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Report to the Chicago Park District on Conflicts with Ring-billed Gulls and the 2013 Integrated Ring-billed Gull Damage Management Project

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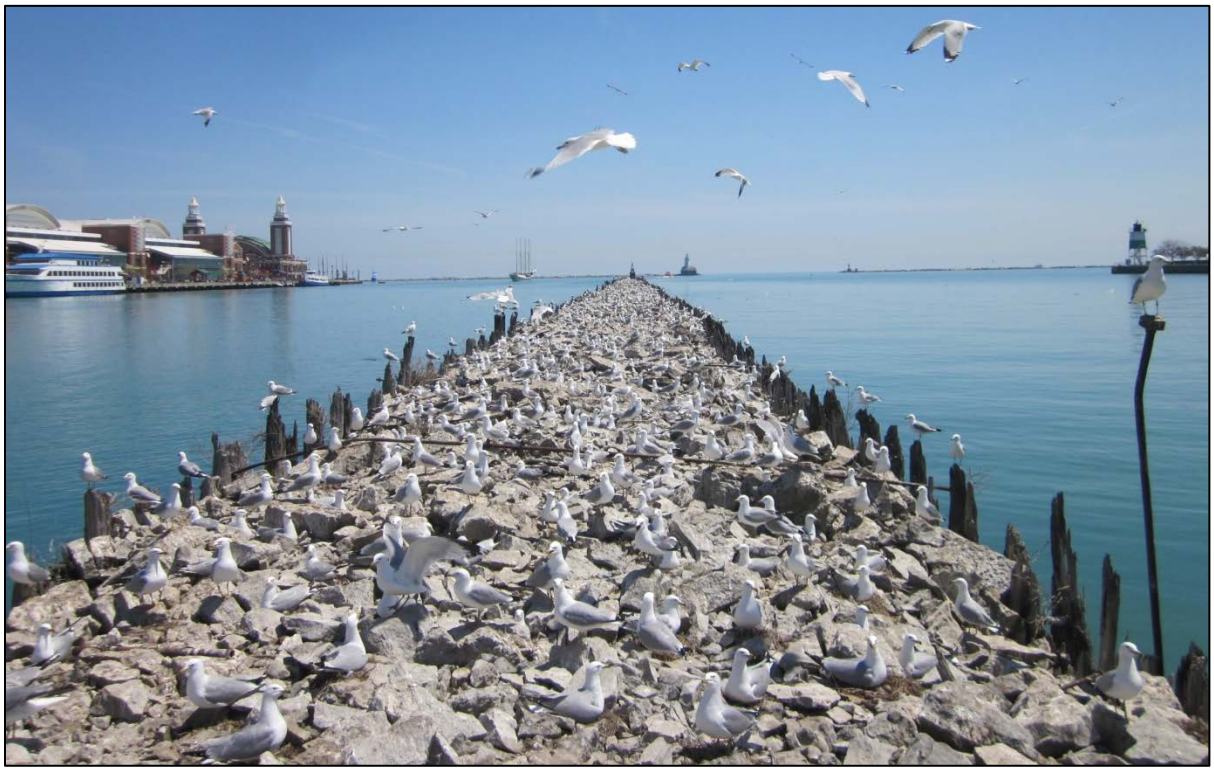

Prepared for
Chicago Park District

By

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EXECUTIVE SUMMARY

The large ring-billed gull (*Larus delawarensis*) population in the City of Chicago has caused various conflicts including general nuisance, property damage, economic losses, and threats to human health and safety. Several studies have shown a relationship between ring-billed gulls and increased levels of fecal indicator bacteria (FIB) such as *Escherichia coli (E. coli)* in nearshore waters. Results of tests for *E. coli* have led to the issuance of swim advisories at Chicago beaches.

The objectives of the Chicago Ring-billed Gull Damage Management Project were to (1) reduce the local production of ring-billed gulls, (2) reduce the severity of conflicts with gulls including the issuance of swim advisories, and (3) evaluate how limiting the production of gulls affects gull use of Chicago's beaches.

Since the beginning of the Chicago Ring-billed Gull Damage Management Project in 2007, USDA-WS established that oiling eggs with food-grade corn oil was a successful method in reducing gull production. Between 2007 and 2013, 89,278 ring-billed gull nests were rendered inviable. It is estimated that between 71,422 and 169,628 hatch-year ring-billed gulls have been prevented since the initiation of this project**.**

Management of ring-billed gull nests has contributed to a significant reduction in hatch-year gull use of Chicago beaches. Since 2007, hatch-year gull use of beaches has declined by 85%, with all analyzed beaches showing a significant reduction.

The combined observations of hatch-year and after hatch-year gull use of beaches illustrated a reduction in gulls compared to 2007 observation totals. Conflicts with landowners and land managers have been reduced as a result of our efforts to limit production of young gulls.

The connection between ring-billed gulls and water quality is becoming more evident. It has been demonstrated that a relationship exists between gulls and the concentration of *E. coli* at beaches. During our seven treatment years and the prior (pretreatment) year, the Chicago Park District has routinely sampled for *E. coli* as a FIB to assess water quality. During the 2013 swim season the proportion of tests resulting in a swim advisory compared to 2006 (baseline year) declined at 13 of 14 beaches.

BACKGROUND

The ring-billed gull is a medium-sized gull with adult plumage consisting of a white head, neck, underside, and tail contrasting with its grey wings. Adults measure 45 cm from bill to tail, having a 50 cm wingspan and weighing about 0.7 kg (Godfrey 1966). Wing-tips of primaries are black with white spots and the legs and feet are yellow-green. The bird's name originates from a distinctive black ring around the tip of the bill. The ring-billed gull is an adaptable and opportunistic bird often found nesting in colonies on break walls, bare soil, piers, structures, and rocks (Schreiber and Schreiber 1975).

Ring-billed gulls are gregarious nesters requiring only a small territory, and their colonies often contain thousands of pairs. Herring gulls (*Larus argentatus)*, Canada geese *(Branta Canadensis*), common terns (*Sterna hirundo*), and Caspian terns *(Hydroprogne caspia)* are often seen sharing colonies with ring-billed gulls in the Great Lakes Region. Ring-billed gulls are faithful to their nesting regions. Gabrey (1996) reported that 41% of sub-adults and 63% of adults return to their natal colonies. Banding data revealed little immigration or emigration in or out of the Great Lakes Region deeming it a closed system (Weseloh 1984, Gabrey 1996). Over 75% of breeding adults and 55% of chicks banded at a colony were recovered <39 km from the colony in subsequent breeding years (Gabrey 1996).

Ring-billed gulls are long lived birds with few factors contributing to mortality. USGS records indicate the oldest band record for a ring-billed gull is 27 years, 6 months (J. Lutmerding, USGS, Bird Banding Laboratory, personal communication, October 11, 2012). While the average ring-billed gulls lifespan is 10 to 15 years (Ryder 1993). Gulls generally nest in isolated areas over water and therefore have few natural predators. Ring-billed gulls were drastically reduced by hunting in the late nineteenth century due to an increased demand for white feathers in the fashion industry (Graham 1975). However, the Migratory Bird Treaty between Canada and the United States in 1916 afforded protection which fostered an increase in population (Canadian Wildlife Service 1975).

Gull foraging behavior

Gulls are adaptable, opportunistic feeders that readily switch food types based on availability and accessibility (Vermeer 1970). The diet of ring-billed gulls is highly variable (Darling 1965). Gulls feed on dead fish and garbage, are known to seek out earthworms following rain events, feed on insects and rodents when available in high numbers, and are often seen accepting food from members of the public. Gulls spend their nights at a common roost, usually on a lake, a river, or a structure where they are safe from mammalian predators and from human disturbance (Costello 1971). Prior to sunset and again at sunrise they can be seen commuting between their daytime feeding and loafing sites and their night-time roosts. Adult ring-billed gulls at Great Lakes nesting colonies have been known to travel an average of 25 km to utilize anthropogenic food sources (Belant et al. 1998).

Gull breeding biology

Ring-billed gulls attain sexual maturity in 2 to 3 years (Ludwig 1974). Gulls begin to arrive on the breeding colonies in the Great Lakes Region in late February to early March. Upon arrival, gulls spend nearly a month establishing territories, engaging in courtship rituals, and building nests. Egg laying begins in April in the Great Lakes Region with an average clutch consisting of 2.82 +/- 0.45 eggs (Mousseau 1984). Eggs are green to brown with dark spots. Adult pairs take turns incubating the eggs for approximately 25 to 27 days. The average hatching success ranges from 75% to 94% with an average fledge rate ranging from of 0.8 to 1.9 young per nest (Mousseau 1984, Brown and Morris 1994, Brown and Morris 1996).

Gull populations

Data on ring-billed gull populations in Illinois are limited. Information on gull populations in Illinois is provided for informational purposes. Data from the USGS Breeding Bird Survey (Sauer et al. 2012) for the period of 1966-2010 indicated that the ring-billed gull populations have increased in Illinois (Figure 1).

