969 through 1987, all were banded under the permits held by Cohen and Chevalier. All banding took place between the 4s. Banding data and observations by biologists at the airport are presented in an effort to determine the history of this species at the airport during our tenures here. Two of the upland sandpipers banded here were subsequently recovered, both at the airport. Each was banded at JFK when they were too young to fly. One was banded on July 6, 1976 and was recovered May 8, 1978. The other was banded June 12, 1981 and was recovered May 28, 1990. This latter bird may be a longevity record for the species; the hiatus between times captured was 9 years.

The total number of upland sandpipers banded at JFK each year is as follows: 1969 - 2; 1970 - 9; 1971 - 19; 1972 - 12; 1973 - 6; 1974 - 15; 1975 - 8; 1976 - 22; 1977 - 26; 1978 - 34; 1979 - 41; 1980 - 30; 1981 - 57; 1982 - 36; 1983 - 71; 1984 - 6; 1985 - 0; 1986 - 14; 1987 - 2. All were banded when they were too young to fly except for on adult in 1971, 1 adult in 1977, 2 adults in 1978, and 1 adult in 1979. The number banded appears to drop off markedly after 1983, which may be a result of the grassland management at the airport. It has been suggested that it was after 1983 that the grass was allowed to grow high during the summer, whereas during previous years it was always kept shorter during the summer months. Although the longer grass does not appear to hinder the upland sandpipers' success at JFK, it does affect the success of those trying to locate and capture them so they can be banded. None were banded in 1988, 1989, 1990, 1991, or 1992. Each of these years Chevalier was busy during the summer with other chores on the airport and was not able to devote time to banding. He retired in October 1992, and no one was here to resume his work from then until December 1994, when I began working at JFK.

Dates when upland sandpipers were either banded or recaptured (followed by an R) are:

June 1, 1977
June 3, 1977 (3)
June 8, 1977 (3)
June 14, 1977
June 17, 1977

June 19, 1977 (4)
June 21, 1977 (2)
June 22, 1977
June 26, 1977
June 28, 1977 (2)
June 29, 1977
July 6, 1977 (2)

May 5, 1978 R
June 1, 1978 (2)
June 6, 1978 (2)
June 14, 1978 (3)
June 15, 1978 (2)
June 16, 1978 (3)
June 19, 1978
June 20, 1978 (6)
June 21, 1978 (3)
June 24, 1978 (3)
June 28, 1978 (2)
June 29, 1978 (2)
June 30, 1978 (3)
July 5, 1978
July 8, 1978
July 24, 1978

June 3, 1979 (2)
June 7, 1979 (3)
June 12, 1979
June 14, 1979 (4)
June 16, 1979 (6)
June 17, 1979
June 20, 1979 (5)
June 21, 1979
June 22, 1979 (4)
June 25, 1979 (3)
June 26, 1979
June 27, 1979 (4)
June 28, 1979
July 3, 1979 (2)
July 4, 1979

June 2, 1980 (3)
June 4, 1980
June 7, 1980 (2)
June 10, 1980

June 12, 1980 (2)
June 16, 1980 (3)
June 17, 1980 (3)
June 18, 1980
June 19, 1980 (2)
June 20, 1980
June 21, 1980
June 22, 1980
June 23, 1980 (3)
June 24, 1980 (3)
June 25, 1980
June 27, 1980
July 4, 1980

June 23, 1981
June 24, 1981 (2)
June 25, 1981 (2)
June 29, 1981
July 27, 1981

May 31, 1982 (2)
June 1, 1982 (2)
June 2, 1982 (5)
June 6, 1982
June 8, 1982 (6)
June 9, 1982
June 10, 1982 (3)
June 11, 1982
June 14, 1982 (3)
June 16, 1982 (2)
June 19, 1982
June 20, 1982 (2)
June 23, 1982
June 25, 1982
June 26, 1982

June 8, 1983 (3)
June 9, 1983 (7)
June 10, 1983 (3)
June 13, 1983 (3)
June 14, 1983 (5)
June 16, 1983 (3)
June 17, 1983 (4)
June 22, 1983
June 26, 1983

June 27, 1983 (2)
June 30, 1983 (5)
July 1, 1983 (5)
July 3, 1983 (2)
July 4, 1983
July 9, 1983
July 11, 1983
July 27, 1983

June 9, 1984
June 10, 1984
June 25, 1984
July 11, 1984
July 13, 1984
July 20, 1984

June 3, 1986 (1)
June 5, 1986 (3)
June 6, 1986
June 10, 1986 (2)
June 14, 1986
June 16, 1986 (3)
July 1, 1986
July 9, 1986
July 14, 1986

June 20, 1987
July 23, 1987

May 28, 1990 R

From the above banding dates, upland sandpipers are here during the months of June and July; one might conclude from the banding data that the earliest date the birds are back at JFK was May 8, and the latest they were here was July 27, however, most banding dates start at the end of May and beginning of June, which may be more representative of when the birds are on their nests, and when they have young in the area, because the birds being caught are primarily young that can not fly and therefore can be chased down, and during the time that there are young in the area, the adults can be caught because they are more likely to come close enough to a person with a net when the parents are protecting their young.

Dates during 1994 and 1995 when members of the Bird Control Unit, or other biologists at the airport, observed upland sandpipers at JFK are:

May 11, 1994 (1)

May 19, 1994 (1)
May 23, 1994 (2)
May 24, 1994 (1)
May 25, 1994 (1)
June 8, 1994 (2)
June 14, 1994 (6) (of which, 2 were chicks)

June 10, 1995 (3 Adults, 1 Juvenile)

From the above observation data, it appears that many upland sandpipers arrive at JFK through May, but eggs do not hatch until the end of May and in June and some may hatch as late as July.

Whimbrel (Numenius phaeopus) WHIM % +

Godwit

Hudsonian Godwit (Limosa haemastica) HUGO +

Marbled Godwit (Limosa fedoa) MAGO +

Ruddy Turnstone (Arenaria interpres) RUTU % +

Red Knot (Calidris canutus) REKN % +

Sanderling (Calidris alba) SAND % +

Sandpipers

Semipalmated Sandpiper (Calidris pusillus) SESA % +

Western Sandpiper (Calidris mauri) WESA +

Least Sandpiper (Calidris minutilla) LESA +

White-Rumped Sandpiper (Calidris fuscicollis) WRSA +

Baird's Sandpiper (Calidris bairdii) BASA +

Pectoral Sandpiper (Calidris melanotos) PESA +

Dunlin (Calidris alpina) DUNL % +

Curlew Sandpiper (Calidris ferruginea) CUSA +

Stilt Sandpiper (Micropalama himantopus) STSA +

Buff-Breasted Sandpiper (Tryngites subruficollis) BBSA % +

Ruff (Philomachus pugnax) RUFF +

Dowitchers

Short-billed Dowitcher (Limnodromus griseus) SBDO % +

Long-billed Dowitcher (Limnodromus scolopaceus) LBDO +

Common Snipe (Capella gallinago) COSN +

American Woodcock (Scolopax minor) AMWO % *

November 6, 1995 I found a dead woodcock that had been runover at JFK on landside. The previous week someone brought a live woodcock to the Jamaica Bay Wildlife Refuge to release, because she had found it on the sidewalk in Manhattan. This time of year they are migrating south and because they are weak fliers they have to land periodically, which forces them down in unsuitable territory. As a result, it is not uncommon to find them in unusual situations around New York City. However, this species has very little suitable habitat on JFK where they would ever choose to spend much time, although before JFK was turned into an airport, there was a significant area of freshwater marsh that would have had wet bottomlands that would have provided excellent feeding opportunities. Now, all that has changed, so the only woodcocks we have here are the occasion migrants. They are hit by planes only on very rare occasions, and never have caused any damage.

Phalaropes

Wilson's Phalarope (Steganopus tricolor) WIPH +

Red-necked Phalarope (Lobipes lobatus) RNPH +

Red Phalarope (Phalaropus fulicarius) REPH +

Gulls

Comparing all bird species and groups of species, gulls represent the greatest bird hazard to aircraft at airports throughout the world (Burger 1983) because they are widely distributed, common, large, often found in groups, and they congregate at habitats usually in abundance at airports. Worldwide, the majority (60 percent) of serious bird-related incidents at airports affecting civilian aircraft involve gulls (Solman 1981). The "Final environmental impact statement, gull hazard reduction program, John F. Kennedy International Airport" prepared by the United States Department of Agriculture and United States Department of the Interior (1994) stated that when comparing all the other threats to aircraft, including mechanical failure, pilot error, and weather, gulls pose a greater threat than all the other threats combined, to civilian aircraft, and the following authors are cited: Blokpoel (1976), Frings (1984), and Griffin and Hoopes (1991). Bourque questions the accuracy of this statement (personal communication). Blokpoel informed him no such a statement was ever made in his book, Bird Hazards to Aircraft, that was cited. Bourque (personal communication) stated that Griffin and Hoopes appeared to have cited the Blokpoel reference, without ever reading the book, as apparently had others (Bourque's opinion).

On pages 198 and 199 of Blokpoel's book, however, is a table in which it is apparent that gulls are involved in more collisions with aircraft than most other species combined (data were presented from Australia, Canada, Germany, Holland, India, Sweden, United Kingdom, and the USSR). Bourque also told me that (personal communication) Frings said five percent of all bird ingestions lead to engine failure, many of which are due to the pilot shutting the engine down.

To determine if the statement erroneously attributed to Blokpoel has any truth, I attempted to find appropriate data for analysis. Recently the airline industry agreed to share data from aircraft operations with the FAA in an effort to identify unsafe trends before accidents occur. The decision to share data was announced at the FAA's 1995 aviation safety conference in New Orleans. The FAA pledged that the information on aircraft operations would remain confidential, which was a key component in winning airline approval to allow the agency access to inflight recorded data (as written in 1995 issue of Airport Report Express, editor B. Cook).

Either way, in terms of total bird strikes, four gull species pose the greatest threat to aircraft at JFK. Herring gulls, ring-billed gulls, great black-backed gulls, and laughing gulls are the four species most common to the area. At JFK, between 1979 and 1993,

76.5 percent of all bird strikes involved gulls (United States Department of Agriculture and United States Department of the Interior 1994). For years, the main attractant to these gulls were the two landfills near the airport, however, both of these have since been shut down. Meanwhile, laughing gulls, which previously were very uncommon in the area, have begun nesting nearby and are now responsible for a great number of bird strikes.

Laughing Gull (*Larus atricilla*) LAGU % *

Introduction

Since laughing gulls became established less than 20 years ago, the number of bird strikes at JFK doubled, which placed JFK higher on the list of airports that required wildlife management to help rectify the situation. JFK ranks the highest of all airports in North America, when calculating the number of bird strikes as a percent of plane movements. JFK has worked to minimize the hazard, however, the issues involved require both short-term and long-term approaches if we are ever to solve the problem. These approaches, to ameliorate the laughing gull situation, as well as to manage all the other wildlife hazards at JFK, are described below. Data are presented, analysis, and discussion.

Included among the breeding birds are thousands of pairs of gulls that nest on the islands in Jamaica Bay. Three of these nesting islands are immediately adjacent to JFK's runways, and as fate would have it, it is on these islands that the only breeding colony of laughing gulls in all of New York State exists, or more accurately, thrives. This colony is a protected resource, which is valued both by the National Park Service and the State of New York's Department of Environmental Conservation. The protection of this colony has come at a very high cost, because it poses a significant hazard to the flying public. Due to the colony's location, an unusually high number of laughing gulls have been involved in bird strikes, or collisions with aircraft, a reality that needs to be managed because bird strikes cause plane crashes.

Laughing gulls currently nest in Joco Marsh, Silver Hole Marsh, and East High Meadow Marsh in Jamaica Bay. These marshes are actually a series of interconnected *Spartina* spp. wetlands totaling approximately 650 acres. Although many creeks and waterways divide these wetlands, it is apparent from the air that these marshes constitute a unit which is adjacent to JFK. From 1979 when only 15 pairs of laughing gulls were found on this property, the colony has grown to 5,830 laughing gull nests in 1995. Because laughing gulls used to nest in New York State, but were eliminated by overhunting largely for feathers and in part for eggs, by the turn of the century there were no nesting

pairs remaining in the entire state. For this reason, in part, their return in 1979 was a cause celebre. However, their rapid rate of increase was attributed to the rapid increase in bird strikes at JFK, doubling the total in 10 years.

The number of bird strikes each year increased from approximately 200 to 400. Because each of these strikes possessed the potential for disaster, laughing gulls were quickly recognized as presenting a serious safety problem to the flying public. Port Authority hired the best experts available to study the problem, make recommendations, and then it set out to minimize the risk with state of the art wildlife management. JFK approached the problem from several angles: recognizing that many birds were flying over the airport due to off-airport attractants, we attempted to ascertain what those attractants were, in an attempt to reduce their draw. We also recognized there were certain on-airport attractants that needed to be identified and eliminated. In compliance with federal, state, and city regulations, we conducted surveys to find where the birds were going, and with this information we can make further management decisions.

Laughing and Non-Laughing Gull Survey at JFK During 1994 and 1995

Bird surveys were conducted at JFK during 1994 and 1995. Indices of the number of laughing gulls and non-laughing gulls (great black backed, herring, and ring-billed) flying over the airport were calculated for each month. We found that the mean number of non-laughing gulls over JFK ranged from about 5 to 15 per hour during each month of the year. Laughing gulls returned to the JFK area in late winter and early spring, their numbers peaked during the summer, and then declined in late summer and autumn when the adults and young dispersed and no longer returned to the colony each day. Some winter plumage laughing gulls have been seen through till December, and others may even stay in the area through the winter, but probably most of the remaining laughing gulls depart when the temperatures get real cold. So far, the weather is still mild so some can remain without much problem.

As a direct result of the data collected at JFK during May and June of 1994 that we presented to the United States Fish and Wildlife Service, the Service issued a special purpose permit on June 17, 1994 which made it legal to shoot at JFK. Leading up to June 17th, however, data were submitted to the Fish and Wildlife Service to determine that if the number of laughing gulls had reached a point that the Service felt was sufficient to require shooting in an effort to maintain the safety of the people flying into and out of the airport. Laughing gulls flying over JFK were found to pose a significant hazard because they can collide with planes and damage their engines, thereby creating a tremendous amount of damage, that could lead to a devastating accident. To protect the public, laughing gulls were shot during 1994 for the fourth consecutive season, thereby reducing the number of laughing gull related bird strikes by 90 percent.

Based on the laughing gulls' behavior, the Port Authority of New York and New Jersey applied for a permit to shoot gulls in 1995. This application was initially denied. Port Authority was confident that the laughing gulls would return, and they were well aware that their numbers could rapidly increase, leading to an imminent risk that would threaten the public, if measures were not taken. JFK's almost 10 square miles of complex ecosystem borders one of the richest biological systems in the northeast, making this area difficult for any wildlife biologist to manage. Nevertheless, this task is constantly met by Port Authority, and it was not very helpful when it learned its permit application had been denied, especially after we had received a verbal commitment from the Fish and Wildlife Service that we would receive the permit.

The Port Authority's officials were aware that the number of laughing gull-related bird strikes at JFK was nearly perfectly correlated with the number of laughing gulls that nest at the National Park Service's Jamaica Bay Wildlife Refuge immediately adjacent to the airport. However, knowing the behavior of the birds, and their number, as well as when they arrive, and how many tend to get struck, was not enough. Still, before issuing a special purpose permit we were required to conduct surveys each day documenting the number of laughing gulls flying over the airport, practically by the hour. As the number of laughing gulls increased, the number of laughing gull strikes increased, and still we had no permit, to shoot gulls, geese, or any of the other species which require a special purpose permit from Fish and Wildlife.

We submitted a report to Fish and Wildlife on June 2, 1995 documenting the pattern of increase of laughing gulls at JFK, showing that there was already sufficient reason to have the special purpose permit. Then on June 3, 1995 Air France's Concorde collided with several Canada geese when landing at JFK. Two engines caught fire, a reported \$6 million dollars worth of damage was incurred, and Fish and Wildlife told us they were going to issue us the permit immediately. We continued conducting surveys and sending in reports to the federal and state officials; the Fish and Wildlife issued JFK a special purpose permit on June 19, 1995, long after the gulls, geese, and other species included in the permit application, had increased in number to the point that they posed a significant hazard to warrant a special purpose permit. Below are the highlights from our June 2, 1995 submission to Fish and Wildlife.

Methods and Materials

Bird surveys were conducted at JFK using two methods: 1) windshield surveys were conducted when driving the perimeter of the airport along the Bay Runway, adjacent to Jamaica Bay, and then up the runway adjacent to Thurston Basin, then across the airport to the mouth of Bergen Basin, where it empties into Jamaica Bay. The route is always the same 10 miles with the same 13 marked stops. It is driven at 8 miles per hour. All the birds seen within 500 feet of the car are identified and counted while driving to each of the 13 stations, which are between 2,500 feet and 3,500 feet apart. At each stop the

vehicle is turned off and the two surveyors get out of the car and count the birds within 500 feet for 3 minutes, noting if each bird is over the airport's taxiways or runways or not. Each survey lasts approximately two hours; the number of birds per hour was calculated to create an index of relative bird activity for that period of the day.

This index provides a relative number on which to base how many gulls, or birds of other species, are flying over the airport per hour. Surveys were conducted during daylight hours. Each morning survey began between 6:05AM to 7:05AM, and lasted until 7:50AM to 9:15AM. In addition, an equal number of one hour surveys were conducted, at any of the 13 stations to determine the number of gulls over JFK per hour. The data are presented in tables. Mean hourly indices are calculated from the surveys of laughing gulls and non-laughing gulls. The numbers are presented in figures to show the relative numbers flying over JFK during May and June, as well as during the entire year, and these numbers were analyzed to present relative peak flights according to different times of the day.

Results

We analyzed 21 morning surveys that provided an index accurately representing the relative numbers of laughing gulls flying over JFK in 1995 from May 25 through June 19. A total of 1,618 laughing gulls were seen during 40.7 hours of survey time, which is a mean of 39.75 laughing gulls per hour. The maximum number of laughing gulls seen in one survey was 230 on June 14; the survey lasted from 6:30AM to 8:35AM. The minimum number of laughing gulls seen during a morning survey during this period was 21; this survey occurred on June 8 and lasted from 6:35AM to 8:35AM.

The index provides a relative measure of the mean number of non-laughing gulls flying over the airport. The number was approximately 10 per hour. During the winter most of the gulls are herring and ring-billed. Some herring gulls use the airport during low tide to drop clams on the hard surfaces. As the number of ring-billed gulls declines in the spring and summer, the number of laughing gulls increases. Laughing gulls are not present all winter. They begin flying over JFK airspace in March and April. By May their numbers are high, and in June they are on their nests. By the middle of June most eggs have hatched. This is the time that adult laughing gull flights over the airport reaches its peak.

Discussion

From mid-May through mid-June the index of the mean number of laughing gulls flying over JFK per hour, using our survey method, totaled approximately 40 per hour. We know that the laughing gulls come from the colony adjacent to the airport, and the peak morning and evening flights coincide with the times when the birds leave the colony in

the morning and return in the evening. These flights create high numbers of laughing gull strikes, thereby increasing the risk of a dangerous aviation incident at the airport. It is for this reason that the laughing gulls have been the center of a controversy. JFK has a federal mandate to manage this risk, which we have been doing successfully. To date we have done this by applying to the Fish and Wildlife Service and the NYS Department of Environmental Conservation for depredation permits. New York has given us the permit rapidly, however the Fish and Wildlife Service holds off until the number of gulls flying over the airport increases by 500 percent. That is, non-laughing gull species flying over the airport amounts to an index of approximately 10 per hour. Using the same index, but with the laughing gulls amounting to 40 per hour, the total number of gulls flying over the airport increases to 50 per hour. It is unreasonable for the Fish and Wildlife Service to wait so long, and until the risk is so high, before they issue a depredation permit.

In 1975 when a plane caught fire due to striking gulls when taking off at JFK, the plane burned to the ground. In the 1976 report issued by the Fish and Wildlife Service, they stated that the risk at the airport due to gulls was great and needed to be managed by a "full-time wildlife biologist/ornithologist to develop, implement, and direct all bird-management programs and activities at JFK" (United States Department of the Interior Fish and Wildlife Service 1976). This was three years before any laughing gulls were even nesting in New York State, and long before laughing gulls posed any problem whatsoever at JFK. Therefore, without any laughing gulls in the vicinity, the number of gulls flying over the airport that the Fish and Wildlife Service stated constituted such a great risk that needed immediate attention, was considerably less than that which they currently tolerate, until the numbers reach 50 per hour, using the index described above.

By the end of March each year, when the laughing gulls have been in the vicinity for only a short time, and when there are relatively few laughing gulls compared to the number that will be in the same area by the end of June, the number of laughing gulls over the airport already equals the number of non-laughing gulls over the airport. Therefore, the danger has increased by 100 percent over what the Fish and Wildlife Service told us was a great risk that needed to be managed. In terms of numbers of gulls flying over the airport, we know that in 1994 the Fish and Wildlife Service waited until the danger had increased by over 300 percent above what they had told us was a great risk that needed to be managed before they issued us a special purpose permit.

In 1995 we provided the Fish and Wildlife Service with supporting data on June 2 showing that the danger had already increased by over 300 percent above what they had told us was a great risk that needed to be managed. Still they waited two and half more weeks before issuing us a special purpose permit. During that time there were multiple bird strikes, one of which caused two engines of a Concorde to catch fire, resulting in over \$6 million dollars worth of damage. Luckily, no one was hurt, but the accident could have resulted in a disaster. We cannot guarantee that if we had been issued the permit earlier that the Concorde accident would not have happened, but we know that our wildlife management techniques are highly effective. Since we began the shooting program we reduced just the number of laughing gulls bird strikes by 90 percent, so we

have a great deal of confidence in our ability, through the many techniques we use each month of the year, to eliminate a high percent of the total number of bird strikes, and therefore potential disasters, before they happen.

Measure of Attractants to Laughing Gulls (Off-Airport)

In an effort to determine where the gulls are going that are flying over JFK, bird surveys have been conducted throughout the area. We have found that greater than 95% of the laughing gulls feed within a 20 mile radius of the colony and most of the feeding occurs in habitats near the shore. We are monitoring the numbers and species of birds found at the nearest water treatment plant (sewage treatment plant) adjacent to the airport, and our surveys also include other possible habitats. Our goal is to determine which habitats in particular are the ones attracting the greatest number of gulls flying over JFK airspace. We have gained permission from the New York Racing Association to conduct surveys at Aqueduct Raceway, which has also been cited as a possible off-airport laughing gull attractant.

Laughing Gull Attractants in the Vicinity of JFK

Introduction

Research was conducted during the months of June, July, and August of 1995, during which time approximately 150 field hours were spent within a radius of 30 miles of the airport. We attempted to determine where laughing gulls were located, where they were going when flying over the airport, whether more laughing gulls flew over JFK than over other surrounding areas, what foods or habitats are the gulls attracted to, and how far they were going to gain access to these resources?

Methods

The study area focused on the land and water resources to the east of the airport because when the birds fly over the airport they are headed in an easterly direction. Areas investigated include: 1) Suburban areas which included residential areas in southeastern Queens and southern Nassau County where the land area covered by buildings, concrete, and blacktop exceed the area that has grass, field, and woodland. 2) On airport location include parking lots, cargo areas, and passenger terminal zones. 3) Jamaica Water Treatment Plant, where sewage is treated, which is right next to JFK. This was surveyed because it has been mentioned over the years as a possible laughing gull attractant. 4) Dry inland parks in Queens and open fields that do not have any bodies of permanent

water. 5) Permanent bodies of fresh water that were surveyed were those city and state parks that have fresh water ponds or lakes, located in eastern Queens and southern Nassau County. 6) Jones Beach Barrier Island was surveyed along the bay side from Lido Beach east to the Fire Island Inlet. 7) Salt water and brackish bays surveyed included those bays along the south shore of Long Island. 8) West of JFK we surveyed included a location on the other side of the airport. Surveys were conducted at Broad Channel to determine if more laughing gulls were flying over JFK, or if possibly due to the management there, greater numbers were flying in the other direction. 9) Landfills in New York City.

All locations were reached by driving and walking. Most were open to the general public. For each location, date, time, number, habitat, and behavior of laughing gulls, herring gulls, great black-backed gulls, and ring-billed gulls were recorded. For habitat the categories were: buildings, grasses, shrubs, trees, beach, type of water nearby (fresh, salt) as well as the type of salt marshes nearby. The distance to the nearest bay and to the laughing gull colony in Jamaica Bay were also recorded. Under weather the temperature and wind speed and direction were recorded, as well as if it was raining, and the percent of cloud cover, and whether it was foggy. The air speed surveys at JFK were conducted by the United States Department of Agriculture. The windshield surveys were conducted while driving at 10 miles per hour with 13 three minute stops at specific stations. Agriculture personnel also conducted one hour station surveys at specific locations along the bay side perimeter of JFK.

Results

1) Suburban Areas

In the suburban areas, which were defined as residential areas with more concrete and buildings than vegetation cover in southeastern Queens County and southern Nassau County. These places were not on or adjacent to any wetlands, or open bodies of fresh, brackish, or salt water. 13 surveys were conducted in suburban areas, totaling 7.1 hours. During these surveys a mean of 13.1 laughing gulls per hour. For laughing gulls, this category ranked 5 out of 7 habitat types surveyed. 63 (68 percent) of the 93 laughing gulls seen were insecting from the tops of trees. In suburban Queens and Nassau County, the number of laughing gulls observed was inversely proportional to the distance to the colony. 95 percent of the laughing gulls observed were all within 10 miles of the colony, while the occasional laughing gull was observed as far as 25 miles away. It also appeared, although the correlation was not as strong, that more laughing gulls were observed closer to the bays, while fewer were inland. Most of the laughing gulls flying inland had a flight pattern that appeared to be that of birds that were meandering. However, at Aqueduct Raceway, during the flea market, laughing gulls were circling overhead with herring gulls, and both species were loafing on the blacktop parking lot. During these surveys 24 herring gulls were observed.

2) On airport locations

On airport locations that we surveyed in this study include two categories: land side attractants were parking lots, cargo areas, and passenger terminal zones, and airside attractants investigated were the ramps, vegetation, runways, and taxiways.

3) Jamaica Water Treatment Plant

Jamaica Water Treatment Plant, where sewage is treated, which is right next to JFK. This was surveyed because it has been mentioned over the years as a possible laughing gull attractant.

4) Dry Inland Queens Parks

This category of habitats that were surveyed called dry inland Queens parks include city parks and fields (school fields, as well as baseball, football, and soccer fields). All were located in Queens. Most locations had either open or closed canopy tree areas surrounding the fields. There were no large sources of water nearby. A total of 14 surveys were conducted during 5.6 hours, during which we observed a mean of 2.1 laughing gulls per hour. During these surveys we observed 12 laughing gulls, 1 herring gull, and 2 ring-billed gulls were observed. 7 surveys were conducted at open fields and parks that were located from 2 to 9 miles north of the colony. Because these locations are north of the colony, JFK is in the direct flight path of any birds attracted to these localities. All these open fields and mowed playing fields, and surrounding urban forests proved to be insignificant laughing gull attractants. Laughing gulls observed were not attracted to these areas, but instead were all flying high and just passing by.

5) Permanent bodies of fresh water

Permanent bodies of fresh water that were surveyed were those city and state parks that have fresh water ponds or lakes, located in eastern Queens and southern Nassau County.

6) Jones Beach Barrier Island

The bay side of the Jones Beach Barrier Island was surveyed from Lido Beach east to Fire Island Inlet. We conducted a total of 13 surveys along the Jones Beach Barrier Island. These surveys totaled 13.42 hours, during which time we observed 45 laughing gulls, 482 herring gulls, 73 great black-backed gulls, and 50 ring-billed gulls. A mean of 3.4 laughing gulls were observed per hour.

7) Bay-Related Areas

Bay-related areas were defined as those areas along the perimeter of the saltwater and brackish bays along the south shore of Long Island, as well as the islands and marshes within the bays, whenever they were accessible. The surveys (n = number of surveys conducted, h = total number of hours of surveys conducted) included Jamaica Bay ($n=20$, $h=14.17$), Hewlett Bay ($n=3$, $h=2.25$), Middle Bay ($n=4$, $h=4.75$), Baldwin Bay ($n=2$, $h=2.25$), East Bay ($n=4$, $h=3.92$), and South Oyster Bay ($n=2$, $h=2.83$), and Great South Bay ($n=1$, $h=1$). 36 surveys were conducted totaling 31.17 hours. A mean of 36.3 laughing gulls were observed per hour of survey time. A total of 1,133 laughing gulls, 471 herring gulls, 36 great black-backed gulls, and 25 ring-billed gulls were observed during these surveys.

8) Broad Channel

West of JFK we surveyed included a location on the other side of the airport. Surveys were conducted at Broad Channel to determine if more laughing gulls were flying over JFK, or if possibly due to the management there, greater numbers were flying in the other direction.

9) Landfills in New York City

Any airport located near a landfill stands a significant risk of increased bird strikes due to more birds in the area that are both attracted to and sustained by the food provided at the landfill. If an airport is in a bird population's flyway between where they live or breed and where they feed, then there will be increased bird flights through the airport's airspace, thereby increasing the risk and eventuality of bird strikes. The Federal Register (1995) published a notice requesting comments to help fulfill the requirement in Section 203 of the Airport and Airway Safety Capacity, Noise Improvement, and Intermodal Transportation Act of 1992 (Public Law 102-581). Specifically, Section 203(b)(2) directs the Secretary of Transportation to conduct a study on whether a landfill within 5 miles of the end of a runway has the potential to attract birds and therefore pose a hazard to aircraft, or to the flying public. There is no question that 5 miles to a runway is a very short distance to many of the bird species that shuttle back and forth from their breeding colonies to a landfill. Thirty miles isn't very far for many gulls to shuttle back and forth when food availability in the area is otherwise scarce, or when competition for other food sources is high. And this distance will probably increase as the number of gulls increases and therefore the competition for resources becomes more intense. It should also be taken into account that as the number of people increases, the number of gulls will increase, and the number of breeding colonies will increase. So while an airport may not

be in the direct path of gulls flying from a breeding colony to a landfill site now, that may not be true in the near future.

Pennsylvania Avenue Landfill (also called Edgemere) and Fountain Avenue Landfills were on either side of JFK for decades until the obvious hazard and risk was realized in a series of major strikes, one of which resulted in the jet burning to the ground; luckily everyone got off safely before the plane exploded. However, there is still one landfill left in New York City. Fresh Kills Landfill is located in Staten Island, and it is 21 miles from the laughing gull colony next to JFK.

Surveys were conducted there July 19, 1995 and August 2, 1995, during which times it was determined that this site is a major gull attractant, and many of the gulls there are laughing gulls. In two hours of windshield and short stop surveys (2-5 minutes each) 1,792 laughing gulls were seen. That is 896 laughing gulls per hour, one of the highest laughing gull counts taken during a per hour survey conducted throughout the New York Metropolitan region during the summer of 1995, with the exception for the number of laughing gulls seen on the colony itself. The other survey with such high numbers was the peak count of laughing gulls flying over Broad Channel, which was 1,472 per hour.

In addition to the 1,792 laughing gulls observed, 1,480 herring gulls were seen, 176 great black-backed gulls, 17 ring-billed gulls, 89 crows, 6 Canada geese, 5 rock doves, and 5 cattle egrets.

It was concluded that the garbage is a major attractant at this landfill, although the actual areas where there is exposed garbage are quite small. Nevertheless, the garbage is continually replenished, and with each truckload more "fresh" garbage arrives, which is available for a brief period, during which the gulls feed when they are hungry. The rest of the time they stand on the ground in large groups. Only 10-15 percent of the laughing gulls seen were foraging. Only two sites had open garbage being dumped into the landfill at any given time; at one only about 80 laughing gulls were seen eating at any given time, and at the other about 120 laughing gulls were feeding at any given time. All the others were all loafing and presumably digesting.

When an area is filled with garbage to a specific height, it is covered with dirt until the area is capped; a process that includes several layers of plastic and cloth blankets and a couple feet of clean fill. The area collects rainwater at the surface, and many birds loaf in these locations. This survey was conducted before any of the laughing gulls on the Jamaica Bay colony had fledged. Approximately 95 percent of the laughing gulls observed at Fresh Kill landfill were juveniles. Apparently this is an important food source for juvenile laughing gulls in the region. There was no way to know where these juveniles will breed, but if a significant number end up breeding at the Jamaica Bay colony, then eliminating this food source could significantly affect the recruitment of breeders to this colony each year.

The Barnegat Light, New Jersey laughing gull colony that Larry Pharo had been banding chicks at from the late 1970s, moved when the landfill in the area was shut down; Mr. Pharo felt the birds had left the colony because the landfill was shutdown (personal communication). Further investigation, however, indicates, that at the same time a jetty was also being built that was completed in 1990, that affected the tidal flow in the area. The colony abandoned the colony by late 1991, and this abandonment appears to be a direct result of nests being flooded because of the new jetty. It is believed, however, that shutting down the landfill may have had an ancillary effect, and that if Fresh Kills Landfill were eliminated as a food source, either by harassing the birds at the landfill so they can not feed there, or with netting, then the laughing gulls currently breeding at Joco Marsh, might be sufficiently affected, and some might move and breed elsewhere. This concept, although untested, is worthy of serious consideration.

Netting Systems

A mobile netting system that was designed to physically exclude birds from the filling areas at the landfill near the Dublin Airport in Ireland, is 100 percent effective. A new landfill has been proposed for construction at Mulhuddart, which is also near the Dublin Airport, and this is to incorporate a netting system. Total exclusion netting systems are effectively operating at landfills in the United Kingdom and Ireland. The sites at the United Kingdom include landfills operated by Wyvern Waste in Somerset and Northumberland Waste in Newcastle. The facility in New castle is 1.5 miles (2.4 kilometers) from the Newcastle Airport. A netting system is also in operation at the North Kerry Landfill operated by Kerry Country Council which is 7.4 miles (12 kilometers) from Farranfore Airport.

The netting system is maximally effective when operated correctly. Operating procedures include: no wasted, other than totally inert waste, is dumped outside the netted area; the net will be moved to a new filling area when the deposited waste has been covered with cover material to a sufficient depth to deny birds access to the waste; the access/egress arrangement to and from the net shall be designed and operated in such a manner as to ensure birds do not gain access to the filling area; and effective road cleaning measures will be continuously operated on the site access roads to ensure any food waste carried from within the net area on vehicle wheels or in the form of spillage is not available to birds. In addition to the netting system, some landfill operators also use pyrotechnics, propane cannons, distress tapes, scarecrows, and birds of prey.

Plan to Establish New Laughing Gull Colony in New York State

When the New York State Department of Environmental Conservation issued the Port Authority of New York and New Jersey Fish and Wildlife License (Depredation License Number DWP95-023, Effective Date January 1995), they wrote in their Findings Statement 617.21, Appendix 1, State Environmental Quality Review, that "Port Authority should prepare a plan for the establishment of a new laughing gull colony. The Port Authority should not rely on the shooting program or on-airport bird control activities as a long term solution. The establishment of another colony, within New York State, would be a Department requirement prior to any destruction of the existing Jamaica Bay colony. The plan shall describe location, site, activities to be undertaken, funding source and time frame pertaining to accomplishing the project." The plan was submitted on May 30, 1995. Below are the methods that were described.

Methods

To establish a new laughing gull colony in New York State we will study the historic distribution of laughing gulls in the New York area. They were common summer residents along New York's coast all through the first half of the 19th century (Giraud 1844). Laughing gulls reached the shores of New York during the spring (DeKay 1844). The number of breeding colonies rapidly decreased along the Atlantic coast (Eaton, 1910) due to the millinery trade (Cruikshank 1942) and possibly as a result of widespread egg depredation (Forbush 1905).

Laughing gulls formerly bred at Orient Point and on certain islands in Great South Bay (Griscom 1923). Latham (1975) wrote of a small laughing gull colony at Orient Point that nested on a gravel flat between salt marshes as recently as 1900. Laughing gulls also bred in South Oyster Bay as recently as 1888 (Eaton 1910). They also bred on Cedar Island at least until 1890 (eggs in the collection of the American Museum of Natural History). In New Jersey, where laughing gulls appear to be increasing (Erwin 1979), the largest colonies are in the marshes near Stone Harbor and Brigantine Refuge. Laughing gulls nest only locally in New England today (Massachusetts and Maine) (Erwin 1979). Herring gulls' usurpation of the laughing gull sites on Muskeget Island, Massachusetts are well-documented (Erwin 1979).

