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Emergency Wildlife Management Response to Protect Evidence Associated with the Terrorist Attack on the World Trade Center, New York City

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ABSTRACT: At the request of the New York City Police Department, the Port Authority of New York and New Jersey, and the New York State Department of Environmental Conservation, a team of USDA APHIS Wildlife Services (WS) biologists mobilized in less than 24 hours to assist federal, state and local law enforcement officials in managing birds and rodents impacting the recovery of evidence as a result of the September 11, 2001 terrorist attacks on the World Trade Center. During the 10-month recovery effort from September 2001 to June 2002, more than 1.7 million tons of debris was shipped from "Ground Zero" in Manhattan to a high-security crime scene at the Fresh Kills Landfill (FKL), Staten Island, New York. Close to a billion pieces of debris were sorted by law enforcement officials to recover personal effects, human remains, and other evidence to document the crime and identify victims, as part of the largest forensic investigation in U.S. history. Within days of bringing debris to FKL, more than 2,600 gulls were on site, disrupting work of law enforcement officials and creating a concern that evidence would be lost to birds. Historically, FKL has been a feeding and loafing site for over 100,000 gulls. To address this unprecedented wildlife damage management problem, WS implemented an integrated bird and rodent management program that involved 69 biologists from 23 states. The goal was to reduce the impact of gulls, crows, house mice, and Norway rats on law enforcement personnel, equipment, and evidence collection including a zero-tolerance policy for gulls and crows landing on the working face. A combination of population surveys and direct management activities targeting gulls and crows was initiated 12-14 hours a day, 7 days a week using visual and noise deterrents including pyrotechnics, mylar tape, human and dead-bird effigies, lasers, paint ball guns, and lethal removal of a limited number of birds. In addition, commensal rodent surveys with snap traps were conducted twice monthly to document population trends and explore the need for rodent control on site. We deployed over 23,000 pyrotechnics and dispersed over 172,000 gulls and 5,000 crows from the site. We removed 293 house mice and 46 Norway rats in 6,000 trap-nights. The program was highly effective in preventing gulls and crows from feeding on remains and disrupting workers. We discuss other key lessons learned regarding an emergency response program to manage wildlife.

KEY WORDS: commensal rodents, crow, emergency response, forensic evidence, gulls, mylar tape, protecting evidence, pyrotechnics, September 11, 2001, World Trade Center, zero-tolerance

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"There were days that you would come up here and you see some of the most magnificent sunrises and some of the most magnificent sunsets you could see. And then there were days you would come up here and it stinks of methane and days you come up here and it just sinks of death. Death has a very distinct odor. You would come here and the entire hill would just stink and reek of death. The track vehicles and heavy equipment blowing by and the whole hill shakes as they go by. The constant noise of the machinery running and the debris being moved from one place to another. The Department of Agriculture setting off the fireworks continually to keep the birds away. And it's not your nice peaceful view of sitting along the beach, watching seagulls fly by. These were nasty birds and they were very aggressive. We knew what piles were rich in body parts by the way the seagulls descended on it. And you would have to fight the seagulls for the human remains. It was just constant noise. You go home with the beep, beep, beep in your head of the trucks going back and forth and going backwards."

Inspector James Luongo, Incident Commander at Fresh Kill Landfill, NYC Police Department, describing "The Hill" and unforeseen challenges, particularly early on, regarding gulls attempting to feed at the World Trade Center recovery site (source: http://Sonicmemorial.org/ public/stories.html)