The Colonial Waterbird Survey was conducted in 1999 and covered the shoreline and islands of the Great Lakes and some inland colonies near the shore of the Great Lakes. Survey data indicated that there were 7,381 nesting pairs of ring-billed gulls on the Illinois portion of the Lake Michigan coast, an additional 31,161 pairs of ring-billed gulls along the Indiana portion of the Lake Michigan coast, and 29,166 pairs of ring-billed gulls at 21 sites along the southern half of the Wisconsin portion of the Lake Michigan coast (Cuthbert et al. 2003). This survey was not a complete count of gulls nesting in the states and did not include any birds that might have been nesting on inland lakes and rivers, nor was it a complete census of rooftops and other nesting sites.

Conflicts with ring-billed gulls

The large population of gulls in the Chicago region causes a range of problems for people and the environment. These problems include causing a nuisance in public open spaces; contributing to property damage and economic losses to structures (e.g., flat roofs and stonework); adverse aesthetic impacts; foul odors near nesting sites; potential health and safety risks caused by accumulations of fecal material on buildings, near outdoor dining areas and at recreational sites; and potentially reducing recreational enjoyment of beaches by contributing bacteria that result in the issuance of swim advisories.

In Chicago, two major nesting colonies exist near marinas and it is thought that adult gulls and their offspring from both colonies are partially responsible for excessive amounts of bird droppings on boats and docks in marinas. Gulls from the Dime Pier colony frequent Navy Pier, a popular tourist attraction, and create negative interactions with large numbers of people. Also, representatives from the Chicago Police Department-Marine and Helicopter Unit and the U.S. Army Corps of Engineers indicate that gulls are a nuisance at their facilities (E. Beltran, Sgt of Police Chicago Police Marine Unit, personal communication, June 13, 2013 and G. Vejvoda, Facility Manager, U.S. Army Corps of Engineers, personal communication, April 26, 2012).

Research has documented that gulls are a source of fecal contamination at beaches. Fluctuations in gull populations at beaches have been correlated with changes in FIB densities in beach water samples (Converse et al. 2012, Whitman and Nevers 2003). Edge and Hill (2007) showed that bird droppings served as primary sources of *E. coli* contamination. Levesque et al. (2000) documented that the bacterial content of ring-billed

gull droppings can contribute to microbiological contamination of recreational waters and Nugent et al. (2008) described how ring-billed and other gulls contributed to increased fecal coliform levels in a municipal drinking water source. Gull numbers at beaches appeared to be significantly correlated with water and foreshore sand concentrations of *E. coli* taken 24 hours later (Whitman et al. 2004). DNA fingerprinting of *Salmonella* isolates from sand and water at 63rd Street Beach were a reasonably good match to gull feces isolates, but other birds could also have been *Salmonella* vectors. Hansen et al. (2011) concluded that waterfowl, including Canada geese, ring-billed gulls, and Mallard ducks were the primary source of *E. coli* contamination at beaches, while also cautioning that total bird counts were not a reliable predictor of the main contributor of *E. coli*.

Further evidence was provided immediately to the north of Chicago, where the Lake County Illinois Health Department used DNA ribotyping to genetically analyze *E. coli* samples from four beaches and "found that gull feces were the predominant source of the bacterial counts" (Lake County Board 2004, Soucie and Pfister 2003, RTI International 2011). Further public health concerns were noted at beaches heavily used by gulls when additional studies conducted by the Lake County Illinois Health Department identified the pathogens *Salmonella* spp. and *Proteus mirabilis* in fresh gull feces at Lake County beaches (M. Adam, Lake County Health Dept., personal communication, July 29, 2009). It has also been demonstrated that in Racine, Wisconsin gull feces is capable of carrying human pathogens (Converse et al. 2012, Kinzelman et al. 2008) and that gulls are a significant non-point source of fecal contamination on beaches (Kinzelman et al. 2004).

The increased ring-billed gull population has also impacted aviation safety. Nationally, gulls are the species group most frequently involved in collisions with civil aircrafts in the USA. From 1990-2012, 9,248 gulls were reported struck nationally (Dolbeer et al. 2013). Additionally, gulls along with waterfowl and raptors are the species group responsible for the most damaging strikes (Dolbeer et al. 2013). Bird strikes into the windshield or engine of an airplane have the potential to cause substantial damage. For example, during takeoff from a Great Lakes airport an aircraft ingested gulls into two engines which subsequently caused an uncontained engine failure in one of the engines. Both engines were damaged beyond repair. Airport operations recovered 14 gull carcasses from the engine and runway, with estimated costs of $1 million for repairs and $0.5 million in lost revenue (Wright 2010). According to Federal Aviation Administration records, ring-billed gulls have been involved in collisions with aircraft at Chicago Midway International Airport 75 times and Chicago O'Hare International Airport 106 times between January 1, 1990 and August 31, 2013 (FAA Birdstrike Database). Since it is estimated that only 20% to 25% of all bird strikes are reported (Conover et al. 1995, Dolbeer et al. 1995, Linnell et al. 1996, Linnell et al. 1999), the number of collisions with gulls in Chicago is likely much higher than FAA records indicate.

Lastly, evidence also suggests that other bird species may be negatively impacted by the increase in the ring-billed gull population. Researchers have implicated ring-billed gulls as negatively influencing nesting success of piping plovers and common terns (Maxson and Haws 2000, Morris et al. 1980).

Previous efforts addressing gull damage and conflicts at Chicago's beaches

The Chicago Park District (CPD) has employed an integrated approach to reducing the number of conflicts attributed to gulls at Chicago beaches. Most visibly, are the improvements in beach cleanliness. Public education and beach cleanup practices have contributed to a decline in the number of gulls foraging at Chicago beaches. Projects such as the Beach Ambassador Program have provided outreach to the public emphasizing the importance of not littering. An ample supply of trash receptacles (including solar powered compactors) in high traffic areas has led to less uncontained litter. Additionally, early morning cleanup crews and daily beach grooming efforts have been utilized to reduce the litter and therefore the number of gulls foraging on Chicago's beaches. Furthermore, the implementation of canine harassment has been valuable as a management technique at select locations. Beaches with historically high numbers of swim advisories and high gull use have benefitted from canine harassment (Hartmann et al, 2010). Canine harassment activities have shown to be effective in significantly reducing the bird population while also providing reductions in FIB at the administered beach (Converse et al. 2012).

Managing nests to prevent reproduction

Oiling eggs with 100% food grade corn oil has been shown to be effective at reducing the hatch rate of gulls (Pochop et al. 1998, Blackwell et al. 2000). After multiple years of minimizing the production of fledglings through egg oiling, a reduction in the number of nesting attempts may be detectible at the gull colonies (Olijnyk and Brown 1999). It is also possible that gull nesting colonies may relocate as a result of the physical destruction of nests (Ickes et al. 1998), thus creating even more conflicts if relocated nesting colonies move closer to airports or on rooftops where significant damage could be sustained. However, egg oiling is a less intrusive method of preventing production than physical nest destruction and in USDA-WS experience is less likely to result in the relocation of a nesting colony (J. Cummings, USDA-WS, personal communication). In addition, egg oiling performed early in the nesting cycle is considered humane (Hadidian et al. 1997).

OBJECTIVES

The objectives of the Chicago Ring-billed Gull Damage Management Project were to (1) reduce the local production of ring-billed gulls, (2) reduce the severity of conflicts with gulls including the issuance of swim advisories, and (3) evaluate how limiting the production of gulls affects gull use of Chicago's beaches. We hypothesized that oiling the majority of ring-billed gull eggs will continue to reduce the number of hatch-year ring-billed gulls produced in Chicago, and that the decrease in the number of hatch-year ring-billed gulls will therefore reduce severity of conflicts with gulls, including swim advisories on Chicago's beaches.

METHODS

Colony assessment and egg oiling at Dime Pier, DuSable Harbor Breakwall, and Lake Calumet

Prior to initiating egg oiling, visits to Dime Pier, DuSable Harbor Breakwall, and Lake Calumet took place on April 15 and April 19, 2013 to assess the colony size and nesting stage. In order to facilitate the application of oil early in incubation, nesting chronology was estimated via egg flotation as described by Nol and Blokpoel (1983).

Once incubation began, eggs were treated with food grade corn oil that was applied using a pressurized four-gallon backpack tank and hand-held spray wand. The spray wand was equipped with a tip that produced a fan pattern. Sprayers were pressurized and delivered oil at rates between 3 to 6 ml/sec. The sprayer tips were held about 15 to 20 centimeters (6 to 8 inches) above each egg and approximately 3 ml of corn oil were applied to each egg. The oiling treatment consisted of two USDA-WS staff walking transects through the colony with backpack sprayers to apply corn oil to all eggs in each nest. All nests at Dime Pier were treated and counted. Nests at DuSable Harbor Breakwall were counted to determine a total colony count. The number of nests to be treated in order to reach 80% of the colony was calculated and then those nests were treated.

