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# Gulls in urban environments: landscape-level management to reduce conflict

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**Abstract**

Populations of several species of gulls (*Larus* spp.) have increased dramatically throughout coastal areas of North America and Europe during the past several decades. These increases have been attributed generally to protection from human disturbance, reduction in environmental contaminants, availability of anthropogenic food, and the ability of gulls to adapt to human-altered environments. Gull abundance in urban areas has resulted in numerous conflicts with people including hazards to aircraft, transmission of pathogens and parasites through contamination of water sources, damage to buildings from nesting material and defecation, and general nuisance. Various architectural and habitat management approaches presently are available to reduce gull/human conflicts. For example, gull use of putrescible-waste landfills may be reduced by covering refuse, diverting anthropogenic food to covered compost facilities, erecting wire grids over exposed refuse, and manipulation of turf height in loafing areas. Nesting on roofs can be alleviated through modifications of roofing substrate, reducing the number of roof structures present, and placement of overhead wires. Also, attractiveness of airports to gulls can be reduced through drainage of temporary water and by decreasing the availability of prey and loafing sites through habitat management. Architectural design and characteristics of adjacent habitat should be considered during the planning stages of new facilities in areas where use by gulls is likely. Although control activities can be effective at the site where the gull problem occurs, uncoordinated management efforts may cause relocation of the problems to surrounding areas. Also, site-specific management will rarely solve the problem across a larger scale (e.g., city-wide). A working group comprised of the respective city or county planning commission, affected businesses and other government agencies, private citizens, and wildlife professionals could be formed to provide overall direction for gull management. This working group would define the extent and nature of the problem, develop an appropriate management strategy incorporating ecology of the nuisance species, and conduct periodic assessments of program efficacy. An integrated, landscape-level management approach is necessary to ensure an overall reduction in conflict between gulls and people in urban environments. 

*Keywords:* Gulls; *Larus* spp.; Nuisance wildlife; Urban planning; Wildlife damage management; Habitat management

## 1. Introduction

Populations of several species of gulls have increased throughout North America and Europe in recent years (Harris, 1970; Spaans, 1971; Drury and Kadlec, 1974; Vermeer, 1992; Conover, 1983; Belant and Dolbeer, 1993a). For example, data from the North American Breeding Bird Survey indicate that ring-billed and laughing gull populations have increased about 5% annually since 1966 (Peterjohn et al., 1994; Burger, 1996) (Fig. 1). In the Great Lakes

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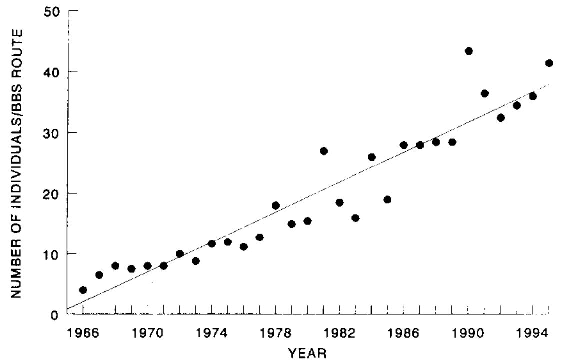


Fig. 1. Increase in North American breeding population of laughing gulls, based on North American Breeding Bird Survey (BBS) data (adapted from Burger, 1996).

region, both breeding and winter populations of herring gulls (*Larus argentatus*) and ring-billed gulls (*L. delawarensis*) have increased dramatically. For example, the nesting population of ring-billed gulls along the Canadian portion of the lower Great Lakes increased from about 56,000 pairs to 283,000 pairs between 1976–1990; herring gulls increased from 440 to 1300 pairs during these same years (Blokpoel and Tessier, 1991). Winter populations of ring-billed and herring gulls along the south shore of Lake Erie increased 21- and 6-fold, respectively, from the 1950s to the early 1980s (Dolbeer and Bernhardt, 1986).

Suspected causes for these increased gull populations include the protection of breeding colonies (Kadlec and Drury, 1968; Spaans, 1971), an increase in nesting habitat from the creation of dredge disposal islands (Patton and Hanners, 1984), and exploitation of landfills by gulls as dependable sources of food (Verbeek, 1977; Burger, 1981; Patton, 1988; Belant and Dolbeer, 1993a).

In a survey of municipalities in the United States regarding vertebrate pests, gulls were ranked as the 9th most frequently occurring nuisance (Fitzwater, 1988). Recently, U.S. Department of Agriculture Animal Damage Control biologists indicated a high priority for development of control methods to alleviate gull conflicts (ranked 6th among 66 wildlife damage problems) (Packham and Connolly, 1992). Gull conflicts with humans include transmission of pathogens and parasites through contamination of water sources and upland habitat (Mudge and Ferns, 1982; Butterfield et al., 1983), damage to buildings (Bradley, 1980; Vermeer et al., 1988; Belant, 1993), and hazards to aircraft at airports (Blokpoel, 1976; Dolbeer et al., 1993a).

