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# Aerodrome Bird Hazard Prevention: Case Study At John F. Kennedy International Airport

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**Abstract**

The collision of birds with aircraft is a serious problem at John F. Kennedy International Airport (JFKIA), New York. Gulls (Larus spp.) accounted for 86% of bird strikes (an aircraft striking >1 bird) from 1988-1990, averaging 260 strikes/year. Laughing Gulls (L. atricilla) are present from May-September in association with a protected nesting colony in Jamaica Bay National Wildlife Refuge adjacent to the airport. The colony increased from 15 nests in 1979 to 7,629 nests in 1990. During the 1970s and 1980s, JFKIA implemented various management activities to reduce gull strikes, including maintenance of tall grass, improved sanitation, drainage of standing water, and increased harassment. These programs, although beneficial as part of an integrated bird management program, did not result in reduced numbers of gull strikes. A specific program to reduce gull strikes was undertaken from May-August 1991-1998 in which 2-5 people stationed on airport boundaries shot gulls flying over the airport. In 7,159 person-hours of shooting, 55,452 gulls were killed (2,263-14,866/year), comprised of 50,521 Laughing Gulls and 4,931 other gulls (L. argentatus, L. marinus, L. delawarensis). The number of aircraft striking gulls declined to a mean of 68.4/year in 1991-1995, a 74% reduction compared with the mean of 259.7 strikes/year for 1988-1990. As a result of the shooting program, the overall bird strike rate declined at JFKIA but the proportion of strikes caused by non-gull species increased, from 14% in 1988-1990 to 39% in 1991-1995. To further reduce strikes by gulls and other species and to minimize the need to shoot gulls, JFKIA implemented an experimental falconry program in 1996-1998. Falconry has provided positive publicity for JFKIA and additional personnel on the airport to disperse birds. However, a statistical analysis of strike data did not indicate falconry reduced the strike rate below levels achieved during the shooting program in 1991-1995. In 1996-1998, when shooting and falconry were both active, the mean gull strike rate (57.3/year) was similar to the rate recorded in 1991-1995 (68.4/year). Strikes by non-gull species increased in 1996-1998 ( = 85.3/year) compared to 1991-1995 (43.0/year). Non-gulls comprised 60% of all bird strikes, 1996-1998. The number of gulls killed/person-hour of shooting was highest in 1991-1992, the first 2 years of the shooting program, but did not differ ($P > 0.05$) among years from 1993-1998. JFKIA, located in a bird-rich coastal

environment, has developed innovative programs to reduce strikes by various bird species whose dynamic populations present ever-changing challenges. A new component of these integrated programs should be the relocation of the nearby gull nesting colony to a site away from JFKIA.

Key Words: Airport, Bird Strike, Falconry, Gull, Integrated Pest Management, JFK, Shooting

## Introduction

The collision of birds with aircraft is a serious problem at John F. Kennedy International Airport (JFKIA), New York. Port Authority of New York and New Jersey (PANYNJ) personnel reported 80-315 aircraft struck by birds/year at JFKIA from 1979-1998 (Dolbeer and Chipman 1999). These strikes have caused millions of dollars in damage to aircraft and represent a significant threat to human safety. From 1988-1990, Laughing Gulls (Larus atricilla) were the species most frequently struck by aircraft at JFKIA, averaging 157 aircraft incidents (52% of all incidents) involving 170 birds (47% of all birds struck)/ year. Other gulls (Herring [L. argentatus], Great Black-backed [L. marinus] and ring-billed [L. delawarensis]), which are present year-round, comprised 34% of the aircraft strikes and another 52 species of birds comprised the remaining 14%. There is a nesting colony of laughing gulls adjacent to JFKIA in Jamaica Bay Wildlife Refuge, a protected area administered by the U.S. National Park Service. This colony increased from 15 nesting pairs in 1979 to 7,629 pairs in 1990. Almost all laughing gull strikes have occurred from May-September with most in June and July during chick rearing (Dolbeer et al. 1989). Nesting Laughing Gulls fly from the colony over the airport to off-airport feeding areas throughout metropolitan New York City (Griffin and Hoopes 1991). Strikes with other gull species occur throughout the year.