Ring-billed gull eggs were first identified on April 15 at Dime Pier and DuSable Harbor Breakwall. Oiling treatments first occurred on April 24, and the colonies were treated an additional four times on a biweekly schedule between May 8 and July 3. Due to the close proximity of Dime Pier and DuSable Harbor Breakwall, the nesting activity at these locations were considered to be one nesting colony and in the remainder of this report will be referred to as the Dime Pier colony.

Data related to changes in total nest numbers and percentage of nests treated at each colony was compared between the seven treatment years (2007 through 2013). The reported total number of nests that were treated at Dime Pier and Lake Calumet were based on the largest number of nests counted during a single round of oiling. Nests that were not oiled were only counted once during the first treatment before chicks were present. Locations where nests were not oiled were marked with flagging tape. During the retreatment visits, areas that were flagged during the first treatment were avoided to minimize disturbance that might affect chick mortality (Fetterolf 1983).

Rooftop populations and new site identification

During 2011 and 2012, the use of an aerial survey was successful in identifying four previously unknown rooftop gull colonies; Jardine Water Purification Plant (JWPP), Lincolnwood, Midway1, and

Midway2 (Hartmann en al. 2013). In 2013, we revisited the four sites between April 11 and April 26 to identify if nesting recurred and track nesting chronology to enable early nest management if needed.

Nests at JWPP and Lincolnwood were managed through egg oiling applications. Three oiling treatments occurred biweekly between April 26 and June 4. Nest management at Midway1 and Midway2 involved nest and egg removal during visits on May 6, May 20, and June 4.

To assist in identifying additional unknown gull colonies, an aerial survey was completed on April 26, 2013. A crew of four people, which included the pilot and three observers, flew in and out of Chicago Executive Airport. The survey was conducted via helicopter at approximately 80 km/hr. at a minimum altitude of 152 m. Five transects approximately 1.6 km apart were completed parallel to Lake Michigan between the southern boundary of the City of Chicago and the Cook County and Lake County boundary line. Additional areas surveyed were the neighboring warehouses adjacent to Midway International Airport, the Chicago Sanitary and Ship Canal and the North and South Branches of the Chicago River.

Gull observation surveys

To evaluate the efficacy of the program and accurately assess the number of gulls contributing to the deposition of fecal matter at beaches, observational surveys of gull presence were conducted at 19 locations along Chicago's shoreline (Figure 2). Observational surveys of gulls were conducted at beaches, harbors, and other historic gull use sites. Survey routes typically started from the northern-most or southern-most end of the city. Each survey location was traversed on foot and the number of hatch-year (HY) and after hatch-year (AHY) gulls observed on and within approximately 75 meters of the beach, (including nearby parks, parking lots, and shoreline) were counted and recorded. Additional data recorded during observational surveys included: time, weather conditions, and species of other shorebirds observed at each location. In addition to the surveys of gull use of Chicago beaches, the number of Canada geese present within the survey parameters was also recorded at each site. Table 1 illustrates the number of surveys conducted each week in each of the seven years when egg oiling was conducted.

To assess the accuracy of the primary observer, a secondary observer preformed an independent gull count simultaneously with the primary observer on three separate occasions. The numbers of total gulls observed were compared to evaluate the similarity of the data; observation estimates were required to be within 10% of each other.

Complete data sets were available to analyze gull use for 9 of the 15 beaches surveyed. Analysis was conducted for weeks 5-10 of the observation periods. For each of the 9 beaches, the number of gulls observed during the surveys in each of the six one-week observation blocks across 2007, 2008, 2009, 2010, 2011, 2012, and 2013 were compared using a two-factor factorial analysis of variance. *A priori* linear contrasts were applied to the week-by-year interaction term to identify at what week of the six weeks analyzed (if any) the seven years differed in the mean number of gulls observed. Separate analyses were conducted for HY, AHY, and total gulls, with the realization that analyses of the total gull numbers are descriptive ventures since total gull numbers are not independent from the two components, HY and AHY numbers. Data collected by the primary and secondary observer were comparable, therefore, only the observations completed by the primary observer were analyzed.

Information was collected at 15 beaches during the entire 2013 swim season. Although statistical analyses were not possible or inappropriate for Foster, Montrose, Oakwood, 63rd Street, 57th Street, and South Shore Beaches, a descriptive evaluation between the mean number of HY, AHY, and total gulls is important to communicate.

Gull use totals at Foster, Montrose, 57th Street, and 63rd Street Beaches were altered due to gull harassment activities during our study period. On a trial basis, dispersal of gulls via canine harassment was conducted at Foster beach in 2006 and 2007 and at 63rd Street Beach in 2007. A full time harassment program was then implemented at 57th and 63rd Street Beaches during the entire 2008 swim season from dawn to dusk. In 2009, canine harassment did not take place at Chicago beaches. During 2010, 2011, 2012, and 2013 a full time canine harassment program was employed at 63rd Street Beach with intermittent visits taking place at 57th Street Beach. Furthermore, in 2012 an intermittent harassment program took place at Montrose Beach.

Observations of 63rd Street Beach were conducted during canine harassment and non-harassment periods for each week of our 2013 study period. We examined the differences in gull use at 63rd Street Beach, including the nearshore waters, beach parking lot, surrounding park, 59th Street Pier, and Casino Pier before and during harassment periods.

Observations occurred at Oakwood and South Shore Beaches during the last four beach seasons (2010-2013). Surveys were not conducted during the first three years of the study period and therefore comparisons were limited to descriptive assessment for changes in gull use.

The Dime Pier nesting colony was observed periodically after oiling operations during the swim season. Fledge date, HY development, and gull movement patterns were observed and recorded for assessment.

Swim advisories on Chicago's beaches

The CPD regularly examines nearshore water quality at beaches in Chicago. Starting in 2012, and continuing in 2013, the CPD no longer issued swim bans based on water quality test results. Alternatively, CPD followed United States (U.S.) Environmental Protection Agency (EPA) recommended guidelines and issued swim advisories when E. coli results were above the federal threshold. Following U.S. EPA guidance, swim advisories were implemented in Chicago when the geometric mean of two *E. coli* sample readings exceeded the threshold of 235 most probable number (mpn) per 100 mL of sampled beach water. Although terminology for reporting swim bans and swim advisories have changed, the methodology used to collect water quality samples has remained unaffected throughout the period covered in this report. Thus, water quality data from 2006 was used as a pretreatment baseline and test results trends were examined across the seven years of nest management.

The proportion of water quality tests exceeding 235 mpn/100 mL at 14 beaches were compared for the swim seasons between 2006-2013 (Table 2). This approach avoids conflict in inferences relative to the number of days during the week that a swim advisory was in place. Of most interest were comparisons for each beach between the pretreatment year (2006) and the final year of treatment in this study (2013). In addition to the 14 beaches, comparisons were made for the four beaches (Foster, Montrose, 57th Street, and 63rd Street) influenced by canine harassment activities during our study period. The extent of canine involvement is illustrated in Table 2.

RESULTS

Egg oiling and nesting chronology at Dime Pier and Lake Calumet

On April 15, USDA-WS observed nests with eggs for the first time at the Dime Pier colony. Five egg oiling treatments occurred between April 24 and July 3. Approximately 85% of the nests were treated at Dime Pier (4,398 nests containing 13,350 eggs) (Table 3, Figure 3). In 2013, the colony size at Dime Pier increased by 344 nests (8%) in comparison to 2012.

Approximately 500 gulls were witnessed utilizing the Lake Calumet colony on April 15 and April 19 during site visits and again on April 26 during the aerial survey. During the site visits to Lake Calumet, USDA-WS personnel did not observe signs of nesting. Since the colony initially abandoned the site during 2010, the vegetation on the site has become visibly denser in areas where gulls historically nested.

Gull chicks were first observed during the third retreatment on May 21 at Dime Pier. The first observation of a fledged HY gull occurred during a survey on June 24. The number of HY gulls observed on beaches continued to increase through observation periods 5-9. As a result of increased HY gull use during observation block 7, USDA-WS estimated a mean fledge date of July 8 for HY gulls from the managed colonies in Chicago.

Minimizing conflicts from rooftop nesting populations

On April 26, during the aerial survey, approximately 385 km^2 (239 mi^2) of Cook County were surveyed for gull nest colonies. During aerial observations, no new nesting sites were identified.

Rooftop locations (JWPP, Lincolnwood, Midway1, and Midway2) that were previously identified during aerial surveys in 2011 or 2012 were again managed to prevent the production of gulls. USDA-WS

determined that nesting should be discouraged and 100% of the nests were treated or removed (Hartmann et al. 2012). Nests at JWPP and Lincolnwood were managed through egg oiling applications. During three treatments at JWPP and Lincolnwood, 51 and 98 gull nests were managed, respectively.

