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Authors

Washburn, Brian E.
Chipman, Richard B.
Francoeur, Laura C.

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Evaluation of Bird Response to Propane Exploders in an Airport Environment

Brian E. Washburn

USDA, Wildlife Services, National Wildlife Research Center, Sandusky, Ohio

Richard B. Chipman

USDA, Wildlife Services, Castleton, New York

Laura C. Francoeur

Port Authority of New York and New Jersey, John F. Kennedy International Airport, Jamaica, New York

ABSTRACT: Bird-aircraft collisions (bird-strikes) cause serious safety hazards to aircraft, costing civilian aviation at least \$496 million annually in the U.S. Non-lethal bird-frightening devices, such as propane exploders, are commonly used to deter birds from airport environments. We conducted a study during August - October 2004 to determine the efficacy of propane exploders utilized with and without concurrent lethal reinforcement activities for altering bird behavior at John F. Kennedy International Airport in Queens, New York. Two groups of 8 propane exploders each were deployed on the airfield. One group of propane exploders was set to "off" (control), whereas the other group was programmed to activate at 15-minute intervals (treatment). This pattern was reversed each week for a 12-week period. In addition, lethal control activities to reduce gull-aircraft collisions were conducted during August and September 2004. We conducted bird observations associated with propane exploders during the lethal control program (8-week period) and following the end of the program (4-week period). The number of bird flocks (≥ 1 birds) that were within 150 m of treatment ($n = 432$) and control ($n = 442$) propane exploders was similar. Simultaneous lethal control activities at the airport did not alter the effectiveness of the propane exploders. Birds responded (e.g., altered flight path) on 3 of 21 (14.3%) occasions when a bird flock was within 150 m of a treatment propane exploder that activated. Our findings suggest propane exploders used in this manner in this airport environment do not significantly alter birds behavior or reduce the threat of bird-strikes. Future research is needed to evaluate techniques such as motion-activated propane exploders to enhance the effectiveness of this tool to reduce wildlife hazards at airports.

KEY WORDS: airport, birds, device, frightening, propane exploder, safety, vertebrate pest control

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INTRODUCTION

Bird-aircraft collisions (bird-strikes) cause serious safety hazards to aircraft, costing civilian aviation at least \$490 million annually in the U.S. (Cleary *et al.* 2005). Gulls, primarily laughing gulls (*Larus atricilla*), have historically accounted for the majority of bird-strikes at John F. Kennedy International Airport (JFKIA) (Dolbeer *et al.* 1993, Dolbeer 1999) in Queens, New York. Laughing gulls from a nearby nesting colony frequently fly over the airfield and consequently increase the risk of hazardous bird-strikes at JFKIA. Since 1991, a shooting program, combined with non-lethal bird-frightening activities and habitat management, has reduced the frequency of laughing gull-aircraft collisions at JFKIA (Washburn *et al.* 2005). However, bird-strikes occur with other bird species. To increase the effectiveness of the bird-strike reduction program, a better understanding of non-lethal components of the integrated bird-strike reduction program at JFKIA is needed.

Non-lethal bird-frightening activities and devices are commonly used to deter birds from airport environments (Transport Canada 1994, USDA 1998). Propane exploders (cannons) are often employed to frighten birds and mammals away as they approach the airfield. Although a few researchers have examined the effectiveness of propane exploders as wildlife deterrents (Bomford and O'Brien 1990, Gilsdorf *et al.* 2002) in

agricultural situations and found this tool to be moderately effective, their effectiveness for altering bird behavior in an active airport environment has not been adequately evaluated. Furthermore, the effect of concurrent direct control activities in enhancing the efficacy of propane exploders for altering bird behavior is unknown. The objectives of this study were to determine 1) the efficacy of propane exploders for deterring birds from the airfield at JFKIA, and 2) if propane exploders affected bird behavior.

METHODS

This study used a repeated measures design that included control (non-functional propane exploder) and treatment (active propane exploder) groups. Active propane exploders functioned normally and were set to activate 3 times every 15 minutes at 60-second intervals. Sixteen (2 groups of 8) permanently placed propane exploders (Reed Joseph M3[®]), spaced at least 300 m apart and currently used as part of the bird strike reduction program at JFKIA, were used for this study. Initially, one group of 8 propane exploders was set to "off" (control), whereas the other group of 8 exploders was programmed to activate at 15-minute intervals (treatment). This pattern was reversed each week during the 12 weeks of the study.

A program to reduce gull collisions with aircraft,

conducted annually at JFKIA since 1991, was continued during 2004 (Washburn *et al.* 2005). As part of this program, 2-5 professional wildlife biologists were stationed on airport boundaries and used shotguns to shoot gulls attempting to fly over the airport. Shooting was conducted on 94 days during 18 May - 1 October 2004 (Washburn *et al.* 2005). 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 shooting range (about 40 m). Observations for the propane exploder study were conducted concurrently with the shooting program for 8 weeks. Following the end of the shooting program, the observations for the propane exploder study was continued for an additional 4 weeks.