## 2. Conflicts with humans

### 2.1. Roof nesting

Although roof-nesting by gulls has occurred for about 100 years (Goethe, 1960), widespread use of roofs and other urban areas by gulls has occurred only recently (Monaghan, 1979; Vermeer et al., 1988; Vermeer, 1992). Initial dispersal of gulls to roofs for nesting occurs typically during rapid growth of colonies on natural sites in surrounding areas (Paynter, 1963; Campbell, 1975; Vermeer et al., 1988; Dolbeer et al., 1990). However, herring gulls banded as chicks have been documented nesting on roofs up to 200 km from their natal colony (Monaghan and Coulson, 1977).

Success of roof-nesting colonies is attributed partially in response to their exploitation of anthropogenic food (Monaghan, 1979). Several authors (e.g., Dolbeer et al., 1990) have hypothesized that roofs were suboptimal nesting habitat, a consequence of the dispersal of breeding adults in a population experiencing rapid growth and lacking more suitable nest sites. In contrast, other studies (Monaghan, 1979; Belant, 1993) have suggested that roofs are a suitable habitat for gulls that only recently have been exploited Fig. 2.

Roof-nesting by gulls has continued to increase and now occurs with some regularity throughout the breeding ranges of various species. Populations of roof-nesting herring gulls in the British Isles increased 17% annually during the 1970s (Monaghan and Coulson, 1977). Dwyer et al. (1996) reported 30 colonies of roof-nesting gulls in the U.S. portion of the Great Lakes, which represented approximately 2% and 4%, respectively, of the total herring and ring-billed nesting populations in this area.

Gulls nesting on roofs typically are considered a nuisance because they harass maintenance personnel, defecate on nearby vehicles, obstruct roof drain systems with debris, and cause structural damage to buildings (Monaghan and Coulson, 1977; Vermeer et

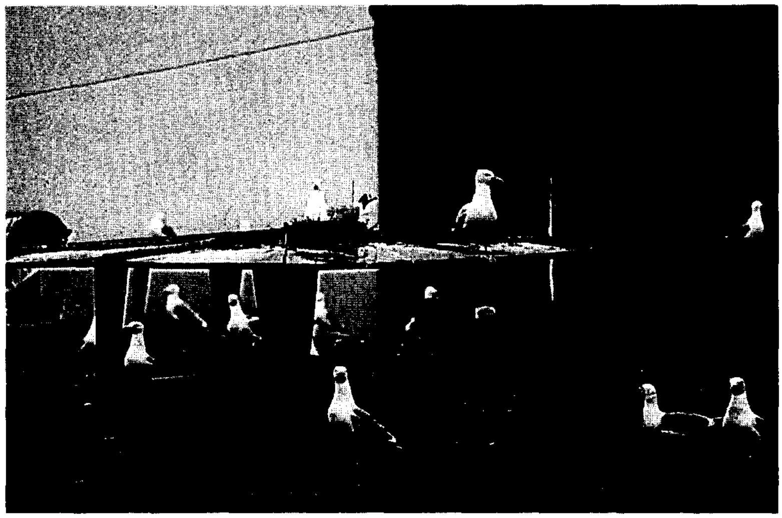

Fig. 2. Herring gulls nesting on a roof adjacent to Lake Erie, northern Ohio.

al., 1988; Belant, 1993). Vermeer et al. (1988) reported that a roof which cost US$350,000 would last only half as long as credited because of chemical erosion from gull defecation and water damage caused by feathers and nest material obstructing drainage (Fig. 3).

Gulls can transport extensive amounts of materials to roofs for nesting. During a nest and egg removal study, Ickes and Belant (1996) removed 4088 L of herring gull nest material (248 total nests) from a roof in a single nesting season. Also, the amount of material used to construct nests varies among gull species. Dwyer et al. (1994) reported mean volumes of herring and ring-billed gull nests of 23.4 and 3.6 L, respectively. Thus, the potential for nest material to damage roofs is dependent in part on the number of nests and which gull species is nesting on the roof.

### *2.2. Airports*

Gulls pose a serious threat to aviation (Fig. 4). For example, an average of 174 gulls (primarily laughing gulls) were struck annually (1988–1990) by aircraft at John F. Kennedy International Airport (Dolbeer et al., 1993a). Arrington (1994) reported that gulls were the fifth most frequently struck group of birds by U.S. Air Force aircraft. Gulls represented 30% of known bird collisions with civilian aircraft in the United States from 1993–1995 (Cleary et al., 1997). Assuming a monetary loss of US$260 M and that gulls represent 16% of birdstrikes which cause damage to civilian aircraft (Cleary et al., 1997), gulls may cause about US$40 M damage annually to U.S. civilian aviation.