From 1901 until 1995, laughing gulls have attempted to breed in only three locations in New York State, and only one of these locations was not abandoned after the first

attempt. All three sites are within 16.5 miles (26.5 km) of each other. One of the sites that was abandoned was in Great South Bay near Jones Beach. The attempt occurred in 1978 (Buckley et al. 1978), and the site has remained abandoned in all subsequent years (Garber, unpublished data), and the other site was at the Dubos Point Wetlands Sanctuary, a property that is owned by the City of New York, under the aegis of the New York City Department of Parks and Recreation, and it is managed by the New York City Audubon Society. Dubos Point is located on the southern shore of Jamaica Bay, in Far Rockaway, 1.2 miles from JFK's runways and 2,000 feet from the marshes where the laughing gulls have successfully bred since 1979. In 1979 a small number of laughing gulls began nesting on Joco Marsh in Jamaica Bay (Post and Riepe 1980). This colony has bred successfully each year since, and has grown substantially. It is the only laughing gull breeding colony in New York State. Although the literature usually refers to this colony as being located on Joco Marsh, nests are found on Joco, Silver Hole, East High Meadow, and East Joco Island. These four islands are all part of the Joco Marsh complex in Jamaica Bay, and they are located adjacent to three runways at John F. Kennedy International Airport.

The number of nests increased from approximately 15 the first year to over 7,000 nests 10 years later. Much has been done to manage the risk from the thousands of laughing gulls flying over JFK each summer, which doubled the number of bird strikes occurring at the airport, increasing the risk at the airport due to a bird-related incident in the neighborhood of 100 percent. During the last 5 years laughing gulls have been shot as part of an ongoing effort to reduce the hazard they presented when flying over the airport. Over 40,000 have been shot, and we are now locked into a shooting program because of the political climate that restricts us from being able to move the colony from the marshes next to the airport, to a new location.

By shooting the gulls flying over JFK, up until the 1995 shooting season we had been able to reduce the number of bird strikes (number of times laughing gulls and planes collide) by 90%, thereby greatly reducing the risk so we can maintain safe airspace for the traveling public. However, the 1995 shooting season, while successful with regard to the number of gulls shot being high. Possible reasons the percent of laughing gull-related bird strikes was correlated are discussed elsewhere in this document. In 1994 the number of nests was reduced, probably from the shooting, to 5,539. The number of laughing gull nests on the Joco Marsh complex in 1995 was 5980. The number of laughing gulls shot by the Department of Agriculture at JFK in 1994 was 3,688 and the number shot by the Department of Agriculture in 1995 was 6,167. Despite this tremendous number killed, overall, the number of laughing gulls along the Atlantic has been increasing by about 5 percent a year; we are not endangering the species in any way. Because we know this colony recently became established, and that new birds from the south continue to colonize this colony, we also know that this colony does not represent a unique gene pool which has evolved while genetically isolated from other populations.

We do not want to go on shooting so many laughing gulls because there is a better solution. This point has never been made clearly or effectively to the various agencies and environmental organizations, therefore I will expand on this point briefly below. Many people believe shooting is bad, Port Authority shoots the birds, therefore their policy needs to be changed. Many people also believe that the National Park Service wants to protect the birds, therefore much of the public has sided with the National Park Service in this debate. Facts are not as they seem. The National Park Service has promoted a policy that has forced the Port Authority into this shooting program, when the Port Authority prefers a much better method of remedying the situation.

First, it needs to be stated for the record that the number of laughing gulls involved in bird strikes before the shooting program began was about 200 per year, most of which occurred from the middle of June through the middle of August. This number doubled the total number of bird strikes at JFK. 200 strikes is very high for any airport, let alone for one species, not to mention that this number Port Authority is committed to relocating the colony, and will do everything possible to establish a new colony in New York State. This will enable us to continue our work aimed toward creating the safest possible airport in the most environmentally sensitive manner.

New Nest Sites

We have thoroughly examined laughing gull nest site selection to determine the best sites for new colony establishment. The literature has several excellent studies. Bongiorno (1970) and Montevecchi (1978) studied nest site selection. Burger and Shisler's (1978, 1980) study built on previous work, and further clarified several questions concerning nest site selection. Burger and Gochfeld (1985) compared the characteristics between different laughing gull colonies. I have conducted additional research on Joco Marsh that provides additional valuable information regarding the selection of a new colony site (Garber, unpublished data).

Feeding Opportunities

We have determined what the laughing gulls eat that nest at Joco Marsh in an effort to site a new colony where adequate foods are available for the adults and the young. The distance of this food source will have to be within range for feeding flights. In addition, we believe we can attract laughing gulls to what we hope will be the designated future nesting location by feeding them on the site. If we provide food, then birds will come and feed there, and this will help provide the on-site numbers with the eventual goal being that some will nest in the area.

Associations

We have considered whether it is better to attempt to establish a new colony in a colony of other colonial nesting seabirds, such as common terns, or if we should work with a salt marsh environment where there are no other colonial nesting seabirds. Tern and gull species are two of the primary associated nesters considered.

Nest Material

We have determine what the preferred nesting materials for laughing gulls are and made sure these materials are available in sufficient quantity so the birds can nest at the chosen site.

Decoy Nests

We will determine whether nests from the previous summer survive the fall, winter, and spring, to serve as a potential attractant to birds scouting the potential nest site the following year. When we choose a site we will bring nest material to the location and make decoy nests, fake laughing gull nests, so it looks like either laughing gulls have nested there during previous years, or have already begun to nest there during the current season, or both.

Decoy Laughing Gulls

Decoy adult laughing gulls, and possibly chicks, will be manufactured and placed on the site chosen for new nest site establishment. These decoys have not been used with laughing gulls before, but decoys have been used to attract other species of colonial nesting seabirds (Kress 1983).

Sound Recordings

In addition to using decoys, sound recordings have been used with success when working to re-establish colonial nesting seabirds in Maine (Kress 1983). Taped calls of adult laughing gulls on Joco or another suitable colony could be used either as tapes, or transferred to micro-chips that some people feel are more durable and suitable to repeated playing in outdoor environments over long period of time. We could experiment with this technology to determine if we can get better results with sounds as part of our mix of laughing gull attractants on the potential new colony.

Rehabilitated Laughing Gulls

The Founder and Director of Suncoast Seabird Sanctuary has offered to loan us 30 to 40 adult laughing gulls that have been rehabilitated and are still unable to fly for various reasons. They have to be kept where they can be fed and maintained. Outdoor pens could be built on the proposed relocation site, so these birds can serve as an attractant for other laughing gulls, in addition to the other attractants mentioned above. In addition, we might rehabilitate laughing gulls shot by the Department of Agriculture that are not killed, and use them on the colony too. These birds have to be fed while they are kept on a potential breeding site as an attractant. We have experts with experience who have offered to help us.

Hacking Laughing Gulls

Eggs can be taken from Joco Marsh and incubated, or chicks can be taken from the nests and fed in captivity for a brief period before taking them to the new nesting colony where they will be raised, either in pens or enclosures. For most seabirds studied, chicks have a strong nest site fidelity and will return when mature to breed (Kress and Nettleship 1988). We would raise young laughing gulls on the new site, continue feeding them the correct food until they were fully fledged and could live on their own. It would be hoped that they would return to breed when they mature. The chicks could be fed with a puppet-like device that simulates an adult laughing gull's head, beak, and mouth. This way the young will imprint on laughing gulls rather than on human beings.

Banding Chicks

All the chicks that are hacked on the new location will be banded so we will know in future years if birds flying over the area are the birds that were raised there. This will provide valuable information about raising techniques, timing, and about whether eggs or young taken from Joco Marsh work equally well, or if one is a preferred method. In addition, during the summer of 1995, for the first time ever, we began a laughing gull banding program on the Joco Marsh colony. We banded 78 chicks during our first season, and hope to increase this number significantly in future years.

Field Observers

We will need to have field assistants recording data that help us decide which methods work the best. We will conduct all these procedures scientifically so we learn from failures and successes and can continually improve the techniques being employed.

Community Outreach

It would be a tremendous help if we had community support before beginning such a project, or series of projects. Contacts will be made with the environmental communities and with the experts in the area, many of whom will work for local schools or government agencies. Some will be naturalists and bird-watchers. Others might not study nature, but many care about nature. To forge relationships with these people in each key community will help throughout the years that will have to be committed to this project.

Potential Hazards

All potential problems will have to be ruled out. For instance, it will have to be determined that we have the permits to do each of the procedures planned. We will have to know that establishing a successful laughing gull breeding colony in this new area will not lead to more problems, such as to more bird strikes at another airport. If we can find sites where the new colony efforts are embraced, that would be so much the better.

Specific Sites

The salt marsh islands within 30 miles of JFK have been investigated. We have identified, measured, and determined the vegetation on each of them, and we have determined their ownership and what colonial nesting seabirds are already nesting there, if any.

Time Frame and Funding

When we get the go-ahead from federal, state, and local regulatory agencies, as well as confirmation of funding, we are ready to begin. Work has begun with the research phase. We have established a network of contacts who would provide assistance. We have completed the 1995 field season and have planned the budget for the 1996 season.

Little Gull (Larus minutus) LIGU +

Common Black-headed Gull (Larus ridibundus) CBHG +

Bonaparte's Gull (Larus philadelphia) BOGU % * +

Bonaparte's gulls are rare to uncommon in the Jamaica Bay region; only a small number are recorded each season. Chevalier (personal communication) said they were involved in bird strikes previous to 1979 when we began keeping bird strike records at the airport. Although I have no reason to doubt this, none has been struck from 1979 through 1995, and it is likely that those that Chevalier reported, were misidentified laughing gulls. Few noticed the laughing gulls as their numbers slowly increased in the area before they became a cause celebre.

Ring-billed Gull (Larus delawarensis) RBGU % * +

Ring-billed gulls are most common at JFK during the winter months, during which time they are involved in collisions with aircraft on a fairly regular basis. 78 were struck at JFK from 1979 through 1995, which is 2 percent of all the birds struck here during that period. All of the 78 were struck singly, except 5 that were involved in a multiple strike, all 5 were involved in the same strike.

Herring Gull (Larus argentatus) (bird banding symbol is HEGU, however we sometimes use HERG at JFK) % * \$ +

Herring gulls are found at JFK 12 months a year, and during each of these months they pose a significant threat to aircraft. From 1979 through 1995, 862 herring gulls were struck at JFK, which is 23 percent of all the birds struck at JFK during that 17 year period. Fortunately, the two landfills on either side of JFK were shut down, temporarily reducing the number of herring gulls at the airport. During the interim, the number of herring gulls nesting at Jamaica Bay Wildlife Refuge has increased by several orders of magnitude. As a result, substantial efforts are taken to keep herring gulls from colliding with aircraft.

JFK encounters higher levels of bird strikes from herring gulls than would likely be the case if there were not so many herring gulls breeding at the Jamaica Bay Wildlife Refuge (see appendices for numbers of gulls nesting at the Refuge). The high numbers of herring gulls in the area account for many strikes, and some of these strikes cause substantial damage to the aircraft. This is a sign that the problem requires serious attention. For instance, at 8:00AM on October 21, 1995 an Evergreen Boeing 747 was departing from runway 13R when the pilot saw several gulls fly across the front of the aircraft, then he heard and felt a thump. Engine #2 was damaged and shut down, the

plane dropped 35,000 pounds of jet fuel over the water, and returned to land at JFK. No one was hurt and the engine had to be replaced. The feathers collected from inside the engine and feathers collected on the runway were sent to Carla Dove at the Smithsonian Institution for identification. The birds involved were positively identified as herring gulls. Based on the upper wing covert of one of the individuals, she identified the bird as a 2.5 pound immature herring gull. Based on the size of the rachis of the feathers, she determined that the birds were all too large to be either laughing gulls or ring-billed gulls, and the gray on the feathers was too light to be a great black-backed gull.

In the winter, when the temperature gets in the teens or lower (Fahrenheit) and the areas where herring gulls collect clams freeze over, clamming temporarily ceases, or diminishes considerably. Last night was the first night of the season that the air temperatures dropped to the teens. Last night a Polar Air 747, in its descent to land at JFK, was at 7,500 feet at 8:00PM when it struck a flock of birds. Engines 3 and 4 had to be replaced, there was damage to the leading edge of the wing, and the engine cowling was dented. A piece of the wing from one of the birds was pulled from an engine which we sent to the Smithsonian Institution for identification. It appeared to be a herring gull, but we will get confirmation, if indeed that is the right identification.

Iceland Gull (Larus glaucoideus) ICGU +

Lesser Black-Backed Gull (Larus fuscus) LBBG % +

The lesser black-backed gull is not one of the gull species most commonly found near the airport, they do not breed on the islands in Jamaica Bay, nor have they ever been involved in strikes at JFK.

Glaucous Gull (Larus glaucescens) GLGU +

Great Black-Backed Gull (Larus marinus) GBBG % * S +

219 great black-backed gulls have been involved in bird strikes at JFK from 1979 through 1995, which is 6 percent of the total. Of all the herring gulls and great black-backed gulls involved in bird strikes at JFK, the great black-backed account for 21 percent of the total. Yet, less than 5 percent of the gulls breeding on the islands in Jamaica Bay, not counting those on the Joco Marsh complex, are great black-backed. More than 95 percent are herring (all gulls breeding on the Joco complex are laughing). Bird strikes from these two species are a function of more than just the number nesting on Jamaica Bay's islands.

Terns and Skimmer

Forster's Tern (Sterna forsteri) FOTE % +

To date none has ever been struck at JFK, however they recently began nesting on Joco Marsh. There were about 15 pair nesting there in 1994, and the number increased to about 20 in 1995 (based on unpublished personal observations of Garber and Riepe).

Least Tern (Sterna albifrons) LETE % * +

Only two least terns were struck at JFK from 1979 through 1995. The first was struck on July 21, 1992, and the second was struck on August 1, 1993.

Roseate Tern (Sterna dougallii) ROST +

Common Tern (Sterna hirundo) COTE % * +

Gull-billed Tern (Sterna nilotica) GBTE % +

Caspian Tern (Sterna caspia) CATE % +

Sooty Tern (Sterna fuscata) SOTE %

Royal Tern (Thalasseus maximus) ROYT +

Black Tern (Chlidonias niger) BLTE +

Black Skimmer (Rhynchops nigra) BLSK % * +

Pigeons, Doves and Cuckoos

Rock Dove (*Columba livia*) RODO % * # +

At JFK the number of pigeon strikes has averaged approximately 4 per year. Because they flock, multiple strikes occur with regularity; to date the greatest number struck in one incident involved 10 rock doves. Apparently the pigeons live closer to the buildings and the landside operations and seldom fly the distance that puts them in the direct path of aircraft. LaGuardia is a smaller airport so the pigeon activity near the buildings and landside interacts more frequently with the airside, resulting in a higher risk. Therefore we have taken measures to insure that we reduce the number of pigeons at LaGuardia. American Airlines has successfully dealt with the pigeon problem in their hangar by hiring contractors who are using the bird frightening agent (toxicant) Avitrol (4-Aminopyridine), as are we.

After evaluating most of the alternatives we decided to test Avitrol, which appeared to be the best available option. Avitrol is a chemical that is applied to food that when eaten causes a physiological response that is so unpleasant, it is felt that the birds are repelled from the area afterward, possibly due to a fright response. This material is therefore most useful when attempting to deter birds from either established feeding sites, or sites that are established first, before adding the Avitrol to the feed. Untreated bait is first strategically placed near the feeding sites, or in a new site that is to be turned into a feeding station. After the birds are trained to feed there, treated bait is added to the untreated bait for the desired effect. Usually just a small portion of treated bait, on the order of 1-3% is adequate. Applications are repeated as often as is necessary. Before choosing Avitrol, other alternatives were considered.

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

Alpha chloralose is a stupefying agent that produces an anesthetic affect inducing a sleep-like stupor in affected animals. The material is administered on a bait and is most useful for situations where capture and transport of animals to other locations is the bird

removal method of choice. The United States Government is completing its series of tests and approval mechanisms for this chemical. There is not current operational policy at JFK to regarding its future use.

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

We planned to conduct an Avitrol test in August 1995. We have certified Pesticide Applicators, certified by the New York City Health Department to purchase Avitrol and to use it. The New York State Department of Environmental Conservation said we could use Avitrol which is approved in the State of New York, and it is a registered pesticide under the Federal Insecticide, Fungicide, and Rodenticide Act. But we needed approval from the New York City Health Department for this specific application. The Deputy Commissioner gave us permission over the phone. They do not give it in writing. For two weeks we baited the area with 4 cups of corn per hundred birds on a daily basis. Because we were feeding 200 hundred birds, the 8 cups were consumed each time the food was laid out. Within a short number of days the birds were there to feed at feeding time. After feeding them for two weeks we applied 1 part Avitrol-treated corn to 9 parts untreated corn. 6 to 7 percent of the pigeons died, only 25 birds returned, the rest left the premises and did not return. The young called for several days after and then went silent. Apparently the young just remain in place and starve to death, which is unfortunate. Three months later the number of pigeons increased to the point that another treatment was necessary. This time, in November 1995, there were 100 pigeons. The birds were baited for two weeks with 4 cups of corn each day. Then instead of using Avitrol in a 1 to 9 ratio, we used 1 to 19 to avoid such a high mortality, however still 6 to 7 percent of the birds died, and all but 15 birds left the premises. And again, the young called with a chirping sound for days afterward.

Mourning Dove (Zenaida macroura) MODO % * # +

During the years 1979 through 1995 there have been 15 mourning dove strikes at JFK. None of these strikes contributed to any problems with the aircraft. The species does not appear to present a problem to aviation. Mourning doves are struck only on occasion,

and are always struck either singly, or to date, at most two at a time, because they do not flock.

Cuckoos

Black-billed Cuckoo (Coccyzus erythrophthalmus) BBCU +

Rare in the area, never been struck at JFK. Known to have bred prior to 1979 at Jamaica Bay Wildlife Refuge.

Yellow-billed Cuckoo (Coccyzus americanus) YBCU +

Rare in the area, never been struck at JFK. Probably breeding in Jamaica Bay area, but not confirmed.

Owls

Common Barn Owl (*Tyto alba*) COBO % * +

The common barn owl is listed as a protected species in New York State. The barn owl is a species of management concern to the United States Fish and Wildlife Service. Its regional and national populations are considered stable, but fluctuating. Even though the species is uncommon in the state, a significant number of barn owls are struck at JFK, which is probably because the species is believed to be doing well on Long Island and Staten Island. A total of 113 barn owls were struck at JFK from 1979 through 1995. This represents 3 percent of all the bird strikes here over this 17 year period. The mean number struck is 6.65 per year. It may be of significance to people watching this species' fluctuations, that the number of barn owl strikes has been dropping at JFK in recent years. There was an average of 9 strikes a year from 1979 through 1990, and then the number dropped to 7 in 1991, then 6 in 1992, 3 in 1993, 4 in 1994, and 1 in 1995 (as of December 5).

The barn owl is known to have the capacity to significantly damage aircraft: on May 7, 1994 a Canadian Airlines Boeing 737-200 struck a barn owl at Palm Springs, California. One engine was damaged. When the pilot landed the aircraft safely, the engine had to be replaced and the passengers stayed at a hotel while a replacement aircraft was located. At JFK, of all the barn owls struck, none are known to have resulted in aircraft damage or delays. All the strikes involved single birds, as opposed to multiples struck simultaneously.

Barn owls are seldom seen flying in the area because they are active over the runways at night, which accounts for why the barn owls that are struck are found dead in the morning when the first sweep occurs. They are struck here 12 months a year. The greatest number of strikes occurs during the middle of the summer and then continues for several months. Then after the summer is over, the number of barn owl strikes declines each month until the strike record reaches a low in May. They pick up slightly in June, and there are considerably more struck in July, and the peak month is August. These strike rates probably reflect the total number in the vicinity of the airport.

Barn owls nest breed throughout the year, almost exclusively in association with human habitation. Nests are commonly found in abandoned buildings, around agricultural areas, and in towns and cities. They nested in Hangar 17 at JFK in 1983; two fledglings were taken from the airport and placed in nests at Floyd Bennett Field by Hannah Richard, who used to do wildlife rehabilitation in the area, where barn owls used to nest in the old

hangars; she wrote an article about the two young and published it in *The Conservationist*. When the hangars were improved, the owls were displaced, which provided the impetus for the National Park Service to begin their efforts of building and erecting barn owl boxes in an effort to provide adequate nesting opportunities for them in the area.

There are now about 20 barn owl boxes at Gateway National Recreation Area's units near the airport, those units being the ones in Queens and Brooklyn. Of the 20 boxes, about 12 are active. During mid-summer most of the young of the year have fledged and those that live in the area often feed here at the airport. In addition there are more barn owls in the area in August because migrating birds are moving through. We know that some of the barn owls migrate south because barn owls that were banded in the area by Chevalier were recaptured at Cape May. These factors account for the strike peak in August. Then, as some of the birds migrate south, and the naive birds learn, and others are struck, the number of barn owls in the area probably declines, as does the number of birds that are struck at JFK.

Snowy Owl (*Nyctea scandiaca*) SNOW % * +

15 snowy owls were struck from 1979 through 1995. All the strikes occurred during the months of November through February. This is less than one strike a year. During the winter of 1994-1995 we might have had 3 snowy owls at the airport, one of which was struck. I know this is not a significant sample, but it may be that we strike about one-third of the snowy owls at the airport. Some species have a much higher strike rate, that is a higher percent of the birds at the airport are struck. Other species are here but seldom if ever are struck. At some Canadian airports, such as Calgary, there are so many snowy owls that at times the airport operations personnel even shoot them. At JFK the number of snowy owls never reaches such levels.

Long-eared Owl (*Asio otus*) LEOW % * +

A long-eared owl was struck in November 1995. To my knowledge, this is the only long-eared owl ever recorded in a bird strike at JFK. This species is not common in the region. Only about 20 nests have been reported in the New York area during the past 30 years, and nests usually occur in woodlands growing in freshwater wetlands. Because there are not many suitable habitats nearby, it is assumed that this was not a resident individual, but rather one that was passing through.

Short-eared Owl (*Asio flammeus*) SEOW % * +

In 1983 one short-eared owl nested in a stand of *Phragmites* at JFK east of Runway 4R, where Anthony Grace had filled in the wetlands (Chevalier, personal communication).

Caprimulgids, Swift, Hummingbird, and Kingfisher

Common Nighthawk (Chordeiles minor) CONI % * +

Only one was struck at JFK since 1979, although they regularly occur in the area.

Whip-poor-will (Caprimulgus vociferus) WPWI +

Never been struck at JFK since we began keeping bird strike records at the airport. Rare in the area, but are seen on occasion in spring and early fall. Used to be more common in the Long Island Pine Barrens and in the New Jersey Pine Barrens, but their numbers are declining, probably because they are ground nesters which are vulnerable to increasing numbers of mammalian predators that are correlated to increasing numbers of humans in the area.

Chimney Swift (Chaetura pelagica) CHSW +

Common in the area, but never involved in a bird strike at JFK.

Ruby-throated Hummingbird (Archilochus colubris) RTHU +

Never struck at JFK in the years we have been keeping records, but are so small, we might never know if there was such a strike. This species used to nest in New York City, but ruby-throated hummingbirds are no longer very common in the entire region, and to my knowledge none has nested in the city in years. They move through the airspace in spring and early fall.

Belted Kingfisher (Megasceryle alcyon) BEKI % +

Observed at JFK and at Jamaica Bay Wildlife Refuge, but never struck at the airport. Heard one calling on the other side of Bergen Basin on November 13, 1995.

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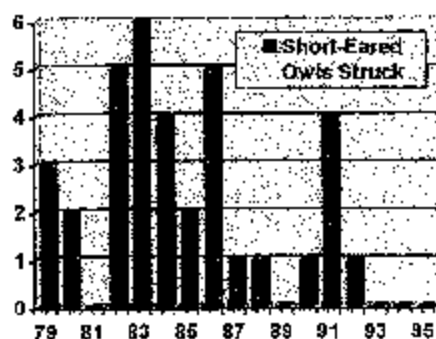
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The nest had 4 eggs; three hatched, one egg never hatched. Chevalier banded one of the chicks. 35 short-eared owls have been struck at JFK in the past 17 years (1979 through 1995), which averages slightly more than 2 per year. All the strikes have occurred from October through June, although one was struck after April. 3 were struck in 1979, 2 in 1980, 5 in 1982, 6 in 1983, 4 in 1984, 2 in 1985, 5 in 1986, 1 in 1987, 1 in 1988, 1 in 1990, 4 in 1991, 1 in 1992.

Burrowing Owl
(*Athene cunicularia*)
BUOW % * +

A burrowing owl stayed at the airport for weeks one year (Chevalier, personal communication). I believe the record was published in Kingbird.



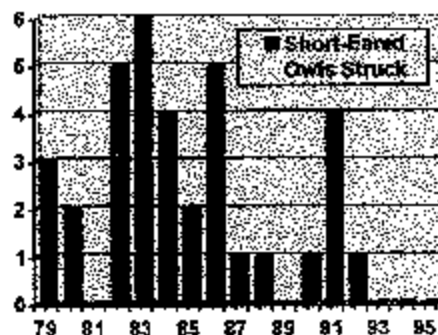
Northern Saw-whet Owl (*Aegolius acadicus*) NSWOW +

Never been involved in a bird strike at JFK, but do occur, although rarely, in late fall and winter in the region. Are seen with regularity during this time of the year at the Jamaica Bay Wildlife Refuge.

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Woodpeckers

Red-Headed Woodpecker (Melanerpes erythrocephalus) RHWO +

Rare in the area, never been involved in a strike at JFK.

Red-Bellied Woodpecker (Centurus carolinus) RBWO +

Rare in the area, mostly seen in spring and early fall, although in recent years a fair number have been overwintering in Manhattan's Central Park. Never been involved in a strike at JFK.

Yellow-bellied Sapsucker (Sphyrapicus varius) YBSA +

Rare in the area, never been struck at JFK.

Downy Woodpecker (Dendrocopos pubescens) DOWO +

Uncommon to rare in the area; never been struck at JFK.

Hairy Woodpecker (Dendrocopos villosus) HAWO +

Very rare in area, only reported sporadically at the Jamaica Bay Wildlife Refuge. Never been struck at JFK.

Yellow-shafted Flicker (Colaptes auratus) YSFL % * +

Common during spring and autumn at JFK. A total of two have been struck since 1979; one in September 30, 1984 and the other in March 21, 1995. Also common in surrounding areas.

Wood Pewee, Flycatchers, Phoebe, and Kingbirds

Eastern Wood Pewee (Contopus virens) EAWP +

Uncommon in area, seen only in spring and early fall. Never been struck at JFK, and because they are so small and do not flock, they wouldn't present a problem.

Yellow-Bellied Flycatcher (Empidonax flaviventris) YBFL +

Never been struck at JFK and to date has not been recorded here. Occur rarely at Jamaica Bay Wildlife Refuge

Acadian Flycatcher (Empidonax virescens) ACFL +

The small flycatchers call in the overgrown areas of the airport but because they have never been struck and do not pose a threat to aircraft, we have not focused on them.

Alder Flycatcher (Empidonax traillii) ALFL +

In the area but never involved in bird strikes at JFK, and are of no concern because they are so small and usually fly solo.

Willow Flycatcher (Empidonax alnorum) WIFL +

Very similar to the alder flycatcher, although the call is different, as is the preferred habitat, which is alder thicket, not willow. We have never struck one at JFK, and if we had, it would not have caused any damage, and therefore is not a concern at the airport.

Least Flycatcher (Empidonax minimus) LEFL +

Never been struck at JFK, not a concern at the airport.

Scissor-tailed Flycatcher (Tyrannus forficatus) STFL %

I saw one at the Dallas-Fort Worth Airport during the summer of 1995. They are regularly seen at airports within their range, which includes much of Texas in the summer, and along the Gulf Coast and much of Florida's Gulf Coast in the winter. JFK is well outside of this species' range.

Olive-Sided Flycatcher (Nuttallornis borealis) OSFL +

Never been struck at JFK and not a concern.

Great-Crested Flycatcher (Myiarchus crinitus) GCFL +

Never been struck at JFK, and not a concern.

Eastern Phoebe (Sayornis phoebe) EAPH +

Uncommon to rare in the area; never been involved in a strike at JFK, not of concern to us.

Kingbirds

Eastern Kingbird (Tyrannus tyrannus) EAKI % +

Regularly seen at JFK but never been involved in a bird strike. They usually occur alone, and instead of perching in a tree, at the airport they perch on the ground.

Western Kingbird (Tyrannus verticalis) WEKI +

Rare but seen during the autumn at Jamaica Bay Wildlife Refuge. Never been struck at JFK and not a concern here.

Horned Lark, Martin, and Swallows

Horned Lark (Eremophila alpestris) LARB % * # +

We have a fair number of horned larks at JFK 12 months of the year. They breed here and overwinter here. In all the years that we've been recording birdstrikes there have only been two struck at JFK. Both strikes occurred on November 11, 1995, there was no damage. Although they are present, they seldom flock like the snow buntings, but rather are seen singly, or often, in small groups. Apparently they are adept at avoiding aircraft, or, another possible reason that this was the first winter any were recorded as having been struck here is because the Bird Control Unit training program has been effective. A similar case exists with tree swallows, see below.

Purple Martin (Progne subis) PUMA +

Rare, only a few individuals recorded at the Jamaica Bay Wildlife Refuge throughout spring and early fall. Never been struck at JFK and are not a problem here.

Swallows

Barn Swallow (Hirundo rustica) BARS % +

Common, regularly seen, but never been stuck at the airport. To date they have never posed a threat.

Tree Swallow (Iridoprocne bicolor) TRES % * +

As is the case with horned larks, see above, tree swallows are common at the airport, but only on occasion do they exist in huge numbers, as happened in the autumn of 1995. During a ten day period we had approximately 50,000 tree swallows flocking on the airside of JFK. On September 22, 1995 a turboprop was landing on 22R when it flew through a flock of approximately 500 tree swallows. The pilot reported the strikes and

the ground in the landing gear. During the next week the number of tree swallows at JFK continued to increase. Eventually there were approximately three similar-sized flocks totaling approximately 25,000 birds flying, feeding, drinking, and resting at JFK. On September 30, 1995 an American Airlines Boeing 767 was landing on 22L at 3:40 PM when it struck approximately 100 tree swallows; no one was hurt and there was no visible damage to the aircraft. Again there was a strike on October 1, 1995 when Canada Air was arriving on 22L. The pilot saw the birds but did not think any were struck. There was no damage, and two birds were struck. October 2, 1995 most of the tree swallows moved on, and by October 3, 1995 there were only about a dozen left at JFK.

These birds are normal here this time of year. In the fall huge flocks of tree swallows stage in this area near the coast, so this behavior was normal. However, the September 22 multiple tree swallow strike was the first reported tree swallow strike at JFK, so for this reason it was unusual. Until now, such a bird strike would probably have been reported as having been caused by a sparrow. With the increased training and professionalism of the Bird Control Unit, the need for accuracy has been recognized and the ability of the Bird Control Unit to identify birds has improved substantially, so the Bird Control Unit members are doing a much better job of identifying birds. As a result, this strike was reported accurately, and subsequent tree swallow behavior on the airport was carefully monitored and managed appropriately. An extra FS-3 was kept on the job during the days and hours when the birds required the greatest amount of management.

Whether a flock of tree swallows could pose a threat to aircraft is difficult to say. We know flocks of small to medium-sized birds do pose a significant risk, so we have to assume, until we learn otherwise, that even tree swallows might pose a danger. For this reason, for here on in, when we see large flocks of tree swallows near a runway, we dispatch a vehicle with a loudspeaker to play harassing tapes to keep the birds away from the general area. In addition, pyrotechnics are used to continually harass the birds to keep them from the runways and taxiways. In addition, the pools of water that represent possible sources of drinking water have been dispatched with Schorling brooms. Great efforts have been taken to manage this situation.

Rough-winged Swallow (Stelgidopteryx ruficollis) +

Seen on occasion in spring and early fall at the Wildlife Refuge. Never been struck at JFK; not a concern at the airport.

Bank Swallow (Riparia riparia) +

Seen on occasion in spring and early fall at the Wildlife Refuge. Never been struck at JFK; not a concern at the airport.

Cliff Swallow (Petrochelidon pyrrhonota) +

Seen on occasion in spring and early fall at the Wildlife Refuge. Never been struck at JFK; not a concern at the airport.

Jays and Crows

Blue Jay (Cyanocitta cristata) BLJA % +

No blue jays have ever been struck at JFK.

American Crow (Corvus brachyrhynchos) AMCR % * #.+

American crows live in the area, feed on the airport, sometimes breed on the airport, but we work to manage this behavior, and they commonly fly over the runways, however they seldom collide with planes. Since 1979 only 10 American crows have been involved in birdstrikes, which is approximately one quarter of one percent of all the birdstrikes at JFK. Of these, 7 were in June and July, one was in April, and two were in September. Here is an accounting of each of the strikes: one was struck on April 2, 1984, one on July 19, 1985, one on September 21, 1986, one June 30, 1989, two on July 29, 1990, one on July 30, 1990, one July 10, 1993, one September 13, 1993, and one on June 7, 1995. Because crows are predators that eat bird eggs and chicks of other species, including birds as large as gulls, their presence deters many birds and therefore having crows at the airport may help us keep large numbers of other more dangerous species off the airport. Under Depredation Order 21.43 the United States Fish and Wildlife Service states that we can shoot crows if they pose a threat to the safety of people flying in and out of the airport. Since I began working here in 1994 it has not been necessary to shoot any crows, and to my knowledge, this has never been necessary at JFK.

Fish Crow (Corvus ossifragus) FICR % +

Fish crows live in the area and occasionally fly over the airport, however there are not incidents of fish crows ever being struck. I believe this is because all crow strikes were classified as common crows.

Wrens

Carolina Wren (Thryothorus ludovicianus) CARW +

Rare, only a few individuals ever seen each season at the Wildlife Refuge. Never been struck at JFK, not a concern to us.

House Wren (Troglodytes aedon) HOWR +

Confirmed to be breeding in area, but never seen breeding at JFK. Very few are ever seen or heard at the Wildlife Refuge.

Winter Wren (Troglodytes troglodytes) WIWR +

Rare, one or a few individuals recorded throughout the season at the Jamaica Bay Wildlife Refuge.

Sedge Wren (Cistothorus platensis) SEWR +

Very rare, recorded only sporadically, not seen every year at the Wildlife Refuge. Never been struck at JFK, small and not of any concern.

Marsh Wren (Eistothorus palustris) MAWR % +

Used to be called the long-billed marsh wren. Marsh wrens call in the tall grasses growing in the wetlands of Jamaica Bay. There are some breeding at East Pond near the Jamaica Bay Wildlife Refuge Headquarters. However, none breed at JFK, and they are not found here often, and have never been involved in a bird strike.

Thrushes

Eastern Bluebird (Sialia sialis) EABL +

Some migrate through in spring and late fall, when they are seen at the Wildlife Refuge on occasion. Never been struck at JFK and do not present a threat. Their numbers are slowly recovering in the Northeast with all the bluebird boxes being put up, but still uncommon in the area.

Veery (Catharus fuscescens) VEER % +

Seen at JFK in spring and early fall, but not common. Not involved in bird strikes and do not present a threat to aircraft.

Gray-cheeked Thrush (Hylocichla minima) GCTH +

One or two individuals seen at the Wildlife Refuge in spring and early fall each year. Never been struck at JFK, and is not perceived to ever present a problem.

Swainson's Thrush (Hylocichla ustulata) +

Migrate through in spring and fall when some are seen in the area, but they have never been involved in a bird strike at JFK.

Hermit Thrush (Hylocichla guttata) HETH +

Migrate through in spring and fall when some are seen in the area, but are not part of the bird strike record at JFK and are not perceived to ever present any threat to aircraft.

Wood Thrush (Hylocichla mustelina) +

Move through in spring and early fall. They need large woodlots to breed, which do not occur in the area. None has been struck at JFK.

American Robin (Turdus migratorius) AMRO %

Common in the area, far fewer here in winter, but some remain all year round. Never been struck at JFK.

Mimids

Northern Mockingbird (Mimus polyglottos) NOMO % # +

Common in the area, almost always seen solo, never been involved in a bird strike at JFK and not a concern at the airport.

Gray Catbird (Dumetella carolinensis) GRCA % +

Common in the area, almost always seen solo, never been involved in a bird strike at JFK and not a concern at the airport.

Brown Thrasher (Toxostoma rufum) BRTH % * +

Only one ever struck at JFK, on August 31, 1993. Seen at JFK and the Wildlife Refuge, but not particularly common at either place, and not of concern with regard to the strike record. Do not appear to present a risk to aircraft.

Pipit, Waxwing, and Shrikes

Pipits

Water Pipit (Anthus spinoletta) WAPI +

Waxwing

Cedar Waxwing (Bombycilla cedrorum) CEDW +

Shrikes

Loggerhead Shrike (Lanius ludovicianus) LOSH % +

Northern Shrike (Lanius excubitor) NSHR +

Starling

European Starling (*Sturnus vulgaris*) % * # +

Strike Record

During the period 1979 through 1993, 263 European starlings were struck by aircraft at JFK. This is 7 percent of the total number of birds struck, and is less than 1 percent of the total aircraft struck. These strikes resulted in damage or delay to one aircraft. The number of aircraft struck should be considered the more meaningful statistic, since 194 of the 263 starlings struck were involved in just one incident, which occurred in 1991. Nearly all the starlings that were involved in aircraft collisions were struck during August, September, November, and December. The August and September numbers reflect locally raised juvenile starlings for the most part that are staging in the airport. Those struck in November and December are probably from flocks that have newly arrived at the airport and result in some strikes when they are first learning about the hazards here.