As required by U.S. Federal Aviation Administration Regulation 14CFR139, JFKIA has had an active bird management program since the 1970s to discourage birds from feeding, drinking, and loafing on airport grounds. This program has included habitat alteration (tall grass and removal of standing water on airport), the use of vehicle-based bird patrols and runway sweeps, and the deployment of various bird-frightening techniques. However, these measures have done little to prevent laughing gulls and other gull species from flying over the airport to off-airport feeding, nesting and resting sites (Dolbeer et al. 1989, Sillings et al. 1992).

As one approach to solving the problem, U.S. Department of Agriculture (USDA) biologists, under a cooperative agreement with the PANYNJ, initiated an experimental management program at JFKIA in 1991 to reduce strikes by gulls, primarily laughing gulls. From 20 May-8 August 1991, biologists shot gulls attempting to fly over the airport. Hypotheses tested were that shooting would not only directly reduce the number of gulls flying over the runways but also enhance ongoing bird-frightening programs at JFKIA by conditioning gulls to avoid the airport. Because strikes by gulls were significantly reduced at JFKIA

in 1991 (Dolbeer et al 1993), the shooting program was continued during late May-early August in 1992-1998. In 1994, an Environmental Impact Statement (EIS) was finalized that addressed the management of gulls to reduce bird strikes at JFKIA (USDA 1994). The EIS recommended that the shooting program be continued as part of an integrated management program until other actions are taken that would result in relocation of the gull colony.

In 1996-1998, the PANYNJ implemented experimental falconry programs to complement the shooting program. The PANYNJ contracted with falconers (different contractor each year) to fly trained falcons and hawks, in addition to using traditional bird-scaring techniques (e.g., pyrotechnics), from June-October 1996, July-November 1997, and May-November 1998 (Table 1). The falconry contractor active in 1998 will continue through 2000. Having shooting and falconry programs conducted during a 3-year period, combined with a long-term database on bird strikes (Burger 1985), provided a unique opportunity to examine the effectiveness of these 2 programs (1996-1998) compared to baseline years when only shotgun shooting was done (1991-1995) and when neither program was active (1988-1990).

## Methods

### Shooting

Shooting was with 12-gauge shotguns using primarily #4 steel shot (250 rounds of #2 steel shot were used in 1998) on 31-62 days annually from May-August 1991-1998 (Table 1). Two to five shooters were stationed along the southern airport boundaries where gulls often crossed the airport. Shooting typically was conducted from 0530-1300 or from 1300-2030. Shooters stood or sat in the open and wore blaze-orange vests. Shooting was directed away from the airport at flying gulls that came within range (about 40 m).

All shooters operated under federal and New York State permits issued to the USDA or PANYNJ. In 7,160 person-hours of shooting in 1991-1998, 55,452 gulls were killed, comprised of 50,521 laughing, 3,632 herring, 722 great black-backed, and 577 ring-billed gulls (Table 1). The Laughing Gull colony declined from 7,629 nests in 1990 to 5,448 nests in 1998. Dolbeer et al. (1993, 1997), Dolbeer and Bucknall (1994) and Dolbeer and Chipman (1999) provide additional details about the shooting program and nesting colony.

### Falconry

Falconers generally flew their birds (primarily peregrine falcons [Falco peregrinus], peregrine-gyrfalcon [F. rusticolus] Hybrid, Saker falcons (Falco cherrug), and Harris' hawks [Parabuteo unicinctus]) daily on the airport. Typically, the falconers used "lure flights" in which the falcon did not attack and kill target birds but simulated hunting by chasing a lure

swung from a leash by the falconer. In addition, the falconers used pyrotechnics, amplified distress calls and occasional shotgun shooting with live ammunition to disperse birds. Watermann (1997), T. C. Management (1998) and Falcon Environmental Services (1998) provide additional details about the 1996-1998 falconry programs.

### Evaluation of shooting and falconry

Bird strikes have been consistently recorded daily at JFKIA since the mid 1970s. Bird strikes are classified as "pilot-reported" when a person (usually a pilot) reports a strike and 'unreported" when JFKIA bird-patrol personnel find bird remains within 200 feet of the centerline of an active runway and no other cause of death is suspected (Burger 1985).