INTRODUCTION

Human-wildlife conflicts can arise under a variety of circumstances and working environments. Few could have predicted the conditions that would require emergency application of wildlife damage management principles and practices that resulted from a terrorist

attack on September 11, 2001. This attack killed 2,823 people and destroyed the World Trade Center (WTC), a part of the New York City skyline for 30 years. Immediately after the terrorist attack, law enforcement officials were faced with the critical question of finding a facility to serve as an open-air crime lab to sort and catalog WTC debris. The decision was made to use the recently closed Fresh Kills Landfill (FKL) in Staten Island, New York. Debris began to arrive on September 12, 2001. During the 10-month recovery effort from September 2001 to June 2002, more than 1.7 million tons of debris was shipped 20 km from "Ground Zero" in Manhattan to the high-security crime scene at FKL. Close to a billion pieces of debris were sorted by law enforcement officials to recover personal effects, human remains, and other evidence to document the crime and identify victims as part of the largest forensic investigation in U.S. history. Within days of bringing debris to FKL, more than 2,600 gulls (*Larus* spp.) were on site, disrupting work of law enforcement officials and creating a concern that evidence would be lost to birds.

Municipal solid waste landfills like FKL provide important foraging and loafing areas for gulls and crows (*Corvus brachyrhychos* and *C. ossifragus*) in the Northeastern U.S. The greatest abundance of birds at these facilities is usually associated with proximity to large bodies of water during winter months and migration (Slate et al. 2000, Belant et al. 1995). Fresh Kills Landfill had an extensive history of gull use during its 53 years of operation. In November 1986, Dolbeer and Woronecki (1987) documented over 100,000 gulls (80% herring gulls, *L. argentatus*; 20% black-backed gulls, *L. marinus*; and <1% ring billed gulls, *L. delawarensis*) on the site. At the time, this likely represented the largest concentration of gulls in Eastern North America (Dolbeer and Woronecki 1987).

Another baseline measure of the gull and crow populations that could have potentially accessed FKL and disrupted recovery operations is the number of these species recorded during the Audubon Christmas Bird Count (CBC) conducted each December in a 15-mile diameter circle on Staten Island. The 10-year mean annual count of gulls (primarily herring gulls) from 1991-2000 showed about 54,000 gulls in the vicinity of the landfill (Table 1). The 10-year mean for crows numbered 19,461 birds (National Audubon Society 2004).

Concern was also raised that house mice (*Mus musculus*) and Norway rats (*Rattus norvegicus*) could interfere with recovery efforts. Rodents could feed on human remains, transmit disease, gnaw on wiring and equipment in temporary shelters, and consume and contaminate food supplies for workers. In addition, the mere presence of rodents provided another level of stress to an already overstressed work force. In particular, a dramatic increase in the Norway rat population could significantly impact collection of human remains for DNA analysis. As part of the operation and closure plans for the FKL, the NYC Department of Sanitation had been monitoring and controlling rodent problems through services provided by private pest control operators, although rodenticides had not been used recently because of non-target species concerns.

The 10-month WTC recovery project involved moving debris with trucks and barges from Ground Zero to FKL. More than 108,000 truckloads of material were moved from barges parked on the Arthur Kill River adjacent to FKL to the 175-acre processing area designated as the "The Hill". Once WTC debris made it to FKL, law enforcement officials focused their efforts on collecting and documenting 1) human remains, 2) personal effects, and 3) criminal evidence. Concern by New York City Police Department (NYPD) and the Federal Bureau of Investigation (FBI) over perceived loss of human remains to birds (gulls; crows; vultures, *Cathartes aura*) and commensal rodents (rats, mice) led to a request for the U. S. Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services (WS) to address problems associated with wildlife. As a result, wildlife management became an integral part of the recovery effort.

In this paper, we document the role WS played in the WTC recovery project to ensure the maximum recovery of forensic evidence at risk of being lost to wildlife at FKL. We also discuss program efficacy in terms of birds dispersed from the site and rodent monitoring efforts. Personnel and logistical commitments are documented to assist in implementing future comprehensive emergency wildlife management programs. Lastly, we discuss key lessons learned regarding an emergency response program to manage wildlife.

Table 1. Annual number of gulls and crows counted on the Staten Island Christmas Bird Count during December, 1991 - 2000 (National Audubon Society 2004), compared to numbers counted in December 2001 when bird management program was ongoing at Fresh Kills Landfill.