Locations considered desirable for placement of landfills are similar to those required for airports (e.g., on the periphery of urban areas) (Lake, 1984). Because most gull/aircraft collisions occur on or adjacent to airports (Rochard and Horton, 1980; Cleary et al., 1997), the Federal Aviation Administration (FAA) issued Order 5200.5A to prohibit waste disposal sites within 5000 ft (1500 m) of runways used by piston-type aircraft and 10,000 ft (3000 m) of runways used by turbojet aircraft. The FAA is often required to assess the potential hazard solid waste disposal facilities outside these minimum distances pose to aircraft safety. Many of these required decisions are a consequence of gull activity at airports (Harrison, 1984).

### *2.3. Transmission of disease*

Because of increasing gull populations in urban areas, the role of gulls in the dissemination of human diseases has been examined. Gulls have been reported to carry bacteria (e.g., *Bacillus* sp., *Clostridium* sp., *Campylobacter* spp., *Escherichia coli*, *Lis-*

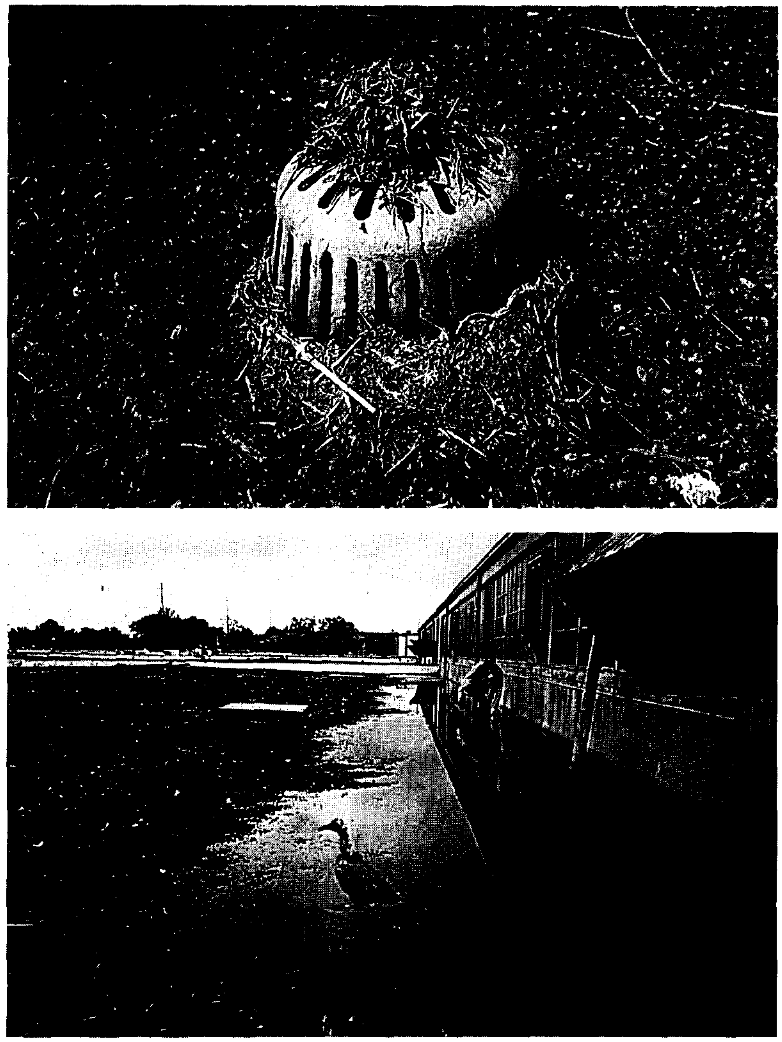

Fig. 3. Nest material can plug drain systems on roofs of buildings (top) and cause extensive flooding and damage (bottom).

*teria* spp., *Salomonella* spp. ) that cause enteric disease of humans (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). Although causal relationships for transmission of diseases from gulls to humans are difficult to document, increasing evidence suggests that gulls may be important vectors. For example, in England, Monaghan et al. (1985) described the prevalence of *Salmonella* spp. in herring gulls and determined a significant, positive correlation between the proportion of gulls carrying salmonellae and the incidence of salmonellosis in the human population in the same area. In Scotland, Reilly et al. (1981) determined that gulls were the source of contamination for 3 of 26 occurrences of human and animal 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). However, evidence suggests that gulls act as dispersal agents for pathogens (e.g., *Salmonella*) rather than being primary sources

Fig. 4. Ring-billed gulls at nesting colony on Burke Lakefront Airport, Cleveland, OH.