Rooftops Midway1 and Midway2 were located on warehouses in close proximity to Midway International Airport. USDA-WS removed the nests rather than oiling the eggs to promote early abandonment of the sites and to decrease the potential risk of gull/aircraft collisions. Over three visits to Midway1, 119 ring-billed gull nests and 52 herring gull nests were removed. The greatest number of nests removed during a single visit occurred on May 6 when 87 ring-billed gull nests and 23 herring gull nests were removed. Over a period of three visits to Midway2, 14 herring gull nests were removed. The greatest number of nests removed during a single visit occurred on June 13 when 6 herring gull nests were removed.

A total of 135 ring-billed gull nests and 199 herring gull nests were gathered from the four rooftop colonies. In comparison to 2012, the number of nests present at the four rooftop locations declined by 92% (Table 4). At Midway1 and Midway2, gulls were observed establishing new nests after their initial nests were removed. Therefore, it is highly likely that the number of nests removed and reported was greater than the actual colony size at these two sites.

Observations of gull use of Chicago habitats

Hatch-year gulls were first observed arriving on Chicago beaches on June 24, and from this date gull use on beaches increased for each of the following four observation periods until a reduction was seen during week 10 (Figure 4). Between weeks 5-10, an increase in HY gull use in comparison to 2012 was noted at 13 of 15 beaches observed (Table 5) (Table 6). Of the 9 beaches not affected by canine harassment, 7 observed an increase in HY gulls compared to 2012 (Table 5). The highest average increase in HY gulls were observed at Chicago's southern-most beaches. Calumet Beach and Rainbow Beach observed an average increase of 17 HY gulls per survey, while the two northern-most beaches observed an average increase of 5 gulls per survey. Overall, HY gulls at the nine analyzed beaches witnessed an average increase of 7.2 HY gulls per survey per beach during weeks 5-10. HY gulls observed per observational survey in 2013 were similar to 2009 and 2010 observations when a greater number of nests were left untreated (Table 4). Nevertheless, the number of HY gulls observed on the nine analyzed beaches declined by 85% from 2007 to 2013 (Table 5) and exhibited a statistically detectable week by year interaction ($P<0.08$) at all 9 beaches (Table 7). As in the past years of observation, differences in HY gull usage of beaches became statistically evident as the season progressed to a time when HY gulls would be expected to arrive *en masse*. Early in the HY arrival period there are too few HY gulls using the beaches to detect differences between years.

During 2013 the nine analyzed beaches all documented a reduction in AHY gull use during weeks 5-10 compared to 2012. Together, the nine beaches observed a total reduction of 32% compared to the previous year. Additionally, a 37% reduction was observed at the analyzed beaches when compared to the initial year of observations in 2007, with 2 of 9 beaches exhibiting a statistically detectable week by year interaction ($P<0.08$). (Table 7, Figure 5).

As a result of the reduction in AHY gulls on Chicago beaches, the effects of HY's increasing did not negatively impact the total number of gulls on the nine analyzed beaches. Although the total number of gulls observed is the sum of the HY and AHY and therefore not independent of its components, it is still important to examine changes since the ultimate success of this project depends on whether or not limiting recruitment can eventually affect an already existing gull population.

The mean number of total gulls observed per weekly observation block in 2013 compared to 2007 declined 58%, with 8 of 9 beaches indicating a reduction in total gull usage (Table 5, Figure 6). Furthermore, 3 beaches exhibited a statistically detectable week by year interaction ($P<0.08$) compared to the initial year of observations in 2007 (Table 7). In comparison to 2012, a reduction of 23% was seen in the mean number of total gulls observed at the analyzed beaches during 2013.

During 2012, HY gulls accounted for 4% of the gulls on the beach. However, an increase in HY gulls combined with a reduction in AHY's resulted in the HY population to account for 16% of the total gulls on the beaches in 2013. In contrast, during the initial study period in 2007, HY gulls represented 43% of the total gulls observed on beaches during weeks 5-10 (Table 5).

Canine harassment was conducted at 63rd and 57th Street Beaches in Chicago during 2013. At 63rd Street Beach, harassment was performed from dawn to dusk. Observations that occurred pre-harassment (i.e. pre-dawn) or on days when canines were not present, indicated that gulls primarily gathered on the beach. During 21 observations while canines were not actively deployed, a mean of 208 gulls were observed at the site with 119 gulls observed utilizing the beach. Surveys conducted while canines were actively dispersing birds showed that gulls were not utilizing the beach and were forced to loaf off-site. While harassment activities were being conducted, a mean of 78 gulls were observed at the site which encompassed the beach, nearshore waters, beach parking lot, surrounding park, 59th Street Pier, and Casino Pier. Of the 78 gulls utilizing the site during harassment periods, a mean of seven gulls were observed on the beach (Table 8).

Canine harassment was conducted intermittently at 57th Street Beach. When gull harassment was being conducted on 57th Street Beach, typically canines would cease deployment at 63rd Street Beach and move to 57th Street Beach. All randomly selected surveys during the 2013 swim season occurred while canine harassment activities were taking place at 63rd Street Beach and not at 57th Street Beach. Therefore, USDA-WS did not conduct an observation at 57th Street Beach while canine harassment activities were taking place.

Three quality control gull observational surveys were completed by a secondary observer during the swim season. During each of these surveys, estimates of the number of gulls using the locations were within 10% of each other for the number of total gulls observed. Total gull use data recorded by the secondary observer were -2.5%, -0.8%, and -6.4% away from the primary observer's totals.

As gull observations were conducted, Canada geese were recorded at all observation points during the beach season. From the beginning of the surveys (May 29) through the nesting season, geese were not observed utilizing Chicago beaches as nesting locations. During this time period, non-breeding geese were most often observed in small numbers at 12th Street, 31st Street, and Rainbow Beaches. After the nesting season, geese were seen grouping together to begin their molt (mid-June to early July). While molting and flightless, the geese formed one large group and congregated primarily on 31st Street Beach and were only seen occasionally at other beaches near 31st Street Beach. After the molt (mid-July), the goose presence on Chicago beaches increased greatly and was dispersed primarily among six beaches (Montrose, North Avenue, 12th Street, 63rd Street, Rainbow, and Calumet) (Table 9).

Frequency of swim advisories on Chicago's beaches

At 14 beaches without canine harassment, water quality test results were compared from egg oiling years with the data from 2006, the year before initiating egg oiling. During 2013, the proportion of water quality tests compared to 2006 decreased at 13 beaches, with 6 of the decreases statistically detectable ($p \leq .08$) (Table 2). When comparing 2013 to 2012, the proportion of tests resulting in a swim advisory declined at 9 of 14 beaches, with these decreases primarily representing a small proportion in 2012 decreasing to a smaller proportion in 2013.

In addition to the 14 monitoring locations mentioned above, water quality testing was carried out at 4 beaches influenced by canine harassment activities during our study period. Table 2 shows years in which canine harassment was conducted full-time or intermittently. The most notable improvement in the proportion of swim advisories issued was experienced at 63rd Street Beach. During the 2008 and 2010-2013 swim seasons, the proportion of tests exceeding the recommended threshold during full-time harassment periods, were .06, .21, .11, .23, .14 respectively. During 2006, 2007, and 2009, when canines were not used to disperse gulls full-time at 63rd Street Beach, the proportion of tests exceeding guidelines were .50, .57, and .57, respectively (Table 2).

DISCUSSION

Management efforts and results of the Chicago Ring-Billed Gull Damage Management Project are compared to 2007, our baseline year. Differences in gull use of beaches between 2013 and 2007 does not reflect the entire impact of the project and it is impossible to estimate how much our efforts to limit gull production in Chicago ultimately decreased the potential cumulative effect of gull recruitment during the previous six years. Furthermore, comparisons are made to the initial egg oiling program in 2007, when 52% of

the known Chicago ring-billed gull nests were rendered inviable, and is highly likely that fewer gulls used beaches in 2007 compared to 2006, the year prior to nest management.

The known nesting population of ring-billed gulls in Chicago decreased for the second straight year of this project; we feel that we were effective in locating and managing colonies within Chicago. Through completing an aerial survey and by observing a reduction in total gulls at our survey locations, it is unlikely that there is a substantial local nesting population that we are unaware of. The total number of ring-billed gulls nesting in Chicago at the identified colonies decreased by 19% in 2013 compared to 2012. While nests at the Dime Pier colony slightly increased (8%), fewer gulls utilized the rooftop colonies, as nesting was discouraged and 100% of the eggs were rendered inviable. For the third time in the past four years, birds elected not to utilize the Lake Calumet dike as a nesting site. Visits to the Lake Calumet colony during the nesting season confirmed birds were active at the site, but did not initiate nesting activities. As in previous years when nesting did not occur, we believe that the vegetation at the site grew to a height and density which exceeded ideal nesting conditions for the birds.