To evaluate the shooting and falconry programs, I made comparisons of strike rates (number of strikes/year) for gull species and all other bird species (hereafter referred to as "non-gull species") among years using chi-square statistics for proportional data (Fleiss 1973:14-22). First, I compared strike rates for 1988-1990 (baseline years in which there was no shooting or falconry) with strike rates for 1991-1995 (shooting but no falconry). Second, I compared strike rates for 1991-1995 (shooting but no falconry) with strike rates for 1996-1998 (shooting and falconry). In making comparisons among years, I first used all strikes (unreported and pilot-reported combined) and then repeated the analysis using only pilot-reported strikes. In all analyses, I used number of strikes instead of number of strikes/10,000 aircraft movements as the response variable because aircraft movements at JFKIA (355,000 in 1996) have increased by only about 3% per year, 1988-1997 (USDA 1994; Lampl 1998).

To determine if the falconry program reduced the number of gulls shot in 1996-1998, when shooting and falconry were conducted simultaneously, I used 1-way analysis of variance to compare the mean number of gulls shot/person-hour of shooting, 1991-1998, and tukey tests to determine which annual means were different ($P < 0.05$) (Statistix 1994).

### Results

Strike Rates: 1988-1990 (No Shooting, No Falconry) vs. 1991-1995 (Shooting, No Falconry)
Strikes with gull species: In 1991-1995, when shooting but no falconry was done, there was a mean reduction of 74% ($X2 = 111.69$, 1 df, $P < 0.01$) in all strikes (unreported and pilot-reported) with gulls ( = 68.4 strikes/year) compared to the annual mean for the baseline years, 1988-1990 ( = 259.7 strikes/year, Fig. 1). When only pilot-reported strikes were considered, there was also a significant ($X2 = 6.28$, 1 df, $P = 0.02$) mean reduction (64%) in strikes with gulls in 1991-1995 ( = 7.6 strikes/year) compared to 1988-1990 (21.0 strikes/year, Fig. 2).

Strikes with non-gull species: For all strikes (unreported and pilot-reported), there was

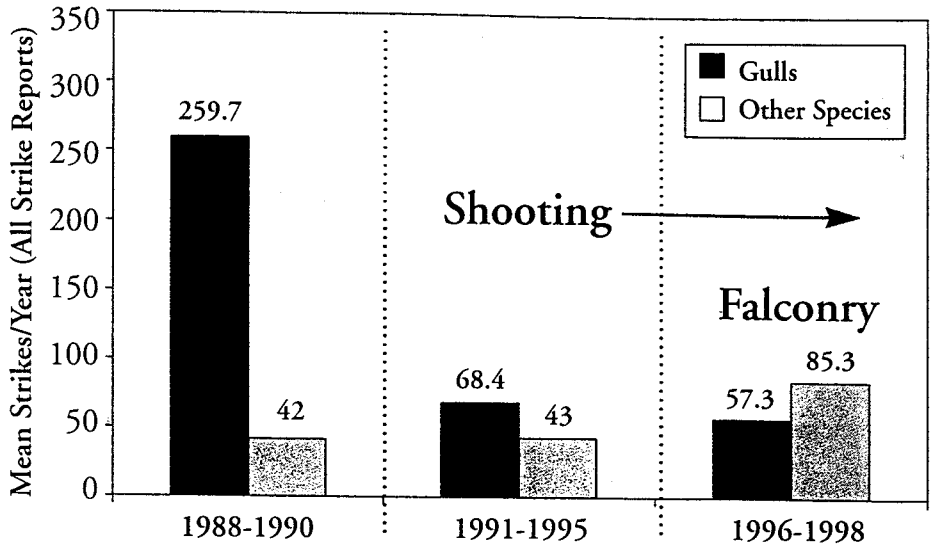



*Fig. 1 Mean number of bird strikes/year (pilot reported and unreported) involving gull species and other bird (non-gull) species, JFK International Airport, New York, 1988-1990 (baseline years), 1991-1995 (shooting) and 1996-1998 (shooting and falconry)*