(Hatch, 1996). Gull feces has also been implicated in accelerated nutrient loading of aquatic systems (Portnoy, 1990).

### *2.4. General nuisance*

Gulls are frequently considered a general nuisance because of their noise, defecation, and harassment of people (Blokpoel, 1983; Vermeer et al., 1988; Belant, 1993). Blokpoel and Tessier (1984) reported ring-billed gulls stealing food from patrons of outdoor restaurants, frightening tourists, and fouling tables and park benches. Solman et al. (1983) reported gulls competing for food with domestic turkeys and captive animals at a zoo.

## 3. Management techniques

Gulls in North America are protected under the Migratory Bird Treaty Act of 1918 to which the United States, Canada, Mexico, Russia, and Japan are signatories. As such, management techniques reported herein that involve capture and killing of gulls or disturbing nests or eggs require Federal and State permits. Local permits may also be required when conducting certain management activities. All applicable permits must be obtained prior to conducting control activities.

### *3.1. Nonlethal control*

#### *3.1.1. Habitat management*

The most effective technique to reduce gull use of nesting or loafing areas is to modify habitat. At an industrial site in Ontario, nest habitat was made less attractive by filling in a pond and bulldozing vegetation (Blokpoel and Tessier, 1992). Without use of additional control techniques, however, some gulls may have continued to nest (Blokpoel and Tessier, 1992). Smith and Carlile (1993) determined that mowing silver gull (*L. novaehollandiae*) colony sites prior to nesting reduced nest density and nesting success.

Optimal loafing sites for gulls are characterized by large open areas with good visibility. Increasing grass height by limiting mowing at airports, parks, or landfills can discourage gull use of these areas. Vegetation manipulation can also be used to reduce abundant prey species of gulls, making the area less attractive. For example, Caccamise et al. (1995) determined that mowing oak scrub habitat at Atlantic City International Airport would reduce habitat suitability for Japanese beetles, an important food item for laughing gulls in the area. A decline in abundance of Japanese beetles was anticipated to reduce laughing gull use of the airport.

Architectural design of building roofs also can be effective in reducing their attractiveness to gulls. For example, gulls apparently prefer light-colored gravel surfaces and avoid dark (i.e., black) tar or rubber surfaces for nesting, probably because of the increased temperatures of these dark surfaces and the tackiness of these materials when walked upon (Belant, 1993). Gulls also prefer and have greater hatch success when nesting near structures (e.g., vents, air conditioning units) (Belant, 1993). Reducing suitability of roofs for nesting or loafing should be considered during the planning stage of new buildings in areas where colonization by gulls is likely and when roofs of existing buildings require repair or replacement. Roof modifications alone, however, will likely be only partially effective (Blokpoel and Tessier, 1992).

*3.1.2. Removal of food sources*

Sanitary landfills frequently attract large numbers of gulls and other birds, at least seasonally (Horton et al., 1983; Patton, 1988; Belant et al., 1995a). Several authors have suggested that the availability of garbage increases (Kadlec and Drury, 1968; Hunt, 1972; Pons, 1992), or is essential for (Sibley and McCleery, 1983), reproductive success. A study using radio telemetry in Cleveland, OH indicated that adult ring-billed and herring gulls foraged on average 25 and 18 km from their nesting colonies and were frequently found at landfills (Belant et al., 1995b). Thus, landfills can be an important food source for gulls throughout urban areas. As gulls do not consistently use landfills throughout the year, management efforts may need to be intensified or additional techniques implemented during periods of high use. For example, in northern Ohio gulls are present in large numbers during July–January only (Fig. 5).

Covering the exposed face of landfills with soil or a commercial cover material at the end of each working day will reduce availability of forage to gulls. Also, separating food waste from other types of garbage (e.g., compost, construction and demolition debris) will reduce the total area required to be covered. Waste disposal facilities consisting only of non-putrescible waste do not attract gulls (Gabrey et al., 1994; Gabrey, 1997).

Gulls also can exploit other anthropogenic food sources including dumpsters at restaurants, fish offal from commercial boats and processing plants, and

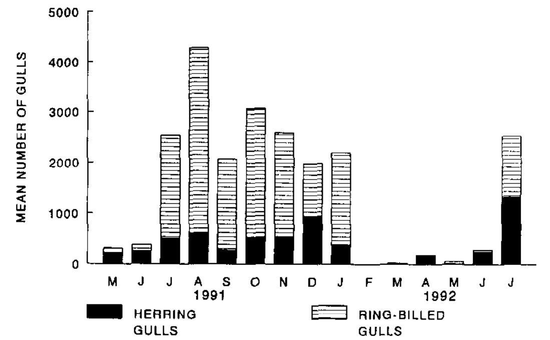


Fig. 5. Mean number of herring and ring-billed gulls at three landfills in northern Ohio, May 1991–July 1992 (from Belant et al., 1995a).

being fed by people at parks or beaches. Reducing availability of food at these and similar locations will aid in reducing overall suitability of the area to gulls.