We believe that managing gull eggs/nests since 2007 has played a major role in reducing the number of gulls contributing to conflicts during 2013. Between 2007 and 2013, 89,278 ring-billed gull nests were rendered inviable. It is estimated that the average fledge rate ranges between 0.80 to 1.9 young/ nest (Mousseau 1984, Brown and Morris 1994, Brown and Morris 1996). Therefore, it is reasonable to believe that since the initiation of this project, between 71,422 and 169,628 hatch-year ring-billed gulls have been prevented from hatching. Managing ring-billed gull nests in the City of Chicago has significantly reduced HY gull use of Chicago beaches. Compared to 2007, HY gull use of beaches in 2013 has declined on average by 85%. Furthermore, we have observed a 37% reduction in the number of AHY gulls on Chicago beaches and a combined reduction of 58% in total gulls.

While improvements were significant over the baseline year, observations of HY and AHY gull use of beaches during 2013 have changed compared to 2012. The number of HY gulls observed at the nine analyzed beaches increased by an average of 7.2 birds per beach per observational survey. These minor increases were only rarely detectable statistically at any beach during weeks 5-10 and counts were similar to previous observation numbers collected during 2009 and 2010. Conversely, in 2013 we observed the fewest number of AHY gulls utilizing Chicago's beaches compared to the previous six years of this project. As a result of the reduction in AHY gulls, the effects of HY's increasing did not negatively impact the total number of gulls on the nine analyzed beaches. While it is not ideal to have HY gulls increase in Chicago, the number still represents a small proportion of the total number of gulls utilizing Chicago's beaches.

Since we believe it is unlikely that a large unmanaged colony exists in the City of Chicago, the increase in HY gulls suggest that gulls reared from nearby colonies not within the geographic management parameters of this study play at least a minor role in the number of gulls on Chicago's beaches. There are two notable gull colonies in adjacent Indiana (Lake County) that likely contribute to gull use on Chicago beaches. The two Indiana colonies were assessed as part of the Great Lakes Colonial Waterbird Survey. Counts of ring-billed gull nests last occurred during 2011 in which a total of 32,510 nests were reported at the two colonies. The next scheduled survey is to occur in 2014. It was reported that nest management activities were not conducted in 2013 as was done in previous years and approximately 30,000 nests were available to produce young. While the Indiana colonies are considerably larger than the Chicago colonies, previous tagging and dying research implied that gulls nesting in Indiana tended to travel only in small numbers to Chicago beaches and primarily to sites nearest to their colony (Hartmann et al 2009). Arrival at Chicago beaches of even a very small percentage of HY gulls produced from 30,000 Indiana nests could easily account for the minor (but not statistically detectable) increase in HY gull observations at Chicago's beaches in 2013. The small number of HY gulls that utilized Chicago beaches suggests that minimizing HY production and recruitment in adult nesting population in Chicago is still considered the most effective way to minimize gull presence on Chicago beaches.

Gull harassment by canines has been effective at limiting the amount of time gulls loaf on 63rd Street Beach. During observations while canines were not actively deployed, a mean of 119 gulls were observed utilizing the beach. Surveys conducted while canines were actively dispersing birds showed that gulls were not utilizing the beach and forced to loaf off-site. A mean of 7 gulls on the beach were observed while harassment activities were being conducted. This disparity in numbers of gulls observed when dogs are present versus when

they are not present suggests there is little aversive conditioning of the gulls to also stay away from the beaches when dogs are absent.

Harassment performed by canines has the ability to reduce the number of gulls and their associated excrement on the beaches. The continued canine management activities at 63rd Street Beach has improved water quality while limiting gull activity. Yet, there is the prospective that canine harassment may displace gulls from one beach to another and therefore, increase gull activity at non-harassment beaches.

In addition to managing the HY production of gulls in Chicago, we believe that making beaches less attractive to gulls through managing refuse and reducing public feeding has resulted in fewer birds utilizing beaches as foraging locations. Although a connection between gulls and increased FIB at beaches has been identified, the interaction between gulls and water quality is complex and not completely understood. Furthermore, each beach has its own set of variables that influences water quality, so it is unrealistic to attempt to decipher whether or not variations in gull use at a beach may have altered the amount of gull fecal matter necessary to affect the testing results for FIB at an individual beach on a particular day.

Even so, during the seven years of this project, a detectible reduction in the number of gulls and the volume of gull excrement on beaches has been documented, and a corresponding downward trend in swim advisories suggests that on several occasions the amount of gull fecal matter may have been reduced to a tolerable level below the threshold that would result in a swim advisory on a specific day. According to Converse et al. (2012), a 50% reduction in the number of gulls on a beach can result in a detectible decrease in *E. coli* densities. During 2013, a reduction in the proportion of water quality tests that resulted in a swim advisory from the previous year was recorded at 9 beaches. When compared to the baseline year in 2006, the proportion of tests resulting in a swim advisory declined at 13 of 14 beaches.

It should be noted that the number of Canada geese using a beach may also influence water quality. During our observation periods, fluctuations in the number of geese observed during surveys varied greatly throughout the swim season. During the first half of our surveys (blocks 1-6 which included nesting and molting periods) 31st Street Beach was utilized most frequently by geese. After the molt, the number of geese observed along Chicago's lakefront more than doubled. At its peak during week 10 (July 29 - August 4), a mean of 154.7 geese were recorded at 14 beaches. The beaches with the highest use during this period were; Calumet (47.0), Rainbow (39.7), and 12th Street (34.3). It should be noted that a goose damage management project was being conducted simultaneously as the gull damage management project. Applications of the Anthraquinone-based chemical repellent FlightControl® PLUS were made to the grass to limit goose foraging near Montrose, 12th Street, 31st Street, 63rd Street, Rainbow, and Calumet Beaches. At the sites where goose foraging was limited, geese were often observed either on the sand or in the nearshore waters.

CONCLUSION

This project has demonstrated that through an intergraded approach, conflicts attributed to ring-billed gulls can be minimized. A multi-year nest management initiative combined with making the City and its beaches "less gull friendly", has shown a reduction of total gulls observed on Chicago's beaches. Additionally, it is encouraging that improvement in FIB test results corresponded with a reduction in the number of gulls utilizing Chicago beaches. Furthermore, the use of canine harassment at 63rd Street Beach has been shown to be effective at minimizing gull excrement on the beach and continues to show encouraging positive water quality test results at the application beach.

As we concluded in our dyeing research conducted in 2008, no evidence exists that significant numbers of gulls from outside Chicago are immigrating to the City during the swim season. Therefore, the influence that Northwest Indiana colonies have on gull numbers would primarily impact Chicago's southern beaches. During 2013, we feel this continues to hold true, even after observing a minor average increase of 7.2 HY gulls per observation survey per beach, the number of HY's still represented a small proportion (16%) of the total gulls. It is reasonable to expect if more than a small percentage of the HY gulls produced from the approximately 30,000 nests in Indiana visited Chicago's beaches, total gull use would have been substantially greater than observed. The small proportion of HY gulls utilizing Chicago beaches continues to suggest that minimizing HY production and recruitment in adult nesting population in Chicago is still considered the most effective way

to minimize gull presence on Chicago beaches. Yet, the larger range of AHY gulls may allow gulls from Indiana to have a greater presence on Chicago beaches, especially if they are left unmanaged and the nesting population grows.

While the Integrated Ring-billed Gull Damage Management Project has focused on limiting the recruitment of HY gulls into existing Chicago colonies, it is also our goal to learn more about HY and AHY gull dispersal after the nesting season. We are hopeful we can gain information on the movements patterns of gulls in the Great Lakes Region as well as understand how harassment efforts at 63rd Street Beach effects nearby beaches. Through future observations of gull use of beaches and satellite tracking of regional gull movements, we are hopeful that we can provide beach mangers pertinent information that will allow them to make science-based decisions regarding future management of ring-billed gulls at nearby colonies.

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Table 1. Number of ring-billed gull observation surveys within week blocks in 2007 through 2013 field seasons in Chicago, Illinois.

Block	Dates	Number of Observations						
		2007	2008	2009	2010	2011	2012	2013
1	5/27-6/2	3	0	3	3	3	3	3
2	6/3-6/9	3	0	3	3	3	3	3
3	6/10-6/16	2	1	3	3	3	3	3
4	6/17-6/23	3	7	3	3	3	3	3
5[1]	6/24-6/30	3	6	3	3	3	3	3
6[1]	7/1-7/7	2	4	3	3	3	3	3
7[1]	7/8-7/14	2	5	3	3	3	3	3
8[1]	7/15-7/21	3	4	3	3	3	3	3
9[1]	7/22-7/28	2	4	3	3	3	3	3
10[1]	7/29-8/4	1	3	3	3	3	3	3
11	8/5-8/11	0	3	3	3	3	3	3
12	8/12-8/18	0	3	3	3	3	3	3
13	8/19-8/25	0	3	3	3	3	3	3
14	8/26-9/1	0	2	3	3	3	3	3
15	9/2-9/9	0	1	3	3	3	3	3

[1] Hatch-year and after hatch-year gull analysis conducted on observation blocks 5-10

Table 2. The proportion of water samples on Chicago's beaches from 2006 – 2013 that exceeded established water quality standards, where 2006 represents a pre-egg oiling treatment baseline year.