Habitat

The regional and national populations of starlings are increasing in size and expanding in distribution. Starlings occupy various open and semi-open habitats, including lightly wooded areas, and this species is most abundant near cities and towns. Starlings nest in a variety of cavities and are believed to have aggressively displaced certain other cavity-nesting species.

Overwintering Roosts

Starling control has taken place at JFK and Newark International Airport. In 1981 Alfred Godin, the U.S. Fish and Wildlife Service expert on bird problems at airports recommended controlling starlings that were roosting in pine trees at the passenger terminal area at Newark. He felt the long-term solution was to eliminate the roosting site by thinning the roost, by removing and/or transplanting some or most of the trees. He felt that they had been planted too close together. It was his opinion that starlings are attracted to tight groupings of pine trees. It is my belief that Port Authority took care of

the problem, however I will not be sure until I find follow-up correspondence or receive verbal confirmation from someone directly involved with the project that that time.

Whether or not starlings are faithful to their individual winter roosts has been investigated by Perdeck (1958, 1967) and Spaans (1977). Perdeck displaced starlings and found adults, unlike juveniles, will return to the overwintering sites from which they were moved. However, Spaan's work did not support Perdeck's conclusions. Spaan wrote that overwintering site tenacity can contribute to a bird's fitness because birds will learn the local feeding grounds, roosting sites, and areas that are safe from predators. But these advantages are significant only if the conditions of the overwintering site remain constant from year to year, and the advantages become less significant if all areas within the bird's overwintering range are equal in the mentioned respects. Spaan concluded that, because he studied starlings in a different region than Perdeck, Spaan's studies were conducted in the Netherlands, low overwintering site fidelity there might suggest that this country is not a very favorable overwintering area for the birds. He suggested that Dutch wintering starlings were there because they ended up off course from their usual migration routes.

Since there are no obvious reasons why Port Authority airports would present particularly unfavorable overwintering sites, we should assume that any starlings we see on our properties in the winter, are potentially going to be there during future winters too, unless something is done to make the airport less favorable, or unless the bird dies, or is killed. Therefore, it is to be Port Authority's policy to thin all stands of evergreen trees so the trees are not tightly clustered, and when necessary, so the branches are not tightly configured. If these measures fail, then the remaining trees may have to be felled. At JFK, thinning pine tree branches and trees was successful at eliminating overwintering starling roosts (Forbes 1995).

Feeding Behavior

In the middle of May 1995, large numbers of starlings on the ground were feeding on chickweed that had just finished flowering. They were eating the closed flower heads that were just turning into seeds. These observations were made at JFK at 130th Place and West Hangar Road at the northeast end of Bergen Basin.

Management

European starlings, being small to medium-sized birds, rarely cause much problem when involved in a single bird strike, however, because this bird commonly occurs in flocks, a danger exists to aircraft when the flocks are found on the airport. The overall potential hazard to aviation at JFK is low and limited compared to the species that account for far more damage to aircraft, delays, and risk of a major incident. The number of starlings on

the airport increases dramatically in the late summer when the young have fledged and they begin joining in flocks, which may be staging behavior in anticipation of, or during, migration. As a result, this is a time to start patrolling the airport and dispersing the flocks, by driving through them, and with pyrotechnics and distress sounds. Shooting some birds in a flock on occasion is also a valuable deterrent, and is recommended. By the beginning of November large flocks of starlings move through JFK's airspace. At 5:00PM on November 6, 1995, after the sun had gone down and it was getting dark, a flock of approximately 1,500 starlings flying at an elevation of approximately 100 feet flew over the landside of the airport in a southwesterly direction. They crossed the bay runway and left the airport, possibly in search of a roosting site. It appeared that they were considering the willow oaks on the airport, but the oaks were not chosen. This behavior continued periodically in the same area around 5:00PM at night through the first week on December. From observing the flock's behavior during the past month, it appears that they break up into smaller flocks during the day and spread out throughout the area to feed. Then at night they regroup back in this area, fly around together, and then settle into a grove of trees for the night. The primary time they become a potential hazard is during the short The night roosting area is near the airport, but off the airport, just north of Howard Beach. During the first week of December Don Riepe visited the roosting area and reported all of them are roosting in just a couple of trees (personal communication)

Vireos, Kinglets, and Warblers

Vireos

None of the vireos are common enough, large enough, nor do they flock, so they do not pose any threat to aircraft at JFK. None has ever been involved in a strike at the airport.

White-eyed Vireo (Vireo griseus) WEVI +

Solitary Vireo (Vireo solitarius) SOVI +

Yellow-throated Vireo (Vireo flavifrons) YTVI +

Warbling Vireo (Vireo gilvus) WAVI +

Philadelphia Vireo (Vireo philadelphicus) PHVI +

Red-eyed Vireo (Vireo olivaceus) REVI +

Kinglets

Golden-crowned Kinglet (Regulus satrapa) +

Ruby-crowned Kinglet (Regulus calendula) +

Warblers

Except for the yellow-rumped warbler, none of the warblers are common enough, large enough, nor do they flock, so they do not pose any threat to aircraft at JFK. None has ever been involved in a strike at the airport. Below, the yellow-rumped is discussed, and our conclusion is that it poses no threat to safe aviation.

Blue-winged Warbler (Vermivora pinus) BWWA % +

Golden-winged Warbler (Vermivora chrysoptera) GWWA % +

Tennessee Warbler (Vermivora peregrina) TEWA % +

Orange-crowned Warbler (Vermivora celata) OCWA % +

Nashville Warbler (Vermivora ruficapilla) NAWA % +

Northern Parula Warbler (Parula americana) NOPA +

Yellow Warbler (Dendroica petechia) YWWA +

Chestnut-sided Warbler (Dendroica pensylvanica) CSWA +

Magnolia Warbler (Dendroica magnolia) MAWA +

Cape May Warbler (Dendroica tigrina) CMWA +

Black-throated Blue Warbler (Dendroica caerulescens) BTBW +

Myrtle Warbler (Dendroica coronata) MYWA % +

The myrtle warbler, also called yellow-rumped warbler, is common at JFK due to the many bayberry bushes on property. Myrtle warblers frequent the airport, especially during the winter and spring months when bay berries become a large portion of this species' diet, when insects are no longer available, except to those birds who know how to find their eggs, or the other stages during torpor. Myrtle warblers are small and have never, to my knowledge, ever been responsible for any damage to an aircraft, and therefore do not pose a problem on the airport. The bayberry, however, being a woody

shrub that can become quite dense and will reach considerable heights, often 15 feet or more, can become important habitat for other avian species. For this reason, the bayberry is managed on JFK property.

Black-throated Green Warbler (Dendroica virens) BTNW +

Blackburnian Warbler (Dendroica fusca) BLBW +

Yellow-throated Warbler (Dendroica dominica) YIWA +

Pine Warbler (Dendroica pinus) PIWA +

Prairie Warbler (Dendroica discolor) PRAW +

Yellow Palm Warbler (Dendroica palmarum) YPWA +

Bay-breasted Warbler (Dendroica castanea) BBWA +

Blackpoll Warbler (Dendroica striata) BLPW +

Cerulean Warbler (Dendroica cerulea) CERW +

Black and White Warbler (Mniotilta varia) BAWW +

American Redstart (Setophaga ruticilla) AMRE +

Prothonotary Warbler (Protonotaria citrea) PROW +

Worm-eating Warbler (Helmitheros vermivorus) WEWA +

Ovenbird (Seiurus aurocapillus) OVEN +

Northern Waterthrush (Seiurus noveboracensis) NOWA +

Louisiana Waterthrush (Seiurus motacilla) LOWA +

Kentucky Warbler (Oporornis formosus) KEWA +

Connecticut Warbler (Oporornis agilis) CONW +

Mourning Warbler (Oporornis philadelphia) MOWA

Common Yellowthroat (Geothlypis trichas) COYE +

Hooded Warbler (Wilsonia citrina) HOWA +

Wilson's Warbler (Wilsonia pusilla) WIWA +

Canada Warbler (Wilsonia canadensis) CAWA +

Yellow-breasted Chat (Icteria virens) YBCH +

Sparrows and Junco

American Tree Sparrow (Spizella arborea) ATSP +

Chipping Sparrow (Spizella passerina) CHSP +

Clay-colored Sparrow (Spizella pallida) CCSP +

Field Sparrow (Spizella pusilla) FISP % +

Song Sparrow (Melospiza melodia) SOSP % +

Vesper Sparrow (Poocetes gramineus) VESP +

Lark Sparrow (Chondestes grammacus) LASP +

Savannah Sparrow (Passerculus sandwichensis) SAVS % # +

Large numbers breeding on the airside of JFK during the summer of 1995. One was seen on JFK's airside on November 13, 1995.

Grasshopper Sparrow (Ammodramus savannarum) GRSP % * # +

Henslow's Sparrow (Passerherbulus henslowii) HESP +

Sharp-tailed Sparrow (Ammodramus caudacuta) STSP +

Seaside Sparrow (Ammodramus maritima) SESP +

Fox Sparrow (Passercilla iliaca) FOSP +

Swamp Sparrow (Melospiza georgiana) SWSP +

White-throated Sparrow (Zonotrichia albicollis) WTSP +

White-crowned Sparrow (Zonotrichia leucophrys) WCSP +

Junco

Slate-colored Junco (Junco hyemalis) SCJU % +

Bobolink and Meadowlark

Bobolink

Bobolink (Dolichonyx oryzivorus) BOBO +

Meadowlark

Eastern Meadowlark (Sturnella magna) EAME % * # ! +

Blackbirds

Yellow-headed Blackbird (Xanthocephalus xanthocephalus) YHBL +

Rusty Blackbird (Euphagus carolinus) RUBL +

Red-winged Blackbird (Agelaius phoeniceus) RWBL % * # +

During the period of 1979 through 1993, 12 red-winged blackbirds were involved in bird strikes at JFK, all of which were struck by a single aircraft. Twelve birds is less than one percent of the total number of bird strikes during that period. And one aircraft struck is less than 1 percent of the total aircraft struck resulting in damage or delay to that aircraft.

Habitat and Food

Red-winged blackbirds nest in vegetation in and near wet areas. They often build their nest in cattails, bulrush, or common reed or other aquatic plants and shrubs. In dry areas, while their nests are usually in vegetation above the ground, they sometimes construct their nests on the ground. They eat insects, spiders, and seeds.

Month

Most red-wings arrive at JFK in late winter and during the spring, however more and more are spending large portions of the winter in the New York area, some even stay the entire winter. They migrate in fairly large flocks, sometimes joined by other birds, such as grackles and starlings. It is usually the male red-wings who arrive first.

Blackbird Flocks Can Be Huge And Dangerous

There was a cluster of 13 bird strikes in one night at Newark International Airport (Garber 1995g) which we concluded were due to a huge flock flying through Newark's airspace on the night of October 25, 1995. During a short period in one night 13 pilots flying into Newark International Airport reported a total of nearly 70 bird strikes. Three of the thirteen pilots reported seeing approximately 100 birds each. The strikes occurred between 2 miles and 20 miles from the airport. This number of strikes is unusually high for any night, even during the peak of fall migration. Al Graser, the General Manager of the Port Authority of New York and New Jersey's Aviation Technical Services reported he had never heard of so many strikes over a one night period.

Preliminary reports from Aviation Technical Services suggested that the birds struck might have been Canada geese. Frank Loprano, the Deputy Chief of Aeronautical Operations at Newark International Airport, thought if the birds had been geese, there would have been more damage to the aircraft. He said the birds might have been gulls, and mentioned he had heard that a landfill might have been reopened recently in northern New Jersey, which could have been responsible for increased numbers of gulls.

Russell Halleran, the FAA's Programs Specialist in the Newark International Airport Tower, said the pilots reported the birds were big and dark, and were at a wide range of elevations, and were spread out over several miles. This information enabled us to rule out Canada geese because there were so many strikes spread over such a huge area, and there was no damage. They might have been brant, which are smaller geese than Canada geese. Brant migrate in this area in large numbers this time of year, but why wasn't there any damage? However, brant migrate north in large numbers, but they return in smaller family groups. Inquiries to naturalists in the area found that large numbers of brant had not appeared anywhere along the East Coast over night. The birds might have been gulls, but why would pilots have said they were dark? Pilots have very good headlights and would have illuminated any birds more than adequately to see whether they were white or black. Because the birds were black, and we had ruled out larger dark birds, such as ducks and geese, we considered the possibility of blackbirds, but why did pilots think they were so big? Beyond this point, the information was not sufficient to make a positive identification, so Halleran sent us the 13 bird strike incident/ingestion reports (FAA Form 5200-7). From these we concluded the following:

The 13 reports filed during the night agree on several points:

- The strikes all occurred on the night of October 25, 1995.
- Once the tower realized there were so many birds out there, all the pilots were warned.
- The night was clear, no clouds, so the pilots could see the birds well with their headlights.
- The birds that were seen were black.

- The birds' size ranged according to the pilot who filed the report; some thought the birds were small, others said medium, others said large. We conclude the birds were, on average, medium in size.
- All the birds struck were hit on the descent and approach to Runway 4R, which means the birds were to the southwest of Newark.
- In the 13 reported incidents, as many as 70 birds were struck, and hundreds of birds were seen.
- Most strikes occurred 6.5 to 10 miles out.
- The birds were flying through a range of elevations.
- 11 strikes occurred above 1,000 feet.
- One pilot reported 4 strikes during his descent and approach; all his strikes occurred between 7,800 and 2,000 feet in elevation.
- 2 strikes occurred below 1,000 feet (the lowest was 200 feet).
- The flock was very large, with many birds, probably thousands.

Conclusions:

- Because this many birds has never been struck on one night before, and because it only happened October 25, not on the next night also, we assume the flock just flew through this airspace at that time, and then it moved on.
- Because all the strikes occurred in the same area and during the same interval of time, we assume this was a single species, and that the birds were in a flock.
- Because there were so many strikes without any damage, ducks, geese, and gulls were ruled out.
- Because the birds that were seen were black, not white, this is further corroboration that gulls were not involved.
- Because, of all the pilot reports, sometimes the birds were called small, or medium, or large, we conclude the birds had to be a size that some people might consider small, while others might consider them medium, and others could think they were large. Therefore, very small species were ruled out because no one would call them large, and very large species were ruled out because no one would call them small. As a result, tree swallows, a species that was flocking at JFK recently, were ruled out. And again, ducks, geese, and gulls were ruled out because everyone considers them large.
- Starlings, although the right size and color, were ruled out because they fly closer to the ground than these birds.

Discussion

Because mixed flocks of "blackbird" species have been flocking this time of year, blackbirds are black, blackbirds fly at night, often at high elevations, but usually at a considerable range of elevations, and because large numbers of blackbirds are flocking in

huge spread out aggregations this time of year, and because some people might call "blackbirds" small, while others could call them medium in size, and if one hit your windshield at 200 knots you might call it large, blackbirds were seriously considered as a possibility.

- We presented the facts to biologists in the region, who all concurred this was a mixed flock of blackbirds. This time of year blackbirds fly south and overwinter in large numbers as nearby as the Delmarva Peninsula. A flock in one field can be as large as 100,000. Wildlife managers report Bombay Hook Refuge in Delaware has hundreds of thousands of blackbirds arriving there right now. From all the information provided, blackbirds were headed south when they were in the airspace southwest of Newark the night of October 25.

Recommendations

Red-winged blackbirds, grackles, starlings, and cowbirds, are the four species that often fit the description of generic "blackbirds," although in this case the birds were probably primarily red-wings and grackles. A flock of starlings caused a Lockheed Electra to crash on October 4, 1960 at Boston's Logan International Airport, and 62 of the 72 passengers on board died; in addition there were 9 serious injuries. On February 26, 1973, when a Lear 24 in Atlanta, Georgia ingested cowbirds into its engines, the plane crashed and there were no survivors. Therefore, we know flocks of blackbirds can prove dangerous, and should be taken very seriously. It was good that the Tower warned pilots of the birds, and it was much safer that the planes striking these birds were incoming rather than outgoing, because a plane cannot afford to lose substantial thrust on take-off, but when decelerating on landing, a multiple strike is less dangerous.

It will prove helpful to continue monitoring Newark's airspace and strikes, especially during peak nights during fall migration. More information will help us learn how to minimize the risk of bird strikes. It is possible, that the radar used by flight controllers could be adjusted to enable us to "see" the birds and direct the pilots to take a route on approach and departure that enables them to avoid the birds. We are currently investigating methods used by researchers to identify birds with radar.

Tanagers, Cardinal, Grosbeaks, and Towhee

Tanagers

Summer Tanager (Piranga rubra) SUTA +

Scarlet Tanager (Piranga olivacea) SCTA % +

Western Tanager (Piranga ludoviciana) WETA +

Cardinal

Northern Cardinal (Richmondia cardinalis) NOCA % +

Grosbeak

Rose-breasted Grosbeak (Phœnicurus ludovicianus) RBGR % * +

Blue Grosbeak (Guiraca caerulea) BLGR +

Pine Grosbeak (Pinicola enucleator) PIGR +

Evening Grosbeak (Hesperiphona vespertina) EVGR +

Towhee, Grackles, and Cowbird

Rufous-sided Towhee (Pipilo erythrophthalmus) RSTO % +

Grackles

Boat-tailed Grackle (Cassidix mexicanus) BTGR +

Common Grackle (Quiscalus quiscula) COGR % # +

Cowbird

Brown-headed Cowbird (Molothrus ater) BHCO % * # +

As stated earlier, on , and . At JFK cowbirds appear to parasitize the grassland nesting birds, laying eggs in the nests on the ground. As a result of the increasing number of cowbirds, the numbers of affected grassland nesting birds has been decreasing. In particular, meadowlarks and grasshopper sparrows appear to have been virtually eliminated from the airport. Based on the data we have collected it is too early to predict whether savannah sparrows are next to go. The net result is that when the young cowbirds have fledged, they congregate during the latter part of the summer on the airside of the airport and present a hazard to aircraft. By October, there are flocks of adults from outlying areas that are also attracted to the area, but they are primarily found on the landside of the airport on green low cut grassy areas. On October 17, 1995 there was a flock of 60 adult cowbirds feeding on the grass near the Department of Sanitation building between the sewage treatment plant and the long-term parking lots. October 24, 1995 a flock of 70 adults were feeding on the grass (Panicum sp.) along the side of the road in front of Building 80, near the Medical Center. These cowbirds were feeding in a "leapfrog" manner as I have seen starlings feed on the low cut grasses on airside.

To manage this species it would be good if we could shoot the flocks on occasion, especially the juveniles when they are naive and congregated on the airside. However, at present Fish and Wildlife will not issue such a permit, however it is a species that we would like to control, and because it is a pest to native species, and in particular, it is the cause of the decline of many species, there is a better than even chance that we could receive permission to manage this species in the future. By shooting the flocks of young on the airport during the summer, we would be eliminating birds raised at JFK. This is unlike the results you would get from killing adults here in October. Eliminating cowbirds attracted from outlying areas would net minimal long-term positive results. This is because during the fall, birds from surrounding regions are always going to be stopping here for short periods of time, particularly during migration, whether or not we eliminate a few here and there.

Oriole, Finch, Goldfinch, Siskin, Redpoll Crossbills, and Dickcissel

Orchard Oriole (Icterus spurius) OROR +

Baltimore Oriole (Icterus glabula) BAOR +

Finch, Goldfinch, Siskin, and Redpoll

Purple Finch (Carpodacus purpureus) PUF1 % +

House Finch (Carpodacus mexicanus) HOF1 % +

American Goldfinch (Spinus tristis) AMGO % +

Pine Siskin (Spinus pinus) PIST % +

Common Redpoll (Acanthis flammea)CORE +

Crossbills and Dickcissel

Red Crossbill (Loxia curvirostra) RECR % +

Three seen November 14, 1995 flying over the landside toward the north side of Jamaica Bay.

White-winged Crossbill (Loxia leucoptera) WWCR +

Dickcissel (Spiza americana) DICK +

Weaver Finches, Longspur, and Buntings

Weaver Finches = Old World Sparrows (Passeridae)

House Sparrow (Passer domesticus) HOSP % * # +

Longspur and Buntings

Lapland Longspur (Calcarius lapponicus) LALO % +

Snow Bunting (Plectrophenax nivalis) SNBU % * +

During the period of 1979 through December 7, 1995, there were 66 snow bunting bird strikes at JFK, which was 2 percent of the total number of bird strikes during that period. Of these, one aircraft was damaged or delayed, which was 1 percent of the total number of aircraft damaged or delayed due to bird strikes during this period. Throughout this period, all the snow bunting birdstrikes occurred during November, except for four that were struck on December 14, 1994. November is when snow buntings first arrive at JFK, and then they spend the winter here, during which time they usually occur in small flocks, of approximately 50 to 100 birds, but some flocks of 300 or more occur from time to time.

When the snow buntings first arrive they are probably naive regarding the dangers at JFK, so that is when they get struck. However, since snow buntings are found here throughout the winter months, one can assume that they learn quickly and pose very little danger to aircraft from December on, unless of course there is an unusually severe winter up north, forcing large numbers of snow buntings further south, later on in the winter. Should that happen, which is to be expected, then we could get large numbers of naive snow buntings after November during the occasional year, so these should be watched for. Airports in the northern cities, such as many in Canada, report large numbers of snow bunting bird strikes. In fact, snow buntings represent one of the major threats to aircraft at some of these northern airports. Luckily, the birds are quite small, however.

since they commonly occur in large flocks to the north of us, there is the chance that they could bring a plane down.

Indigo Bunting (Passerina cyanea) INBU +

Parrots and Parakeets

Black-headed Parakeet (Nandayus nenday) BHPA %

This is not a common species in the JFK vicinity, rather it is an escape that occurs in New York in small numbers, and at this point does not pose a hazard at the airport.

Budgerigar (Melopsittacus undulatus) %

Like the black-hooded parakeet, this is also not a common species in the JFK vicinity, rather it is an escape that occurs in New York in small numbers, and at this point does not pose a hazard at the airport. Unlike the black-hooded parakeet, there is no reason to believe that budgerigars survive the winter here.

Monk Parakeet (Myiopsitta monachus)

Monk parakeets are native to South America. From 1960 to 1972 approximately 100,000 were legally imported to the United States. Due to many having escaped, by the early 1970s the New York City area had more nesting pairs of monk parakeets than any other region in North America, totaling about 200 or more birds. Since then most of New York's monk parakeets were eliminated by the Department of Agriculture, however small numbers still persist in Brooklyn, and small colonies exist in Bridgeport and New Haven, Connecticut (Garber 1988c, 1993). Although this bird nests in colonies and often flies in flocks, because there are so few in the region there is virtually no risk at JFK from this species at the present time.

CHAPTER TEN

Amphibians, Reptiles, and Mammals at John F. Kennedy International Airport

Many of the habitats at JFK are similar to such wild areas that have been preserved in the region, as Fire Island National Seashore. One would might expect to find many of the same amphibian, reptile, and mammal species at JFK that live on Fire Island (Garber 1984). The soils are sandy, and we are surrounded on three sides by salt water, and the airport is affected by tides and ocean spray, many faunal characteristics of the airport are similar to those of barrier islands. Few of the amphibians and reptiles that inhabit such habitats (Garber 1985a) occupy the airport. Most of the reptiles and amphibians of the neighboring Jamaica Bay Wildlife Refuge were introduced, because it too is the product of dredge spoils deposited on wetlands (Garber 1985b). The amphibian, reptile, and mammal species on Long Island's Fire Island National Seashore represent the native fauna still found in such local habitats that have been protected (Garber 1984). To determine the species at JFK, we have had a constant presence of trained professionals observing the activities of wildlife on the airport since 1957. The following is a list of the amphibian, reptile, and mammal species observed at and adjacent to JFK.

Amphibians

Spring Peeper (Hyla crucifer)

The spring peepers that were introduced to the Jamaica Bay Wildlife Refuge were collected at JFK before we filled our wetlands to eliminate standing water habitats to comply with federal regulations in an ongoing effort to create a safe airport environment, that is, one that is less likely to attract high numbers of bird species that have a history of interfering with safe airport operations. The spring peeper's presence indicates that JFK was not all salt marsh before dredge spoils were used to create the airport, but rather the 10 square miles that now constitute JFK represented a range of habitats, which included freshwater wetlands.

Reptiles

Diamondback Terrapin (Terrapin malaclemys)

Diamondback terrapins live in Jamaica Bay (Garber 1988d, 1989e, 1990c, 1995i; Garber and Burger 1995; Burger and Garber 1995) and some lay their eggs on the airport. A female was observed on the 4L extension approximately 100 feet from water on June 12, 1995. Two more females were seen on June 22, 1995 (one at 10:30AM and the other at 11:30AM). They may have both been up to lay eggs because it rained during the early morning hours and the ground was soft? To date, diamondback terrapins have not been a management concern at the airport. Before I started working for the Port Authority, a few terrapins had been seen on the service roads, and adjacent areas, but they were not considered common. It now appears there may be more terrapin activity on the airport than was expected. Most nest east of the 4s in areas that are far removed from aeronautical regions. Because the turtles can become dangerous objects if hurled by jet blast, we will identify prime nesting areas, travel these sites during the prime nesting season, and move any turtles found to a safer location. We will consider the ecological factors affecting diamondback terrapin nesting beach management, should they ever become a problem (Garber 1985c).

Mammals

JFK has had a constant presence of trained professionals observing the activities of wildlife on the airport (Chevalier 1984). The following is a list of the mammal species that we have observed at and adjacent to JFK since 1957. It should also be added that we at JFK are currently planning a mammal survey to be conducted here in September of 1996. We are working with the New York State Museum. Joseph Bopp, who is working on a mammal survey of New York State, will help us set trap lines in the different habitats on the airport in an ongoing effort to determine the species composition of each airport habitat and relative abundances so we can improve the wildlife management plan.

Muskrat (Ondatra zibethica) %

Musk rats inhabit marshes, ponds, lakes, and streams where they utilize a range of habitat and vegetation. Their diet includes a variety of plants, clams, fish, and frogs. They were found at JFK between the 4s in the many ponds and nearby marshy areas (United States Department of the Interior Fish and Wildlife Service 1976) as recently as 1976 and the muskrats survived until their habitat was destroyed as better drainage was provided, and low areas were filled. Muskrats may still be found on the airport; suspicious looking roadkills have been seen by Ogden's building near Federal Circle. They are common at Gateway National Recreation Area.

Big Brown Bat (Eptesicus fuscus) %

There has never been a reported bat strike at JFK. I cannot say whether this is because bat species are not particularly common in the area, or because the bat sonar allows them to avoid aircraft, or because the Bird Control Unit never sees bats when doing their patrols. But it is safe to say that bats do not constitute a major danger to aircraft at JFK, probably because the species that inhabit the area are very small. There are not many bird species that are recognized as bat predators in this area that would be attracted to JFK because bats are here. Sparrow hawks have been observed feeding on bats (Garber 1977), and sparrow hawks, or kestrels, are common here. But this behavior has been observed on only a small number of occasions.

Black-Tailed Jack Rabbit (Lepus californicus) %

Black-tailed jack rabbits have been at JFK for years, and they are still here living on the airside of the airport. How and when they were introduced is open for speculation. Connor (1971) wrote jack rabbits had been introduced to certain limited areas in western

and central Long Island, New York. They were here in 1969 (Wilcox 1977). Chevalier (personal communication) said they were here when he first worked at JFK in October 1957. He felt the rabbits escaped from a shipment. I have heard people say they escaped when a crate of jack rabbits broke open. My feeling is that during Easter season each year, when pet shops sell baby ducks and rabbits, many crates of these animals come through the airport and it is possible that they escaped at that time. But even more likely, when children tire of their baby rabbits, when they are grown and their parents are interested in finding the pets a new home, many get dumped. We know people drive by Rockaway Boulevard and to this day animals get dumped, so it would not be surprising if that is how the jack rabbits were initially introduced. At present they occasionally get runover by Port Authority vehicles, but usually they stay under cover and occasionally end up as food for large raptors.

Eastern Cottontail Rabbit (Sylvilagus floridanus) %

Rodents

Deer Mouse (Peromyscus maniculatus) and Voles

In 1995 Chicago's O'Hare International Airport, with the assistance of the Department of Agriculture and Chicago's Field Museum of Natural History, completed a small mammal survey. The experimental design tested differences in mammal numbers in replicated plots of grass of varying lengths. Tested grass heights were 4 inches, 8 inches, 12 inches, and fallow. Each grass length was tested in four 30 to 50 acres plots on the airport. In 2,560 snap-trap nights, 495 small mammals were captured. Most were meadow voles and deer mice. Fallow and 12 inch grass had 4 times as many rodents as did 4 inch grass, whereas 8 inch grass had intermediate numbers. It was concluded that rodent populations increased to higher numbers within four months of the establishment of the higher grass length.

This may explain why we at JFK observe raptors flying and feeding primarily over the vegetated areas along the bay runway, near the water, and east of the 4s. These are the areas that are fallow. Deer mice live in forests and grasslands, where they feed on seeds, nuts, acorns, and insects.

House Mouse (Mus musculus)

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

Norway Rat (Rattus norvegicus) %

Eastern Gray Squirrel (Sciurus carolinensis) %

Dog (Canis familiaris) %

Porpoise

During the summer of 1995 a small pod of porpoises was in Jamaica Bay near Joco Marsh for over two weeks. We were not able to make a positive identification of the species. Although this was not found on the airport, technically, the airport property extends to a region that includes the aquatic periphery, therefore the porpoises may actually have been on the airport!

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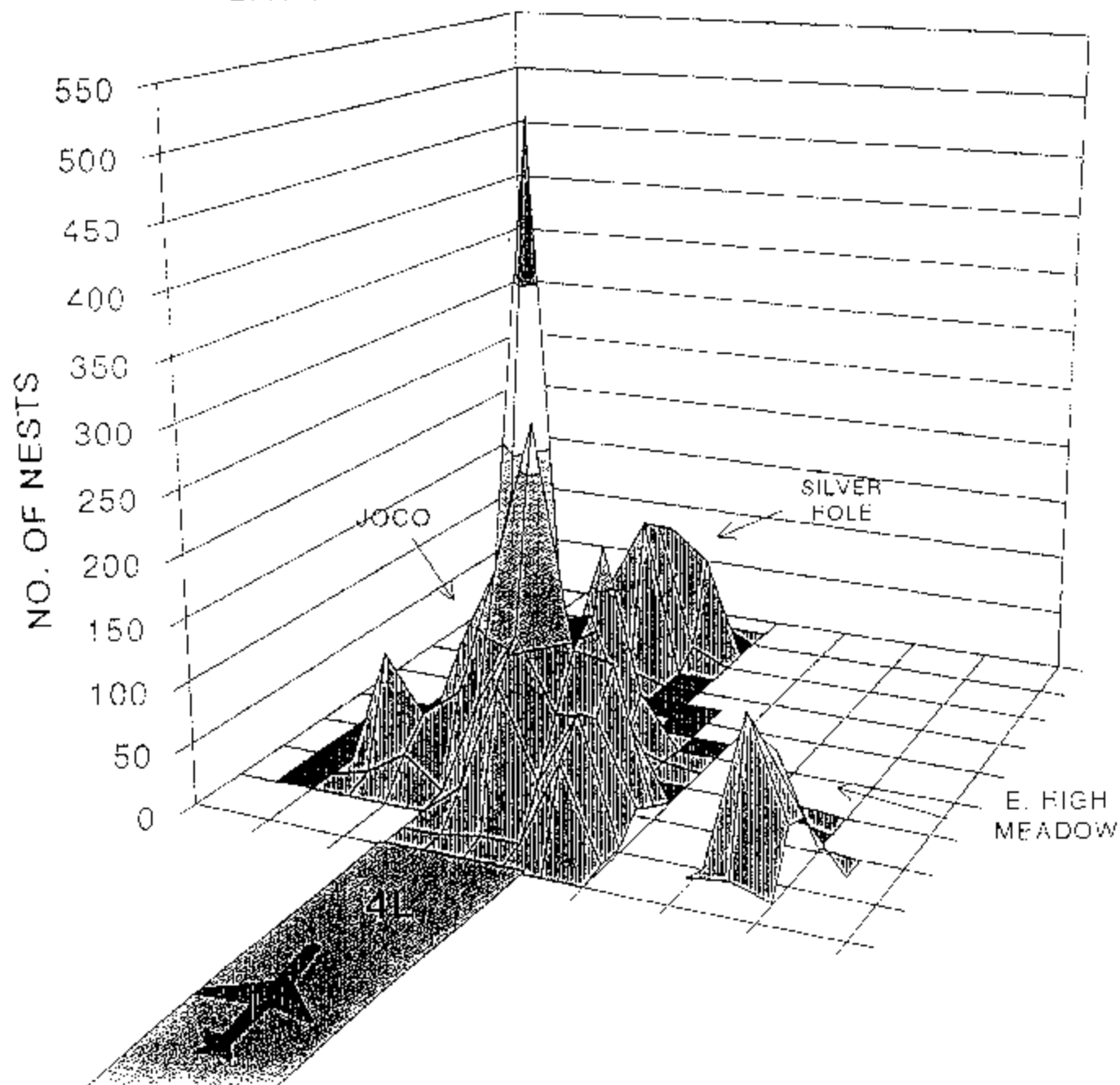
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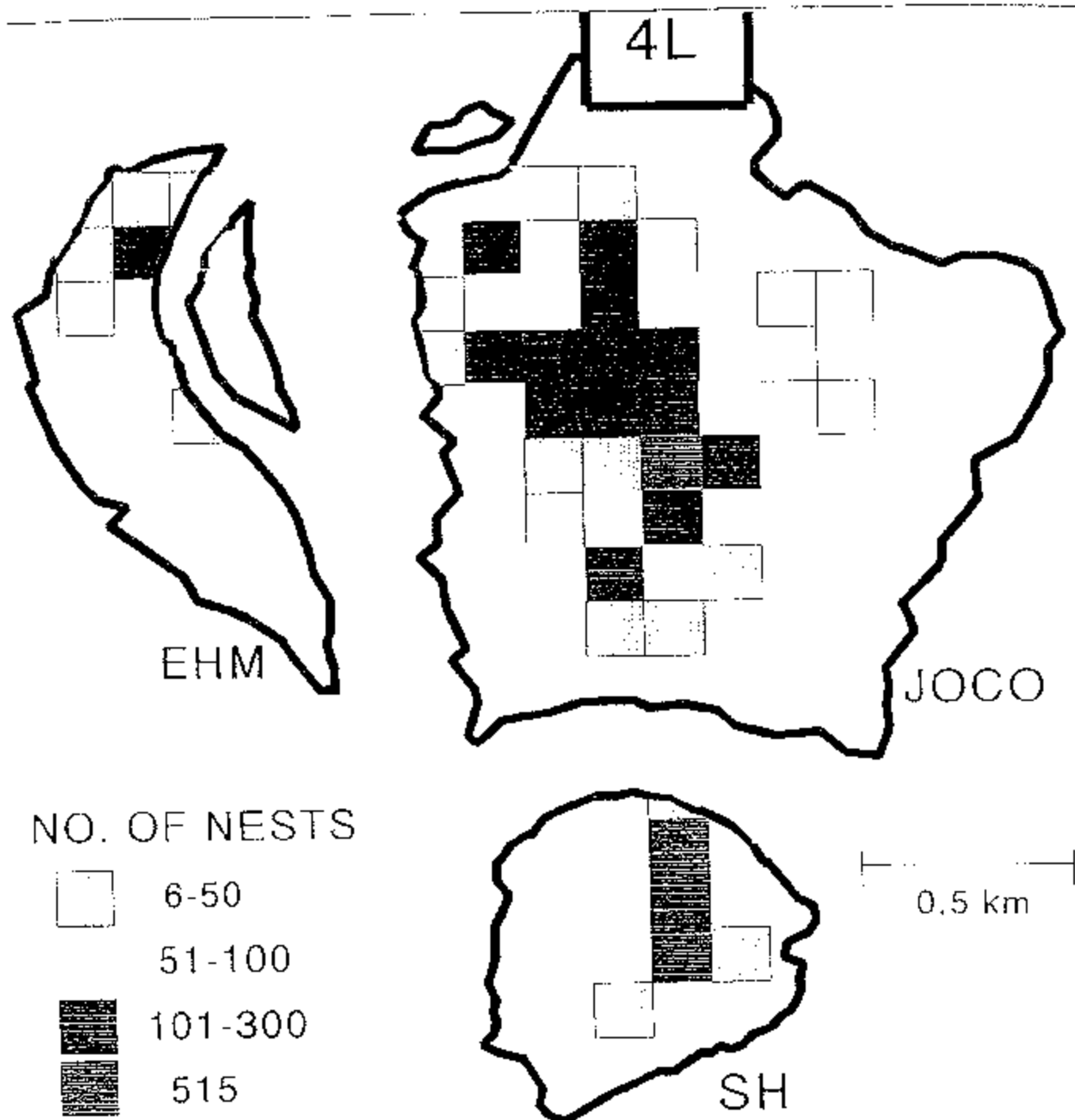
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APPENDICES