*3.1.3. Frightening devices*

Numerous devices including distress and alarm calls, avian predator effigies, mylar flags, and propane exploders have been used with varying success for dispersing gulls (Dolbeer et al., 1994; Solman, 1994) (Fig. 6).

Pyrotechnics have been used successfully to disperse gulls. Curtis et al. (1995) reported pyrotechnics as more effective than a chemical repellent, landfill cover material, or spraying water for dispersing gulls from a landfill. The greater ability to harass gulls with pyrotechnics at all areas of the landfill was attributed in part to its success. Montoney and Boggs (1995) also used pyrotechnics as the primary technique to disperse gulls from an airport. Curtis et al. (1995) and Montoney and Boggs (1995) suggest that lethal control with shotguns would enhance the efficacy of pyrotechnics.

Falcons (typically peregrine [*Falco peregrinus*] and gyrfalcon [*F. rusticolus*]) have been used to disperse several species of gulls, primarily from runways at airports (Erickson et al., 1990). Falconry was first reported used at airports in Scotland during the late 1940s (Blokpoel, 1976). Although effective, falcons must be flown every day; if not, gulls often return to the nuisance site within 2 days (Erickson et al., 1990).

Originally used to deter birds from agricultural crops, mylar flags placed in a 6-m grid have also

Fig. 6. Avian predator effigies (e.g., great-horned owl, center) are ineffective at deterring gulls from nesting colonies.

reduced gull use of loafing areas at landfills for short periods of time; however, they are ineffective in dispersing gulls from nesting colonies (Belant and Ickes, 1997).

Avitrol®, containing 4-aminopyridine, is a chemical frightening agent registered by the U.S. Environmental Protection Agency (USEPA). After ingestion, affected birds become disoriented and emit distress calls while flying erratically, which can frighten unaffected birds from the site (Timm, 1994). Affected birds typically die within 4 h. Avitrol® is registered for use on gulls around structures, nesting and roosting sites, and at airports. However, no formal evaluation of the efficacy of Avitrol® in dispersing gulls has been conducted.

Frightening devices typically are effective for short periods only, because a lack of negative reinforcement results in rapid habituation (Bomford and O'Brien, 1990). Frequent repositioning and altering the timing of activation of frightening devices has reportedly increased effectiveness.

### *3.1.4. Exclusion*

Overhead lines are effective in excluding gulls from nesting, feeding, or loafing areas (Blokpoel and Tessier, 1984; Belant and Ickes, 1996). While searching for food or landing, gulls apparently focus their eyes on the ground and unexpectedly fly into a line while circling or gliding down (Blokpoel and Tessier, 1984). Lines of monofilament, stainless steel, or kevlar placed parallel, in grids, or in spoke configurations over the area being protected have been used successfully. However, monofilament likely requires greater maintenance because it degrades and weakens under ultraviolet light.

There is variation in effective spacing intervals of lines for gull species. For example, Dolbeer et al. (1988) noted that parallel overhead wires spaced at 3-m intervals over a landfill excluded herring, ring-billed, and great black-backed (*L. marinus*) gulls but not laughing gulls. Belant and Ickes (1996) concluded that herring gulls (and likely other large gull species) can be excluded from areas with parallel lines at $\leq$ 16-m intervals whereas exclusion of ring-billed gulls would likely require a line spacing of $\leq$ 6 m. Height of lines does not appear critical for exclusion of gulls although they must be high enough (e.g., $\geq$ 2 m on a roof) to allow access by maintenance personnel. Lines must be placed higher than features present on the area being protected. In one study, gulls accessed a roof with a line system by landing on structures at or above the level of surrounding lines prior to landing on the roof (Belant and Ickes, 1996). Gulls do not appear to habituate to lines (Blokpoel and Tessier, 1984).

Although formal evaluations have not been conducted, several types of netting are marketed to exclude gulls. In contrast to overhead lines, netting provides complete exclusion if installed properly.

### *3.1.5. Repellents*

Several tactile repellents (primarily polybutene compounds) can be used to discourage gulls from roosting or loafing on structures including posts, beams, and building ledges (Solman, 1994). Methyl anthranilate (MA), a trigeminal irritant, has been used successfully to reduce free-ranging gull use of small, temporary pools of water (Belant et al., 1995c). Preliminary research also suggests that MA formulations can enhance effectiveness of landfill cover materials to deter gulls from putrescible waste (Dolbeer et al., 1993b).

