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Managing Gulls to Reduce Fecal Coliform Bacteria in a Municipal Drinking Water Source

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ABSTRACT: Large numbers of ring-billed gulls, herring gulls, and greater black-backed gulls roost each night on a municipal drinking water source in Maine and have been identified as the primary source of elevated fecal coliform bacteria levels. The lake has a resident gull population of approximately 800, while more than 3,000 gulls have been observed during seasonal migration. To alleviate this public health concern, the U.S. Department of Agriculture APHIS Wildlife Services program implemented an Integrated Wildlife Damage Management program in 2005. The program included the use of pyrotechnics and watercraft to harass gulls, as well as shooting to reinforce and enhance the effectiveness of non-lethal methods. Management activities were effective in keeping gulls off the drinking water source and lowering coliform bacteria levels to within EPA water quality standards. Additionally, the integrated program also involves an ongoing survey in areas surrounding the lake to identify feeding, loafing, and roosting areas that may affect gull movement. Information collected from the survey will result in more effective management practices and contribute to the long-term goal of reducing gull use on the lake.

KEY WORDS: bacteria, birds, dispersal, drinking water, fecal coliform, gulls, harassment, integrated wildlife damage management, Maine, public health, shooting

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INTRODUCTION

Lake Auburn is a 2,290-acre (927-ha) municipal drinking water source that is located in Auburn, Maine. Over 45,000 people living in and around the cities of Auburn and Lewiston draw water from Lake Auburn (Sun Journal 2007). Due to the high water quality level of Lake Auburn, less treatment is required than most water sources; Lake Auburn is one of fewer than 60 surface water supplies in the United States that are unfiltered (AWD 2006). Due to the level of water quality and an ongoing watershed protection program, the Auburn Water District (AWD) and the Lewiston Water Department (LWD) have been granted a waiver from the federal filtration requirement of the Surface Water Treatment Rule (AWD 2005). The U.S. Environmental Protection Agency (EPA) and the Maine Drinking Water Program (MDWP) set and enforce standards for water quality governing Lake Auburn. By EPA standards, no more than 10% of the daily water samples taken from Lake Auburn can exceed 20 fecal colonies per 100 ml each month. Otherwise, their filtration waiver is revoked. Installation of a filtration facility would cost the communities of Auburn and Lewiston nearly \$40 million (N. Lamie, AWD, pers. commun. 2007).

In fall 2004, AWD and LWD began to document an increase in the bacteria levels of Lake Auburn. Water quality testing revealed that the bacterium was fecal coliform and the levels were exceeding the limit set by EPA and the MDWP (20 fecal colonies / 100 ml). Fecal coliform can indicate the possible presence of pathogenic (disease-causing) bacteria, viruses, and protozoans (US EPA 2006). Various tests and analyses were conducted

in an attempt to determine the cause of the elevated bacteria levels. A daily bird monitoring program was implemented in the spring of 2005 and revealed large numbers of ring-billed gulls (*Larus delawarensis*), herring gulls (*Larus argentatus*), and greater black-backed gulls (*Larus marinus*) roosting and loafing daily on Lake Auburn. Microbiological analysis of samples corroborated the high levels of fecal coliform input from gulls, primarily through *Campylobacter lari*, which is an indicator of the presence of gulls (CDM 2005).

To determine if the gulls were the cause of the elevated bacteria levels, AWD and LWD began daily harassment with motorboats and pyrotechnics. However, initial harassment efforts were unsuccessful in moving the gulls off Lake Auburn. As the fall migration brought greater numbers of gulls, the bacteria levels in Lake Auburn increased and jeopardized the filtration waiver. The U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services (USDA APHIS WS) program was contacted for assistance to alleviate the threat that the gulls posed to human health and safety.

METHODS

An integrated wildlife damage management approach was taken by Wildlife Services (WS) on Lake Auburn beginning November 21, 2005 through December 13, 2005, when the lake froze. Routine management resumed June 8, 2006; however, intensive management began in early August and ended January 17, 2007, when the lake froze. Management restarted on April 23, 2007 and ran until December 19, 2007. The approach involved two WS employees with a 17-foot motorboat, using lethal

and non-lethal control techniques to disperse the gulls. A wildlife biologist and a technician were assigned full-time to the project starting in 2006.