Species	Annual number of gulls counted (1991 - 2000)			Number counted in Dec 2001
	minimum - maximum	*10-year mean*	*% of total*	
Gulls				
Herring gull	13,970 - 64,824	39,177	73	5,110
Great black-backed gull	6,040 - 21,785	11,666	22	1,240
Ring-billed gull	1,407 - 8,101	2,828	5	2,153
Other gulls[a]	0 - 25	9	<1	5
Total gulls	**22,084 - 78,281**	**53,672**	**100**	**8,508**
Crows				
American crow	3,135 - 51,264	16,986	87	725
Fish crow	60 - 8,063	2,475	13	89
Total crows	**3,195 - 28,238**	**19,461**	**100**	**814**

[a] Lesser black-backed gull (*Larus fuscus*), glaucous gull (*L. hyperboreus*), Iceland gull (*L. glaucoides*), and laughing gull (*L. atricilla*). These numbers do not include counts of Bonaparte's gulls (*L. philadelphia*, mean 195, range 6 - 1,058), because this species does not frequent landfills.

STUDY AREA

Fresh Kills Landfill is located on the western shore of Staten Island, New York and encompasses some 3,000 acres (Dolbeer and Woronecki 1987). It contains a mosaic of wildlife habitat including forested areas, freshwater and tidal wetlands, meadows as well as grass covered capped portions of the landfill, and other early successional habitats (www.nyc.gov). Fresh Kills Landfill is located in the Atlantic Flyway and remains important habitat for more than 45 bird species during fall and spring migration.

The landfill was considered the largest in the world at its peak in the 1980s, receiving 29,000 tons of garbage a day (Molinari 2001). Fresh Kills Landfill took in about 150 million tons of garbage during the 53 years of operation from 1948 to March 2001, when it was closed after a highly political 10-year fight. On September 12, 2001, FKL was re-opened and began receiving WTC debris for sorting and documentation. The work area grew throughout the next 10 months to encompass 175 acres. Landfills normally have few people and limited equipment working on site. The landfill environment on "The Hill" was particularly dangerous because it was unique in the sheer volume of equipment, the number of people working in the landfill in close contact with debris, and numerous temporary buildings (including a cafeteria) in close proximity to the sorting area. In terms of operational activities, one of the NYPD officers described the first few days of sorting on "The Hill" as something akin to a rugby scrum every time a new truckload of material would arrive. At that time, it was a process involving garden rakes and people literally on hands and knees looking for evidence of "life interrupted." A total of 24 federal, state, and local agencies were associated with this project. At the peak of operation, more than 1,000 people were working on site including up to 350 NYPD detectives and 60 or more federal agents from the FBI, Federal Emergency Management Association, Secret Service, and WS. Debris recovery methodology changed over time, and the process became less chaotic, and more efficient and predictable. Machinery for sifting and sorting became more sophisticated and some of the sorting was eventually done inside partially covered structures. The last truckload of WTC debris arrived on June 28, 2002.

EMERGENCY WILDLIFE MANAGEMENT RESPONSE

The New York office of WS received a request for assistance from the Port Authority of New York and New Jersey (PA) on September 17, 2001 regarding bird damage at FKL. The NYPD and the FBI were requesting assistance from the PA, WS, and the New York State Department of Environmental Conservation to protect evidence by reducing feeding activity of "seagulls and turkey hawks" that were described as removing human remains from the sorting area as well as disrupting workers. WS treated this request at the highest priority level. An emergency planning meeting was held among New York WS staff on September 17, recognizing that biologists would be entering what Mayor Rudy Giuliani described as "uncharted waters" in terms of wildlife damage management. A site visit was made the following morning, September 18.