### *3.1.6. Capture*

Several techniques can be used to capture gulls including walk-in traps placed over individual nests, rocket or cannon nets shot over gulls at loafing or feeding sites (e.g., at landfills), and spot lighting at night and capturing with hand-held net (Weaver and Kadlec, 1970; Arnold and Coon, 1972; Solman, 1994). Gulls relocated would likely return to the area of capture; thus, live-captured gulls should be euthanized.

Alpha-chloralose (AC) is a stupefactant that can be applied to bread or corn baits to immobilize nuisance waterfowl, pigeons, and coots (Woronecki et al., 1992). Birds typically become immobilized within 1 h and recover in < 24 h (Woronecki et al., 1992). AC is restricted by the U.S. Food and Drug Administration (FDA) for use by U.S. Department of Agriculture, Animal Damage Control Program biologists. Recent laboratory and field trials suggests that alpha-chloralose could be used to capture gulls in some nuisance situations (Belant, unpublished data). Approval from FDA is necessary before AC can be used for gull management.

## *3.2. Lethal control*

### *3.2.1. Nest / egg disturbance*

Numerous methods of nest/egg disturbance (nest and egg removal, egg removal, nest and egg destruction, egg destruction, and egg replacement) have been evaluated for reducing nesting populations of gulls (Blokpoel and Tessier, 1992; Forbes et al., 1993; Ickes and Belant, 1996). Although these techniques reduce the maximum annual number of gull nests present, nest disturbance typically must be conducted regularly (at intervals of 7–21 days) during the nesting season for multiple years for colony abandonment to occur.

There is differential response to nest disturbance among gulls species. For example, ring-billed gulls appear more susceptible than herring gulls to nest disturbance (Ickes and Belant, 1996). Nest disturbance conducted for 1–10 years did not cause herring gulls to abandon five of six established colonies. However, newly-established ring-billed gull colonies may disperse during the first year of disturbance. Ickes and Belant (1996) also determined that nest and egg removal was no more effective than egg removal (leaving the nest material) in reducing nesting activity. Thus, they recommended egg removal for roof-nesting colonies (unless structural damage from nest material is of concern) and nest and egg or egg destruction (e.g., by crushing nests with tractor-drawn roller) for ground-nesting colonies as the most cost-effective nest disturbance techniques.

Gull eggs also have been prevented from hatching by vigorous shaking, pricking a small hole in the eggshell, and injecting formalin (Thomas, 1972; Hill and Player, 1992; Smith and Carlile, 1993). Applying various oils to eggs topically has also been used to suppress reproduction (Morris and Siderius, 1990; Christens and Blokpoel, 1991; Belant and Seamans, 1993). Although these techniques reduce or eliminate reproduction, as with other nest/egg disturbance techniques, multiple years of application are necessary for colony reduction. For example, Gross (1951) reduced a herring gull population along the coast of Maine after 11 years of spraying eggs with oil. Christens and Blokpoel (1991) suggests that egg oiling could be conducted at locations where hatching-year gulls are the primary problem. The USEPA currently allows food grade oil to be used to prevent the hatching of gull eggs (with necessary Federal and State permits).

### *3.2.2. Toxicants*

The only toxicant registered in the United States for use on gulls is 1339 gull toxicant 98% concentrate (DRC-1339). DRC-1339, applied to bread baits apparently causes renal failure, killing affected birds

24–96 h after ingestion. DRC-1339 can be used to kill herring, great black-backed, and ring-billed gulls in coastal breeding areas or colonies from which they are adversely affecting other colonial-nesting birds (e.g., Knittle et al., 1990; Blodgett and Henze, 1992).

Although not registered for use in the United States, AC has been used in other countries for lethal control of gulls (Caithness, 1968; Coulson et al., 1982; Rochard, 1987; Skira and Wapstra, 1990; Coulson, 1991). A recent study comparing the efficacy of DRC-1339 and AC as toxicants for herring and ring-billed gulls suggests that AC is more humane and will result in higher retrieval rates of affected birds (Belant, unpublished data).

### 3.2.3. Shooting

Shooting gulls is a selective technique that can be used effectively to reduce or eliminate specific offending birds or populations of birds (Thomas, 1972). Shooting gulls has been used to reduce collisions with aircraft, augment nonlethal control techniques, and enhance survival of other species (Thomas, 1972; Dolbeer et al., 1993a; Dolbeer and Bucknall, 1997) (Fig. 7).

### 3.2.4. Predators

Natural predators of gulls have been used successfully to reduce gull abundance at nesting colonies.