Non-Lethal Techniques

Non-lethal methods are a critical component of an integrated wildlife damage management program. Harassment techniques included a motorboat utilizing a 90-horsepower motor, which was driven at varying speeds towards any flock of gulls present on the lake. A 360° flashing white light mounted to the top of the boat was switched on at times of low light for additional harassment. Pyrotechnic crackershells were fired at roosting or flying flocks of gulls from a single-shot 12-gauge shotgun. Crackershells were shot from the boat, or from shore when ice prevented boat access to open water. When aboard the boat, one WS employee operated the boat and the other was positioned on the bow, from which the employee could safely discharge pyrotechnics and firearms as needed. Employees wore Coast Guard-approved personal flotation devices at all times. During the fall and winter, full-body survival suits were worn. WS employees received firearm, pyrotechnic, and boat-safety training as required in Directives 2.615 and 2.625.

Lethal Techniques

In this project, shooting was used as a dispersal technique and to reinforce non-lethal methods. One to 3 gulls were shot from a flock to make the remainder of the birds disperse and to help reinforce non-lethal methods. Lethal shooting was 100% selective for the target species. WS ensured that gulls were killed as quickly and humanely as possible.

Gulls observed roosting, or flying in to roost on Lake Auburn, were approached with the motorboat. Lethal shooting was employed if non-lethal methods were ineffective. Gulls were shot with a semi-automatic 12-gauge shotgun and No. 4 or No. 2 steel shot. Once the gulls were out of range for lethal tactics, non-lethal pyrotechnics were employed, and the gulls harassed off the lake.

Shooters retrieved gulls and empty shell casings with a fishing net; gulls not saved for study specimens were buried. WS employees were very cautious when conducting management on Lake Auburn due to the level of human activity on and around the lake. Boaters and anglers frequent the lake, and there are a college, two major roads, homes, camps, and walking trails along the shores of Lake Auburn.

During the spring and summer, management was conducted 2 to 4 times a week, most often during the last 3 hours of daylight. Fewer lake visits were made during the morning and midday. However, management was conducted throughout the day if gulls were observed on the lake. From late October through December, the number of visits made to Lake Auburn to conduct management activities increased. However, the intensity of the management varied from year to year. In 2005, it was necessary for WS to be on the lake morning and evening (~3-hour shifts) 7 days a week, with a crew from AWD or LWD assisting each of those days. In 2006, WS

rotated shifts with AWD and LWD to provide coverage for 2 to 3 hours each morning and evening, 7 days a week, on Lake Auburn. In 2007, WS rotated shifts with AWD and LWD to provide coverage once a day (during the evening hours), 7 days a week.

Gull Population Study

WS also conducted an ongoing bird population survey of the local gull population in the areas surrounding Lake Auburn, starting August 14, 2006. WS established 35 designated study points that were visited 1 to 3 times a week by vehicle for observation. Study points consisted of other water bodies (lakes, ponds, and rivers), farms, businesses, recreational areas, and other areas of bird activity. A spotting scope and a set of binoculars were used to make observations. The goal of the study was to determine gull attractants to the area around Lake Auburn and to determine the size and composition of the local gull population.

RESULTS

Shooting and Harassment

Nearly 100% of gulls identified using Lake Auburn were ring-billed gulls, herring gulls, and greater black-backed gulls. The integrated wildlife damage management approach taken by WS was successful in dispersing gulls from Lake Auburn. Between 2006 and 2007, 22,568 gulls were dispersed from Lake Auburn (13,541 in 2006; 9,027 in 2007). Compared to the number of gulls dispersed, relatively few were killed. Between 2005 and 2007, 642 gulls (370 ring-billed, 249 herring, and 23 great black-backed) were killed (173 in 2005; 192 in 2006; 277 in 2007) (Table 1). There was an increase in the number of gulls shot between 2005 and 2007. However, there was also an increase in the length of the season we conducted management on Lake Auburn from year to year. Management was conducted only in the fall of 2005, summer through fall in 2006, and spring through fall in 2007.