It was clear from the outset that an integrated, adaptive management approach was required. The stated objectives of the project became to document populations of birds and rodents impacting the recovery effort, and to implement a zero-tolerance policy for crows and gulls landing on the working face to minimize loss of evidence and reduce the impact to law enforcement. On the morning of September 18, WS documented more than 2,600 gulls (and a handful of crows) walking among the workers as well as loafing and feeding. Only one vulture was seen; vultures were not a concern during the project. Conventional bird control activities, relying heavily on pyrotechnics, were immediately initiated (within 24 hours of the request for assistance) by WS with assistance the first few days from PA staff and a private bird management consulting firm (Falcon Environmental). At that time, the NYPD and FBI made a formal request that WS provide wildlife management assistance throughout the recovery effort.

METHODS

To address bird and rodent damage at FKL, WS Operations and WS National Wildlife Research Center biologists implemented a fully-integrated wildlife damage program involving a combination of population surveys and direct management targeting gulls, crows, and commensal rodents.

Gull Surveys

To monitor the population of gulls attempting to access the FKL operations area, a standardized gull survey was conducted daily (usually at 10:00 AM) 7 days a week at two locations adjacent to the debris-sorting area. These sites included a capped area of the landfill and a portion of the Arthur Kill River adjacent to FKL. Biologists surveyed these locations from a standard survey route using binoculars to count total number of gulls and determine species composition.

Rodent Surveys

Commensal rodent surveys were conducted with snap traps twice monthly to document population trends and determine the need for rodent control on site. We used 100 standard Victor rat-sized snap traps placed along transects in three different areas of the landfill including the debris sorting area (Barras et al. 2000). Limited spot control for rats and mice in and around buildings was also initiated at the request of NYPD and other cooperating agencies.

Bird Management

The bird management techniques implemented for this project represented commonly used tools for wildlife management at landfills (Slate et al. 2000) in an uncommon landfill environment. A combination of population surveys and direct management activities were implemented by teams of two WS employees working dawn to dusk (12-14 hours a day), 7 days a week, over the course of 9 months. Visual and noise deterrents used included pistol-launched pyrotechnics, mylar flags, human and

Table 2. Effort and dollars expended by U.S. Department of Agriculture, Wildlife Services in the wildlife control program, Fresh Kills Landfill, Staten Island, New York, September 2001 - June 2002.

Measure of effort	Number	Comments
Number of personnel participating	69	Wildlife biologists, technicians, and specialists from 23 states
Number of days worked	273	Sept. 17, 2001 - June 17, 2002
Person-hours of effort	7,000	Typically 2 persons from ½ hr before sunrise to ½ hr after sunset, 7 days/week
Total costs	$336,563	Salaries, travel expenses, equipment and supplies

dead-bird effigies, hand-held lasers, paintball guns, and limited lethal shooting with a pellet rifle or shotgun. Initially, the NYPD requested WS limit the use of certain techniques including shell crackers and propane cannons over concern about noise complaints from neighbors and the high-stress work environment, in which recovery workers were sensitive to explosions and loud noises. All migratory birds were taken under a Federal U.S. Fish and Wildlife Service (USFWS) depredation permit listing WS employees, PA JFK International Airport Bird Control Unit employees, and NYPD employees as authorized permitees.

RESULTS AND DISCUSSION

An integrated wildlife damage management program was implemented at FKL from September 18, 2001 to June 17, 2002. A total of 69 WS biologists from 23 states provided assistance on this project during 273 work days (Table 2). Total cost of the program was $336,563. The consensus from biologists who had an opportunity to work at FKL was that the experience was sobering, humbling, challenging, and ultimately gratifying to contribute their professional expertise.

Bird Management

The number of gulls counted during daily surveys at the sites adjacent to the debris sorting area was highest in October 2001 (mean of 852 gulls/survey) and declined steadily to less than 40 gulls/survey from March-June 2002 (Table 3). The steady decline in numbers during the fall and winter months, when gull numbers would be expected to be highest, indicated that the management program had a definite impact on the local gull population.