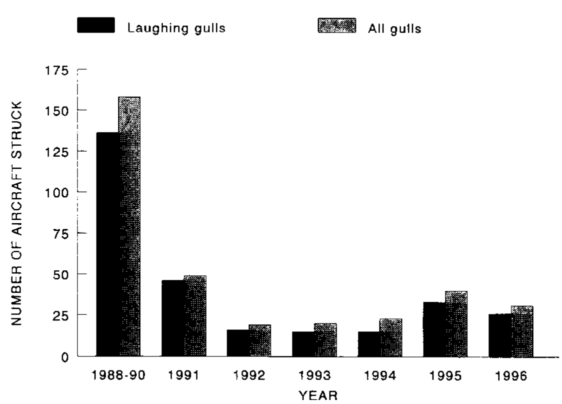


Fig. 7. Number of aircraft striking laughing gulls and all gulls (laughing, herring, great black-backed, and ring-billed) at John F. Kennedy International Airport, 20 May–15 August, 1988–1996. Mean values reported for 1988–1990; shooting occurred from 20 May–15 August, 1991–1996 (modified from Dolbeer and Bucknall, 1997).

Kadlec (1971) documented that red foxes (*Vulpes vulpes*) and raccoons (*Procyon lotor*) released on islands off the Massachusetts coast eliminated the production of herring gulls. More recently, domestic pigs were released on a small island at a float plane airport in Alaska to reduce nesting by mew gulls (*L. canus*) (Rossi et al., 1995). A disadvantage of this technique is that predators likely will depredate nests of nontarget species.

## 4. Management strategies

### 4.1. Site-specific management

Management of gulls at nuisance sites can be effective in alleviating individual problems; however, this approach may cause gulls to disperse to nearby areas and allow similar problems to reoccur. For example, Ickes and Belant (1996) used overhead wires to disperse nesting ring-billed gulls ($>$ 1000 nesting pairs) from a food warehouse in northern Ohio. However, many ($\leq$ 470 pairs) of these displaced gulls apparently relocated about 300 m to nest on an adjacent building without overhead wires. Gulls had not previously nested on this building. Blokpoel and Tessier (1992) also stated that ring-billed gulls displaced from nesting or loafing areas by overhead lines moved to nearby areas to loaf or recolonize.

Problems caused by displaced gulls often are not as serious as the problems caused at the original location (Blokpoel and Tessier, 1986). For example, egg destruction was used to disperse a ring-billed gull colony ($>$ 1900 nests) from Burke Lakefront Airport, Cleveland, OH. Many of these gulls apparently renested 2 km west of the airport in an area where they have not been reported as a nuisance.

Because of the difficulty in coordinating gull control efforts among numerous sites, localized management is likely to continue as the primary solution in the near future. There are, however, instances where localized gull control conducted at numerous sites can be effective over a larger geographical area. For example, the number of roof-nesting ring-billed and herring gulls in metropolitan Cleveland declined from 2549 pairs (12 locations) in 1994 to 1395 pairs (10 locations) in 1995 (Dwyer et al., 1994; Belant et al., 1995b). This reduction in the number of nesting pairs appears a consequence of > 50% of these locations incorporating one or more control techniques. Many of these gulls, primarily ring-billed gulls, apparently renested along Lake Erie near downtown Cleveland and have not caused additional problems.

### 4.2. Landscape-level management

As indicated in Section 4.1, implementation of gull control techniques at several nuisance locations can have an effect at a larger scale (e.g., throughout a city). The difficulty in conducting large-scale efforts is in the coordination of control efforts among individual sites. To effectively manage gull populations at a larger scale, activities must be coordinated through a centralized working group. This working group should include the respective city or county planning commissions as well as landfill managers, other government agencies or businesses experiencing gull problems, and representatives from various public interests. The working group should also include at least one state or federal wildlife professional experienced in wildlife damage management. The primary functions of this working group would include: (1) assessing the extent of the problem, (2) defining relevant aspects of the ecology of the nuisance species, (3) developing an integrated management plan to address the problem, and (4) evaluating the effectiveness of the program.

Assessing the extent of the problem would include determining the species and approximate number of individuals causing the problems; the number of locations where problems occur; the types of real or perceived problems (e.g., damage to roofs, contamination of water supplies, general nuisance); and an estimated loss resulting from the problems, both economic and potential (e.g., risk from transmission of disease or gull–aircraft collisions). Understanding the ecology of the nuisance species (e.g., loafing, feeding, or nesting sites and time of year when present) will aid in determining where control or management activities need to be conducted. For example, gulls nesting on several roofs may feed at a nearby landfill. Thus an integrated management plan could include conducting nest and egg removal on roofs where nesting occurs and incorporating gull harassment and exclusion techniques at the landfill. Periodic assessments of the program will allow the working group to determine if the program is meeting the stated objectives, and if so, whether the program is also cost-effective.