Gull Presence

At the start of the project in the fall of 2005, several thousand gulls were using Lake Auburn. On the first day of work, over 2,000 gulls were observed on the lake. By the end of the 2005 season, presence was down to as few as 5 gulls a day. In 2006, gulls were observed on the lake throughout the year, however, never as large as the flocks seen in 2005. The trend continued with fewer gulls observed and dispersed from Lake Auburn in 2007 compared to 2006 (Figures 4 and 5).

Bacteria Levels

In 2005, during the months of October, November,

Table 1. Number of gull shot, by species and year.

Year	RBGU	HERG	GBBG	Total
2005	38	124	11	173
2006	119	69	4	192
2007	213	56	8	277
Total	370	249	23	642

RBGU – ring-billed gull
HERG – herring gull

GBBG – greater black-backed gull

Figure 1. Monthly average of bacteria (fecal) levels in Lake Auburn for October, November, and December, from 2004 - 2007.

Figure 2. Average bacteria (fecal) level in Lake Auburn for the months of October through December from 2004 - 2007.

Figure 3. Yearly average of bacteria (fecal) levels in Lake Auburn from 2004 - 2007.

and December, there was a 51.5% reduction in bacteria levels in Lake Auburn, compared to the mean for the same time period in 2004. In 2006, the reduction in bacteria levels was even more pronounced— 92.7% compared to 2004. In 2007, there was a 93.1% reduction in bacteria levels compared to 2004 (Figures 1, 2, and 3).

Gull Population Study

As a result of management on Lake Auburn, the gulls began using Taylor Pond as an alternate roosting site. No other roosting sites were found in the greater Lewiston/Auburn area. With crews dispersing gulls on Lake Auburn at dusk, gull counts on Taylor Pond at the

Figure 4. Number of gulls observed on Lake Auburn while conducting management activities from June 2006 through January 2007.

Figure 5. Gull observations made while conducting management activities from April through December 2007. (Note: No harassment was conducted from 5/24/07 - 6/21/07 due to boat motor malfunction.)

Figure 6. Number of gulls observed roosting on Taylor Pond (alternate roost site) in 2006.

Figure 7. Number of gulls observed roosting on Taylor Pond (alternate roost site) in 2007.

same time provided an excellent opportunity to estimate the size of the local gull population. Flocks on Taylor Pond grew from roughly 800 gulls in the summer to over 3,000 in the fall, in 2006 and 2007 (see Figures 6 and 7).

WS and Maine Department of Inland Fisheries & Wildlife (MDIFW) theorized that the local gull population that roosts in Lewiston/Auburn was comprised of immature gulls and non-breeding adults (B. Allen, MDIFW, pers. commun. 2007). Based on year-long observations made by WS, the local population of gulls was estimated at 800 to 1,000 individuals. Breeders and their newly fledged young joined the local population from nearby coastal nesting colonies from mid to late summer. When migrants from other areas came in the fall and stopped over in Lewiston/Auburn, the local population swelled to over 3,000 individual gulls. After the lakes and ponds iced over, as many as 1,000 gulls could still be observed feeding in the Lewiston/Auburn area. Using multiple observers, WS tracked the gulls returning to the coast each evening by following the Androscoggin River, a large flyway that runs through the middle of Lewiston/Auburn. The coast is about 20 to 25 miles (32 to 40 km) away.

Numerous gull feeding locations in the Lewiston/Auburn area were located and monitored while conducting the gull population study in 2006 and 2007. Farms were the largest and most consistent source of food for the gulls. It was not uncommon to see 200 to as many as 1,000 gulls feeding at one time at some of the farms. The two cities also provided feeding opportunities for the local gulls. Observations made in the city usually consisted of smaller groups of gulls (less than 200) exploiting restaurants, malls, garbage, and people, for food.