Table 3. Mean number of gulls counted per daily survey at 10:00 at two sites adjacent to the debris sorting area at Fresh Kills Landfill, Staten Island, New York, October 2001 - June 2002. See Table 1 for approximate species composition of gulls.

Month	Number of surveys	Number of gulls	
		Mean	*95% confidence interval*
Oct	31	852	236 - 1,467
Nov	30	430	167 - 693
Dec	30	216	72 - 359
Jan	31	113	62 - 163
Feb	28	76	41 - 112
Mar	31	37	27 - 47
Apr	30	27	21 - 33
May	30	25	19 - 31
Jun	18	15	10 - 21

An independent indication of the success of the dispersal program came from the numbers of gulls and crows counted on the Staten Island CBC in December 2001 (3 months after WS began the bird management program at FKL). Only 8,508 gulls and 814 crows were counted, which represented 16% and 4%, respectively, of the 10-year mean numbers for gulls and crows, 1991-2000 (Table 1).

Pistol-launched pyrotechnics (bangers and screamers) were the primary tool used by WS for hazing birds throughout the project. A total of 23,976 pyrotechnics was fired during 273 work days, resulting in moving over 172,000 gulls off sites critical to the WTC investigation (Table 4). Persistent individual gulls and crows were harassed multiple times.

The number of gulls dispersed peaked in November at 36,978 and was at its lowest (576) during June, the final month of the project (Table 4). Fewer crows (5,034) were hazed during the same period, but the trend showed a reduction in numbers of birds attempting to enter the FKL that was similar to gulls. Our priority was to disperse birds before they began feeding on the working face of the landfill. Only 2% of all gulls dispersed involved feeding prior to hazing. Peaks in this behavior occurred in September and December (Table 4). Birds were documented most often loafing on site or more commonly simply flying over the landfill. We also calculated a crude index to management efficiency by looking at the ratio of gulls moved/pyrotechnic fired. Higher efficiencies reflect moving greater numbers of gulls/pyrotechnic fired (Slate et al. 2000). Our efficiency decreased over time as we encountered increasingly smaller flocks of gulls that may have become somewhat habituated to our methods (Table 4). To reduce habituation, we supplemented non-lethal methods with shooting a limited number of gulls. Unlike more typical landfill situations in upstate New York, where 300 or more gulls may be removed per winter to reduce habituation (Chipman unpubl. data), only 23 gulls were taken during the 10-month project at FKL.

Other wildlife damage techniques incorporated early on this project included mylar flags, lasers, paintball guns, and human and dead-bird effigies. Other studies have shown that mylar flags can be effective in reducing gull use of loafing areas in landfills (Belant and Ickes 1997). We had good success for more than 3 weeks in keeping 3 species of gulls off a preferred loafing site adjacent to the debris-raking area. Eventually a few gulls were seen under the mylar flags, but these flags remained effective as long as they were maintained and used as part of an integrated program. We also used both human effigies and dead gulls as visual deterrents. Although used in a

Table 4. Number of flying, loafing and feeding gulls dispersed by pyrotechnics at Fresh Kills Landfill, Staten Island, New York, on 273 days from September 2001 - June 2002 (see Table 1 for typical gull species composition on Staten Island).

Month	*Number of gulls dispersed by activity*				*Pyrotechnics*	
	Flying	Loafing	Feeding	Total	No. fired	Efficiency[a]
Sep	5,810	8,309	1,802	15,921	1,652	9.6
Oct	12,738	7,583	506	20,827	2,264	9.2
Nov	18,305	18,364	309	36,978	4,402	8.4
Dec	28,339	5,852	1,403	35,594	4,876	7.3
Jan	14,968	13,424	2	28,394	2,839	10.0
Feb	11,369	4,465	20	15,854	2,402	6.6
Mar	10,968	2,791	0	13,759	3,127	4.4
Apr	2,837	656	24	3,517	1,465	2.4
May	901	77	15	993	709	1.4
Jun	571	5	0	576	240	2.4
Total	**106,806**	**61,526**	**4,081**	**172,413**	**23,976**	**6.2**

[a] number of gulls dispersed per pyrotechnic fired

Table 5. Number of rodents trapped during monthly general surveys and during site-specific trapping at facilities where rodent control was requested, Fresh Kills Landfill, Staten Island, New York, September 2001 - June 2002.