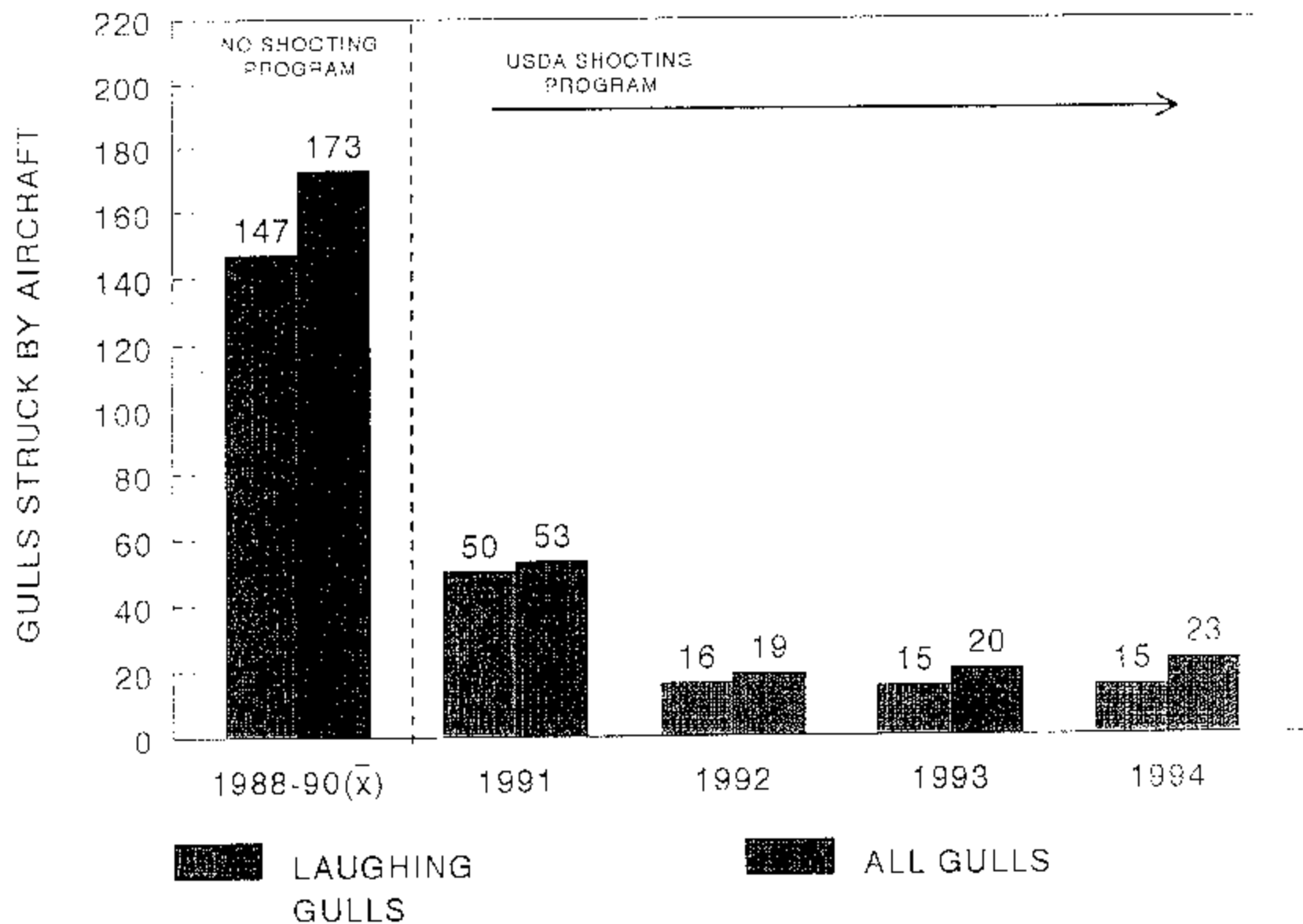
DISTRIBUTION OF LAGU NESTS IN JAMAICA
BAY IN RELATION TO RNWY 4L JFKIA, 1992



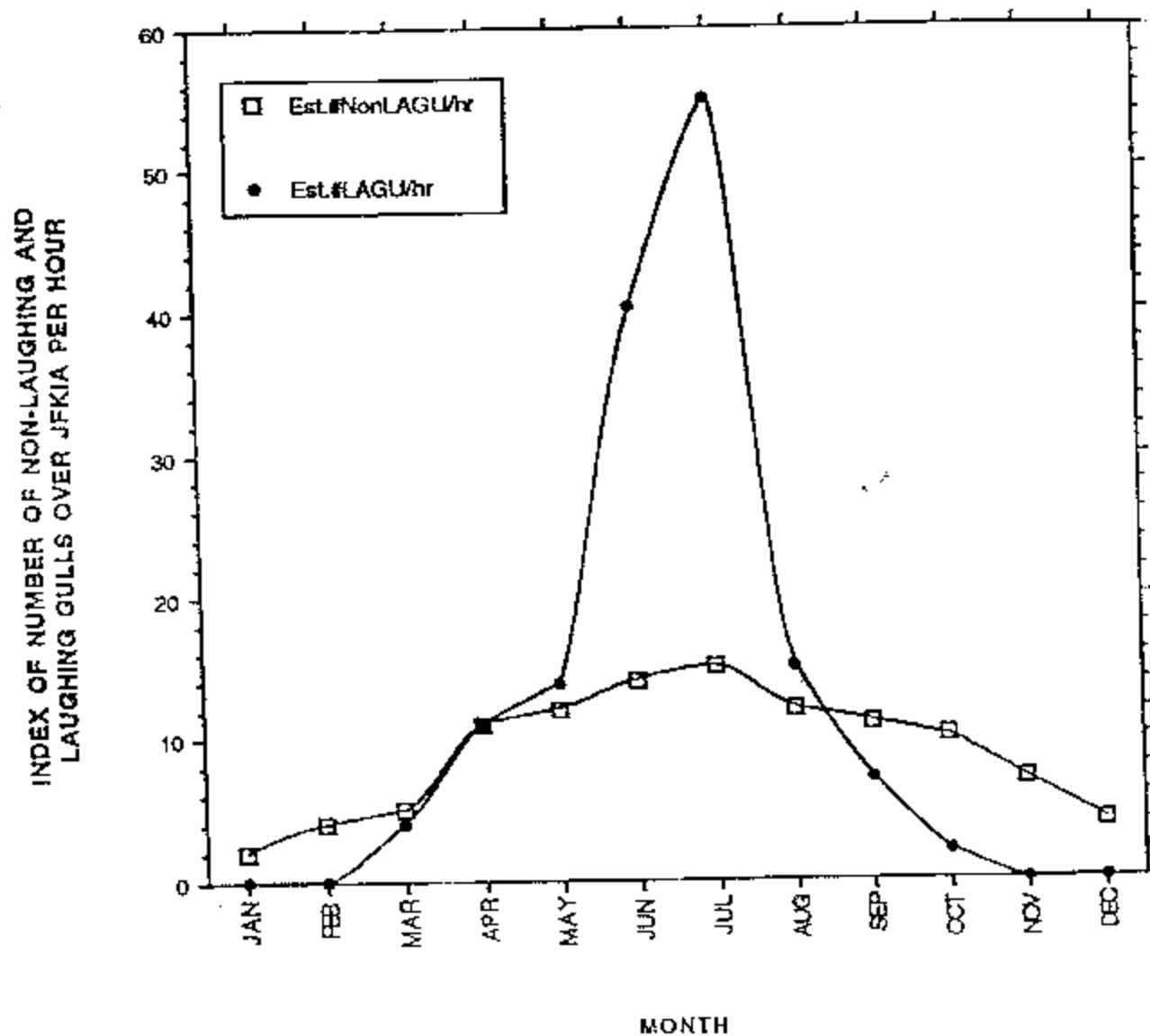


DISTRIBUTION OF LAUGHING GULL NESTS BY 4.7-ACRE
AREAS OF MARSH, JAMAICA BAY, NEW YORK, 1992

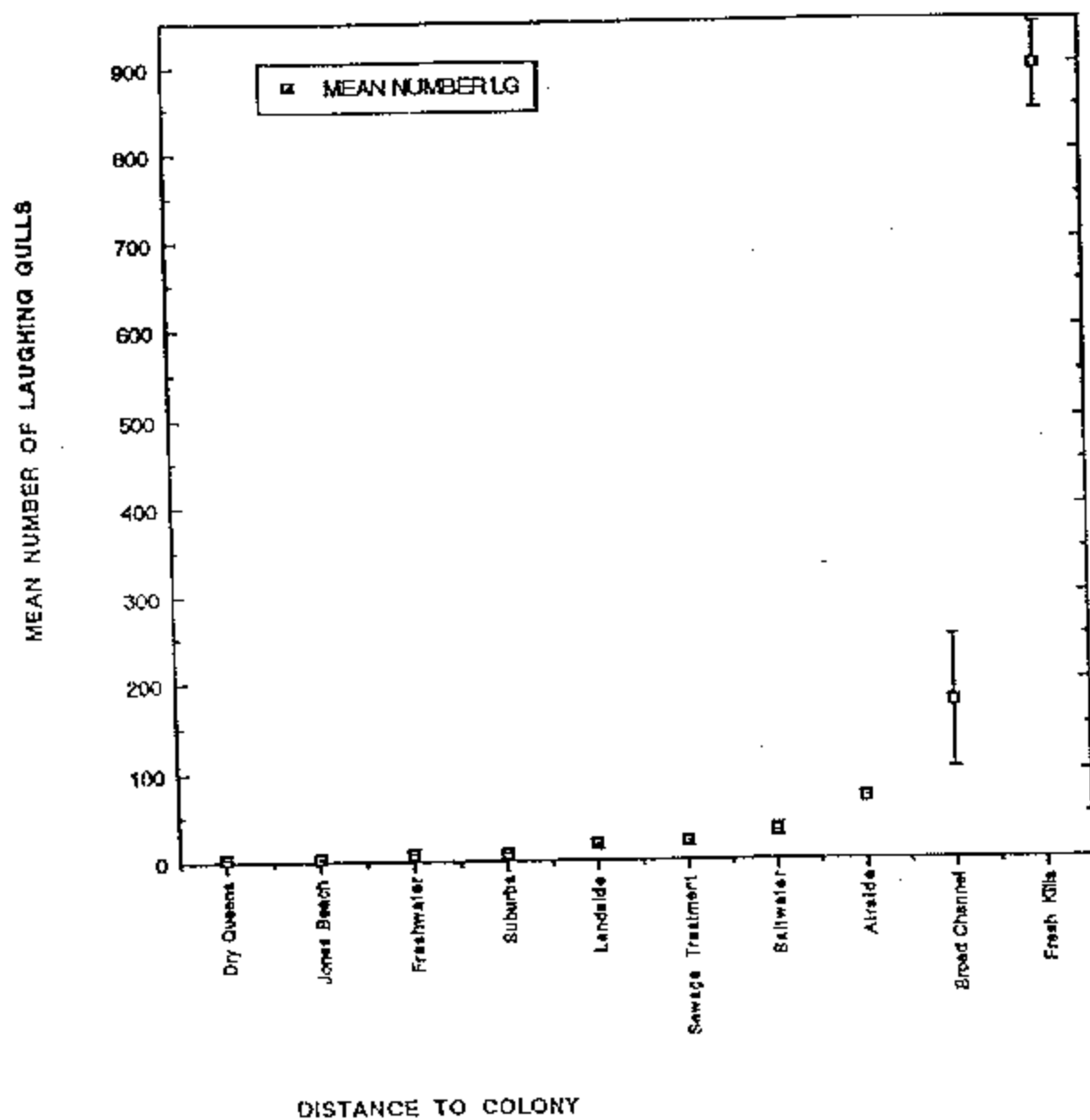
GULLS STRUCK BY AIRCRAFT AT JFKIA 20 MAY-15 AUGUST



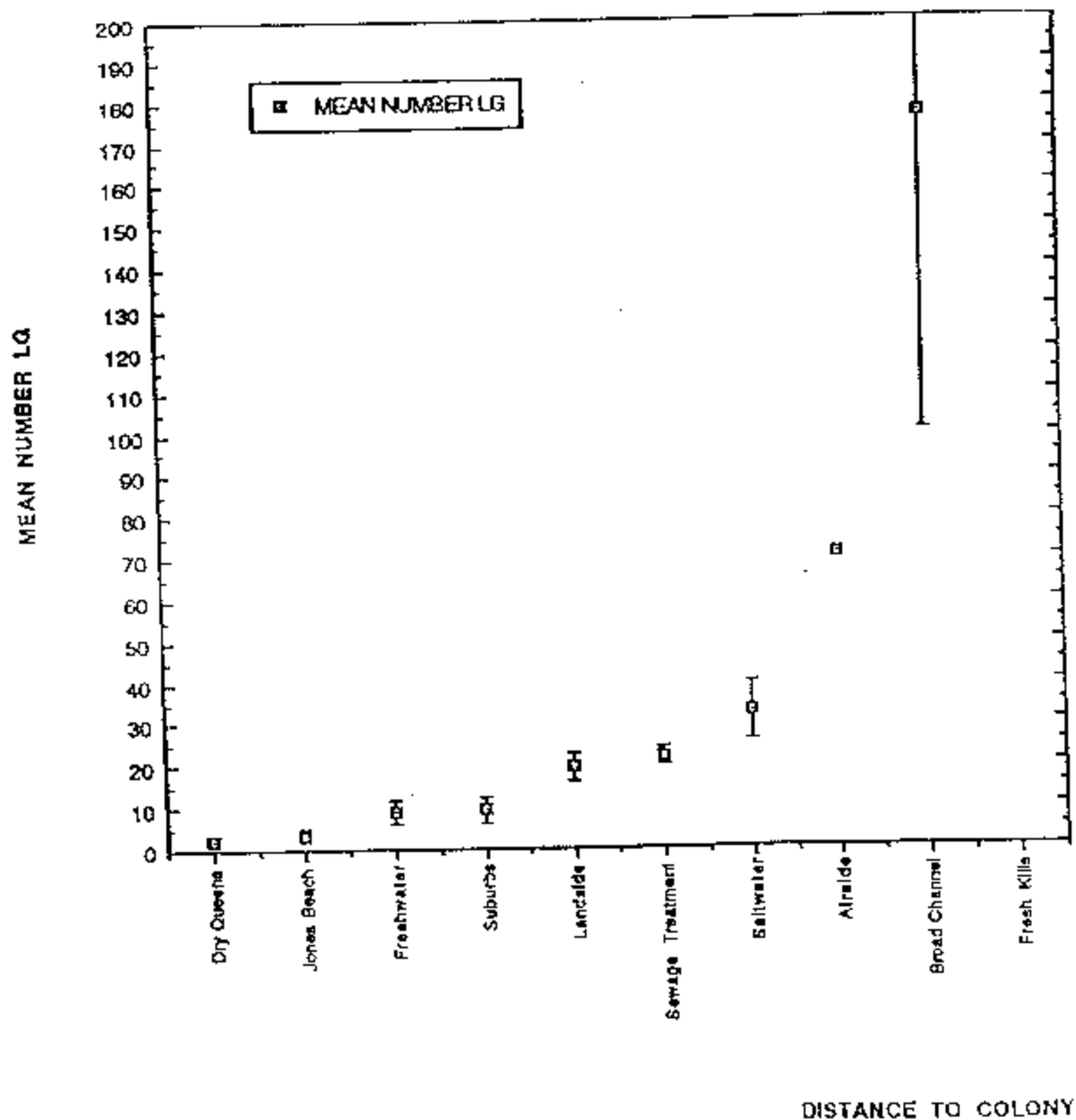
NUMBER OF GULLS OVER JOHN F. KENNEDY INTERNATIONAL AIRPORT PER HOUR PER MONTH

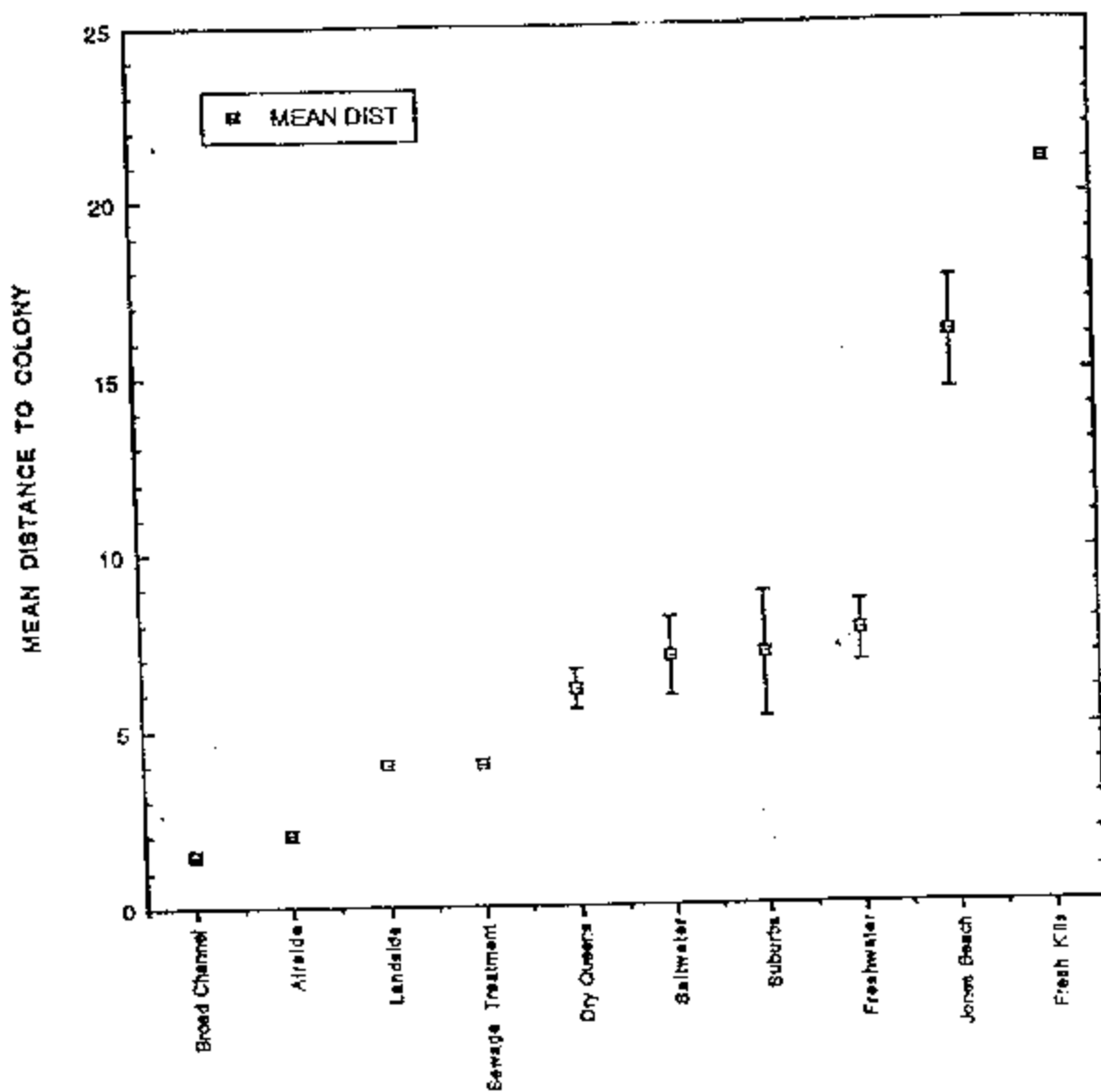


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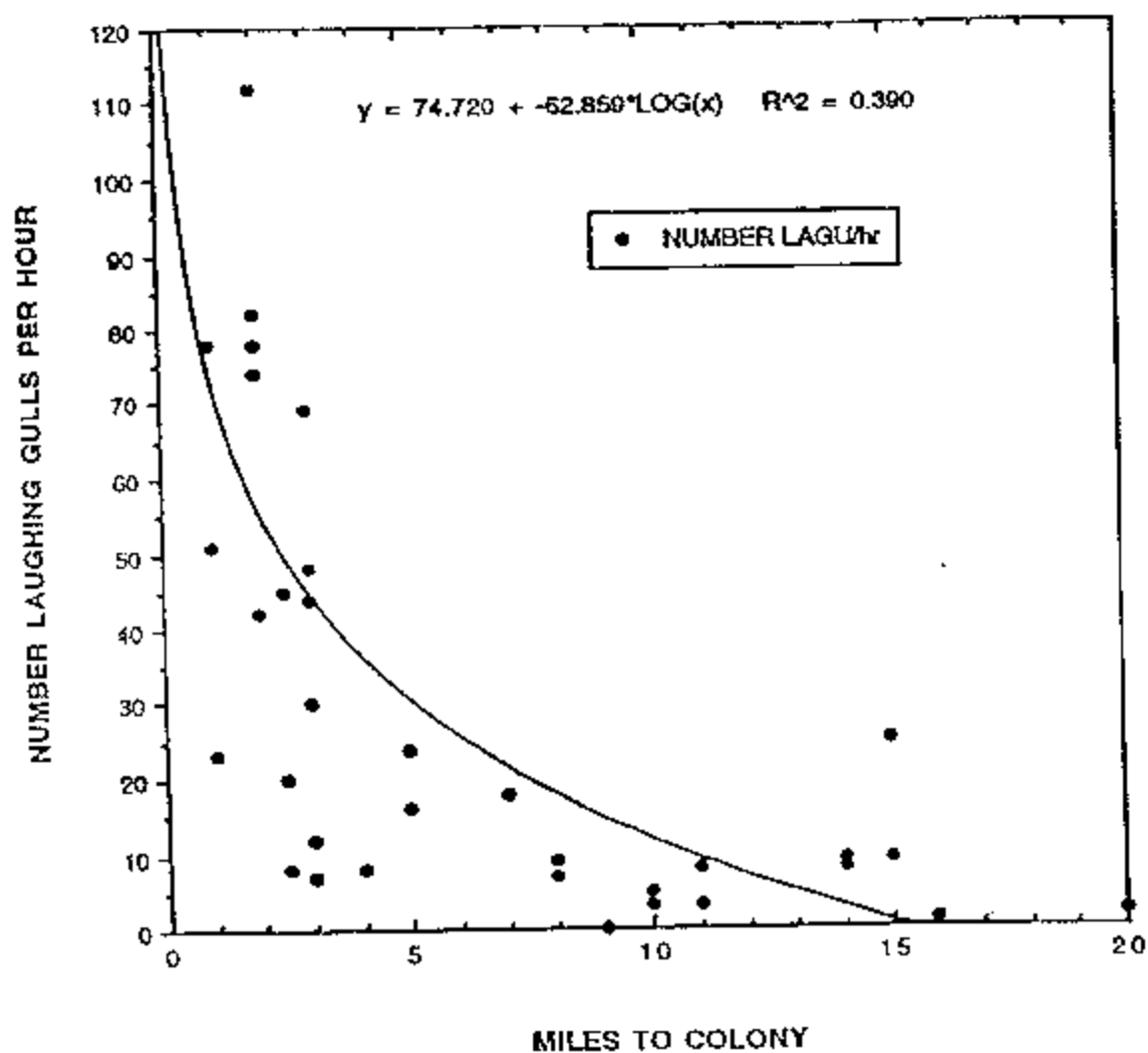