### 4.3. Population reduction

Although many of the nonlethal techniques and management approaches described can be successful in reducing gull abundance at specific locations or across larger areas (e.g., cities), few will aid in resolving the overall problem of an overabundance of gulls. Population reduction is a viable technique that should be considered as a potential tool for resolving gull conflicts with humans. Any population control program is likely to be controversial. Lethal control programs must be biologically justifiable, cost effective, and reasonably humane. Human health, flight safety, and aesthetics must also be incorporated into the benefits of a program; however, these attributes are difficult to quantify economically.

There are two means by which gull populations can be reduced: (1) increasing mortality by killing adults, subadults, or young and (2) decreasing natality by preventing eggs from hatching. Killing breeding adults is more effective than killing an equal proportion of eggs (Fig. 8). Relative cost-effectiveness of the two approaches would depend on the techniques used. Shooting adults would likely cost more than oiling eggs; however, use of a toxicant on adults would not.

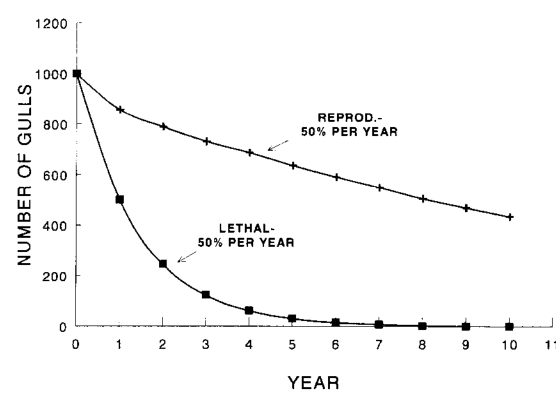


Fig. 8. Comparative effects using simulation modeling of population reduction in a hypothetical colony of laughing gulls (1000 breeding adults) by killing 50% of adults or killing embryos in 50% of nests annually.

Population monitoring is an essential component of any lethal control program. For example, to assess the effects of a gull (primarily laughing gull) shooting program implemented to improve flight safety (Dolbeer et al., 1993a), local, regional, and national population assessments of laughing gulls were conducted (Belant and Dolbeer, 1993a,b; Dolbeer et al., 1997). Using band recovery data and breeding adult population estimates, Belant and Dolbeer (1993a,b) determined that the number of gulls killed would have no direct adverse affect on national or regional populations. Population estimates conducted at the colony affected directly by the control program indicated that the number of breeding adults was reduced by 38% (Dolbeer et al., 1997). The potential effects on non-target species must also be addressed in any lethal control program.

## 5. Summary and conclusions

Gull populations have increased dramatically in numerous areas worldwide. These increasing populations are associated with increased human population growth and development, particularly along ocean coasts and large freshwater systems (e.g., Great Lakes). These large populations of gulls inhabiting urban areas inevitably cause human–gull conflicts including threats to human health and safety, property damage, and reduced aesthetics. Numerous nonlethal and lethal control techniques have been developed, evaluated, and implemented in efforts to alleviate these conflicts. However, virtually all gull control efforts have been employed to address specific localized (individual site) problems. To effectively manage gull populations at a larger scale (e.g., metropolitan area), management must occur typically at a higher organizational level. A working group which includes the city or county planning commission, affected businesses or government agencies (e.g., parks department), representatives from the public, and at least one state or federal wildlife professional could be formed to provide overall direction for gull management. The functions of this working group would be to document the extent and nature of the problem, determine relevant aspects of the ecology of the nuisance species, assess available control techniques to develop an integrated management strategy, and periodically evaluate the effectiveness of the control program. An integrated, landscape-level management approach is essential to most effectively reduce conflicts between gulls and people in urban environments (Table 1).

Table 1
Relative advantages and disadvantages of methods to control nesting gulls (modified from Blokpoel and Tessier, 1992)

| | Method[a] | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | MH | FD | IL | DS | ND | OE | SA | RF |
| *Advantages* | | | | | | | | |
| Effective in excluding gulls | H[b] | H | H | L | L | L | H | H |
| Effective in preventing nesting | H | H | H | H | L | L | H | L |
| Effective in preventing hatching | H | H | H | H | H | H | H | L |
| Degree of permanence | H | H | M | H | H | M | M | H |
| Degree of humaneness | H | H | M | H | M | M | L | H |
| *Disadvantages* | | | | | | | | |
| Costs of equipment | H | H | L | H | L | M | H | H |
| Costs of materials | H | H | L | L | L | M | H | H |
| Costs of labor | H | H | H | H | H | H | H | H |
| Need for specialized skills | H | M | M | M | L | L | H | M |
| Likelihood of effecting other species | H | M | H | M | L | L | M | H |

[a]MH, modify habitat; FD, frightening adults; IL, installing lines; DS, dragging/disking/grading substrate; ND, nest disturbance; OE, oiling eggs; SA, shooting adults; RF, removing food.
[b]H, high; M, medium; L, low.

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