Observations of birds associated with propane exploders were conducted from 4 August to 28 October 2005. An observation plot with a radius of 150 m was established around each propane exploder. Observations were conducted during the morning (06:00 to 12:00 EDT) or afternoon (13:00 to 18:00) 2 days per week (total of 20 observation plots per week). Ten randomly chosen observation plots (5 in the control and 5 in the active group) were observed from a pre-determined observation point for a 20-minute period. During each 20-minute observation period, the number, activity, and species of birds observed within or flying over the observation plot was recorded. In addition, all birds entering the observation plot were monitored for change in direction of flight (or lack thereof) if the propane exploder detonated while the birds were within 150 m of the propane exploder.

For the purpose of analysis, a bird event was defined as an individual bird or a flock of birds (e.g., >1 birds of the same species flying together in close proximity) observed within 150 m of a propane exploder. Repeated measures analysis of variance (RMANOVA) was used to determine if the number of bird events, the average number of total birds, and the number of bird events for selected species observed per 20-minute survey was different between plots with an inactive propane exploder (control) and those with a functional propane exploder

(treatment) during a lethal control program for gulls and following the end of that program (Crowder and Hand 1990).

RESULTS

During 80 hours of observation, 855 bird events, consisting of 5,392 individual birds, occurred when a bird or flock of birds flew or perched within 150 m of a propane exploder. The average number of bird events per 20-minute survey within 150 m of active and control propane exploders was similar ($F_{1,2} = 0.01$; $P = 0.98$; Table 1). The average number of bird events per survey was not different ($F_{1,2} = 0.27$; $P = 0.66$) during the weeks with simultaneous lethal control activities at the airport, compared to weeks after lethal control activities ended (Table 1). There was no significant interaction ($F_{1,2} = 0.01$; $P = 0.98$) between propane exploder treatment and lethal control program status.

The average number of total birds observed within 150 m of active and control propane exploders during each 20-minute survey was similar ($F_{1,2} = 1.41$; $P = 0.36$; Table 2). The average number of total birds observed per survey during the weeks with simultaneous lethal control activities at the airport was not different ($F_{1,2} = 1.53$; $P = 0.34$) than during the weeks after lethal control activities ended (Table 2). There was not a significant interaction ($F_{1,2} = 0.26$; $P = 0.66$) between propane exploder treatment and lethal control program status.

Although differences in the average total number of birds observed near active and control propane exploders were not statistically different, the higher average number of birds per survey observed near the control propane exploders merited further analyses. Due to the potential influence of several large flocks (>100 individuals) of European starlings (*Sturnus vulgaris*), these data were removed from the dataset and reanalyzed. The average number of total birds (except European starlings) observed within 150 m of active ($\bar{x} = 10.0$, SE = 2.31) and control ($\bar{x} = 10.4$, SE = 1.79) propane exploders during each 20-minute survey was similar ($F_{1,2} = 0.01$; $P = 0.96$). The average number of total birds (except European starlings) observed per survey during the weeks

Table 1. Average number of bird events (an individual bird or a flock of birds) that flew or perched within 150 m of active or inactive (control) propane exploder per 20-minute survey during and following a gull lethal control program at John F. Kennedy International Airport, 4 August 2004 to 28 October 2004.

Status of Propane Exploder	Average (SE) Number of Bird Events Per 20-minute Survey		
	Lethal Control (4 Aug. - 30 Sept.)	No. Lethal Control (1 Oct. - 28 Oct.)	Total
Active	3.9 (0.34)	2.9 (0.35)	3.6 (0.26)
Control	4.1 (0.38)	2.8 (0.28)	3.7 (0.27)
Total	4.0 (0.25)	2.9 (0.22)	3.6 (0.19)

Table 2. Average total number of birds that flew or perched within 150 m of active or inactive (control) propane exploder per 20-minute survey during and following a gull lethal control program at John F. Kennedy International Airport, 4 August 2004 to 28 October 2004.

Status of Propane Exploder	Average (SE) Total Number of Birds Per 20-minute Survey		
	Lethal Control (4 Aug. - 30 Sept.)	No. Lethal Control (1 Oct. - 28 Oct.)	Total
Active	23.0 (4.47)	8.8 (2.36)	18.3 (3.14)
Control	28.7 (5.42)	22.7 (8.16)	26.7 (4.51)
Total	25.8 (3.51)	15.7 (4.29)	22.5 (2.75)

with simultaneous lethal control activities at the airport ($\bar{x} = 12.9$, $SE = 2.13$) was not different ($F_{1,2} = 0.42$; $P = 0.58$) than during the weeks after lethal control activities ended ($\bar{x} = 4.9$, $SE = 0.65$). There was not a significant interaction ($F_{1,2} = 0.01$; $P = 0.97$) between propane exploder treatment and lethal control program status.