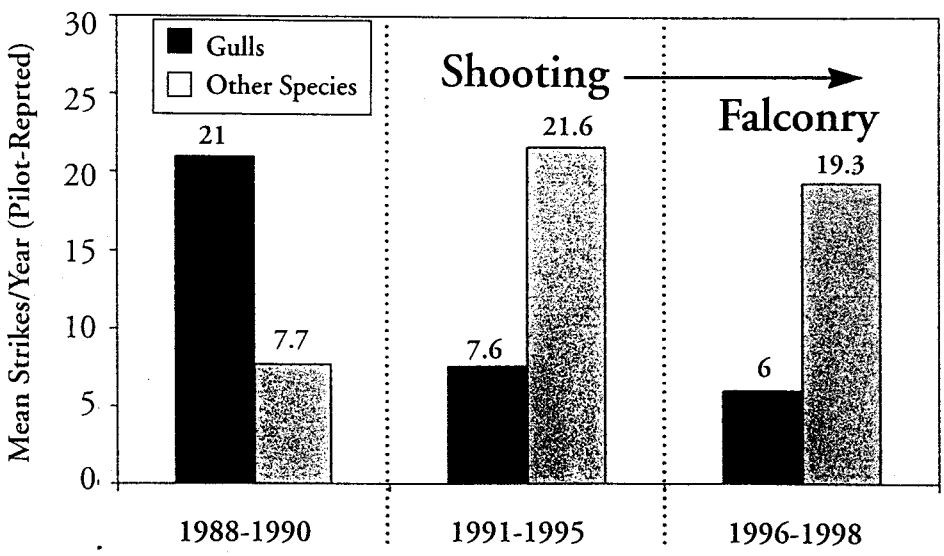
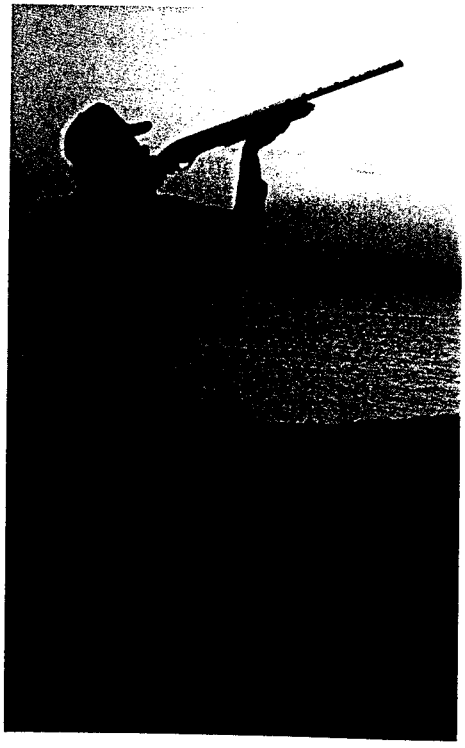



*Fig. 2 Mean number of pilot-reported bird strikes/year involving gull species and other bird (non-gull) species, JFK International Airport, New York, 1988-1990 (baseline years), 1991-1995 (shooting) and 1996-1998 (shooting and falconry)*



*The author at work... collecting the "results" of the hunt. (photos: R.A. Dolbeer)*

no difference (X2 = 0.01, 1 df, P = 0.90) in the mean annual strike rate for non-gull species between 1991-1995 ( = 43.0 strikes/year) and the baseline years,1988-1990 ( = 42.0 strikes/year, Fig. 1). However, when only pilot-reported strikes were considered, there was a 2.8-fold increase (X2 = 6.67, 1 df, P = 0.01) in strikes for non-gull species from 7.7/year in 1988-1990 to 21.7/year in 1991-1995 (Fig. 2).

Strike Rates: 1991-1995 (Shooting, No Falconry) vs. 1996-1998 (Shooting, Falconry)

Strikes with gull species: For all strikes (unreported and pilot-reported), there was no difference (X2 = 0.98, 1 df, P = 0.33) in the mean annual strike rate between 1991-1995 ( = 68.4 gull strikes/year) and 1996-1998 ( = 57.3/year, Fig. 1). When only pilot-reported strikes were considered, there also was no difference (X2 = 0.19, 1 df, P = 0.72) in the mean annual strike rate between 1991-1995 ( = 7.6 gull strikes/year) and 1996-1998 ( = 6.0/year, Fig. 2).

Strikes with non-gull species: For all strikes (unreported and pilot-reported), there was a 2-fold increase (X2 = 13.94, 1 df, P < 0.01) in the mean annual strike rate from 43.0/year in 1991-1995 to 85.3/year in 1996-1998 (Fig. 1). However, when only pilot-reported strikes were considered, there was no difference (X2 = 0.14, 1 df, P = 0.70) in the mean annual strike rate between 1991-1995 ( = 21.7 strikes/year) and 1996-1998 ( = 19.3/year, Fig. 2).