Trapping program	No. of trap-nights	No. of rodents trapped (no. per 100 trap-nights)		
		House mice	*Norway rats*	*Total*
Bi-monthly general survey	4,795	251 (5.2)	22 (0.5)	**273 (5.7)**
Site-specific control	1,279	42 (3.3)	24 (1.9)	**66 (5.2)**
Total	**6,074**	**293 (4.8)**	**46 (0.8)**	**339 (5.6)**

limited fashion, human effigies were ineffective in deterring gulls or crows; however, dead gulls hung upside down from a pole appeared to temporarily deter gulls from small loafing areas.

Hand-held lasers (Blackwell et al. 2002) were used successfully during the first 2 months of the project to move gulls loafing or roosting on the ground at dawn and dusk. A single sweep of the laser would get most gulls up into the air. This visual deterrent, when reinforced with pyrotechnics, was effective in moving gulls from the working face of FKL. Due to lack of range and accuracy, paint-ball guns were the least effective method employed during the project.

Rodent Monitoring and Management

Monitoring and managing the commensal rodent population at FKL was an essential component of our emergency wildlife damage management response program. During the project, WS conducted 16 surveys that captured 251 house mice and 22 Norway rats in 4,795 adjusted trap-nights (Table 5).

Our catch/100 trap-nights for both species never showed a significant trend and remained dynamic throughout the project. The number of rats caught never reached a level that indicated a need to implement a large scale rodenticide program.

House mice were more frequently caught than rats. Other studies have shown an inverse relationship between house mice and rats (Billings and Harden 2000, Witmer et al. 2001). Despite using trapping techniques targeting rats, house mice made up more than 90% of all captures. We did implement site-specific control using snap traps based on request for assistance from other agencies around office trailers, showers, and food preparation and serving areas. We removed 42 house mice and 24 Norway rats from these sites (Table 5), which generated considerable good will from our cooperators at the landfill.

CONCLUSIONS

During the course of the 10-month recovery project, more than 80,000 personal effects and close to 20,000 human remains were recovered from both Ground Zero and FKL (USA Today July 15, 2002). This recovery of human remains and personal effects was essential to identify as many victims as possible through forensic science, especially DNA analysis, and to bring closure to families. The management of birds and rodents at FKL was an integral component of this important effort.

This unprecedented wildlife damage project resulted in a significant number of key lessons learned, including the following:

1) Wildlife Services was able to respond to an emergency request and quickly implement an effective, integrated, science-based wildlife management program to meet project goals and objectives. The project highlighted the effective working relationship between WS operations and research personnel.

2) This project underscored the importance of "planning your work and working your plan", timely communication, and incorporating an adaptive management approach to meet project goals under unusual and stressful environmental conditions.

3) Implementing a strict zero-tolerance policy for managing gulls and crows on the working face of the landfill at the very beginning of the project motivated biologists to reach a rigorous, yet well-defined goal.

4) Traditional bird management tools like mylar tape and pyrotechnics work if implemented with consistent persistence in an integrated fashion. Our rule-of-thumb

for project implementation became to go in early, go long, be aggressive, be flexible, and have a good team support working on site and back in the office.

5) Finally, this project has implications and application for airports and other landfills that need to implement a zero-tolerance approach for gulls and crows. From a professional wildlife management perspective, it is our responsibility to be prepared to address wildlife conflicts in all situations and continue to look for new and innovative ways to solve these critical problems.

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