Thirty-nine species of birds were observed during the surveys conducted at JFKIA. Herring gulls (*Larus argentatus*) and laughing gulls were the most frequently observed bird flocks during the study. Nine species of birds were observed with enough frequency to allow for a species-specific analysis. For all 9 species, the number of bird flocks per 20-minute survey within 150 m of active and inactive propane exploders was similar (all $F_{1,4} < 0.70$; all $P > 0.45$; Table 3).

Birds appeared to respond to the detonation of a propane exploder on 3 of 21 (14.3%) occasions when an individual bird or a flock of birds was near an active propane exploder that detonated. On all 3 occasions, the birds altered their flight path by making a 45-90° turn and continued flying in the new direction. These 3 events involved a laughing gull, a herring gull, and a flock of brown-headed cowbirds.

DISCUSSION

Propane exploders are often suggested as a non-lethal frightening device for deterring birds and other wildlife from using airport environments (Transport Canada 1994, USDA 1998). At JFKIA, permanently placed propane exploders have been employed for over 15 years to frighten birds as they approach the airfield.

The results of this study suggest propane exploders used in this manner in this airport environment do not significantly alter bird behavior or reduce the threat of bird-strikes. The number of birds observed near actively working propane exploders was similar to the number of birds observed near inactive propane exploders throughout the study. Due to the predictability of the systematic detonation pattern and stationary position of the propane exploders, birds likely habituated to the propane exploders. Other studies evaluating systematically detonating propane exploders have found that although initially wildlife might be dispersed or deterred from an area by propane exploders (Stickley *et al.* 1972, Conover 1984), these devices lose their effectiveness within a few days to weeks (Cummings *et al.* 1986, Bomford and

O'Brien 1990, Belant *et al.* 1996).

The concurrent lethal control program focused on reducing gull strikes allowed for the evaluation of the efficacy of propane exploders for altering bird behavior as part of an integrated wildlife damage management program. Our findings suggest the concurrent lethal control program did not increase the effectiveness of the propane exploders for deterring bird use of the airport environment, in particular with respect to the 4 gull species observed at JFKIA. We observed more bird events and higher numbers of birds during the lethal control program. This finding is likely due to a naturally occurring seasonal pattern, where higher numbers and species of birds are using the airfield environment during August and September (e.g., more migrating birds) compared to October (e.g., summer residents such as laughing gulls likely were not present; Belant and Dolbeer 1993).

European starlings accounted for more than half (54%) of the birds observed during the study. Although on the majority of occasions starlings were observed in flocks of less than 20, there were 22 times when large flocks (40-300 individuals) were observed within 150 m of propane exploders (8 flocks were observed near active propane exploders and 14 flocks near inactive exploders). Although the available data from this study is limited, it does suggest that future research might closely examine the effectiveness of propane exploders for deterring large flocks of starlings.

MANAGEMENT IMPLICATIONS

Propane exploders might be an effective component of an integrated wildlife strike reduction program at airports if used differently than during this study. Using motion-activated propane exploders, moving propane exploders frequently, and using propane exploders to deter wildlife from using specific areas that are temporarily attractive (e.g., temporary standing water) might increase the effectiveness of these devices for altering bird behavior (Bomford and O'Brien 1990, Belant *et al.* 1996, Gilsdorf *et al.* 2002). Future research is needed to evaluate the effectiveness of these alternative techniques associated with propane exploders and other non-lethal tools for reducing the risk of wildlife strikes within airport environments.

Table 3. Average number of bird events (an individual bird or a flock of birds) that flew or perched within 150 m of active or inactive (control) propane exploders at John F. Kennedy International Airport, 4 August 2004 to 28 October 2004.

Bird(s)	Active Propane Exploders		Inactive Propane Exploders		F-statistic and P-value
	Average	SE	Average	SE	
Laughing gull	0.60	0.110	0.70	0.128	$F_{1,4} = 0.03$ $P = 0.86$
Herring gull	1.10	0.111	1.10	0.120	$F_{1,4} = 0.01$ $P = 0.99$
Great black-backed gull	0.11	0.029	0.08	0.025	$F_{1,4} = 0.64$ $P = 0.47$
Ring-billed gull	0.07	0.037	0.05	0.023	$F_{1,4} = 0.07$ $P = 0.81$
Common tern	0.17	0.065	0.18	0.059	$F_{1,4} = 0.01$ $P = 0.97$
Double-crested cormorant	0.07	0.023	0.10	0.032	$F_{1,4} = 0.57$ $P = 0.49$
Mourning dove	0.06	0.022	0.13	0.043	$F_{1,4} = 0.36$ $P = 0.58$
Barn swallow	0.27	0.045	0.23	0.050	$F_{1,4} = 0.01$ $P = 0.94$
European starling	0.43	0.067	0.44	0.057	$F_{1,4} = 0.01$ $P = 0.91$

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