Beach	Proportion of tests resulting in swim advisories or bans								2006 vs. 2013	2012 vs. 2013
	2006[1]	2007[1]	2008[1]	2009[1]	2010[2]	2011[2]	2012[2]	2013[2]	p-values	p-values
Juneway	0.09	0.10	0.14	0.03	0.04	0.06	0.07	0.01	0.0392	0.10
Rogers	0.08	0.07	0.12	0.03	0.04	0.06	0.04	0.01	0.068	0.32
Howard	0.08	0.08	0.13	0.03	0.09	0.07	0.04	0.03	0.18	0.64
Jarvis/Fargo	0.08	0.11	0.11	0.01	0.10	0.06	0.13	0.03	0.19	0.0357
Leone/Loyola	0.13	0.08	0.07	0.08	0.07	0.07	0.07	0.04	0.0675	0.52
Hollywood/Osterman	0.18	0.16	0.10	0.12	0.19	0.11	0.10	0.07	0.0676	0.60
North Avenue	0.11	0.20	0.00	0.06	0.03	0.08	0.06	0.06	0.29	0.93
Oak Street	0.09	0.21	0.04	0.03	0.11	0.05	0.00	0.03	0.11	0.15
Ohio Street	0.13	0.18	0.09	0.11	0.07	0.14	0.07	0.10	0.66	0.48
12th Street	0.22	0.10	0.07	0.15	0.13	0.15	0.14	0.18	0.47	0.57
31st Street	0.27	0.41	0.17	0.13	0.21	0.17	0.22	0.14	0.0487	0.20
South Shore	0.21	0.26	0.15	0.16	0.31	0.22	0.16	0.32	0.16	0.0330
Rainbow	0.22	0.41	0.19	0.27	0.24	0.24	0.29	0.19	0.65	0.13
Calumet	0.28	0.41	0.17	0.23	0.22	0.16	0.16	0.15	0.0528	0.83

Beach	Proportion of tests resulting in swim advisories or bans at canine harassment locations[3]								2006 vs. 2013	2012 vs. 2013
	2006	2007	2008	2009	2010	2011	2012	2013	p-values	p-values
Foster	0.19[4]	0.21[4]	0.14	0.08	0.10	0.04	0.11	0.09	0.0901	0.67
Montrose	0.24	0.28	0.25	0.23	0.21	0.23	0.27[4]	0.29	0.52	0.74
57th Street	0.23	0.26	0.00[5]	0.33	0.13[4]	0.14[4]	0.15[4]	0.06[4]	0.0041	0.0782
63rd Street	0.50	0.57[4]	0.06[5]	0.57	0.21[5]	0.11[5]	0.23[5]	0.14[5]	<.0001	0.15

[1] Test results from Illinois Department of Public Health Database http://app.idph.state.il.us/envhealth/ilbeaches/public/
[2] Test results from Chicago Park District (unpublished data)
[3] Years without canine harassment are indicated by no superscript
[4] Intermittent canine harassment
[5] Full-time canine harassment

Table 3. Estimated number of ring-billed gull nests and eggs oiled at Dime Pier/DuSable Harbor Breakwall and Lake Calumet, Chicago, Illinois, in 2007 through 2013. The percentages of nests oiled are shown in parentheses.

	Number of Known Ring-billed Gull Nests						
	2007	2008	2009	2010	2011	2012	2013
Dime Pier/ DuSable Harbor Breakwall	3,797	4,727	4,668	5,292	5,139	4,795	5,191
Lake Calumet	31,395[1]	22,918	21,355	0	3,454	6	0
Total	35,192	27,645	26,023	5,292	8,593	4,801	5,191

	Number of Nests Removed or Treated						
	2007	2008	2009	2010	2011	2012	2013
Dime Pier/ DuSable Harbor Breakwall	3,470	3,773	3,750	3,954	4,223	4,055	4,398
Lake Calumet	15,000	18,363	17,391	0	2,933	0	0
Total	18,470 (52)[2]	22,136 (80)	21,141 (81)	3,954 (75)	7,156 (83)	4,055 (84)	4,398 (85)

	Number of Eggs Removed or Treated						
	2007	2008	2009	2010	2011	2012	2013
Dime Pier/ DuSable Harbor Breakwall	8,764	9,554	8,889	10,285	10,398	10,408	13,350
Lake Calumet	41,753	48,036	41,244	0	6,663	0	0
Total	50,517	57,590	50,133	10,285	17,061	10,408	13,350

[1] 2007 known nests totals were estimated for Lake Calumet

[2] Estimated percentages of nests managed

Table 4. Number of ring-billed gull and herring gull nests and eggs removed or treated at rooftop colonies during 2012 and 2013.

Number of Nests and Eggs Removed or Treated									
Site Name	Location	2012				2013			
		Ring-billed gull		Herring gull		Ring-billed gull		Herring gull	
		Nests	Eggs	Nests	Eggs	Nests	Eggs	Nests	Eggs
Jardine Water Purification Plant	Chicago, IL	885	2,058	37	104	16	37	35	108
Midway1[1]	Chicago, IL	768	1,486	65	142	119	274	52	140
Midway2[1]	Chicago, IL	1	2	14	27	0	0	14	27
Lincolnwood	Lincolnwood, IL	89	200	191	515	0	0	98	216
Total		1,743	3,746	307	788	135	311	199	491

[1] Nests and eggs reported are greater than the actual colony size due to gulls re-nesting during the removal period

Table 5. Mean number of hatch-year, after hatch-year, and total ring-billed gulls observed per observational survey on beaches without canine harassment in Chicago, Illinois during weeks 5-10 of the observation period in 2007 through 2013. Percentage changes for 2013 in comparison to 2007 are shown in parentheses.

Beach	Year	Hatch-Year	After Hatch-Year	Total
Leona/Loyola	2007	41.7	79.2	120.9
	2008	16.1	71.1	87.1
	2009	8.8	114.4	123.2
	2010	11.9	58.3	70.2
	2011	5.1	68.8	73.9
	2012	1.8	113.8	115.6
	2013	7.1(-83)	58.6(-26)	65.7(-46)
Hollywood/ Osterman	2007	114.1	204.4	318.5
	2008	22.2	216.0	238.2
	2009	6.8	161.8	168.6
	2010	11.4	121.7	133.1
	2011	5.1	98.3	103.4
	2012	3.9	134.3	138.2
	2013	7.8(-93)	81.9(-60)	89.8(-72)
North Avenue	2007	83.0	155.7	238.7
	2008	12.2	130.2	142.5
	2009	9.7	145.0	154.7
	2010	15.6	161.5	177.1
	2011	9.5	173.4	182.9
	2012	2.8	160.0	162.8
	2013	12.6(-85)	110.7(-29)	123.3(-48)
Oak Street	2007	4.1	13.2	17.3
	2008	0.4	7.2	7.6
	2009	0.6	15.8	16.4
	2010	1.2	7.8	9.0
	2011	0.7	8.9	9.6
	2012	0.2	6.6	6.8
	2013	0.2(-96)	3.0(-77)	3.2(-82)
Ohio Street	2007	0.4	5.9	6.3
	2008	0.3	4.3	4.6
	2009	0.1	4.4	4.4
	2010	0.3	7.2	7.6
	2011	0.2	7.1	7.3
	2012	0.3	5.7	5.9
	2013	0.0	3.6(-38)	3.6(-42)
12th Street	2007	28.9	57.8	86.8
	2008	16.3	82.3	98.6
	2009	9.8	41.8	51.6
	2010	7.9	37.6	45.4
	2011	4.8	47.1	51.9
	2012	8.3	67.7	76.0
	2013	12.9(-55)	45.0(-22)	57.9(-33)
31st Street	2007	86.3	93.3	179.5
	2008	28.1	129.9	158.0
	2009	17.3	139.7	156.9
	2010	16.1	47.3	63.4
	2011	12.1	89.3	101.4
	2012	3.1	54.4	57.5
	2013	10.9(-87)	23.0(-75)	33.9(-81)
Rainbow	2007	137.9	183.2	321.1
	2008	39.4	263.4	302.9
	2009	28.7	186.1	214.8
	2010	33.9	190.4	224.4
	2011	13.3	153.3	166.6
	2012	10.5	182.1	192.6
	2013	29.6(-79)	156.8(-14)	186.4(-42)
Calumet	2007	180.1	84.8	264.9
	2008	38.3	56.3	94.6
	2009	17.4	63.6	80.9
	2010	27.8	60.7	88.4
	2011	10.2	74.3	84.6
	2012	6.6	79.6	86.2
	2013	20.6(-89)	67.5(-20)	88.1(-67)
Total	2007	676.5	877.4	1553.9
	2008	173.3	960.8	1134.1
	2009	99.1	872.5	971.6
	2010	126.1	692.6	818.6
	2011	60.9	720.7	781.6
	2012	37.3	804.2	841.6
	2013	101.7(-85)	550.1(-37)	651.8(-58)

Table 6. Mean number of hatch-year, after hatch-year, and total ring-billed gulls observed per observational survey at locations influenced by canine harassment in Chicago, Illinois during weeks 5-10 of the observation period in 2007 through 2013. Percentage changes for 2013 in comparison to 2007 are shown in parentheses.