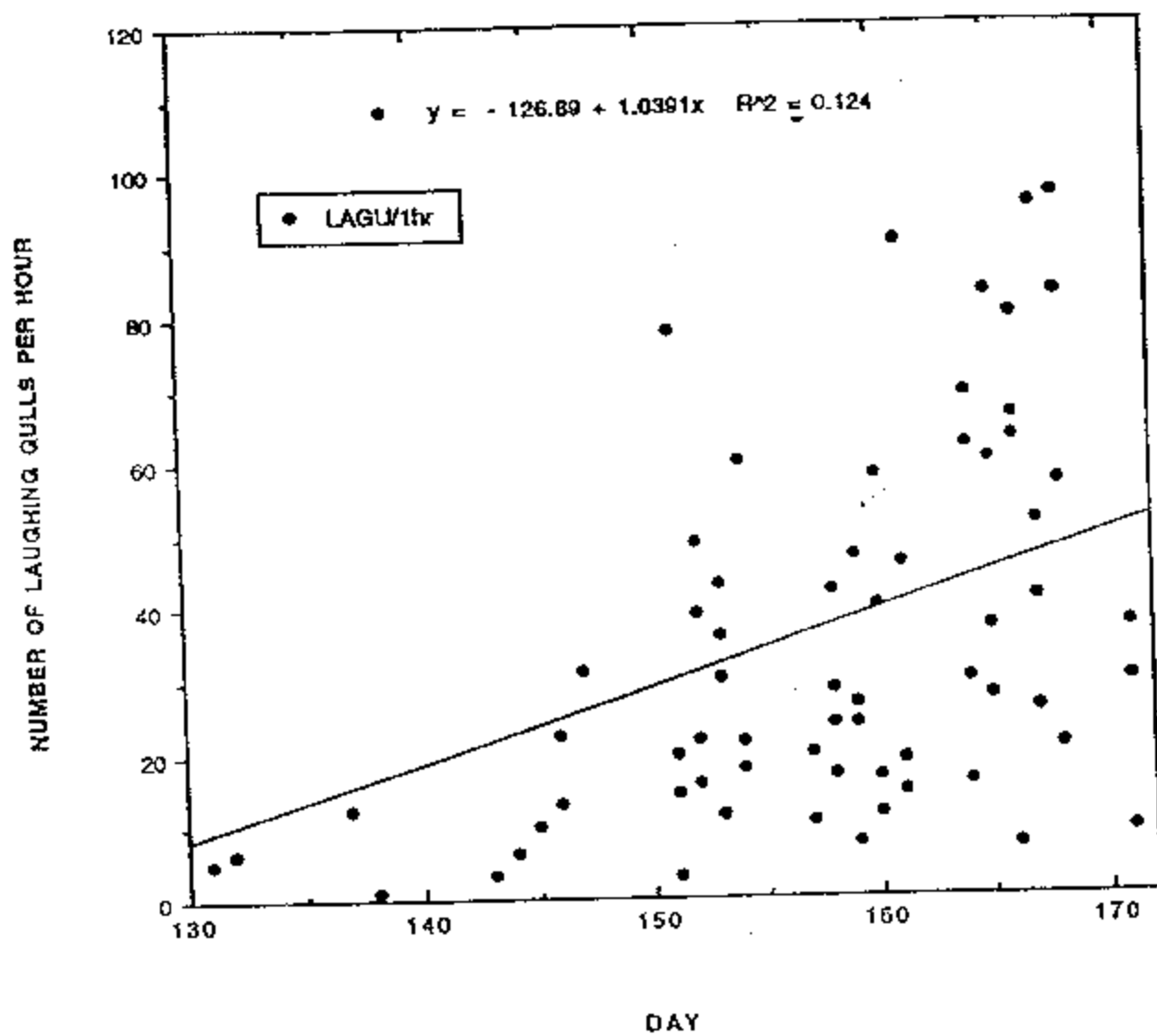
MEAN NUMBER OF LAUGHING GULLS PER HOUR



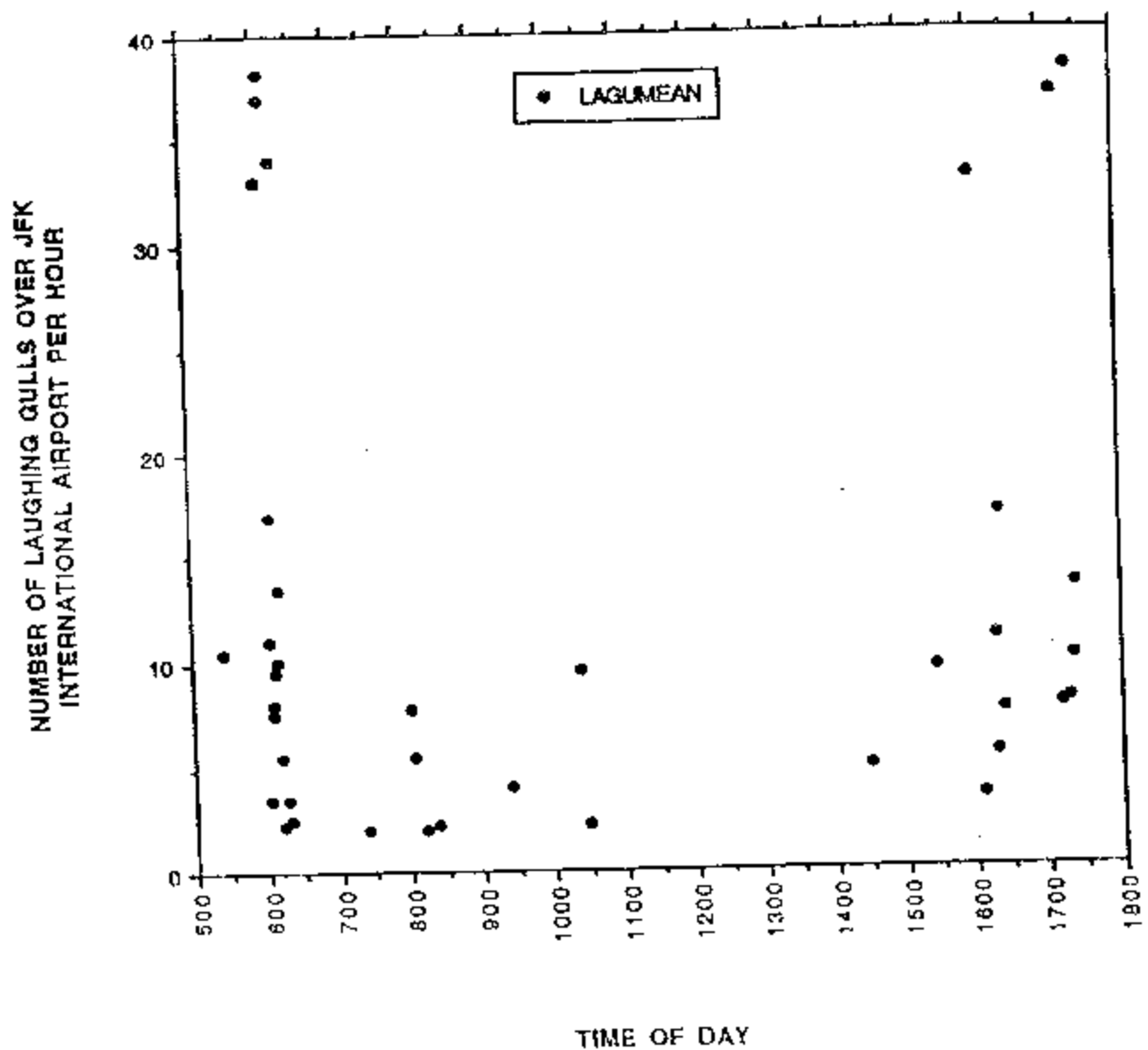


NUMBER OF LAUGHING GULLS ASSOCIATED WITH
BAYS, SALT MARSHES, AND TIDAL CREEKS

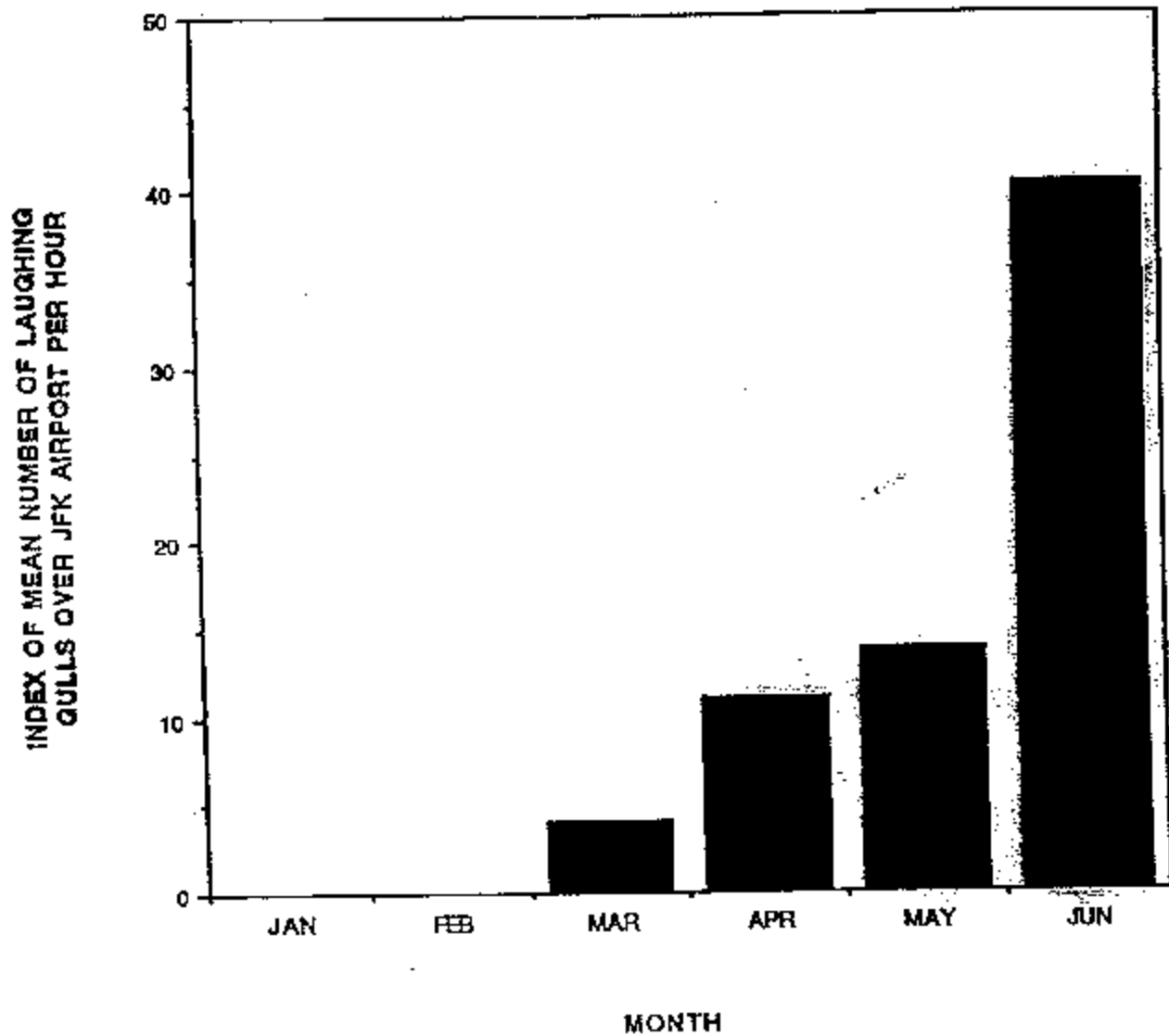


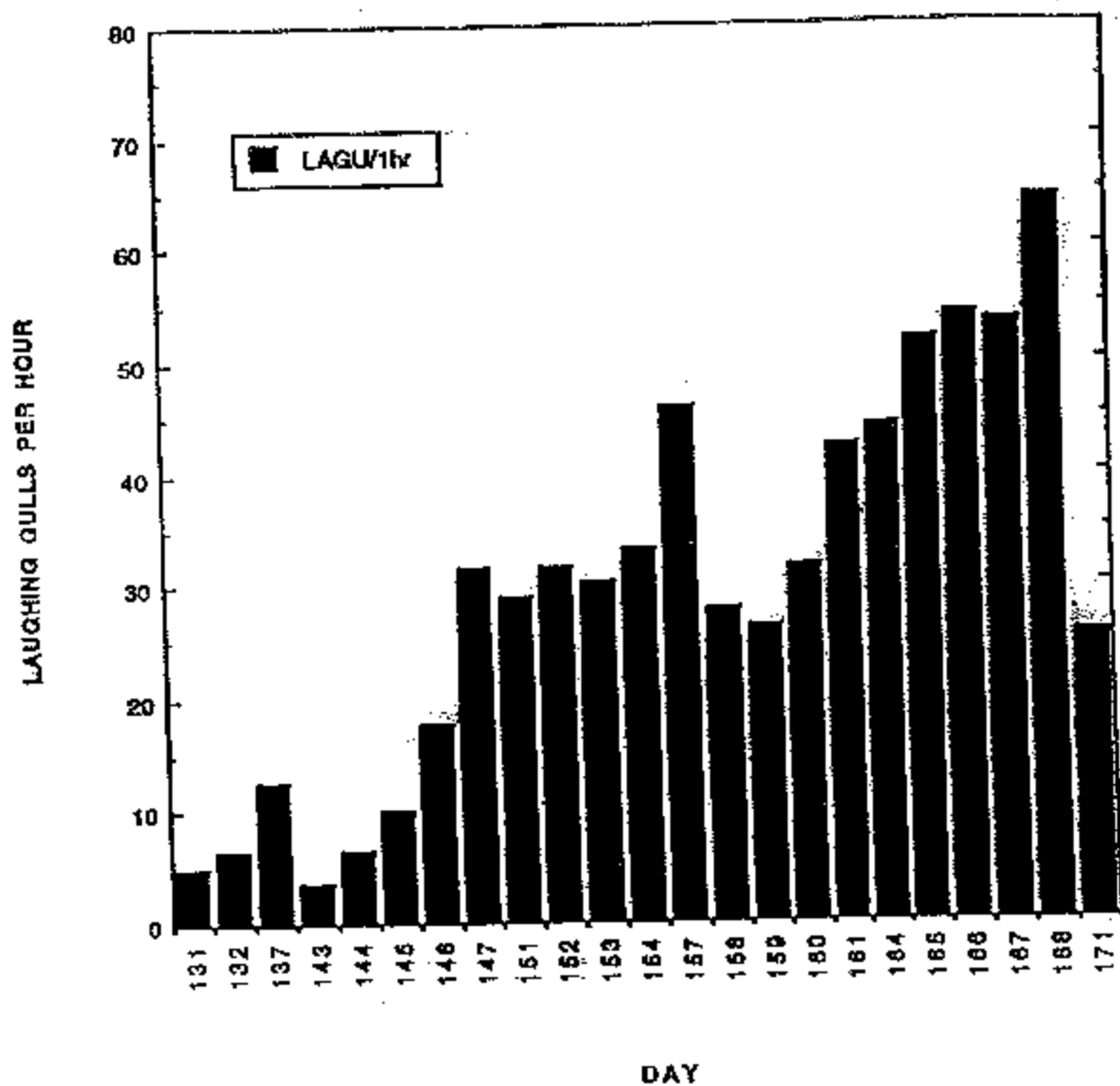


LAUGHING GULLS OVER JFK AIRPORT
MAY 11, 1994 to June 20, 1994



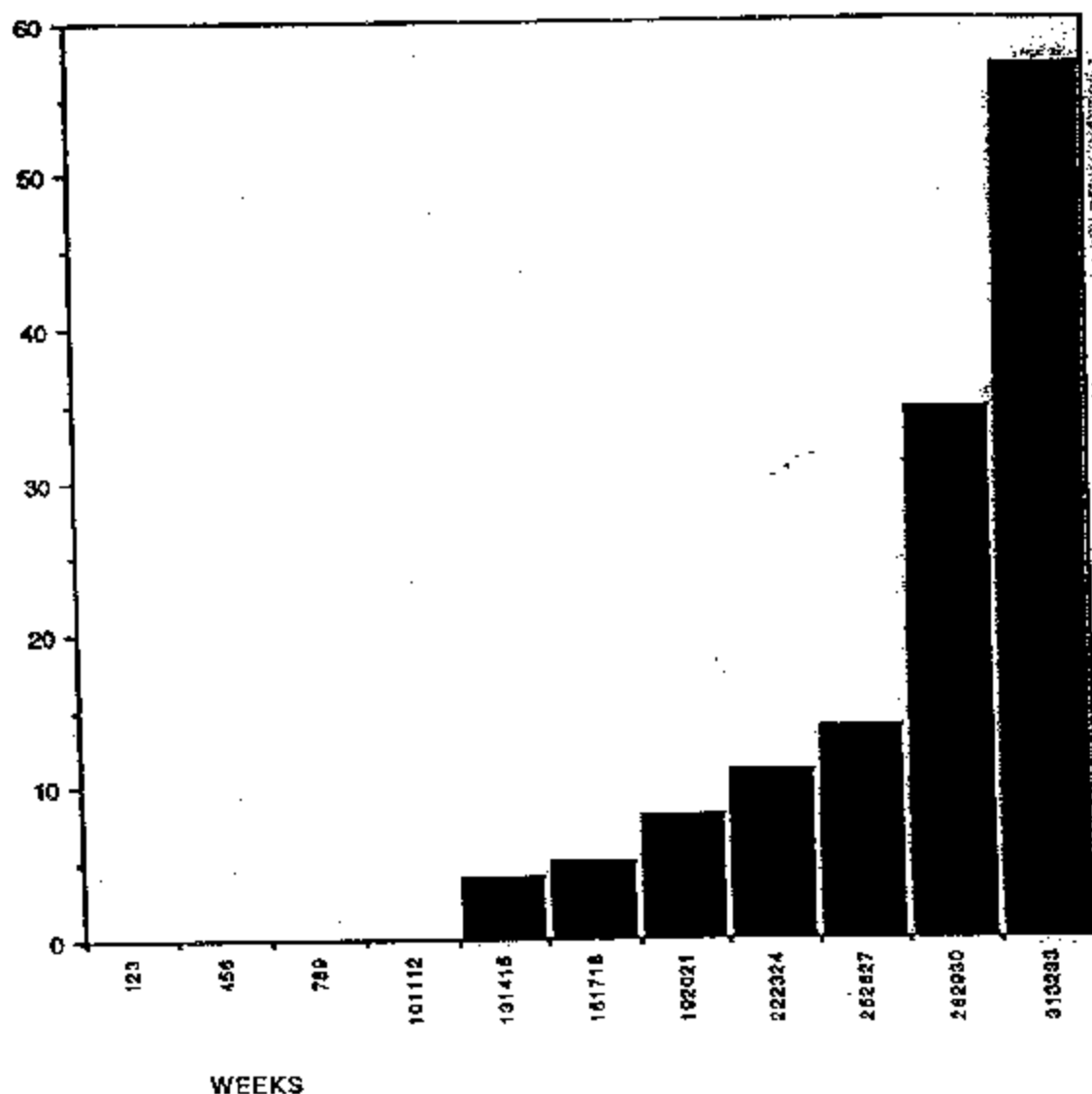
NUMBER OF LAUGHING GULLS OVER
JFK INTERNATIONAL AIRPORT PER HOUR



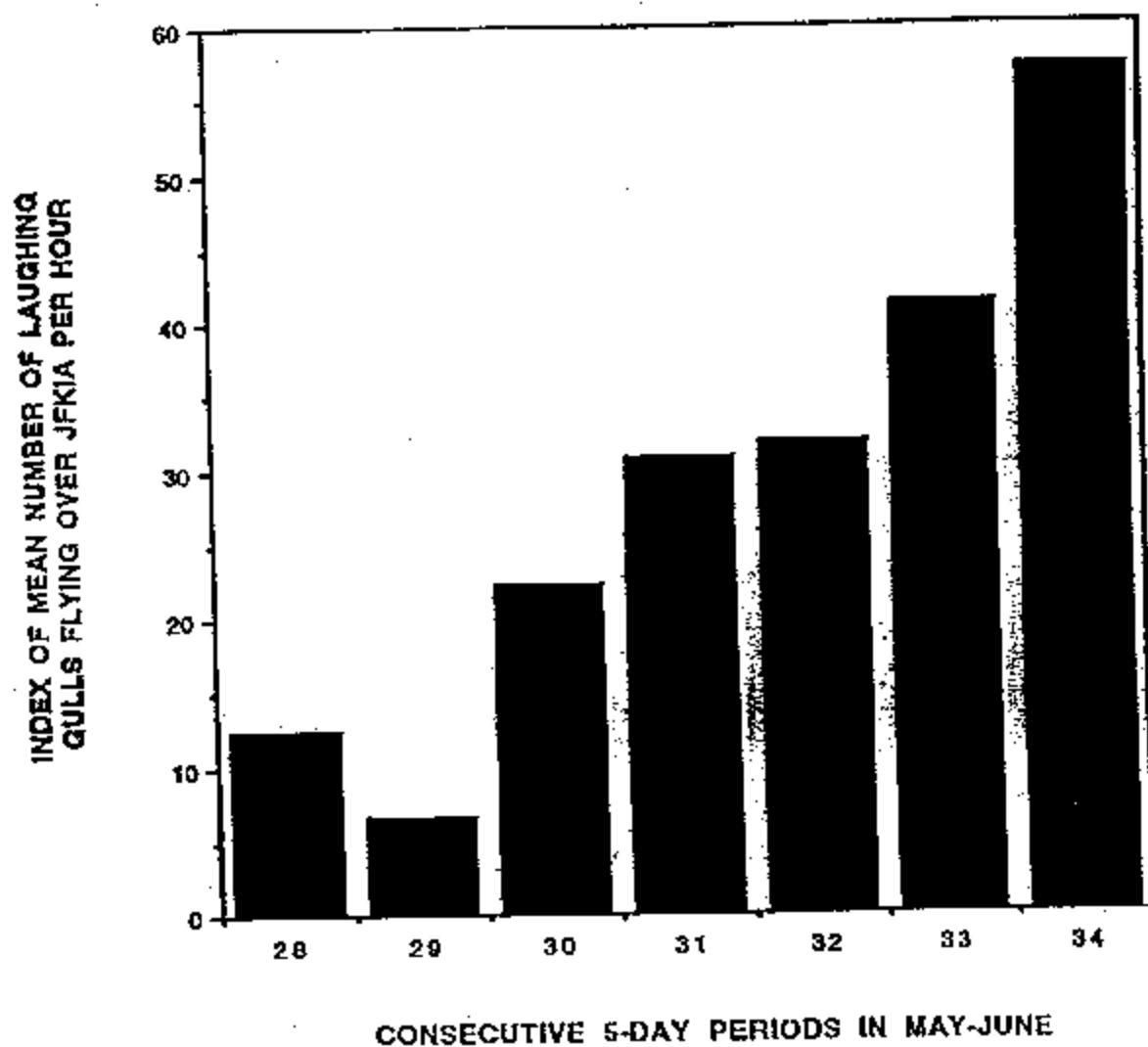


NUMBER OF LAUGHING GULLS FLYING OVER
JFK INTERNATIONAL AIRPORT PER HOUR
DURING EACH CONSECUTIVE 3-WK PERIOD

INDEX OF MEAN NUMBER OF LAUGHING
GULLS FLYING OVER JFKIA PER HOUR

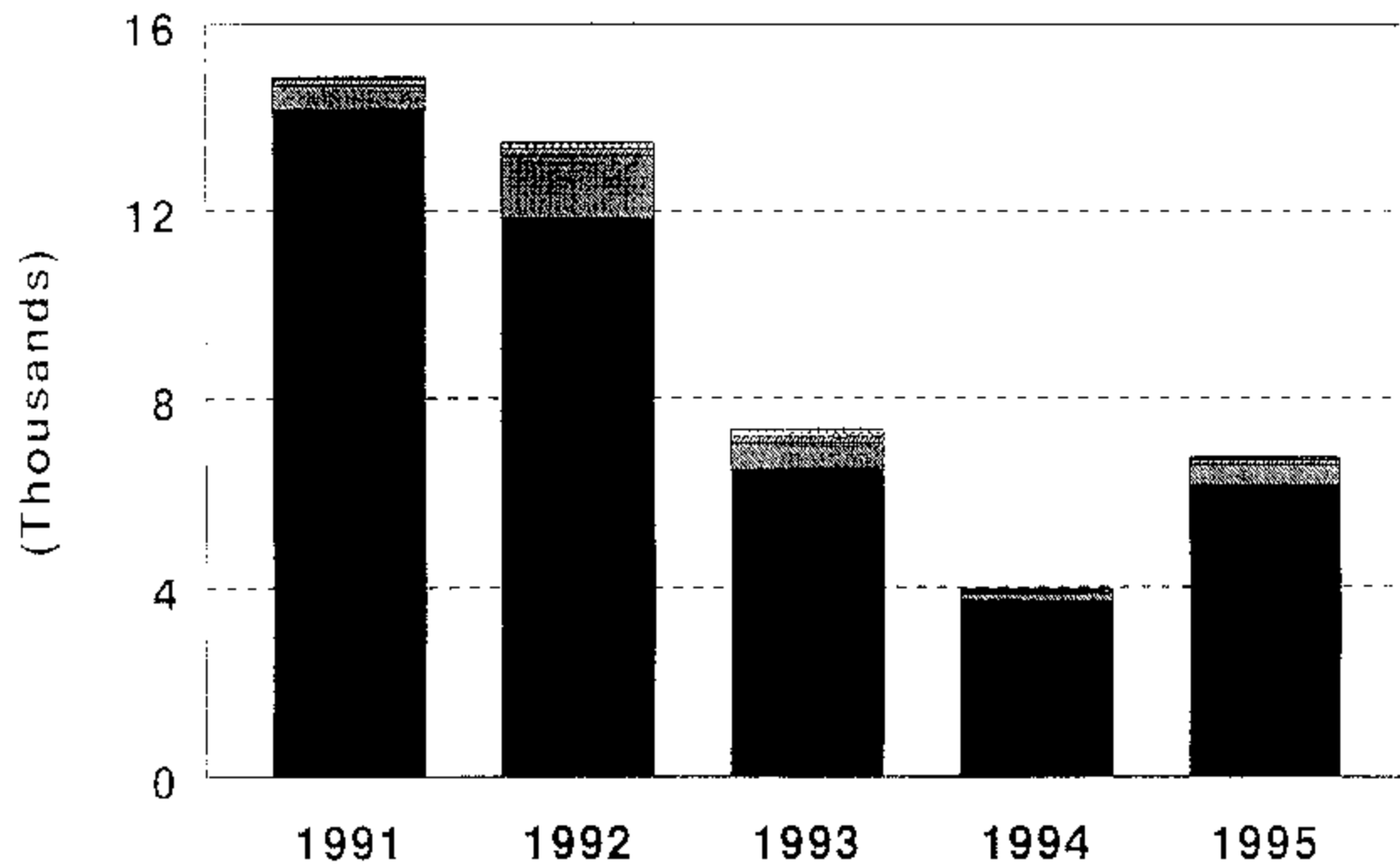


**MEAN NUMBER OF LAUGHING GULLS FLYING OVER
JFK INTERNATIONAL AIRPORT DURING CONSECUTIVE
5-DAY PERIODS IN MAY AND JUNE 1994**