DISCUSSION

Bacteria Levels

The gulls that were using Lake Auburn were causing a serious threat to human health and safety for over 45,000 people. Research has shown that gulls carry various species of bacteria such as *Bacillus* sp., *Clostridium* sp., *Campylobacter* spp., *Escherichia coli*, *Listeria* spp., and *Salmonella* spp. (MacDonald and Brown 1974, Fenlon 1981, Butterfield et al. 1983, Monaghan et al. 1985, Norton 1986, Vauk-Hentzelt et al. 1987, Quessey and Messier 1992). As mentioned earlier, water samples from Lake Auburn tested positive for *Campylobacter lari*. Transmission of bacteria from gulls to humans is difficult to document, however, Reilley et al. (1981) and Monaghan et al. (1985) both suggested that gulls were the source of contamination for cases of human salmonellosis. Contamination of public water supplies by gull feces has been stated as the most plausible source for disease transmission (e.g., Jones et al. 1978, Hatch 1996). Gull feces has also been implicated in accelerated nutrient loading of aquatic systems (Portnoy 1990), which also could have serious implications for municipal drinking water sources. A year-long presence of 800 to 3,000 gulls presented a very real threat to the municipal drinking water source and the people in Lewiston and Auburn that depend on it. Fortunately, management efforts by AWD, LWD, and WS accomplished the goal of lowering bacteria levels to be in compliance with the U.S. EPA and

MDWA. This allowed AWD and LWD to keep their waiver from the federal filtration requirement, saving them upwards of \$40 million in filtration costs. A correlation between gull presence and bacteria levels in Lake Auburn was observed when management was started in the fall of 2005. As soon as management started, bacteria levels decreased (Figures 2 and 3). Historically, bacteria levels increased exponentially through the months of October, November, and December (Figure 1). With year-long gull management, bacteria levels stayed low and steady through most of the year in 2006 and 2007.

Harassment, Shooting, and Gull Presence

The number of gulls observed and dispersed on Lake Auburn decreased in 2007 compared to 2006 (Figures 4 and 5). However, gull presence in the Lewiston/Auburn area remained constant in 2006 and 2007, based on observations made at Taylor Pond (Figures 6 and 7). This shows that the local gull population is learning to avoid Lake Auburn from year to year. In addition, the gulls that continue to use Lake Auburn have been easier to disperse each year. These results could be attributed to year-long management efforts on Lake Auburn. By starting management in spring or early summer each year, the local population of gulls learned early in the season not to use Lake Auburn. That made it much easier to deal with new flocks of gulls as they returned to Lake Auburn each year from nesting colonies and other areas. In this way, the gulls could be managed in smaller groups at different times. Also, the gulls were more apt to leave Lake Auburn when other gulls were already flocked up at Taylor Pond, <1 mile (<1.6 km) away. Due to the compounded results of year-long management, the intensity of management efforts has lessened from year to year during the fall months (October through December) when gull presence and fecal levels have historically been high.

Gull Population Study

The gull population study was started by WS to help determine why the gulls were drawn inland to Lewiston/Auburn in such large numbers. It appears that gulls want to use Lake Auburn because it is a large body of water centered in a major feeding zone that is adjacent to an important flyway (the Androscoggin River). It is also close enough for gulls to travel easily from the coast to forage or loaf. Due to gull management on Lake Auburn, the gulls chose Taylor Pond as an alternate roosting site. Taylor Pond is most likely being used by the gulls because of its close proximity to Lake Auburn (<1 mile, or <1.6 km). A more pronounced spike in the number of gulls observed on Lake Auburn and Taylor Pond could be seen in the fall of 2007 compared to the fall of 2006 (Figures 4, 5, 6, and 7). It appears that the migration was more spread out in 2006, whereas it was much more pronounced in 2007. This could be attributed to the unusually warm and extended fall that was experienced in 2006. Comparatively, fall 2007 was much colder, with winter conditions setting in much earlier than 2006. In 2007, Lake Auburn froze over nearly a month earlier than in 2006.

CONCLUSION

The ultimate goal of the project was to eliminate the threat gulls posed to human health and safety by lowering bacteria levels in Lake Auburn. The integrated wildlife damage management approach utilized in this project was effective in dispersing gulls from Lake Auburn and accomplishing the goal of lowered bacteria levels. A successful partnership between AWD, LWD, and WS made it all possible. The decrease in bacteria levels allowed AWD and LWD to maintain their waiver from the federal filtration requirement, which has saved them upwards of \$40 million in filtration costs.

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