Beach	Year	Hatch-Year	After Hatch-Year	Total
Foster	2007	45.9	71.2	117.1
	2008	34.3	162.1	196.3
	2009	7.6	130.2	137.8
	2010	9.9	86.6	96.5
	2011	3.4	59.3	62.7
	2012	2.7	106.4	109.2
	2013	8.4(-82)	61.2(-14)	69.6(-41)
Montrose	2007	205.5	314.8	520.3
	2008	46.6	313.3	360.0
	2009	20.0	222.7	242.7
	2010	36.0	294.3	330.3
	2011	19.8	350.1	369.9
	2012	8.2	281.6	289.7
	2013	33.1(-84)	209.5(-33)	242.6(-53)
Montrose Harbor	2007	33.0	58.7	91.6
	2008	9.6	37.9	47.5
	2009	7.4	52.6	60.1
	2010	9.3	57.1	66.4
	2011	2.7	35.7	38.4
	2012	4.1	89.4	93.6
	2013	8.4(-74)	33.3(-43)	41.8(-54)
57th Street	2007	109.5	121.3	230.8
	2008	1.3	3.6	4.9
	2009	14.2	96.0	110.2
	2010	15.5	92.8	108.3
	2011	6.9	54.8	61.8
	2012	2.4	109.1	111.4
	2013	14.7(-87)	58.6(-52)	73.2(-68)
63rd Street	2007	65.0	170.6	235.6
	2008	0.5	3.5	4.0
	2009	35.5	252.7	288.2
	2010	2.8	21.6	24.3
	2011	4.5	85.2	89.7
	2012	1.6	33.7	35.3
	2013	8.6(-87)	24.4(-86)	33.0(-86)
Jackson Harbor	2007	34.6	125.2	159.8
	2008	15.7	106.5	122.2
	2009	16.1	105.7	121.8
	2010	14.2	130.8	145.0
	2011	2.3	64.9	67.2
	2012	1.6	115.1	116.6
	2013	6.3(-82)	59.7(-52)	66.0(-59)

Table 7. P-value of year (2007 through 2013) by week (weeks 5-10) interaction for hatch-year, after hatch-year, and total ring-billed gull use of beaches without canine harassment.

Beach	Hatch-Year			After Hatch-Year			Total		
	year	week	yr*wk	year	week	yr*wk	year	week	yr*wk
Leone/Loyola	<.0001	<.0001	.0215	<.0001	.72	.65	<.0001	.0646	..83
Hollywood/Osterman	<.0001	<.0001	<.0001	<.0001	.0019	.48	<.0001	<.0001	.19
North Avenue	<.0001	<.0001	.0002	..0631	<.0001	.0981	.0031	<.0001	.19
Oak Street	<.0001	<.0001	<.0001	.0216	.0669	.0151	.0065	.0125	.0042
Ohio Street	.32	.0309	.0698	.69	.38	.14	.65	.37	.12
12th Street	<.0001	<.0001	.0124	.0256	.58	.0766	.0100	.82	.13
31st Street	<.0001	<.0001	<.0001	<.0001	.74	.95	<.0001	.44	.76
Rainbow	<.0001	<.0001	<.0001	.0070	.18	.16	<.0001	.42	.0370
Calumet	<.0001	<.0001	<.0001	.85	.0267	.95	<.0001	.0004	.0200

Table 8. Mean number of total ring-billed gulls observed at 63rd Street Beach during periods of time with and without canine harassment during 2012 and 2013.

Gulls Observed at 63rd Street Beach during 2012		
Location	Non-harassment Periods (*n*=17)	Harassment Periods (*n*=41)
Nearshore[1]	0.4	2.5
Park[1]	70.2	4.6
Beach[2]	128.3	30.2
Casino Pier[2]	59.1	26.6
59th Street Pier[2]	22.3	39.1
Total	280.3	103

Gulls Observed at 63rd Street Beach during 2013		
Location	Non-harassment (n=21)	Harassment (n=35)
Near Shore[1]	1.9	1.0
Park[1]	4.8	4.3
Beach[2]	118.9	6.8
Casino Pier[2]	36.9	27.7
59th Street Pier[2]	45.2	38.3
Total	207.7	78.1

[1] Canines did not have access to this area
[2] Canines had access to this area

Table 9. Mean number of Canada geese observed per survey at beaches in Chicago, Illinois during weeks 1-15 in 2013.

Beach	1 5/27- 6/2	2 6/3-6/9	3 6/10-6/16	4 6/17-6/23	5 6/24-6/30	6 7/1-7/7	7 7/8-7/14	8 7/15-7/21	9 7/22-7/28	10 7/29-8/4	11 8/5-8/11	12 8/12-8/18	13 8/19-8/25	14 8/26-9/1	15 9/2-9/8	Mean Week 1-15
Leona/Loyola	0.7	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Hollywood/Osterman	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.1
Foster	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Montrose	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.7	41.3	25.0	25.7	6.9
North Avenue	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.7	8.3	18.0	25.7	23.0	5.4
Oak Street	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	3.3	0.2
Ohio Street	1.3	0.7	1.3	0.0	0.0	5.7	0.0	4.0	12.0	12.0	0.0	5.7	8.0	9.3	0.0	4.0
12th Street	4.0	21.0	0.0	5.3	0.0	0.0	2.7	27.0	5.3	34.3	54.3	9.3	0.0	0.0	4.3	11.2
31st Street	3.7	16.3	13.7	17.3	37.3	18.7	25.7	19.7	12.0	7.3	0.0	0.3	1.7	0.0	0.0	11.6
57th Street	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
63rd Street	8.7	0.0	0.0	6.7	0.0	0.0	0.0	0.0	0.0	12.3	3.0	13.7	0.0	16.3	0.0	4.0
South Shore	0.0	0.3	4.0	0.0	0.0	0.0	23.0	0.0	0.0	0.0	6.3	0.7	0.0	0.0	0.0	2.3
Rainbow	48.0	4.3	1.7	0.7	0.0	0.0	0.7	10.3	3.3	39.7	5.3	59.0	0.7	0.0	0.0	11.6
Calumet	1.0	2.7	1.7	1.7	0.0	0.0	0.0	2.0	29.7	47.0	27.0	0.0	25.3	47.3	32.3	14.5
Total - All Beaches	69.3	45.3	22.3	31.7	38.3	24.3	52.0	63.0	62.3	154.7	100.7	108.7	95.0	124.0	88.7	