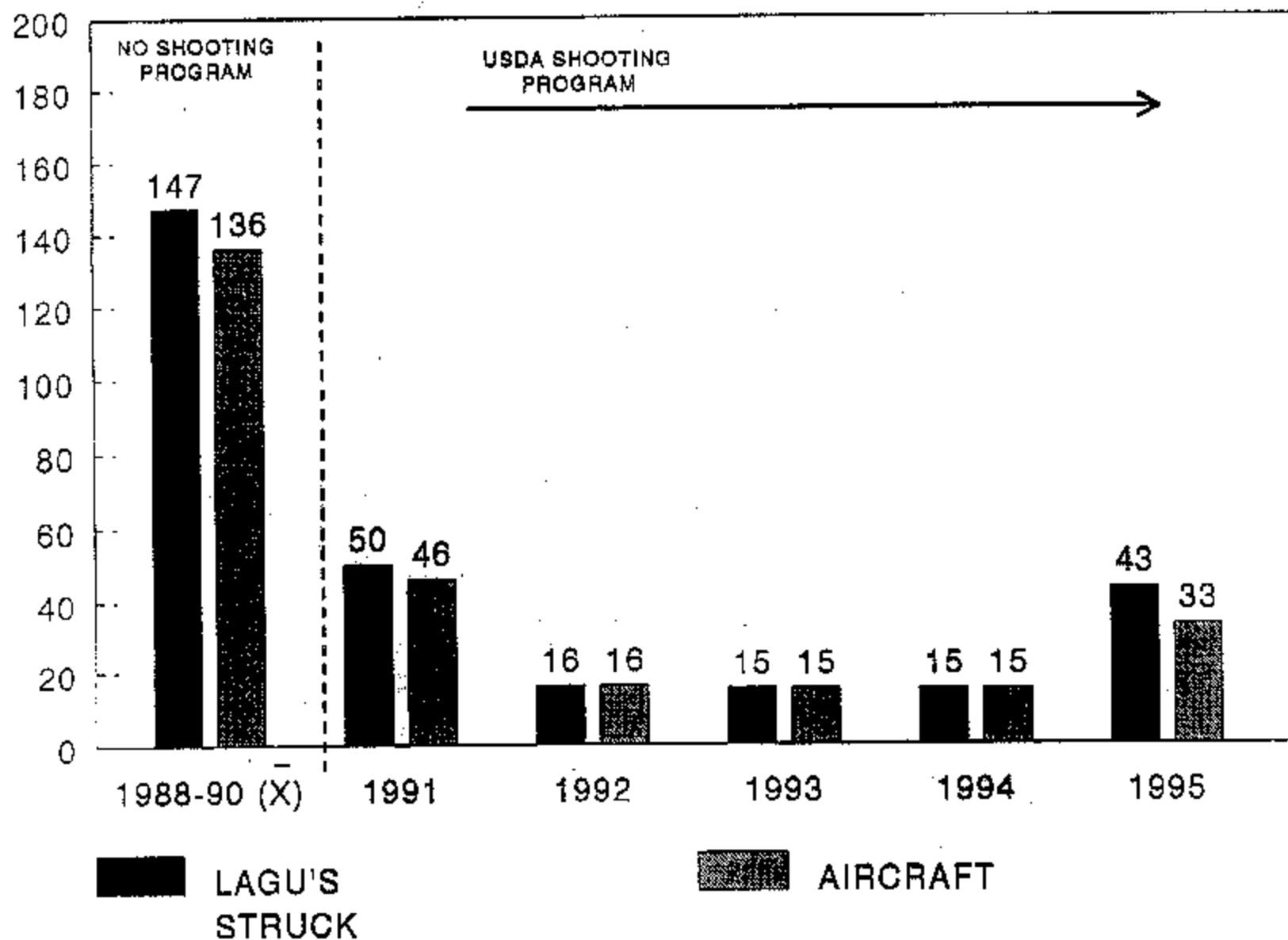


GULLS SHOT AT JFK INTERNATIONAL AIRPORT BY USDA BIOLOGISTS, 1991-1995

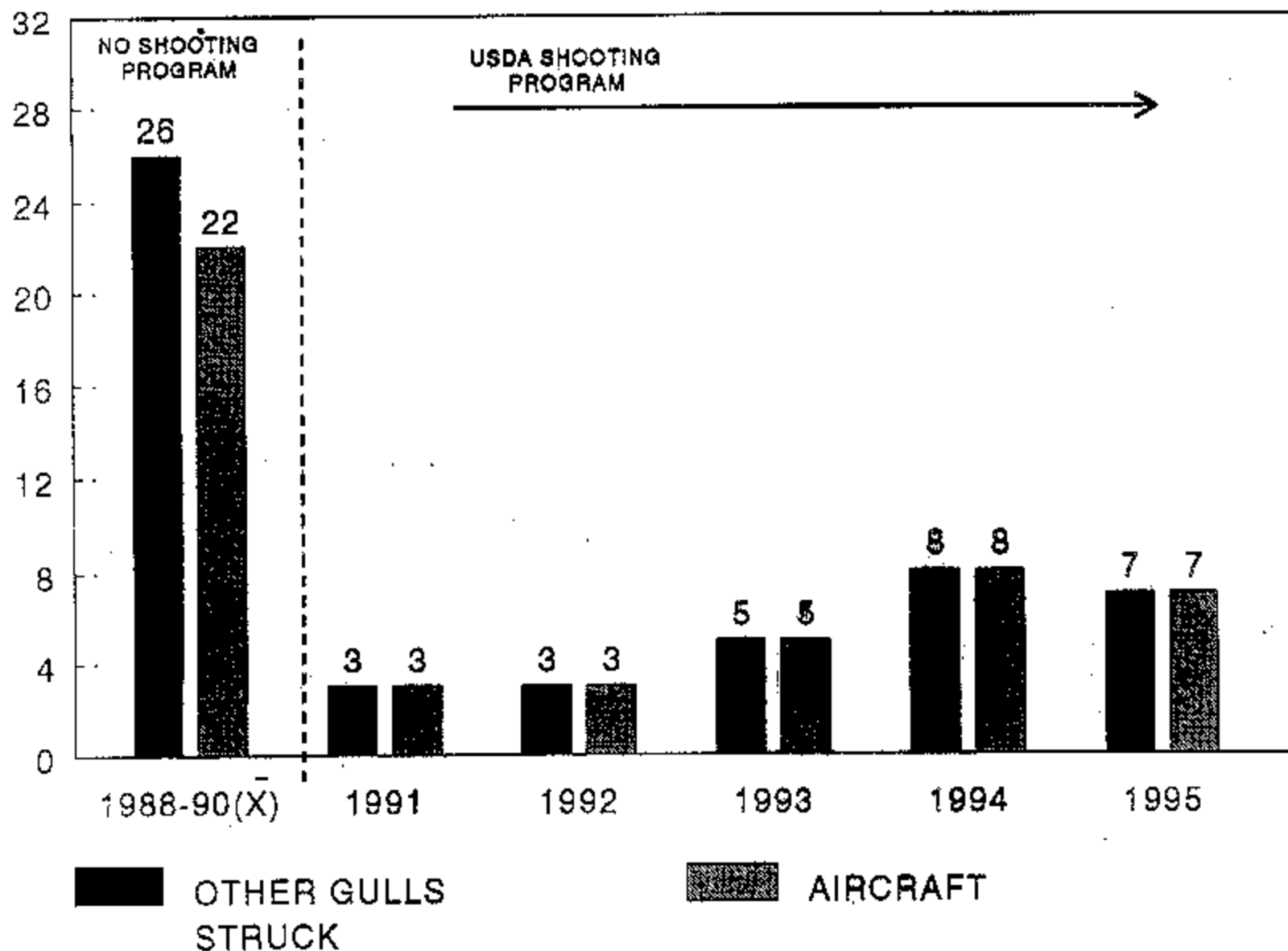
LAGU HERG GBBG RBGU



NO. OF AIRCRAFT STRIKING LAGU'S AND NO. OF LAGU'S STRUCK, 20 MAY-15 AUGUST

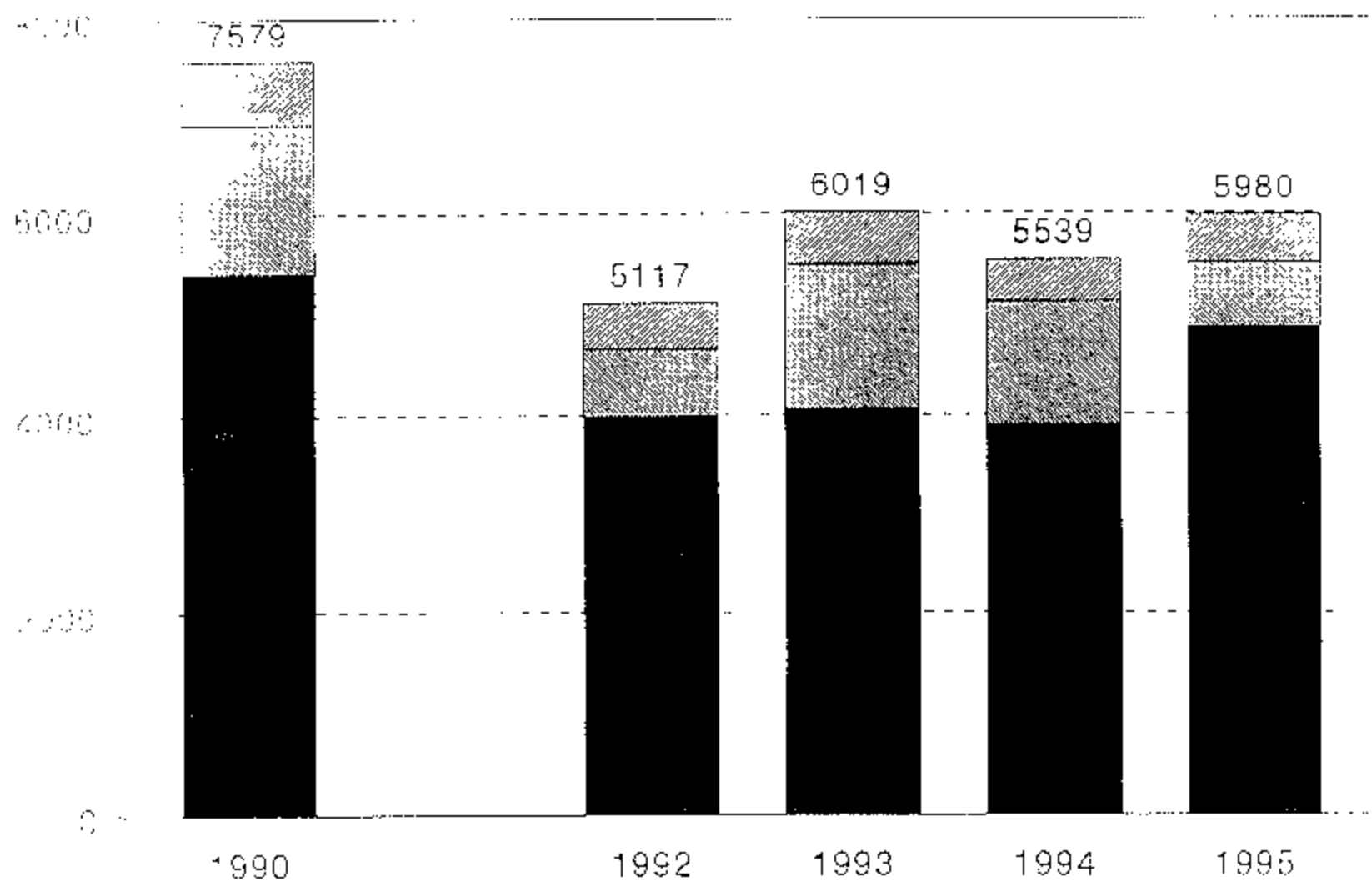


NO. OF AIRCRAFT STRIKING OTHER GULLS AND NO. OF OTHER GULLS STRUCK, 20 MAY-15 AUG



NO. OF LAUGHING GULL NESTS, JAMAICA BAY 1990-1995

JCCO E.H. MEADOW SILVER HOLE



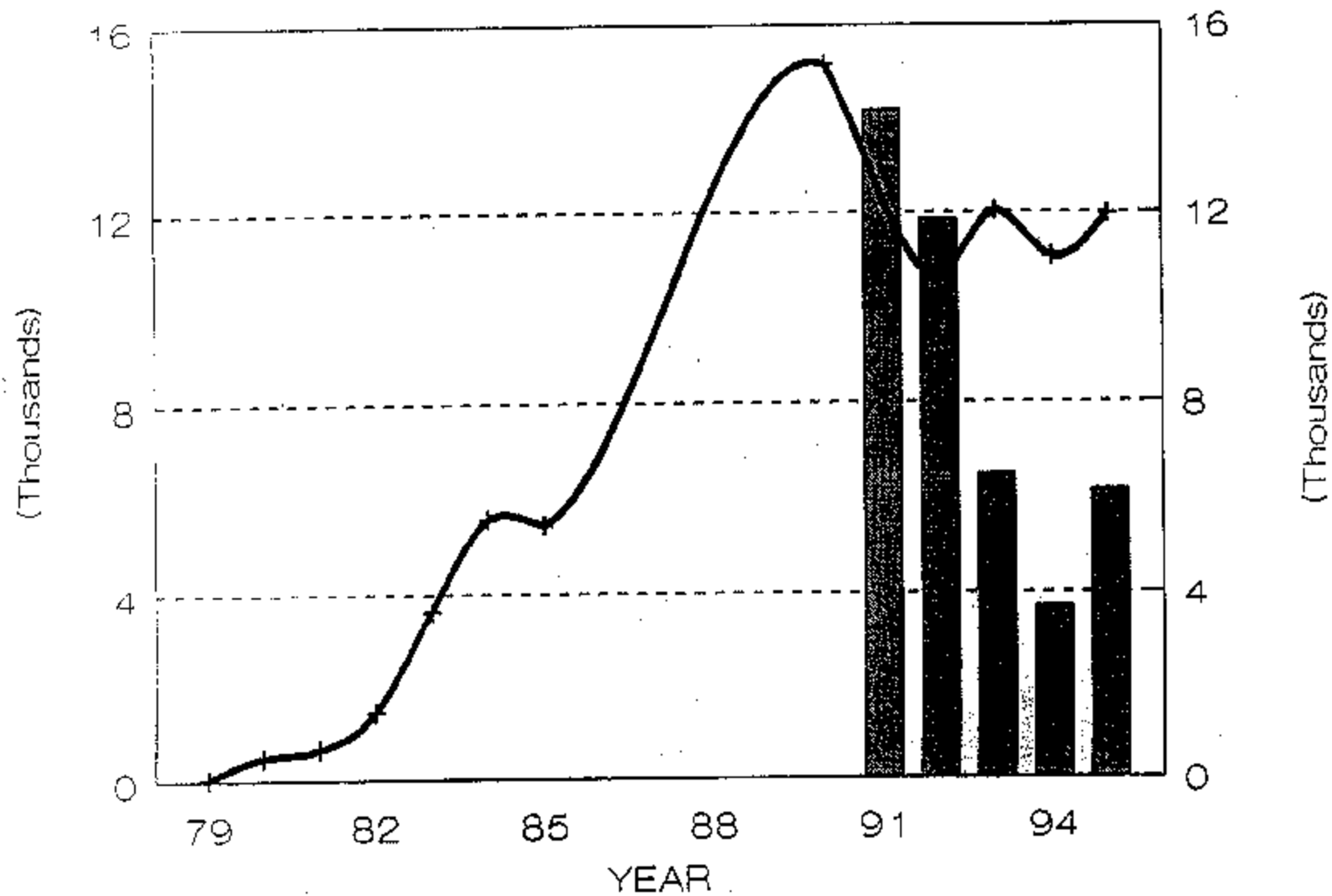
LAUGHING GULLS - RESPONSE OF NESTING
POPULATION TO SHOOTING AT JFKIA

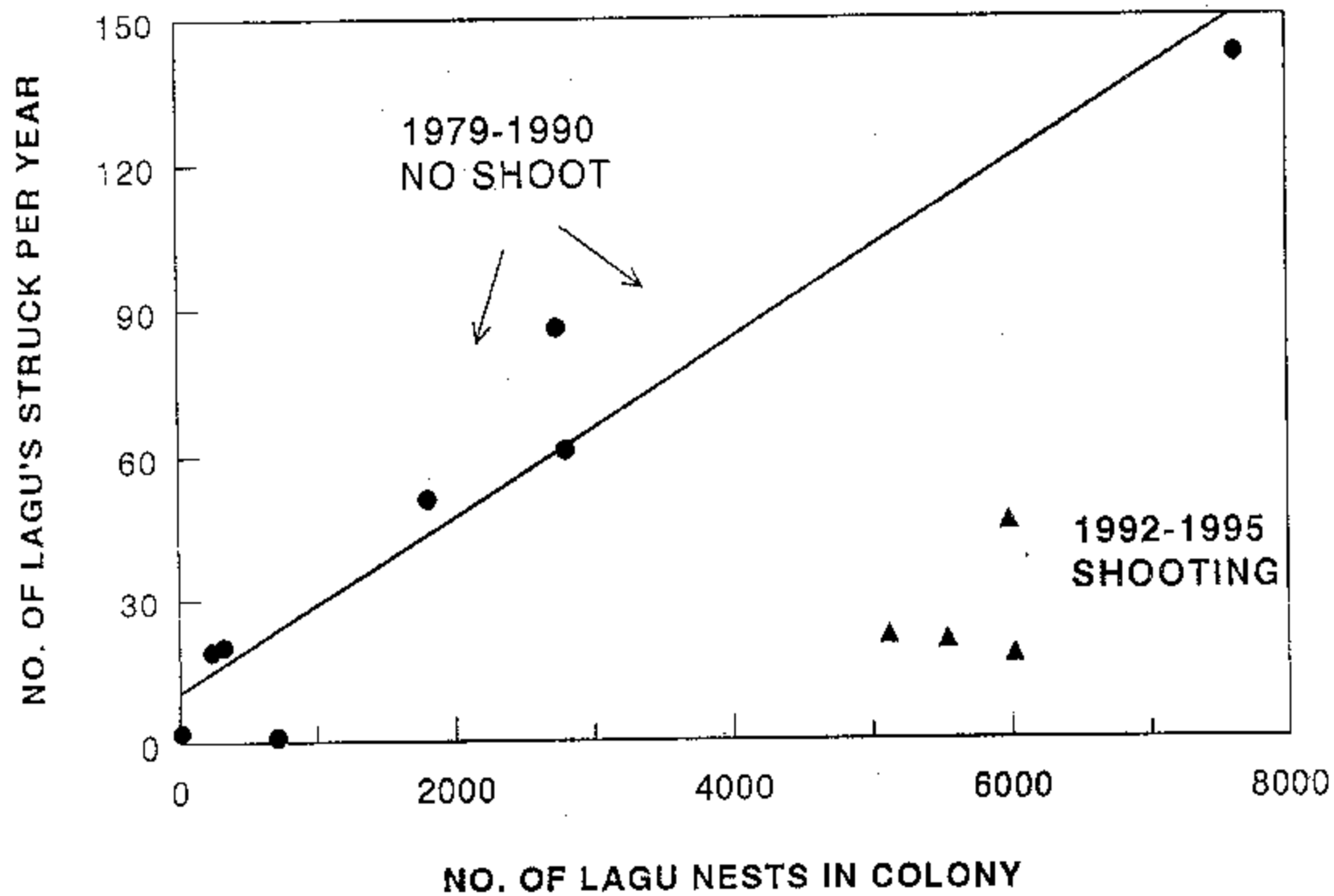


NO. KILLED

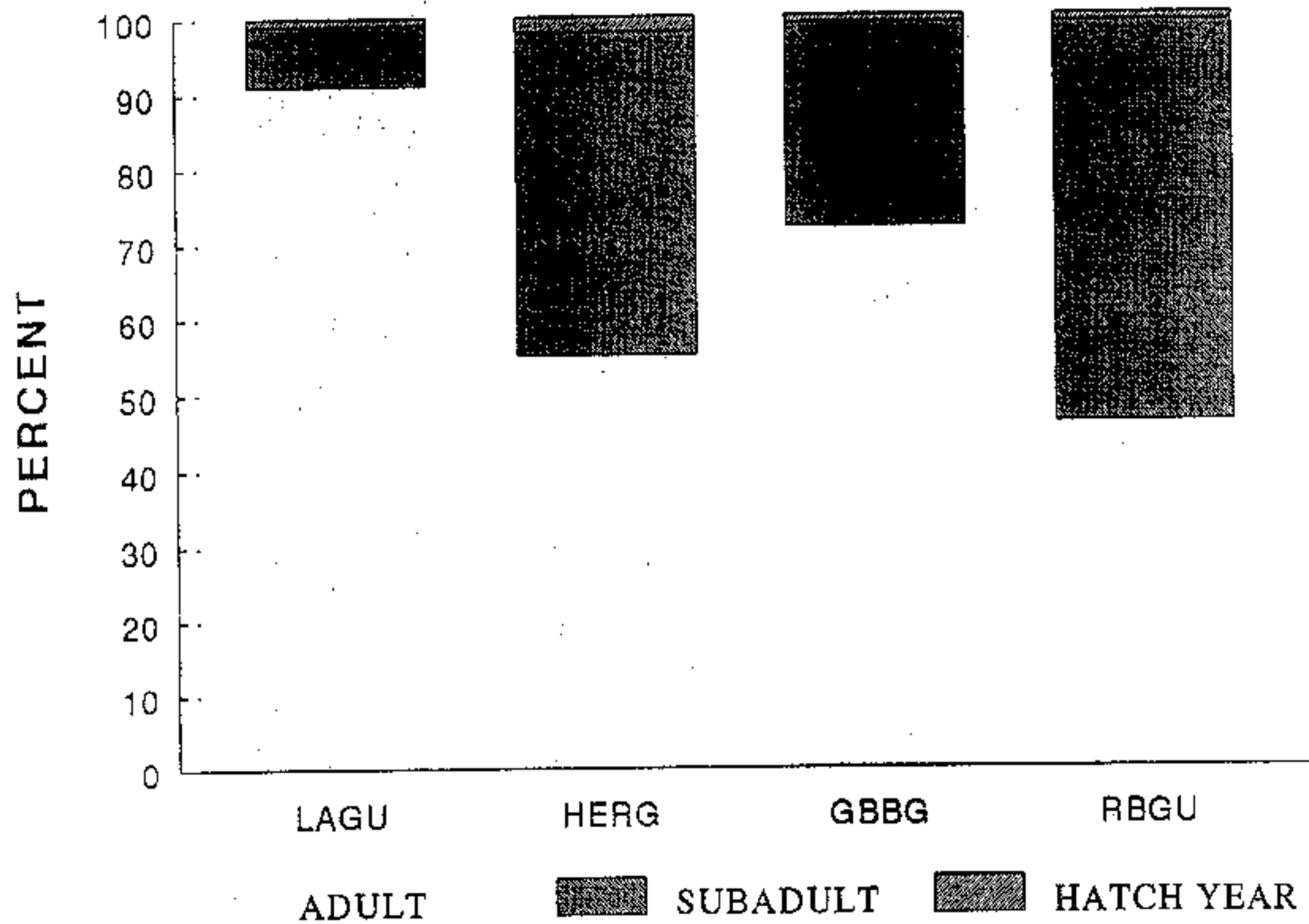
+

NO. NESTING

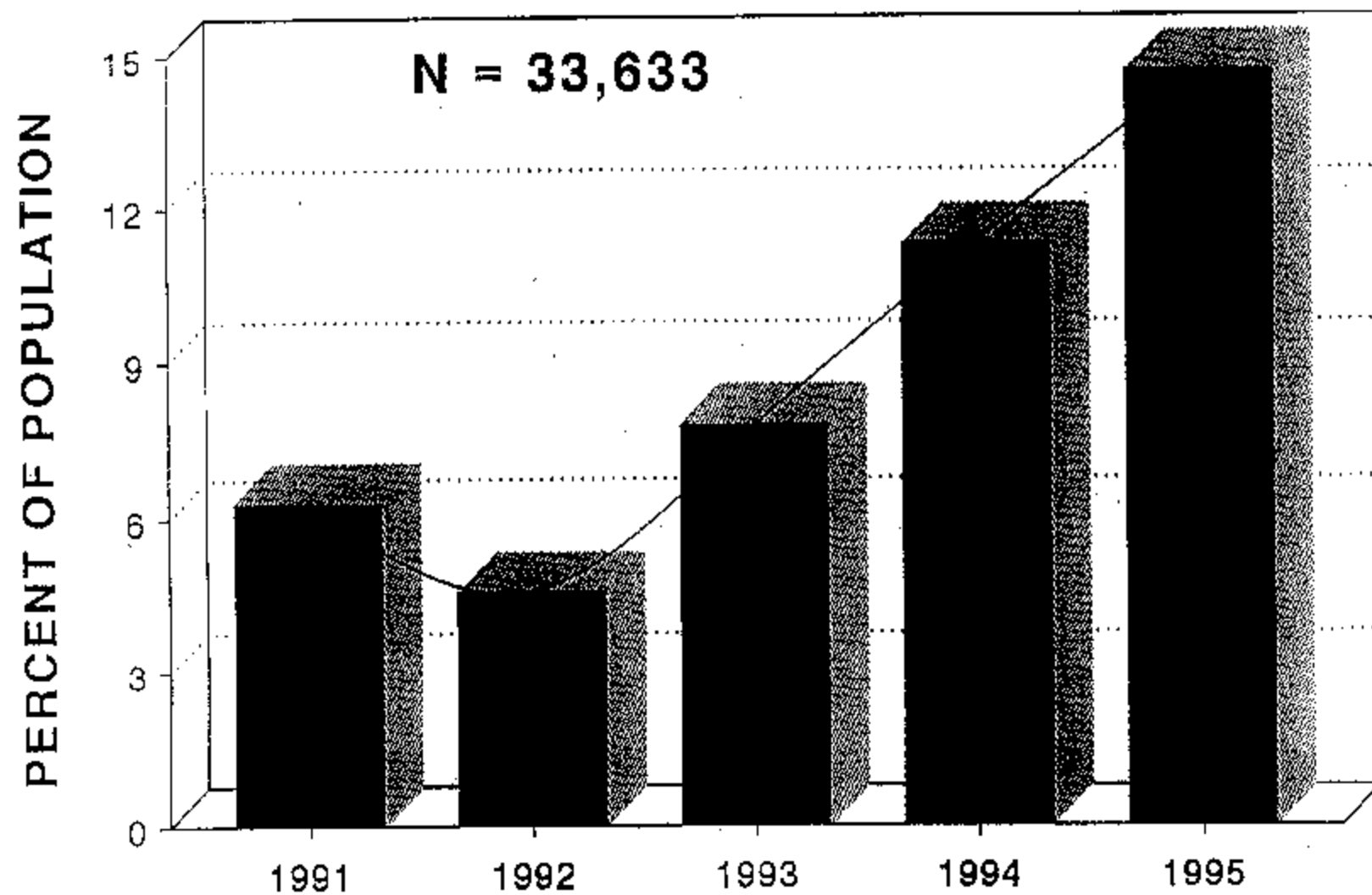




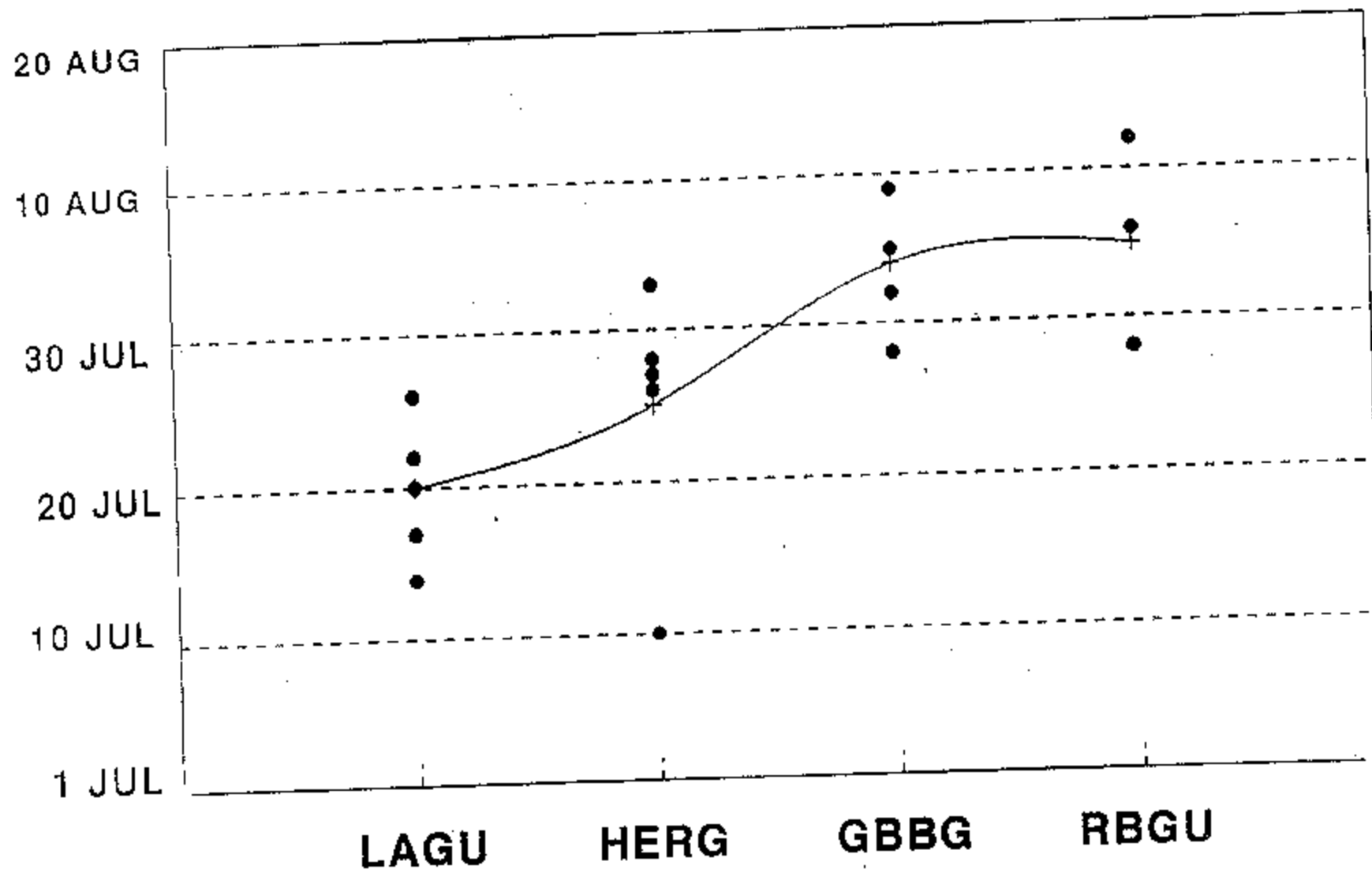
AGE COMPOSITION OF GULLS SHOT AT JFKIA 1991-1995



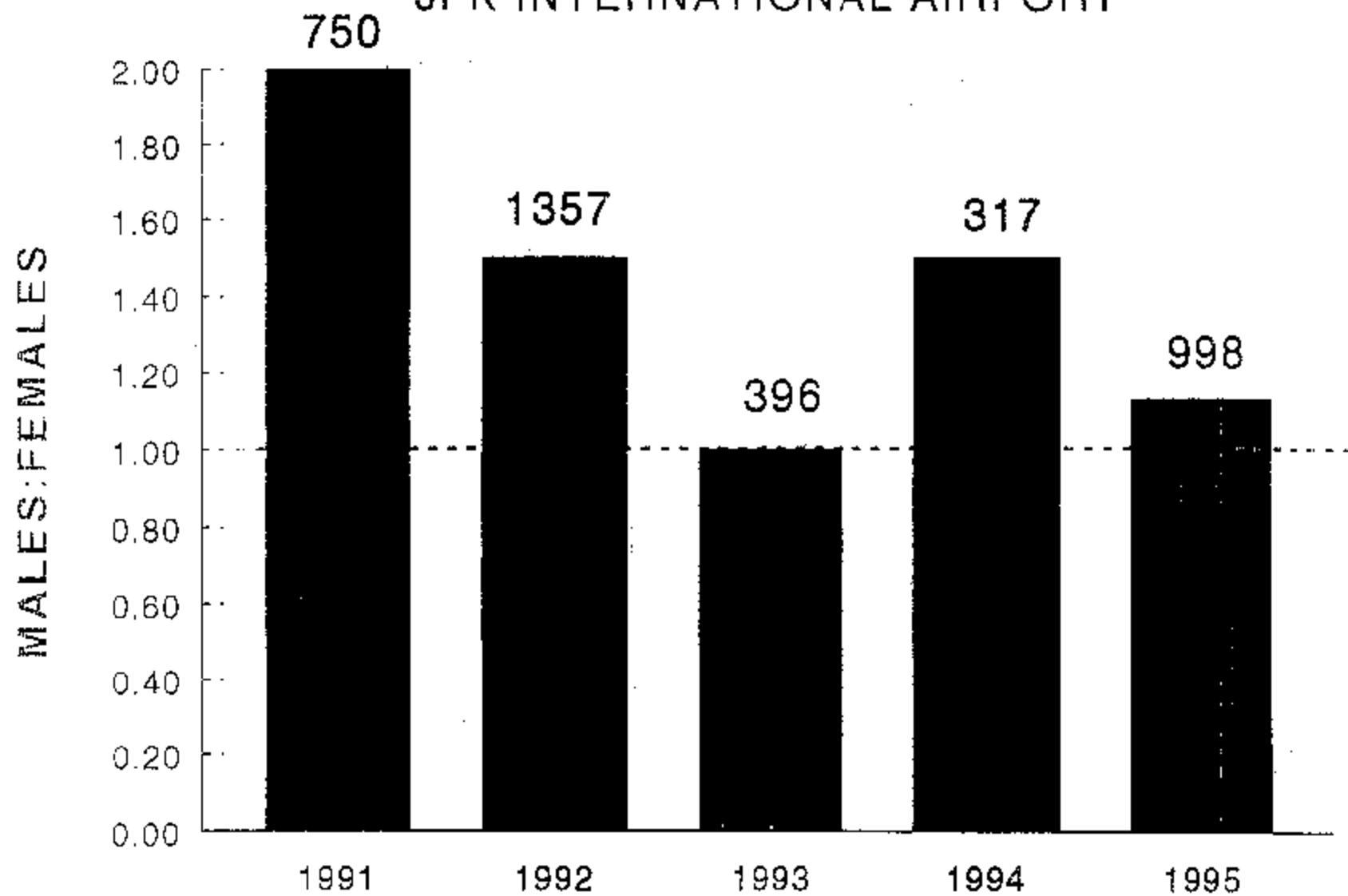
1-YEAR OLD LAGU'S AS % OF ANY LAGU'S SHOT AT JFK AIRPORT, 1991-95



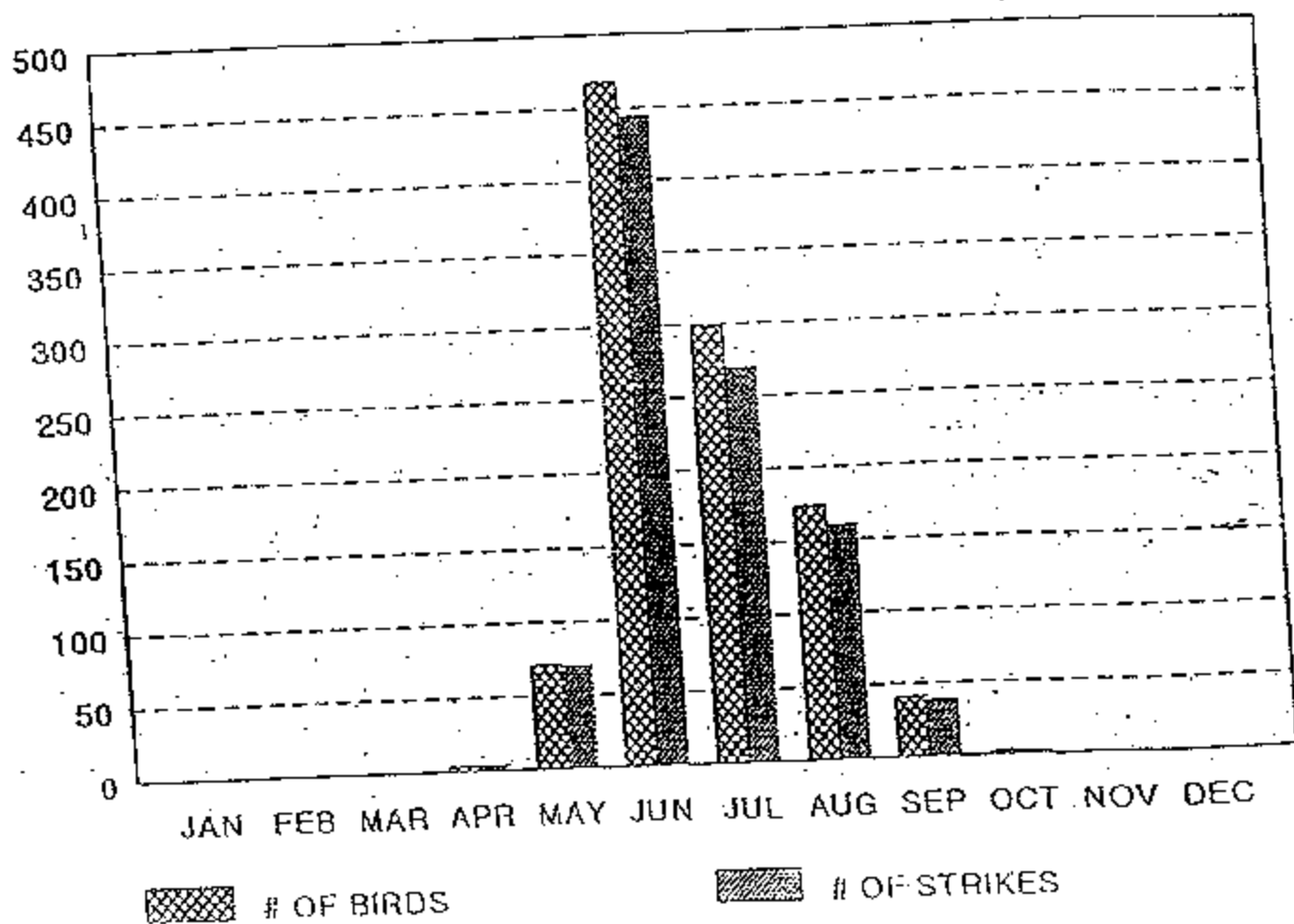
**DATES INITIAL HATCHING-YEAR GULLS SHOT,
JFK INTERNATIONAL AIRPORT, 1991-1995**



RATIO OF MALES TO FEMALES SHOT JFK INTERNATIONAL AIRPORT



BIRD STRIKES BY MONTH, 1979-1993, JFKIA LAUGHING GULLS



BIRD STRIKES BY MONTH, 1979-1993, JFKIA
BIG GULLS (HERG, GBBG, RBGU)

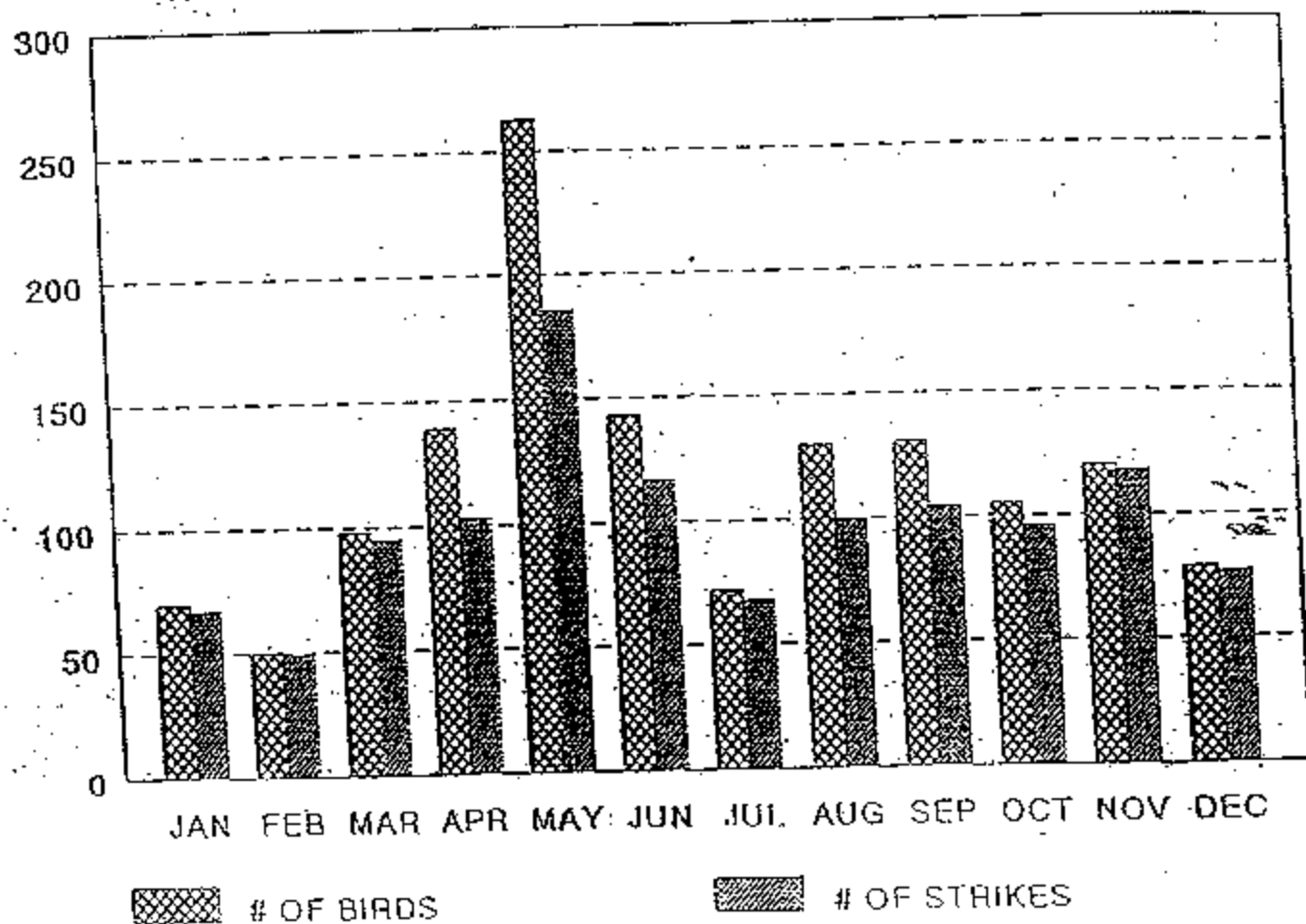
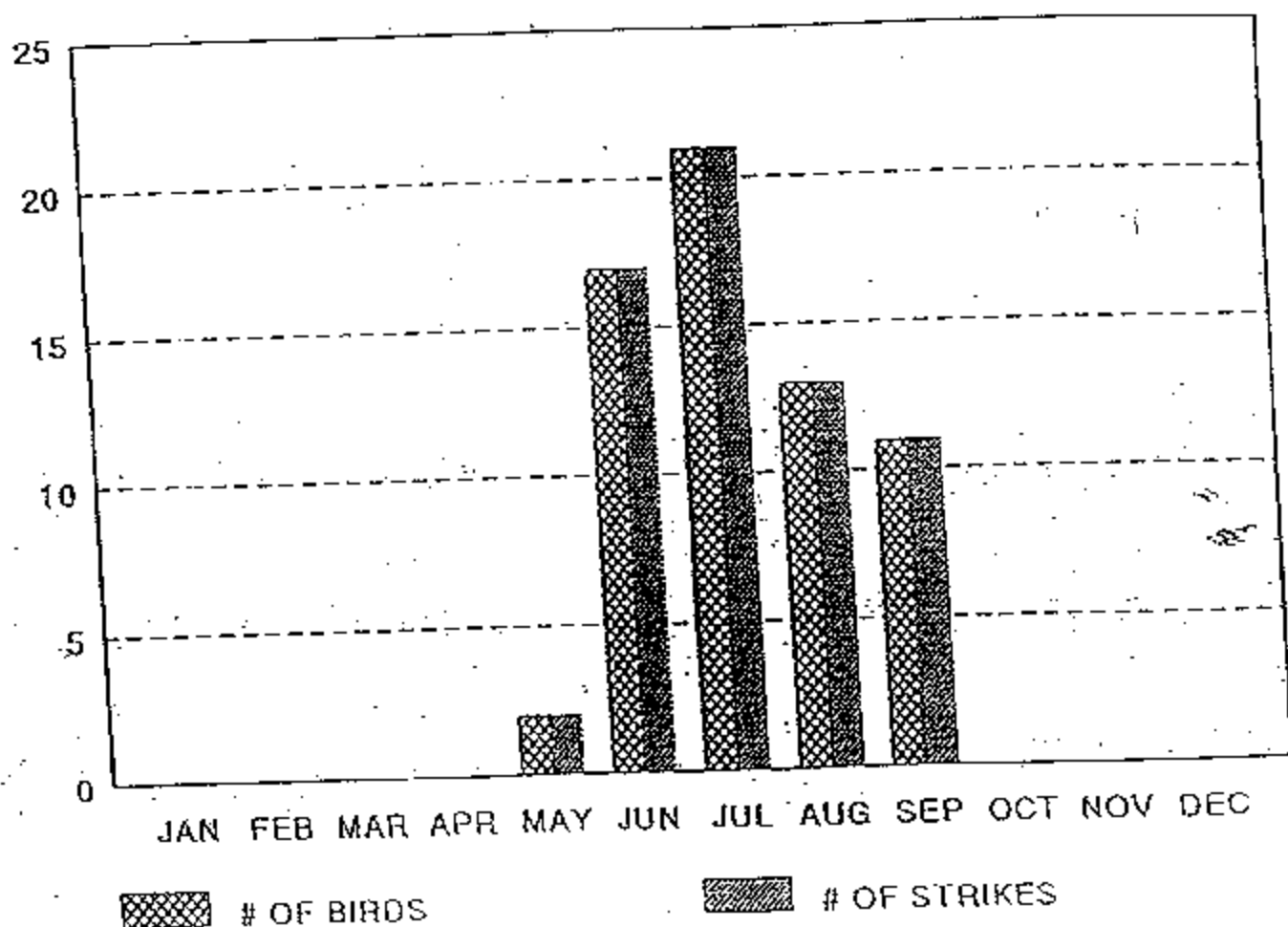
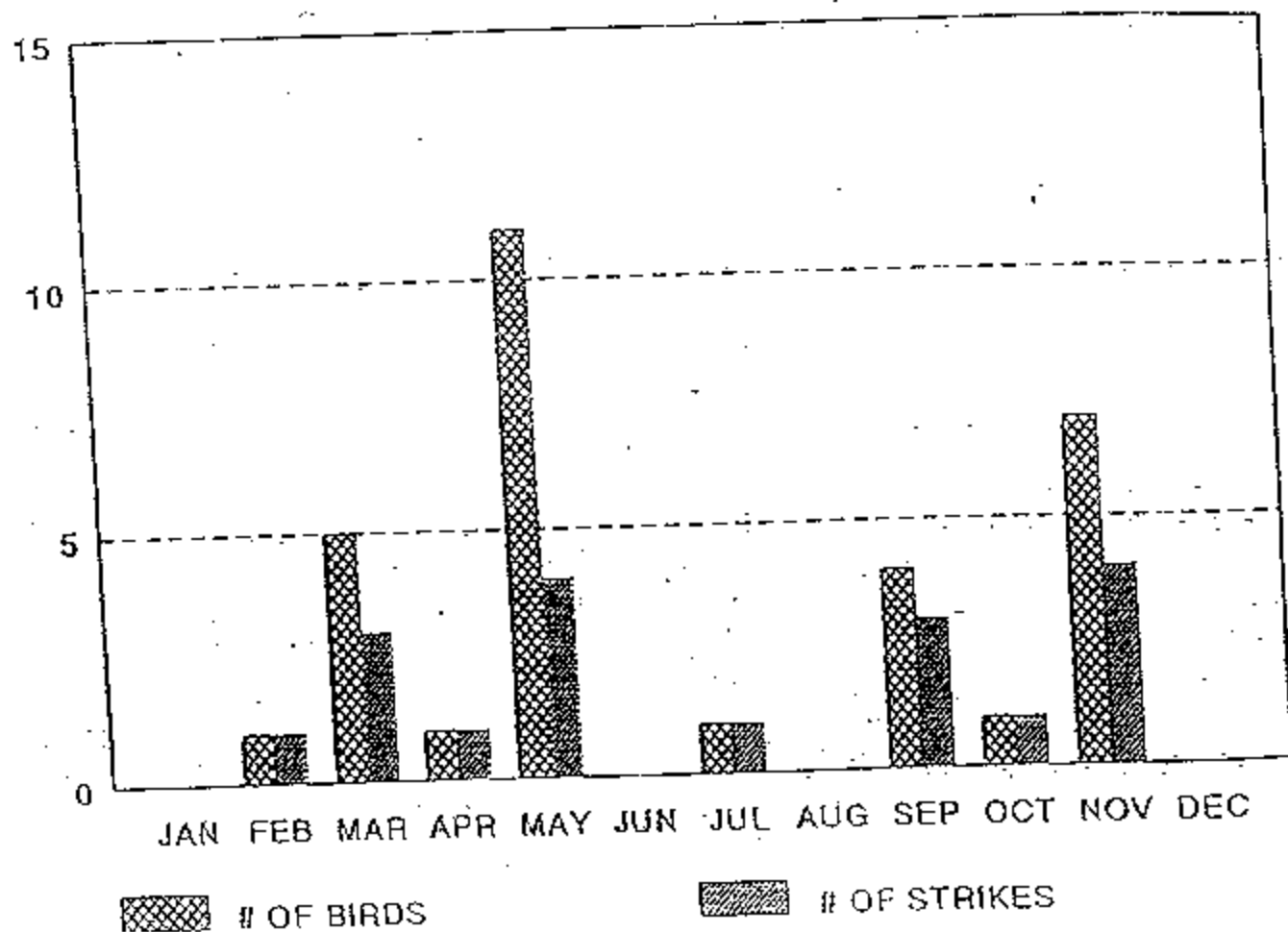


TABLE 6

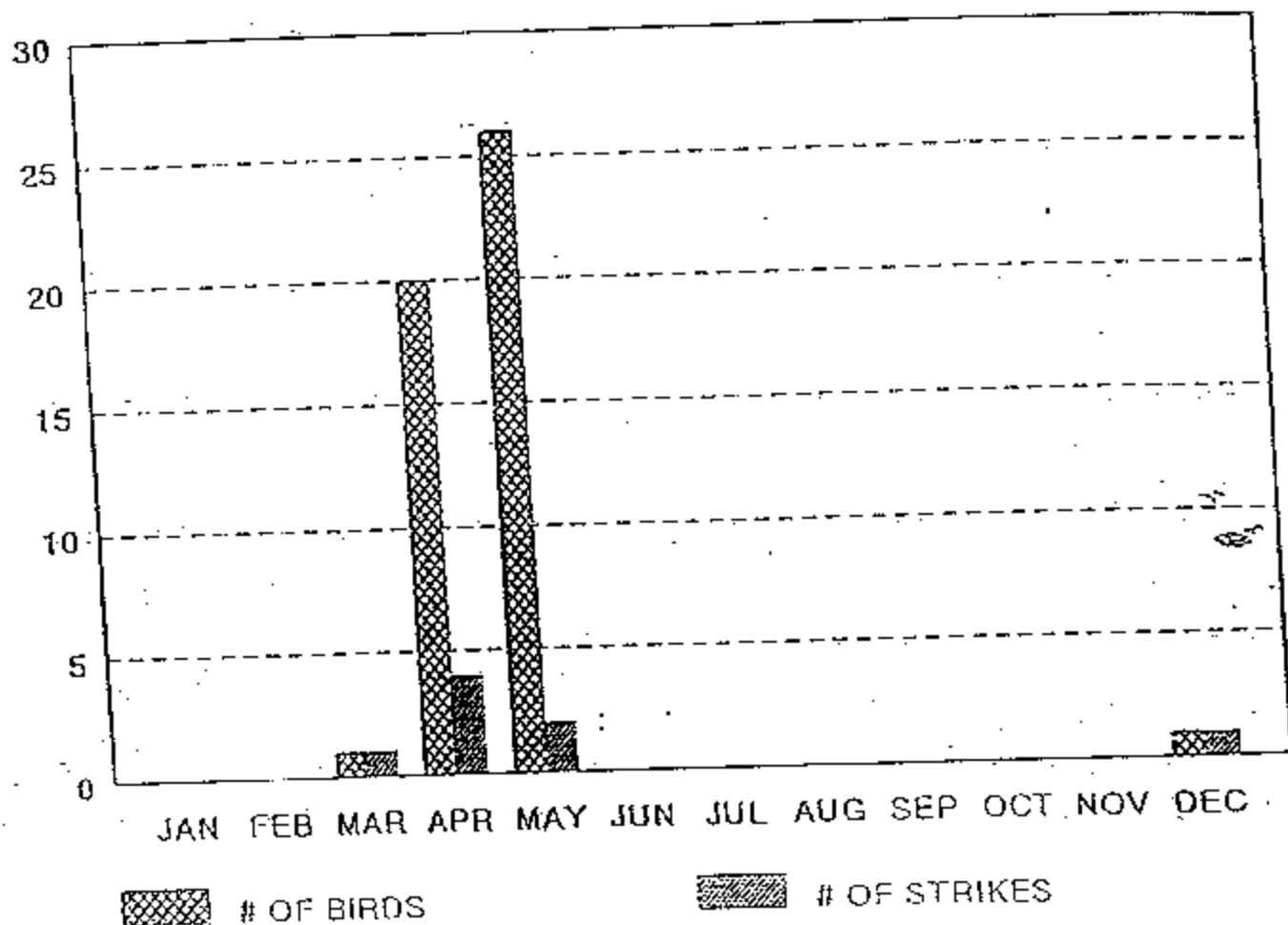
BIRD STRIKES BY MONTH, 1979-1993, JFKIA CATTLE EGRETS



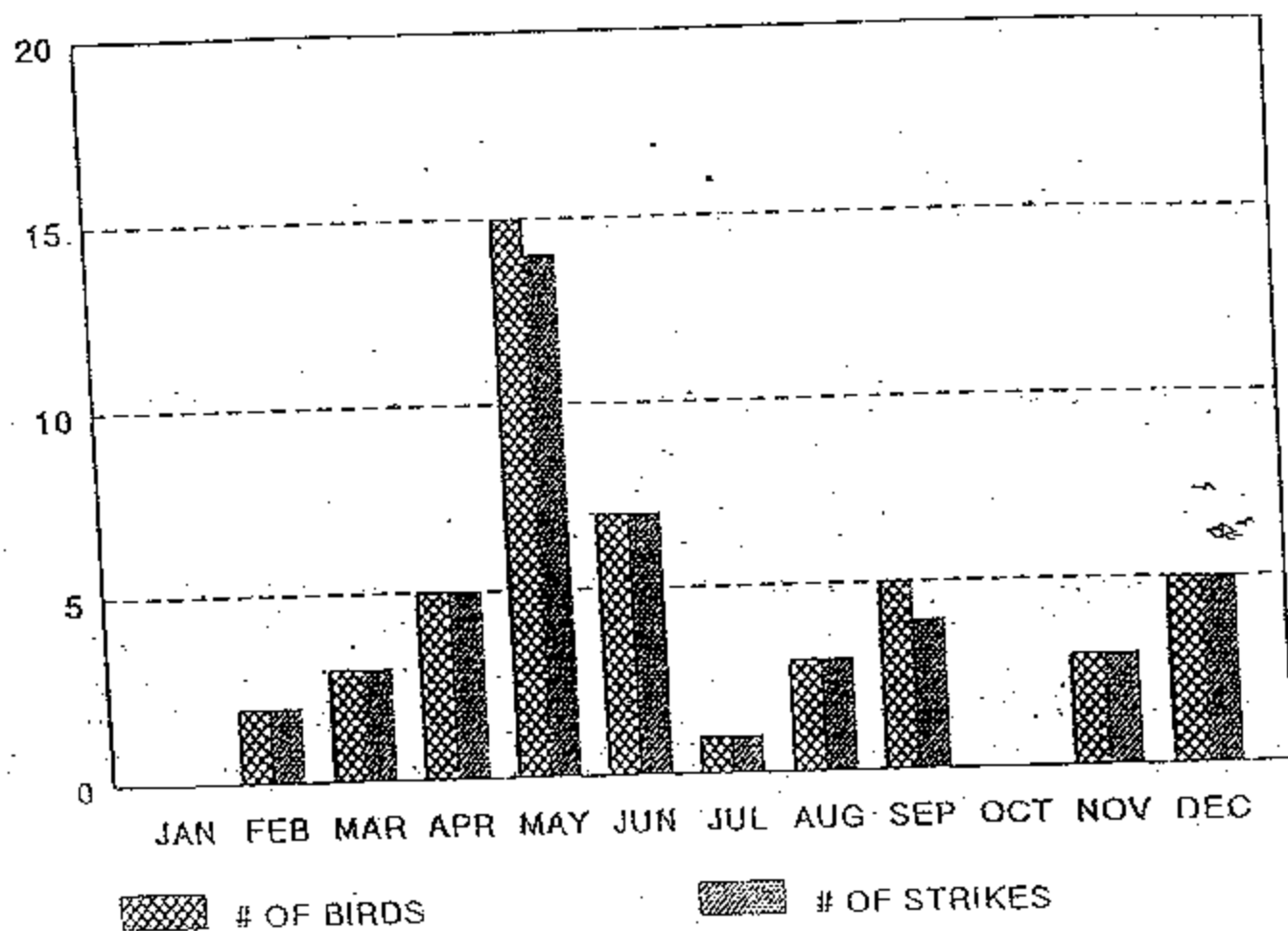
BIRD STRIKES BY MONTH, 1979-1993, JFKIA CANADA GEESE



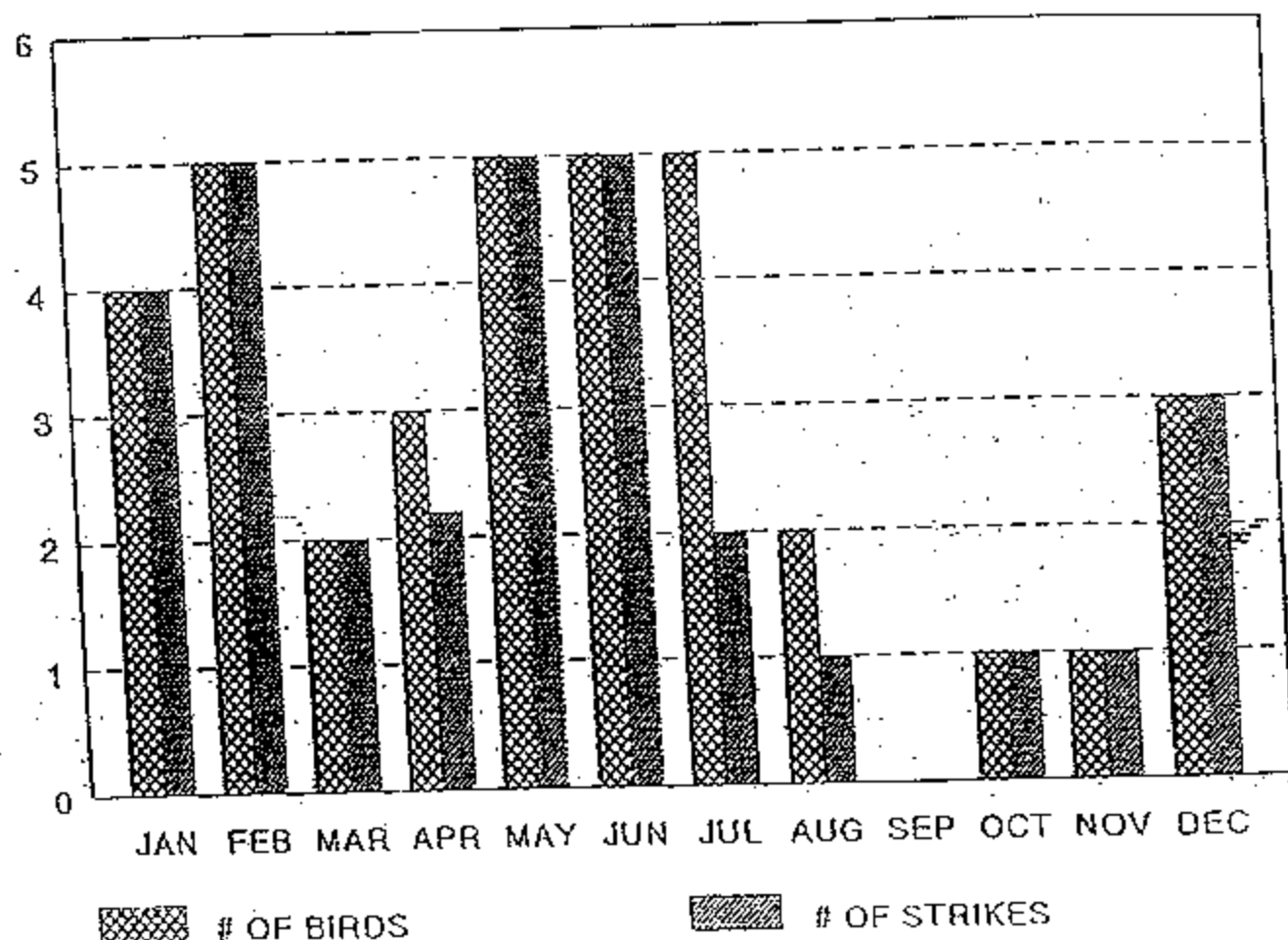
BIRD STRIKES BY MONTH, 1979-1993, JFKIA BRANT