Number of Gulls Killed per Person-hour of Shooting: 1991-1998

The number of gulls killed/person-hour during the shooting program differed (P < 0.01) among years, 1991-1998 (Table 1). The kill/person-hour was significantly (P < 0.05) higher in 1991, the first year of the program, than in any of the subsequent 7 years. The numbers killed/person-hour in 1996-1998, when falconry and shooting were done simultaneously, were the lowest for the 8 years but were not different (P > 0.05) than means in 1993-1995.

Changes in Species Composition of Birds Struck By Aircraft, 1988-1998

In 1988-1990, strikes with gulls ( = 259.7/year) represented 86% of all strikes recorded ( = 301.7/year, Fig. 1). During the first 5 years of the shooting program (1991-1995), the percent of strikes involving gulls declined to 61%. In 1996-1998, gulls ( = 57.3 strikes/year) comprised only 40% of the species involved in strikes ( = 142.6 strikes/year).

## Discussion

Shooting gulls at JFKIA clearly reduced the number of strikes with gulls, based on a comparison of strikes in 1988-1990 (baseline years) and 1991-1998 (shooting). No nontarget gulls or other wildlife were affected because shooting with nontoxic shot was directed only at gulls attempting to fly over the airport. However, this shooting program resulted in the killing of 55,452 gulls. In an effort to develop alternative, nonlethal

methods to reduce strikes, the PANYNJ added falconry to their integrated bird management program at JFKIA in 1996-1998.

The statistical analysis of strike data (both all strikes and pilot-reported strikes), however, did not support the hypothesis that the falconry programs in 1996-1998 reduced gull strikes at JFKIA below baseline levels achieved by the shooting program in the 5 years immediately prior to falconry. There were slightly fewer gull strikes in 1996-1998 compared to 1991-1995, but the reductions were not statistically significant and the strike numbers were within the range of values for 1991-1995. In addition, the number of gulls killed/person-hour of shooting was not statistically different among years in 1993-1998.

As noted by Blokpoel (1976), falconry on airports has attracted public interest because it uses a medieval sport to protect modern jet aircraft. Falconry, as practiced at JFKIA, is also attractive to the general public in that it is a biological control procedure in which birds are usually only dispersed and not killed. JFKIA has, indeed, received considerable positive media coverage in 1996-1998 regarding the falconry program as an environmentally friendly means of reducing bird strikes (L. Rider, PANYNJ, Personal Communication). Another benefit has been that the falconers, during their daily routines, provide additional personnel on the airfield to harass birds using a variety of methods in addition to falconry as a supplement to the regular bird patrol staff at JFKIA. JFKIA has not sacrificed other components of their bird management program to employ the falconers (L. Rider, PANYNJ, Personal Communication).

In 1991, the PANYNJ naturally focused management efforts on gull species because gulls comprised 86% of all recorded strikes, 1988-1990. The shooting program at JFKIA in 1991-1998 was designed to deal with this specific problem of gulls from a protected wildlife refuge adjacent to JFKIA flying over the airport to dispersed feeding sites beyond the airport. As a result of this shooting program directed specifically at gulls, strikes with gulls were reduced by over 70%. By 1996-1998, gull species comprised only about 40% of the strikes. However, strikes by non-gull species increased during the 1990s, both in absolute numbers and as a percent of the total strike rate, from 1988-1990 levels. There was no evidence from the analysis of strike data (all strikes and pilot-reported strikes) that the combined gull-shooting and falconry programs in 1996-1998 reduced the number of strikes by these non-gull species from levels recorded in 1991-1995. Aside from the specialized shooting program directed specifically at gulls, the PANYNJ should continue in their commitment to develop an innovative, integrated bird management program, including habitat management and the use of various bird-frightening techniques, to prevent gulls and other bird species from using the airport (USDA 1994). Falconry, which provides positive publicity and other unique attributes, can have a role in this integrated bird management program at JFKIA. However, additional years of data are needed to provide a more complete assessment of the exact role that falconry can play in reducing strikes. Negotiations with the U.S. National Park Service should continue to develop a program to relocate the gull nesting colony adjacent to JFKIA to a site away from the airport.

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