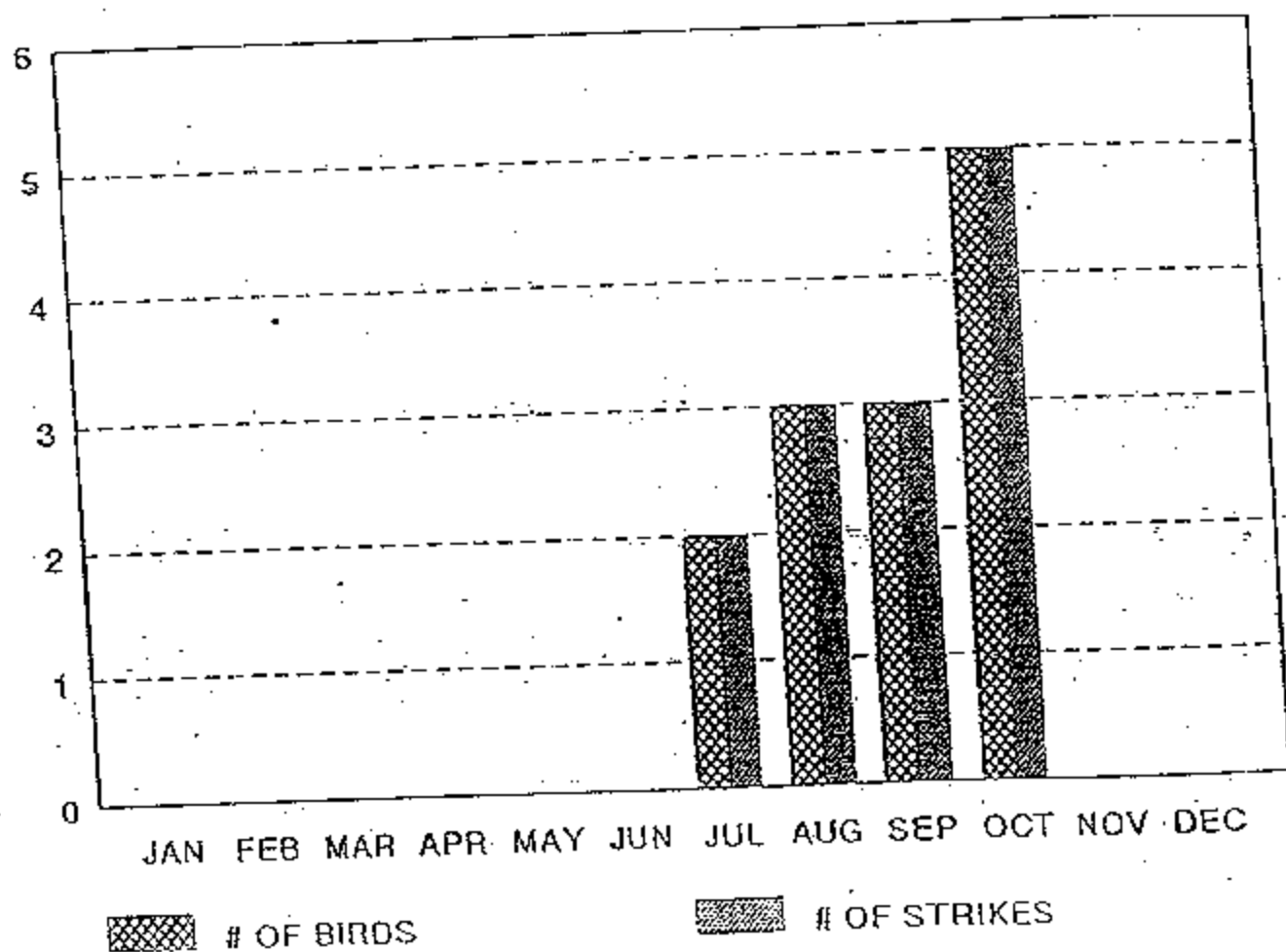
BIRD STRIKES BY MONTH, 1979-1993, JFKIA MALLARDS



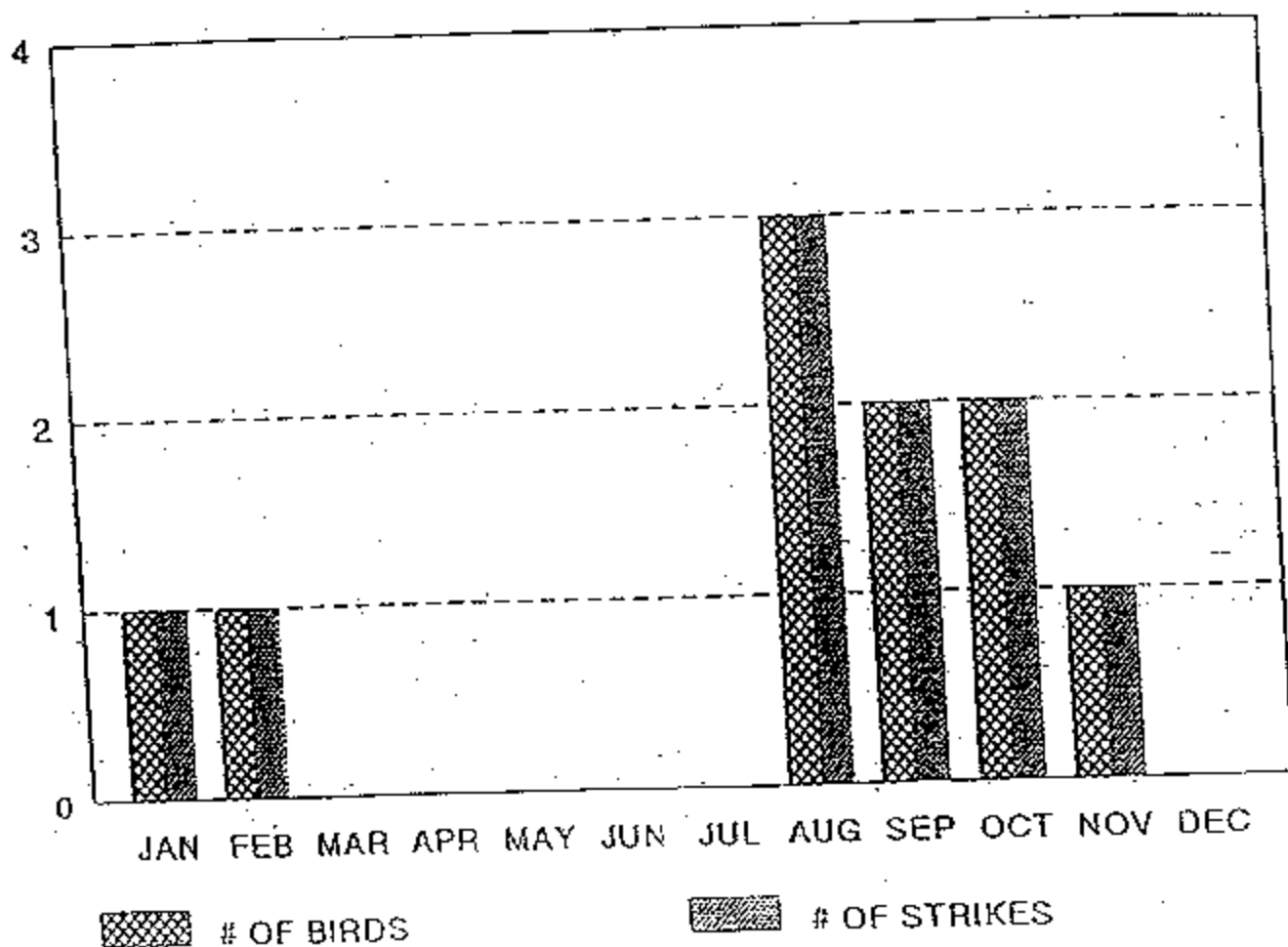
BIRD STRIKES BY MONTH, 1979-1993, JFKIA
AMERICAN BLACK DUCK



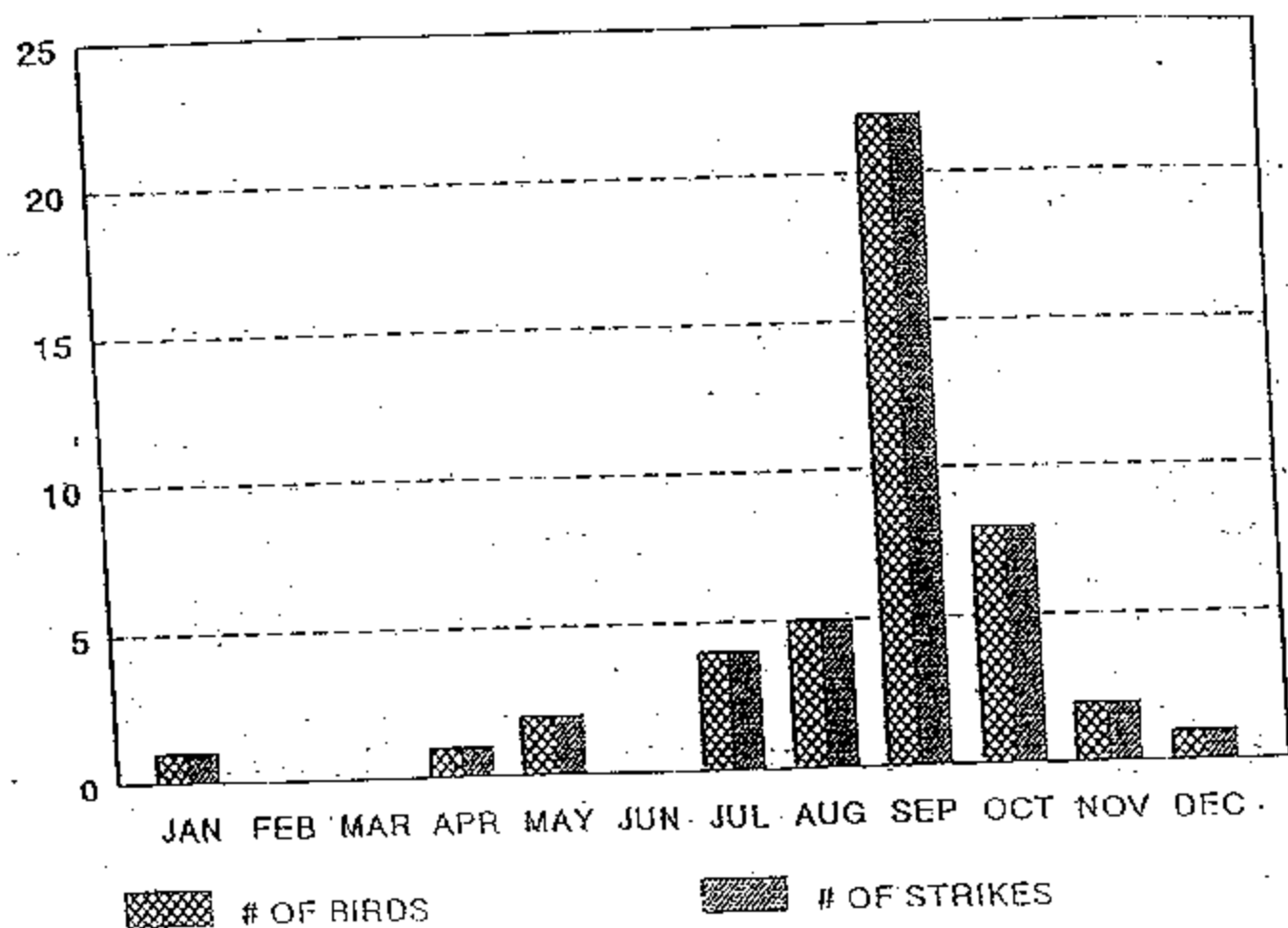
BIRD STRIKES BY MONTH, 1979-1993, JFKIA OSPREY



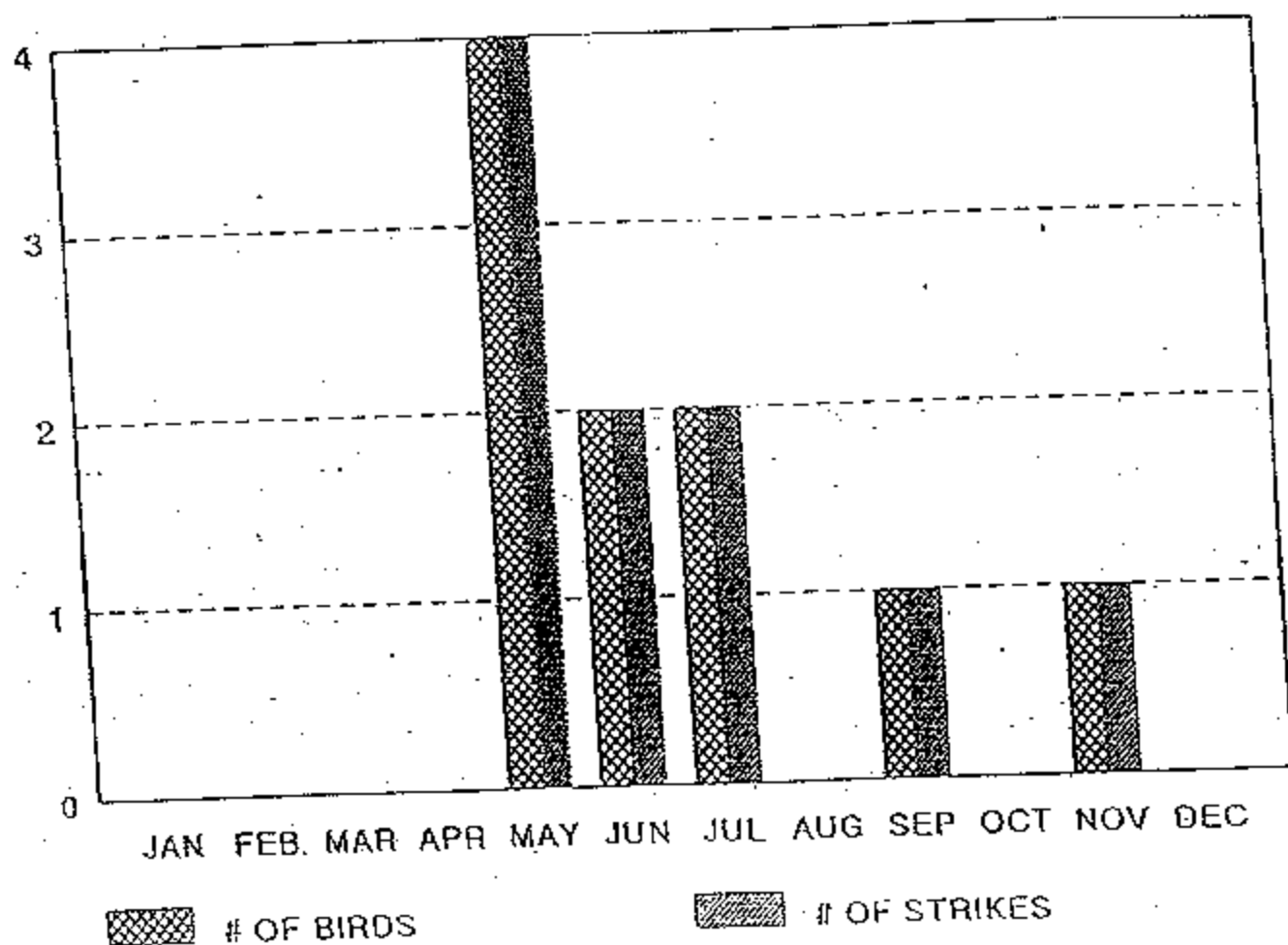
BIRD STRIKES BY MONTH, 1979-1993, JFKIA
PEREGRINE FALCON



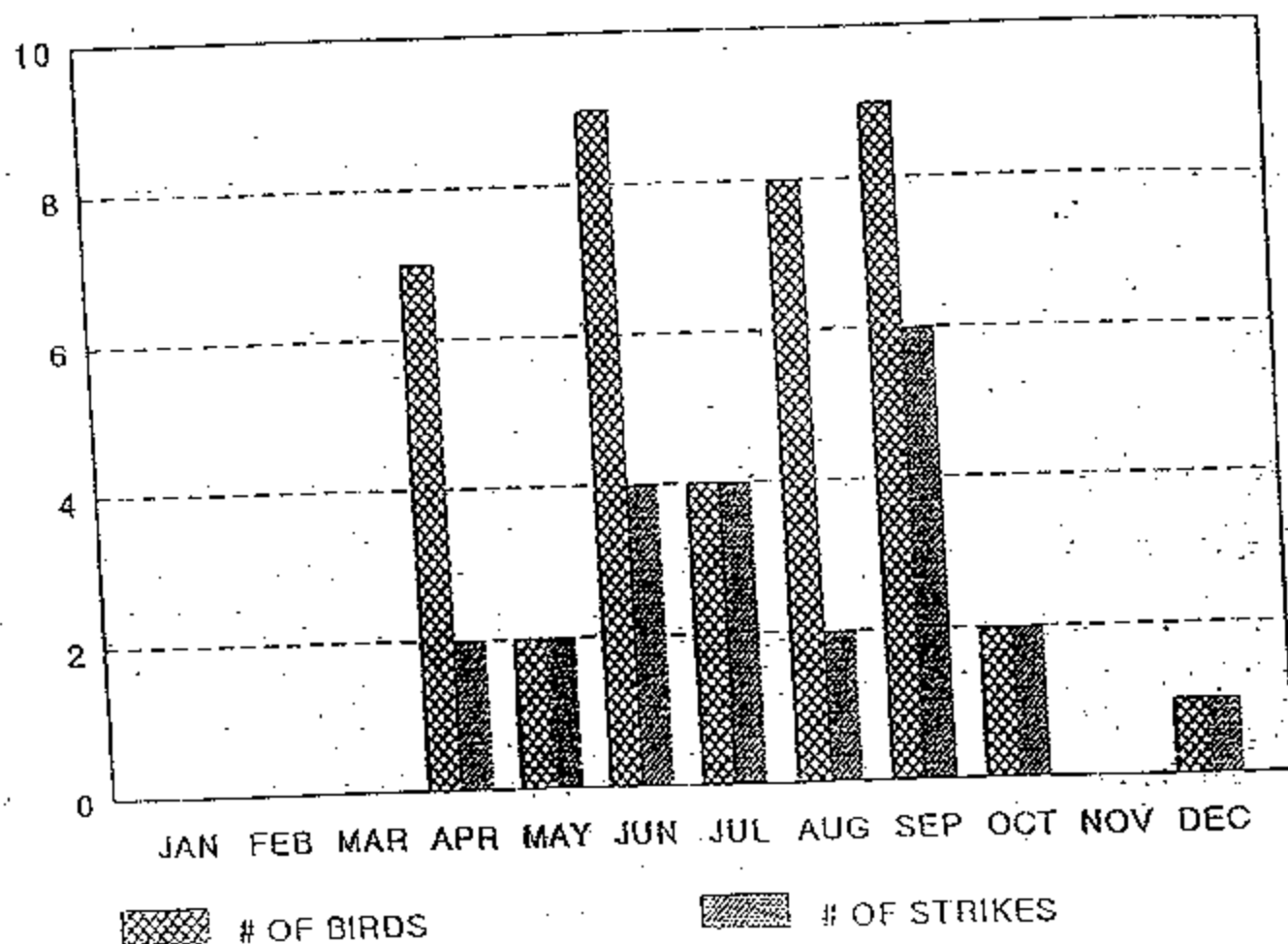
BIRD STRIKES BY MONTH, 1979-1993, JFKIA
KESTREL



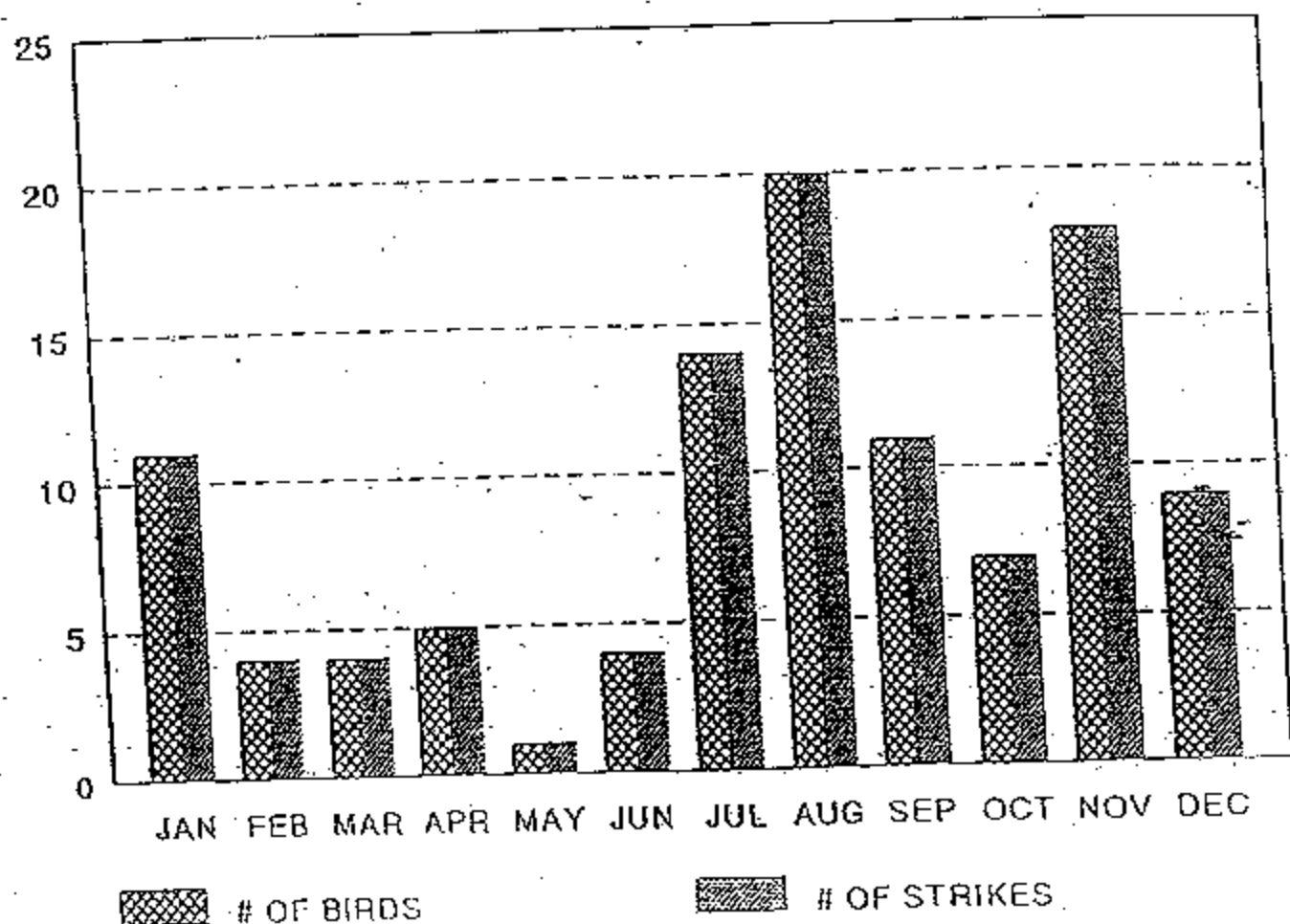
BIRD STRIKES BY MONTH, 1979-1993, JFKIA
RING-NECKED PHEASANT



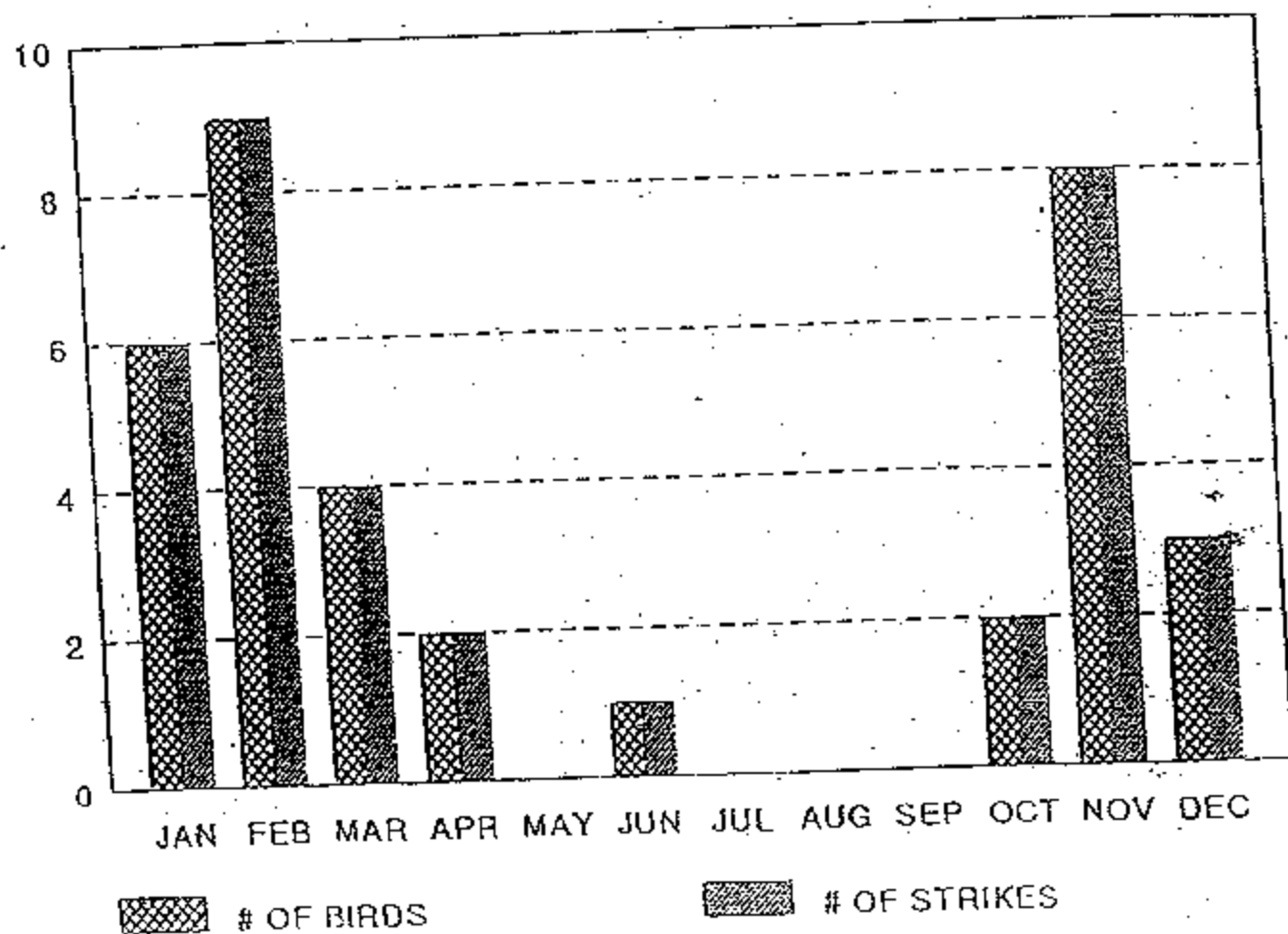
BIRD STRIKES BY MONTH, 1979-1993, JFKIA ROCK DOVE (PIGEON)



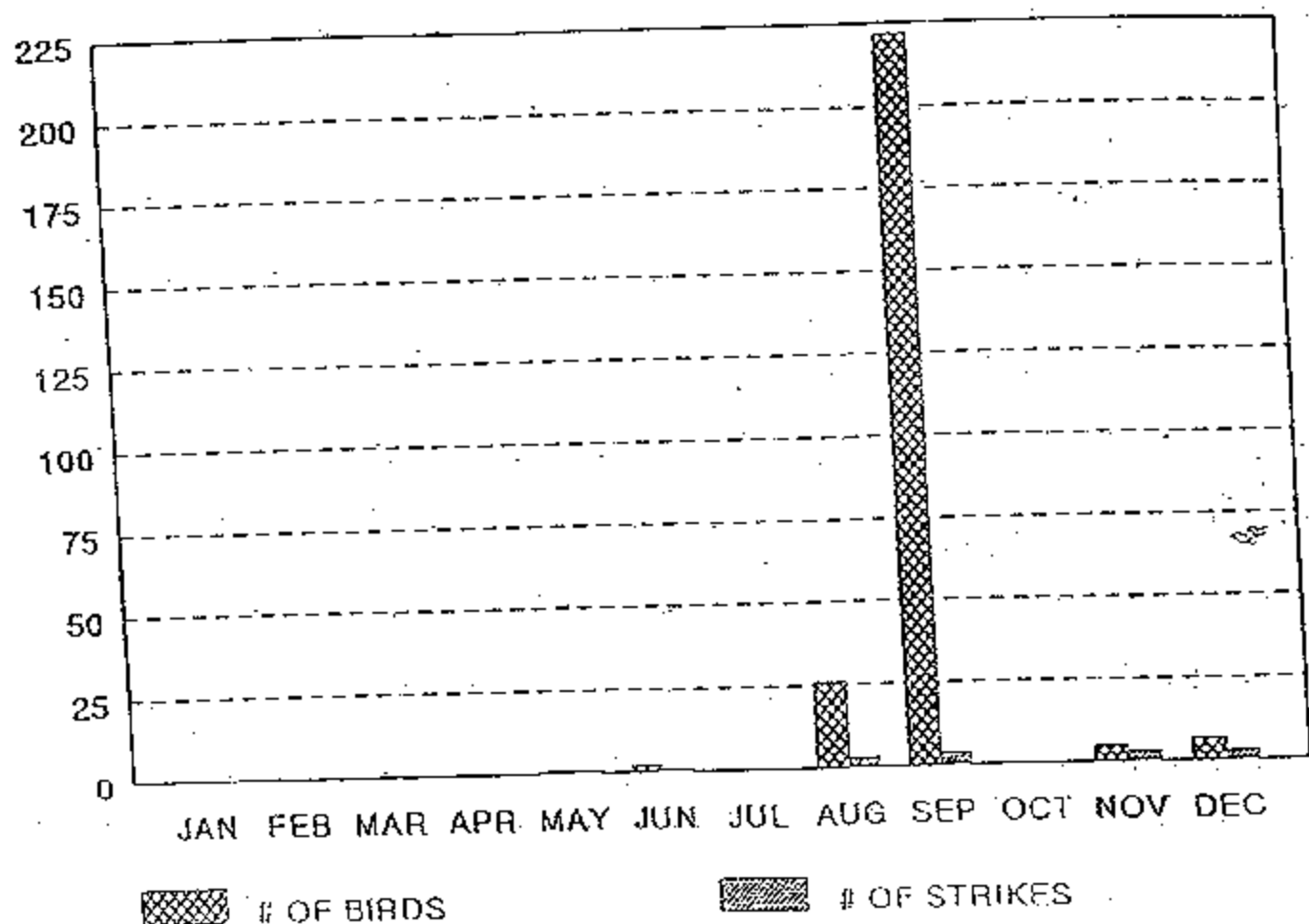
BIRD STRIKES BY MONTH, 1979-1993, JFKIA
BARN OWLS



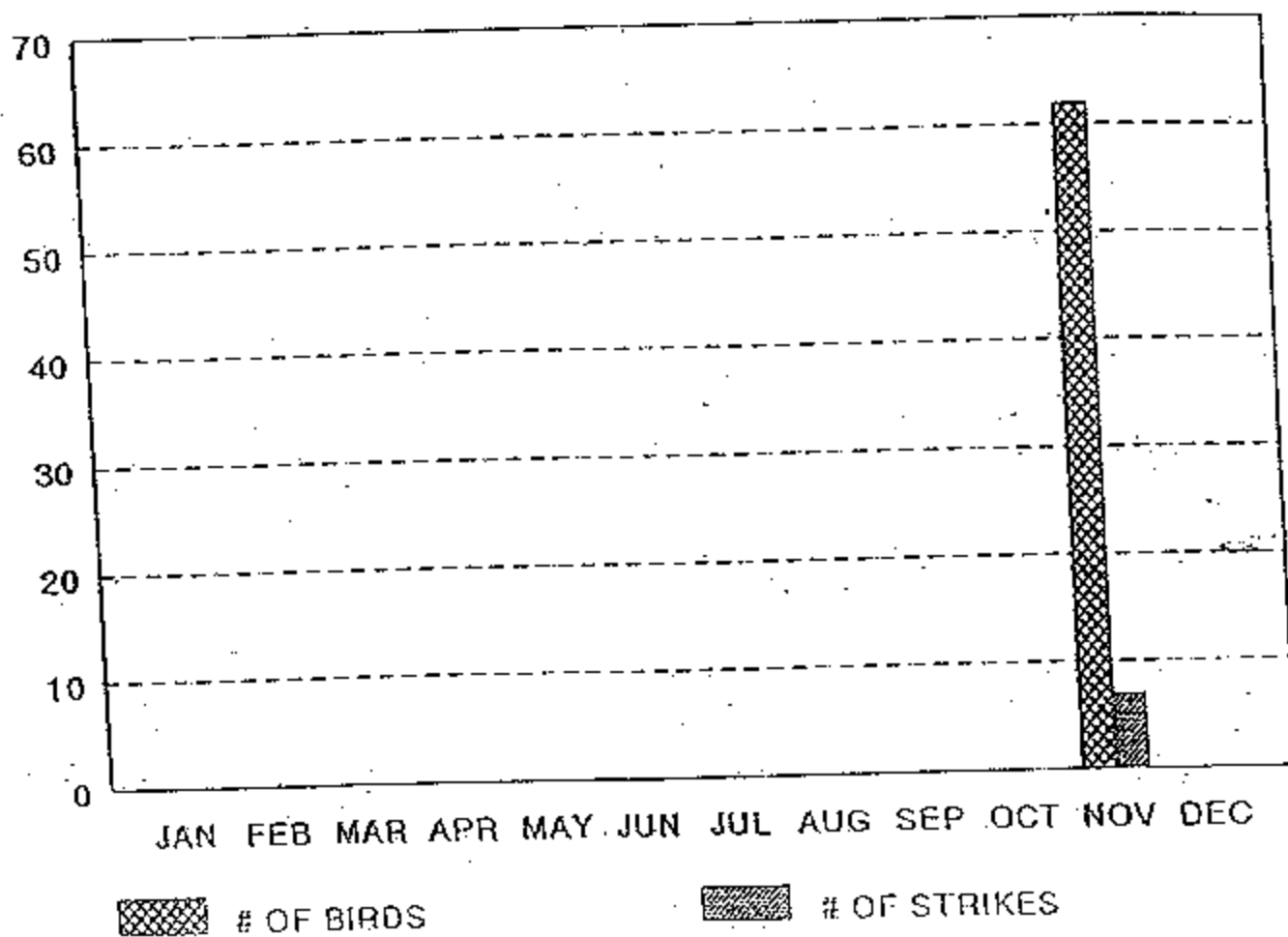
BIRD STRIKES BY MONTH, 1979-1993, JFKIA
SHORT-EARED OWLS



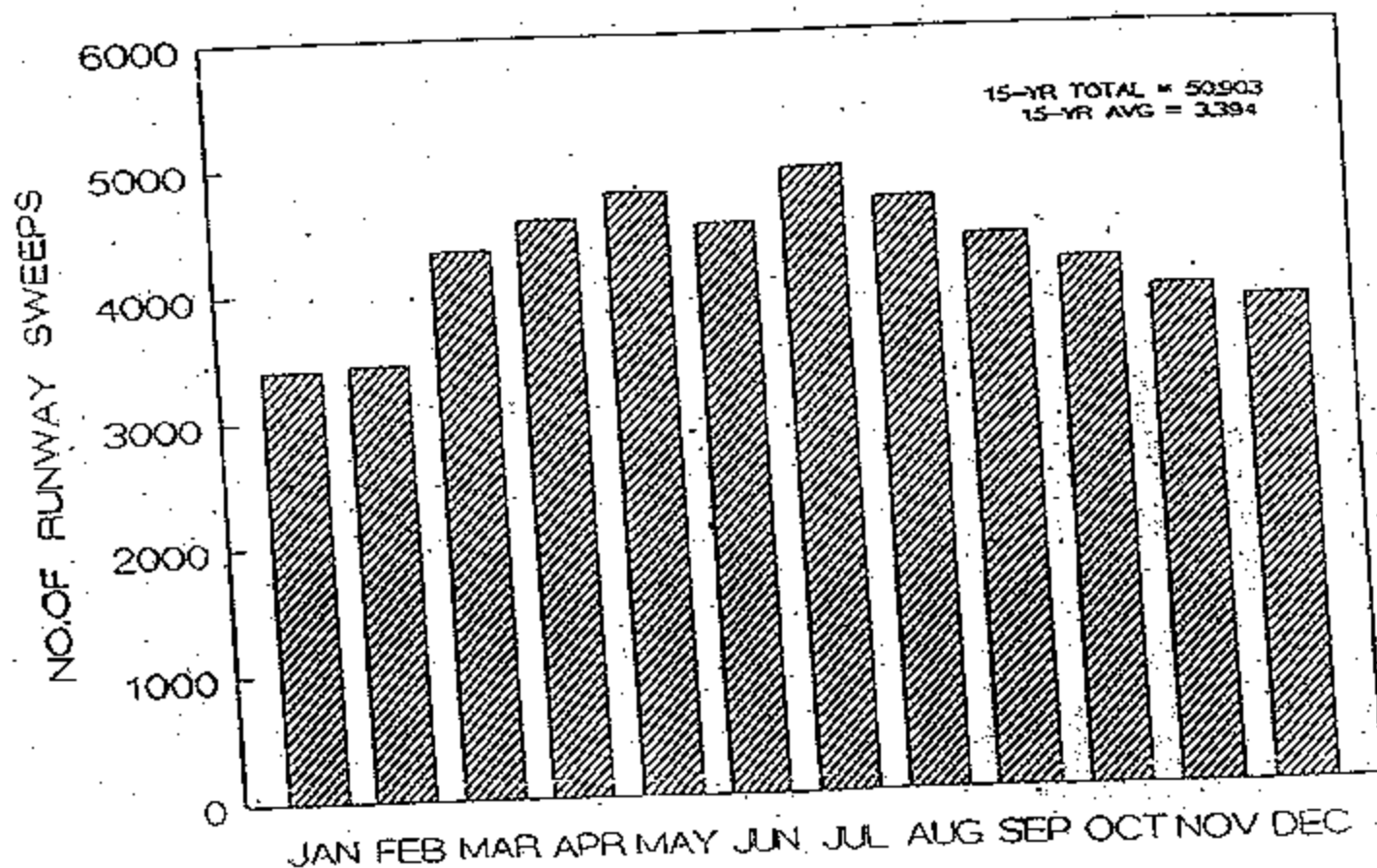
BIRD STRIKES BY MONTH, 1979-1993, JFKIA EUROPEAN STARLING



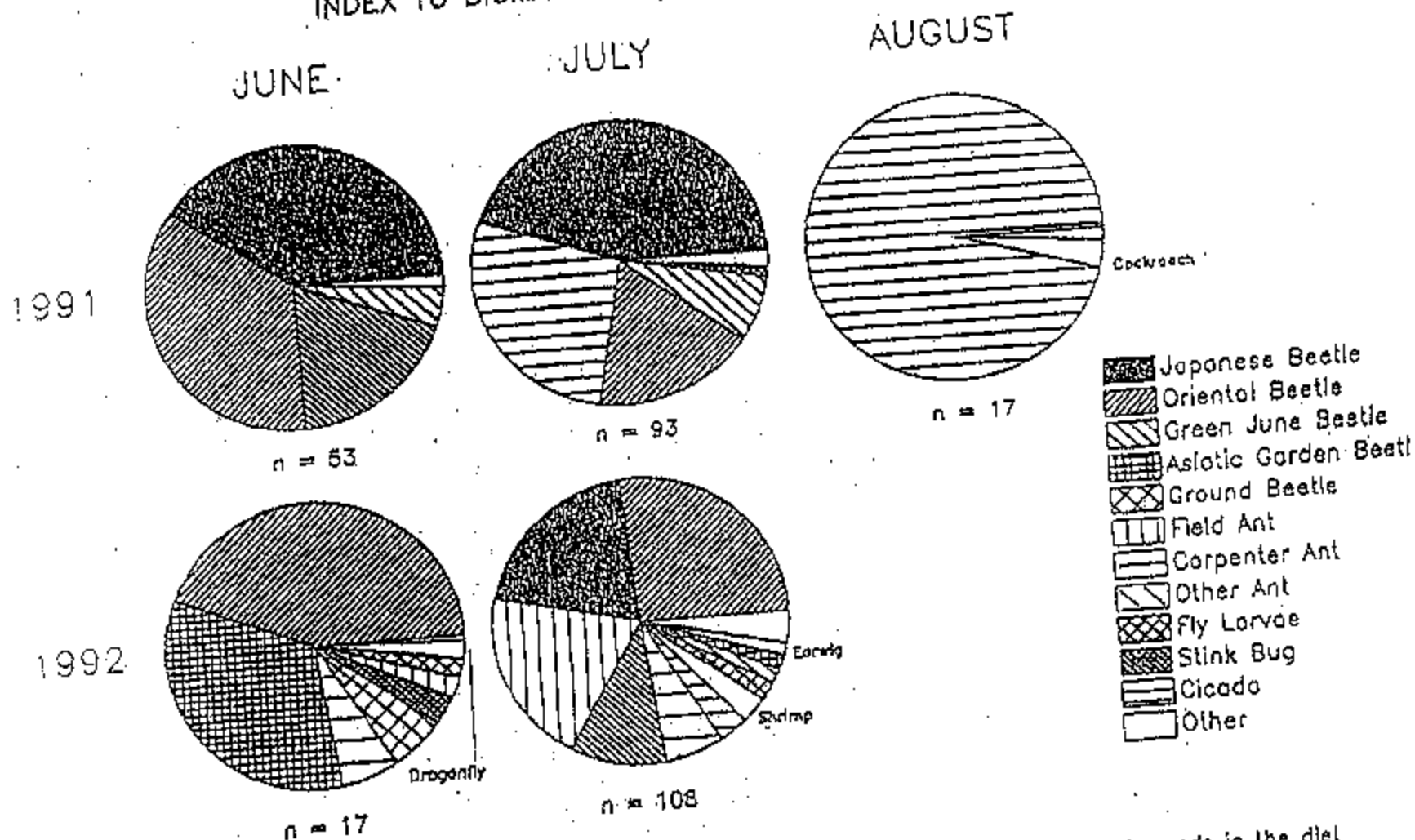
BIRD STRIKES BY MONTH, 1979-1993, JFKIA SNOW BUNTING



NO. OF RUNWAY SWEEPS TO SCARE BIRDS
JFK INTERNATIONAL AIRPORT, 1976-1990



LAUGHING GULL DIET - JFK INDEX TO BIOMASS FOR ARTHROPODS



Percent composition, based on an index to biomass, for the major taxa of arthropods in the diet of Laughing Gulls from JFK.

PLANT LIST

Plant material selected for newly constructed areas should include species which do not serve as an attraction for feeding or roosting place for birds which could represent a hazard to aircraft at the airport. Selected plant material should also be tolerant of typical urban conditions, such as salt, wind, dust and ozone pollution.

With the recommendations from consulting experts, a comprehensive planting list of species to minimize the attraction of birds has been compiled:

Botanical Name

Common Name

Deciduous Trees

Acer buergerianum
Acer campestre
Acer negundo
Acer platanoides
Carpinus betulus
Celtis occidentalis
Fraxinus americana
Fraxinus pennsylvanica
Ginkgo biloba
Glodisia triacanthos
Kochiura paniculata
Larix laricina
Metasequoia glyptostroboides
Phellodendron amurense
Platanus acerifolia
Populus deltoides
Populus maximowiczii
Pyrus calleryana
Quercus acutissima
Quercus coccinea
Quercus macrocarpa
Quercus phellos
Quercus robur
Salix babylonica
Sophora japonica
Tilia americana
Tilia cordata
Tilia euclhara
Tilia tomentosa
Ulmus Hollandica
Ulmus parvifolia
Zelkova serrata

Trident Maple
Hedge Maple
Box elder
Norway maple
European Hornbeam
Hackberry
White Ash
Green Ash
Ginkgo
Thornless Honeylocust
Golden rain tree
Eastern Larch
Dawn Redwood
Amur Corktree
London planetree
Cottonwood
Japanese poplar
Callery Pear
Sawtooth oak
Scarlet oak
Bur oak
Willow oak
English oak
Babylon weeping willow
Japanese pagodatree
American Linden
Littleleaf Linden
Crimean Linden
Silver Linden
Elm
Chinese Elm
Zelkova

Botanical Name

Common Name

Coniferous Trees

Pinus nigra
Pinus thunbergiana

Austrian pine
Japanese Black Pine

Shrubs

Acanthopanax sieboldianus
Abelia grandiflora
Amorpha fruticosa
Baccharis holmifolia
Caragana arborescens
Cotinus coggygria
Deutzia lemoinei
Euonymus alatus
Exochorda racemosa
Forsythia sp.
Hibiscus syriacus
Hydrangea arborescens
Hypericum prolificum
Juniperus horizontalis
Lonicera canadensis
Philadelphus coronarius
Physocarpus opulifolius
Potentilla fruticosa
Ptelea trifoliata
Robinia hispida
Salix discolor or tristis
Shepherdia argentea
Spiraea spp.
Syringa vulgaris
Tamarix gallica
Taxus canadensis
Weigela

Five fingered aralia
Glossy abelia
False Indigo
Groundsel Bush
Pea shrub
Smoke or Wig tree
Deutzia
Burning bush
Pearlbush
Goldenbell
Rose of Sharon
Smooth hydrangea
Shrubby St. Johnswort
Creeping juniper
Honeysuckle
Sweet syringa
Common ninebark
Bush cinquefoil
Water Ash
Roseacacia locust
Pussy willow
Buffalo berry
Spiraea
Lilac
French Tamarack
Yew
Weigela

Groundcovers

Hedera helix 'Baltica'
Juniperus horizontalis
Pachysandra
Vinca minor

English Ivy
Creeping Juniper
Pachysandra
Periwinkle

Grasses

Andropogon gerardi
Andropogon scoparius
Eragrostis richodes
Sorghastrum avenaceum

Big Blue Stem
Little Blue Stem
Sand Love Grass
Indian Grass

PLANT MATERIAL NOT RECOMMENDED

The following vegetation species should be avoided because of their high food value to birds:

Plants to be Avoided:

Celastrus spp. (Bittersweet)
Cornus amomum (Silky dogwood)
Cornus florida (Easter flowering dogwood)
Cornus racemosa (Gray dogwood)
Cornus stolonifera (Red osier dogwood)
Crataegus spp. (Hawthorn)
Juniperus virginiana (Eastern red cedar)
Lonicera maackii (Amur honeysuckle)
Lonicera tatarica (Tatarian honeysuckle)
Malus spp. (Crabapple)
Parthenocissus quinquefolia (Virginia creeper)
Prunus spp. (Cherry)
Pyracantha spp. (Fire thorn)
Rhus spp. (Sumac)
Sorbus americana (Mountain ash)
Viburnum trilobum (American cranberry)

A more detailed list of trees, shrubs and vines attractive to songbirds is included in Table 1 at the end of this report.

January Census

Waterfowl of Jamaica Bay Wildlife Refuge (1980-1995)

Loons, Grebes and Cormorants

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Red-throated Loon	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Common Loon	1	0	0	0	0	0	0	2	0	0	1	0	4	1	0	2
Pied Billed Grebe	1	0	0	0	0	3	0	1	2	0	0	0	0	1	0	1
Horned Grebe	42	0	0	54	24	43	25	59	6	46	13	35	22	22	4	66
Red-necked Grebe	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1
Great Cormorant	0	0	0	1	0	0	0	1	17	92	49	58	64	163	2	76
Double-crested Cormorant	0	0	0	5	9	0	2	134	49	9	10	83	16	14	0	13

Swans and Geese

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Mute Swan	0	0	0	0	0	0	0	22	18	20	20	24	34	13	1	28
Snow Goose	53	0	0	1	0	0	39	140	7	1001	1001	485	350	300	260	554
Brant Goose	512	61	1042	941	417	593	1991	1022	420	603	603	785	422	3202	31	5847
Canada Goose	256	29	189	363	739	249	398	1033	1620	1342	1342	925	2288	1313	693	1350

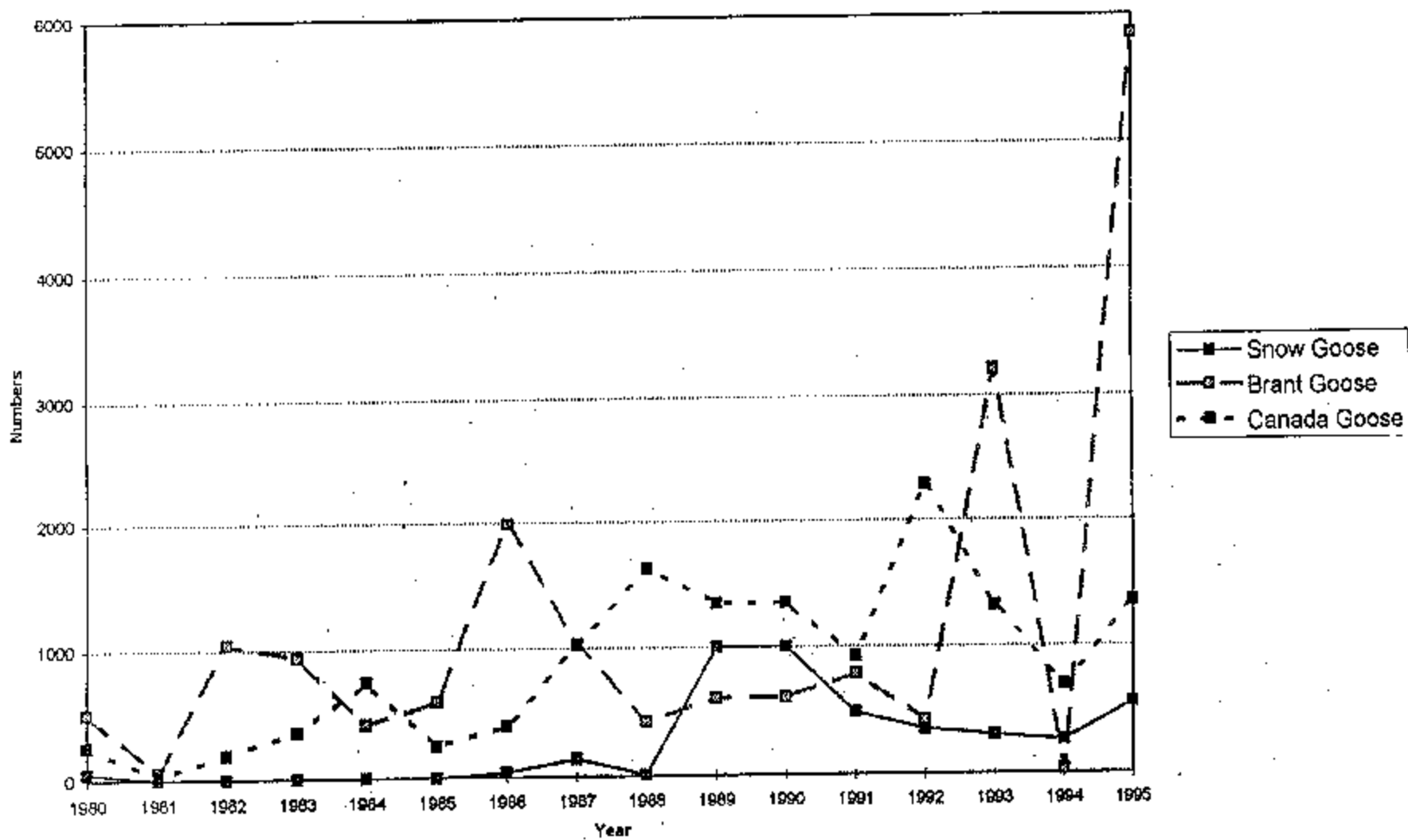
Scaup, Wigeon, etc.

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Eurasian Wigeon	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1
American Wigeon	192	34	433	266	21	107	29	165	67	151	24	173	30	211	0	172
Canvasback	0	915	560	1229	2700	973	121	354	137	57	7	6	53	5	0	30
Redhead	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0
Greater Scaup	655	300	1883	2752	27300	6265	7432	2066	4326	2828	720	1117	290	3995	0	1997
Lesser Scaup	0	0	0	0	0	5	3	0	0	0	0	0	0	0	0	0

Scoters, Oldsquaw and Goldeneye

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Oldsquaw	0	0	0	0	0	0	5	0	20	0	0	4	47	35	0	58
Black Scoter	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0
Surf Scoter	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Common Goldeneye	45	8	34	14	50	15	15	45	36	25	4	2	6	36	0	17

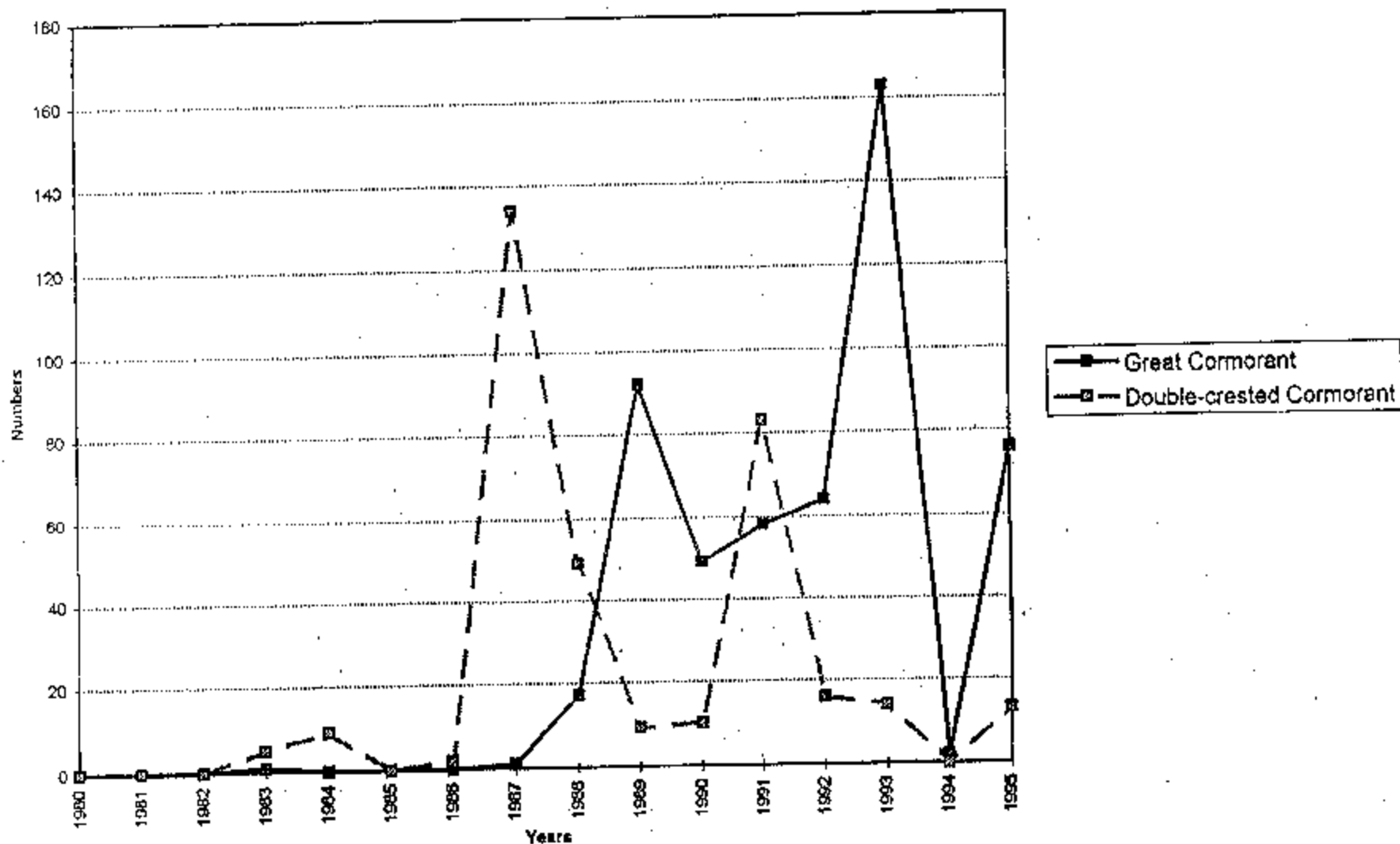
Geese of JBWR (1980-1995)



Data from Winter-Census in January

Bay was frozen in Winter 94

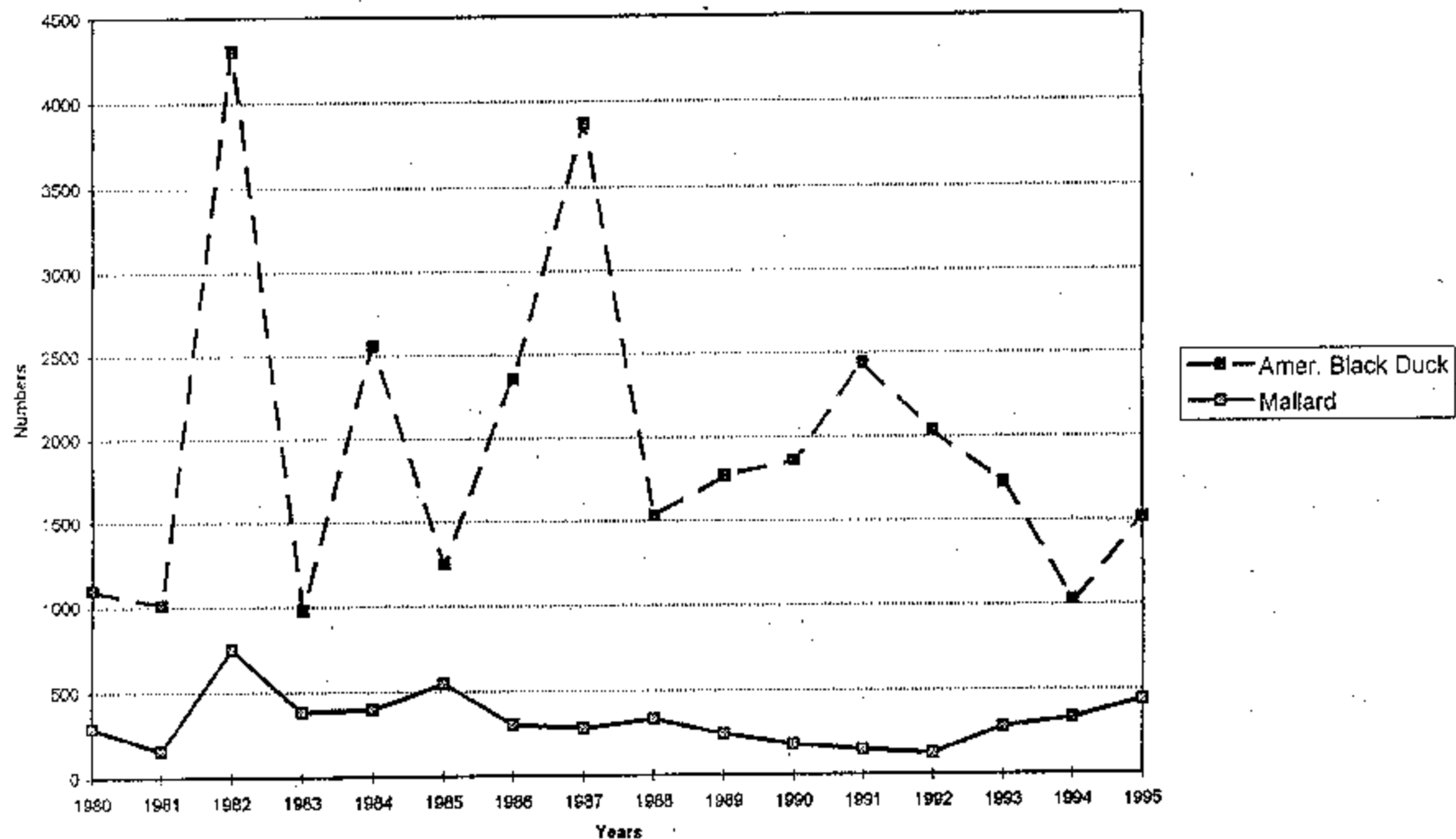
Cormorants of JBWR (1980-1995)



Data from Winter-Census in January

Bay was frozen in Winter 94

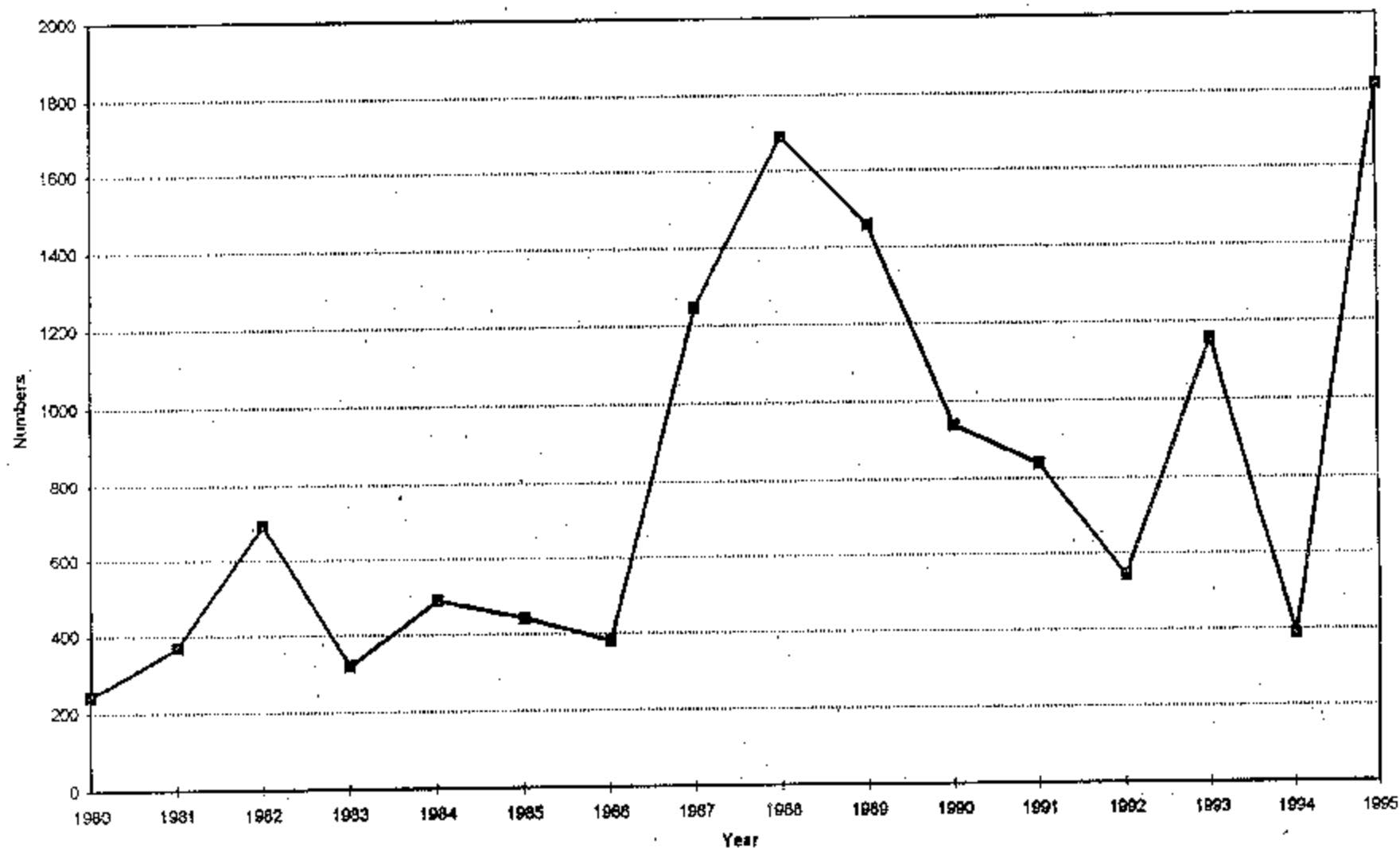
American Black Duck and Mallard of JBWR (1980-1995)



Data from Winter Census in January

Bay was frozen in Winter 94

Bufflehead of JBWR (1980-1995)



Data from Winter-Census In January

Bay was frozen in Winter 94

Gateway National Recreation Area

Jamaica Bay Wildlife Refuge

1995 Gull Census (excluding LAUGHING Gulls)

	CP	RB	SI	LEM	SWIN	HOFF	BPT	SH	JOCO	EHM	TOTAL
TOTAL GULLS (NESTING PR.)	1197	680	255	287	147	135	153		0		2855
GGB GULLS (NESTING PR.)	60	34	38	88	14	31	3				266
HERRING GULLS (NESTING PR.)	1137	646	218	201	133	104	150				2589
LAUGHING GULLS (NESTING PR.)											0

RUFFLE BAR

RB - Robert Bar-Hachok - 5/22, 4hrs (D. Avrin, D. Riapo, S. Garber, B. Gallup, S. Metelc)

CP - Canastota Pt - 5/24, 4hrs (D. Riapo, N. Coronà, S. Gilmore, Liz Anne, 278 gulls)

CP - 5/25, 5hrs (D. Avrin, D. Riapo, D. Taft, A. Stewart, D. Davis, 679 gulls)

CP - 5/31, 8 hrs (D. Riapo, J. Zuzworsky, J. Bucknall, Jennifer Allen), 172 gull nests

CP - 6/4, (D. Riapo and others), 88 gull nests

SI - Subway Island

LEM - Little Egg Marsh

SWIN - Swinburne Island - 6/1 (D. Riapo, D. Taft, J. Allen, J. Zuzworsky, R. Mullally)

HOFF - Hoffman Island - 6/1 (D. Riapo, D. Taft, J. Allen, J. Zuzworsky, R. Mullally)

BPT - Breezy Point Tip

JOCO - Joco Marsh - 6/4 (D. Riapo, and others)

EHM - East High Meadow Marsh - 6/4 (D. Riapo and others)

SH - Silver Hole Marsh - 6/4 (D. Riapo and others)

APPENDIX 33

**The Port Authority of NY & NJ, Report on Rare Incident:
13 Birdstrikes in One Night at Newark International Airport**

THE PORT AUTHORITY OF NY & NJ

John F. Kennedy
International Airport
Jamaica, New York 11430
(718) 244-4444

To: Jack K. Gartner
From: Steven D. Garber, Ph.D.
Subject: Newark International Airport Bird Strikes
Date: October 30, 1995
Copy: Al Graser, Ken Charuk, Frank Lopprano, Kevin Dillon, Russell Halleran,
Vincent Cimino, Don Riepe, George Haas, Joe Pane, Janet Bucknall,
Richard Dolbeer

REPORT ON RARE INCIDENT:

13 BIRDSTRIKES IN ONE NIGHT AT

NEWARK INTERNATIONAL AIRPORT

** We concluded that a huge flock of blackbirds caused the multiple bird strikes at Newark International Airport on night of October 25, 1995*

During the night of October 25, 1995, 13 pilots flying into Newark International Airport reported a total of nearly 70 birdstrikes! Three of the thirteen pilots reported seeing approximately 100 birds each. The strikes occurred between 2 miles and 20 miles from the airport. This number of strikes is unusually high for any night, even during the peak of fall migration. Al Graser, the General Manager of The Port Authority of New York and New Jersey's Aviation Technical Services reported he had never heard of so many strikes over a one night period.

Preliminary reports from Aviation Technical Services suggested that the birds struck might have been Canada geese. Frank Lopprano, the Deputy Chief of Aeronautical Operations at Newark International Airport, thought if the birds had been geese, there would have been more damage to the aircraft. He said the birds might have been gulls, and mentioned he had heard that a landfill might have been reopened recently in northern New Jersey, which could have been responsible for increased numbers of gulls.

Russell Halleran, the FAA's Programs Specialist in the Newark International Airport Tower, said the pilots reported the birds were big and dark, and were at a wide range of elevations, and were spread out over several miles. This information enabled us to rule out Canada geese because there were so many strikes spread over such a huge area, and there was no damage. They might have been brant, which are smaller geese than Canada geese. Brant migrate in this area in large numbers this time of year, but why wasn't there any damage? However, brant migrate north in large numbers, but they return in smaller family groups. Inquiries to naturalists in the area found that large

numbers of brant had not appeared anywhere along the East Coast over night. The birds might have been gulls, but why would pilots have said they were dark? Pilots have very good headlights and would have illuminated any birds more than adequately to see whether they were white or black. Because the birds were black, and we had ruled out larger dark birds, such as ducks and geese, we considered the possibility of blackbirds, but why did pilots think they were so big? Beyond this point, the information was not sufficient to make a positive identification, so Halleran sent us the 13 bird strike incident/ingestion reports (FAA Form 5200-7). From these we concluded the following:

The 13 reports filed during the night agree on several points:

- The strikes all occurred on the night of October 25, 1995.
- Once the tower realized there were so many birds out there, all the pilots were warned.
- The night was clear, no clouds, so the pilots could see the birds well with their headlights.
- The birds that were seen were black.
- The birds' size ranged according to the pilot who filed the report; some thought the birds were small, others said medium, others said large. We conclude the birds were, on average, medium in size.
- All the birds struck were hit on the descent and approach to Runway 4R, which means the birds were to the southwest of Newark.
- In the 13 reported incidents, as many as 70 birds were struck, and hundreds of birds were seen.
- Most strikes occurred 6.5 to 10 miles out.
- The birds were flying through a range of elevations
- 11 strikes occurred above 1,000 feet.
- One pilot reported 4 strikes during his descent and approach; all his strikes occurred between 7,800 and 2,000 feet in elevation.
- 2 strikes occurred below 1,000 feet (the lowest was 200 feet).
- The flock was very large, with many birds, probably thousands.

BASED ON FACTS:

- Because this many birds has never been struck on one night before, and because it only happened October 25, not on the next night also, we assume the flock just flew through this airspace at that time, and then it moved on.
- Because all the strikes occurred in the same area and during the same interval of time, we assume this was a single species, and that the birds were in a flock.
- Because there were so many strikes without any damage, ducks, geese, and gulls were ruled out.

- Because the birds that were seen were black, not white, this is further corroboration that gulls were not involved.
- Because, of all the pilot reports, sometimes the birds were called small, or medium, or large, we conclude the birds had to be a size that some people might consider small, while others might consider them medium, and others could think they were large. Therefore, very small species were ruled out because no one would call them small. As a result, tree swallows, a species that was flocking at JFK recently, were ruled out. And again, ducks, geese, and gulls were ruled out because everyone considers them large.
- Starlings, although the right size and color, were ruled out because they fly closer to the ground than these birds.
- Because mixed flocks of "blackbird" species have been flocking this time of year, blackbirds are black, blackbirds fly at night, often at high elevations, but usually at a considerable range of elevations, and because large numbers of blackbirds are flocking in huge spread out aggregations this time of year, and because some people might call "blackbirds" small, while others could call them medium in size, and if one hit your windshield at 200 knots you might call it large, blackbirds were seriously considered as a possibility.

CONCLUSIONS:

- We presented the facts to biologists in the region, who all concurred this was a mixed flock of blackbirds. This time of year blackbirds fly south and overwinter in large numbers as nearby as the Delmarva Peninsula. A flock in one field can be as large as 100,000. Wildlife managers report Bombay Hook Refuge in Delaware has hundreds of thousands of blackbirds arriving there right now. From all the information provided, blackbirds were headed south when they were in the airspace southwest of Newark the night of October 25.

RECOMMENDATIONS:

Red-winged blackbirds, grackles, starlings, and cowbirds, are the four species that often fit the description of generic "blackbirds," although in this case the birds were probably primarily red-wings and grackles. A flock of starlings caused a Lockheed Electra to crash on October 4, 1960 at Boston's Logan International Airport, and 62 of the 72 passengers on board died; in addition there were 9 serious injuries. On February 26, 1973, when a Lear 24 in Atlanta, Georgia ingested cowbirds into its engines, the plane crashed and everyone aboard died. Therefore, we know flocks of blackbirds can prove dangerous, and should be taken very seriously. It was good that the Tower warned pilots of the birds, and it was much safer that the planes striking these birds were incoming rather than outgoing, because a plane cannot afford to lose substantial thrust on take-off, but when decelerating on landing, a multiple strike is less dangerous.

It will prove helpful to continue monitoring Newark's airspace and strikes, especially during peak nights during fall migration. More information will help us learn how to minimize the risk of birdstrikes. It is possible, that the radar used by flight controllers could be adjusted to enable us to "see" the birds and direct the pilots to take a route on approach and departure that enables them to avoid the birds. We are currently investigating methods used by researchers to identify birds with radar.