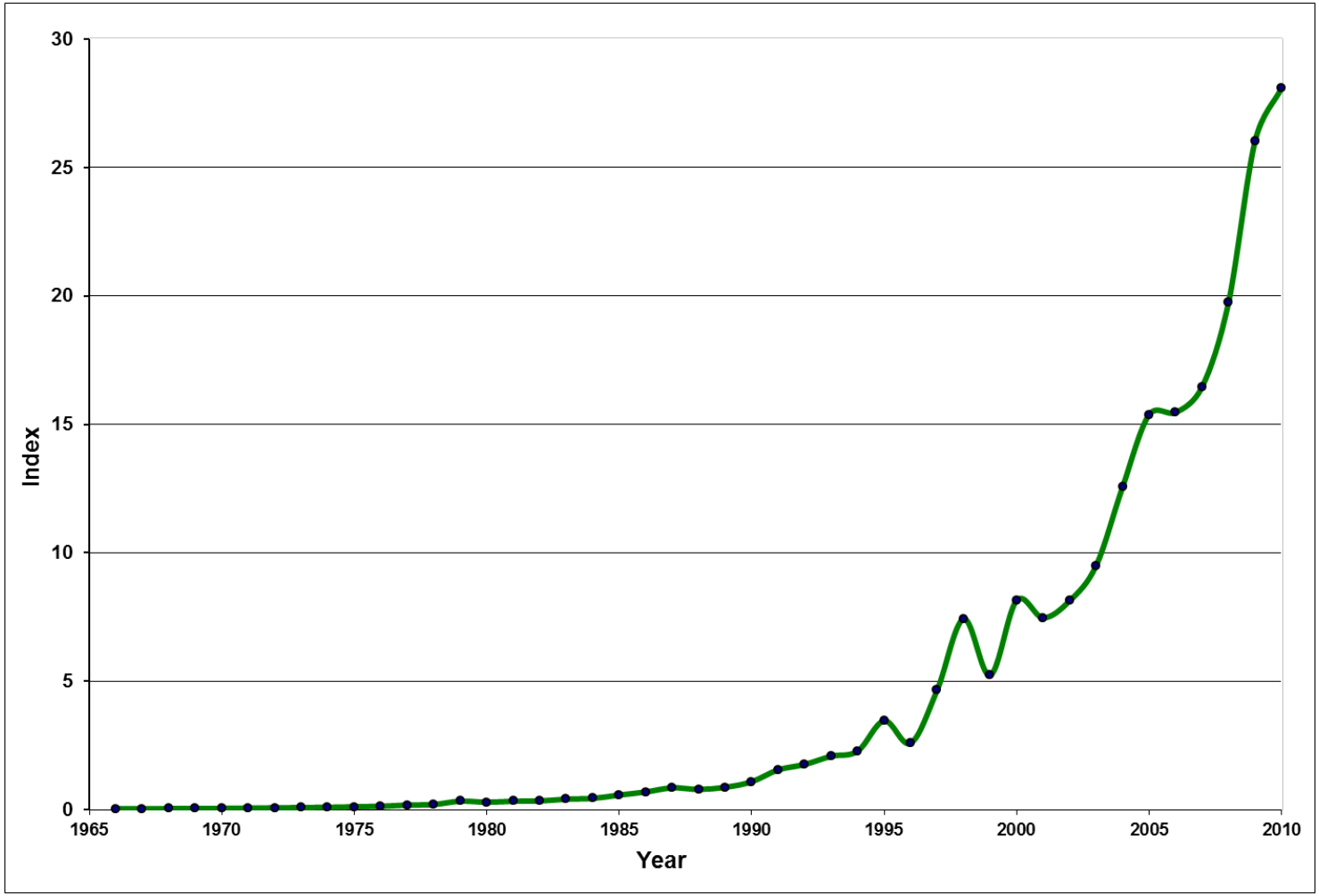


Figure 1. Breeding Bird Survey annual population indices for ring-billed gulls in Illinois from 1966-2010 from Sauer et al. (2012).

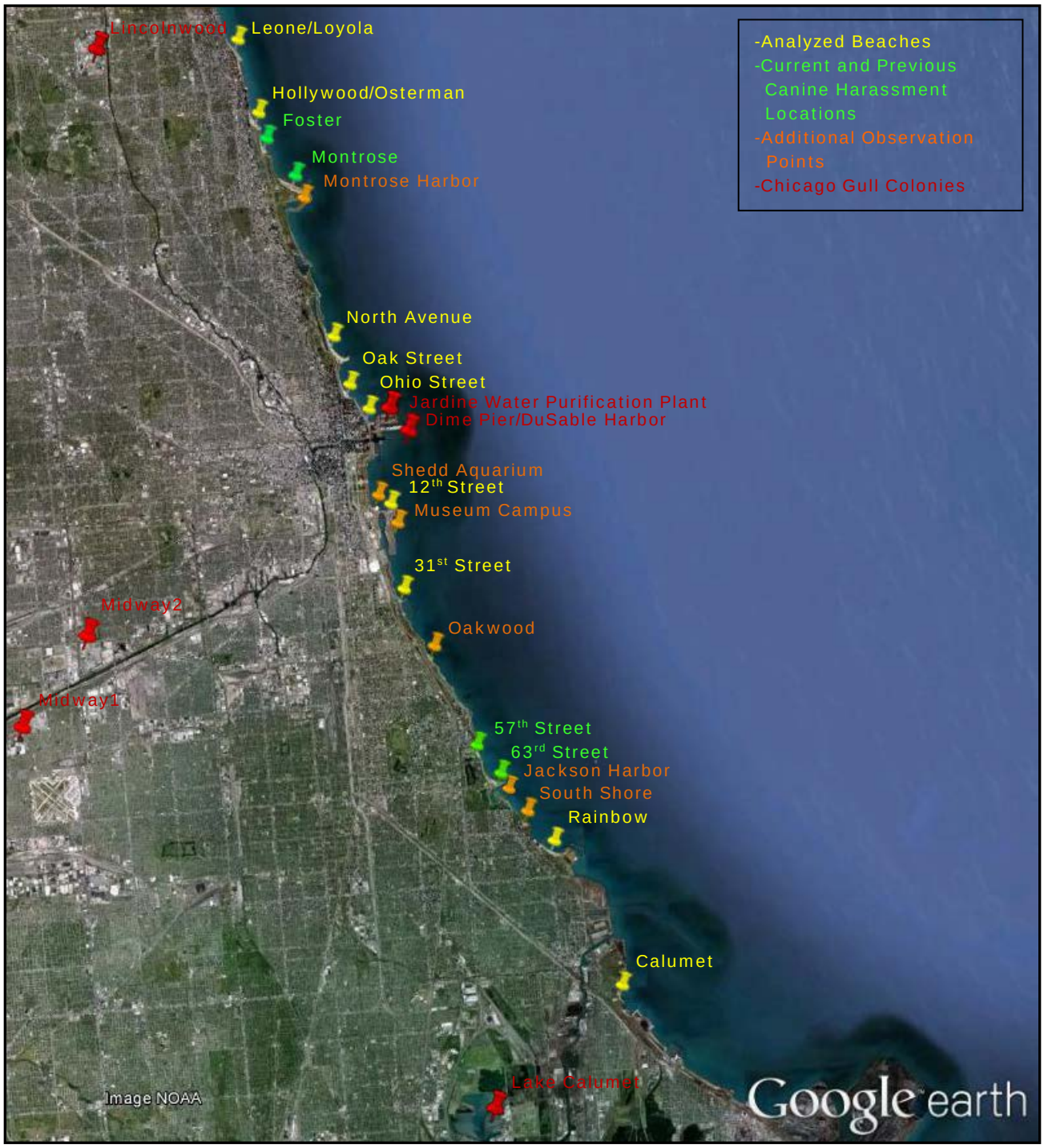
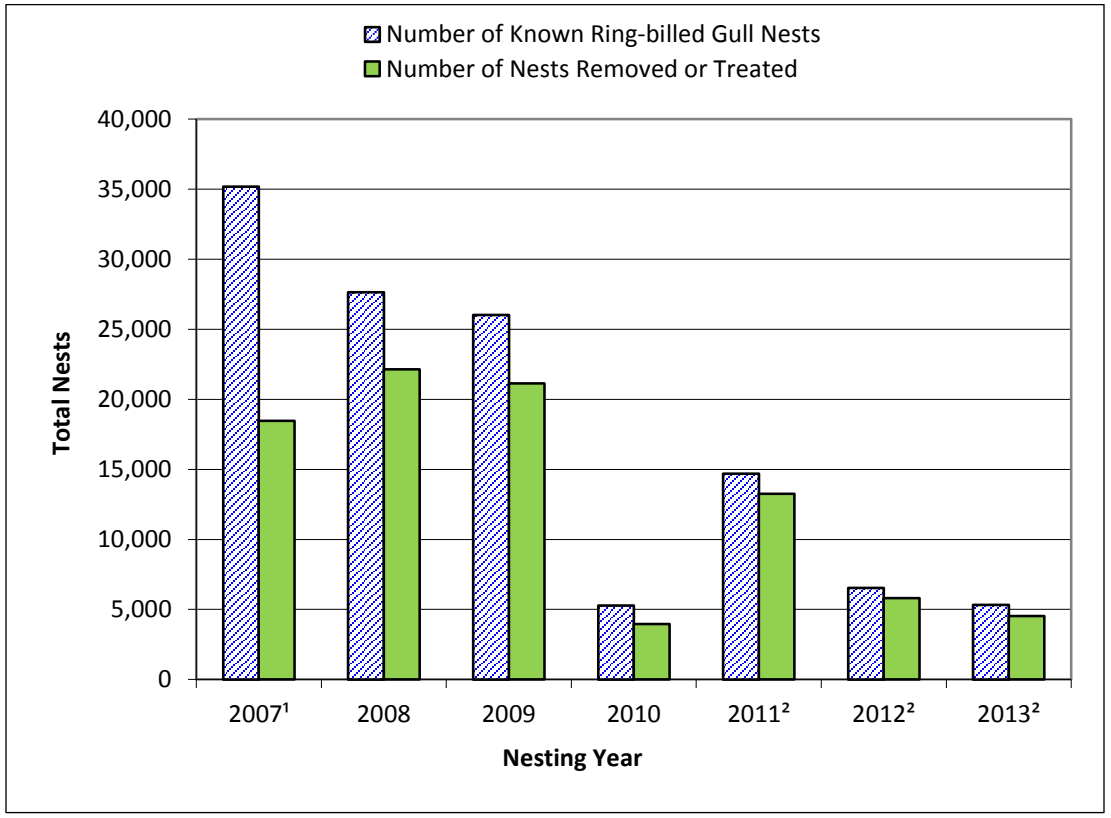
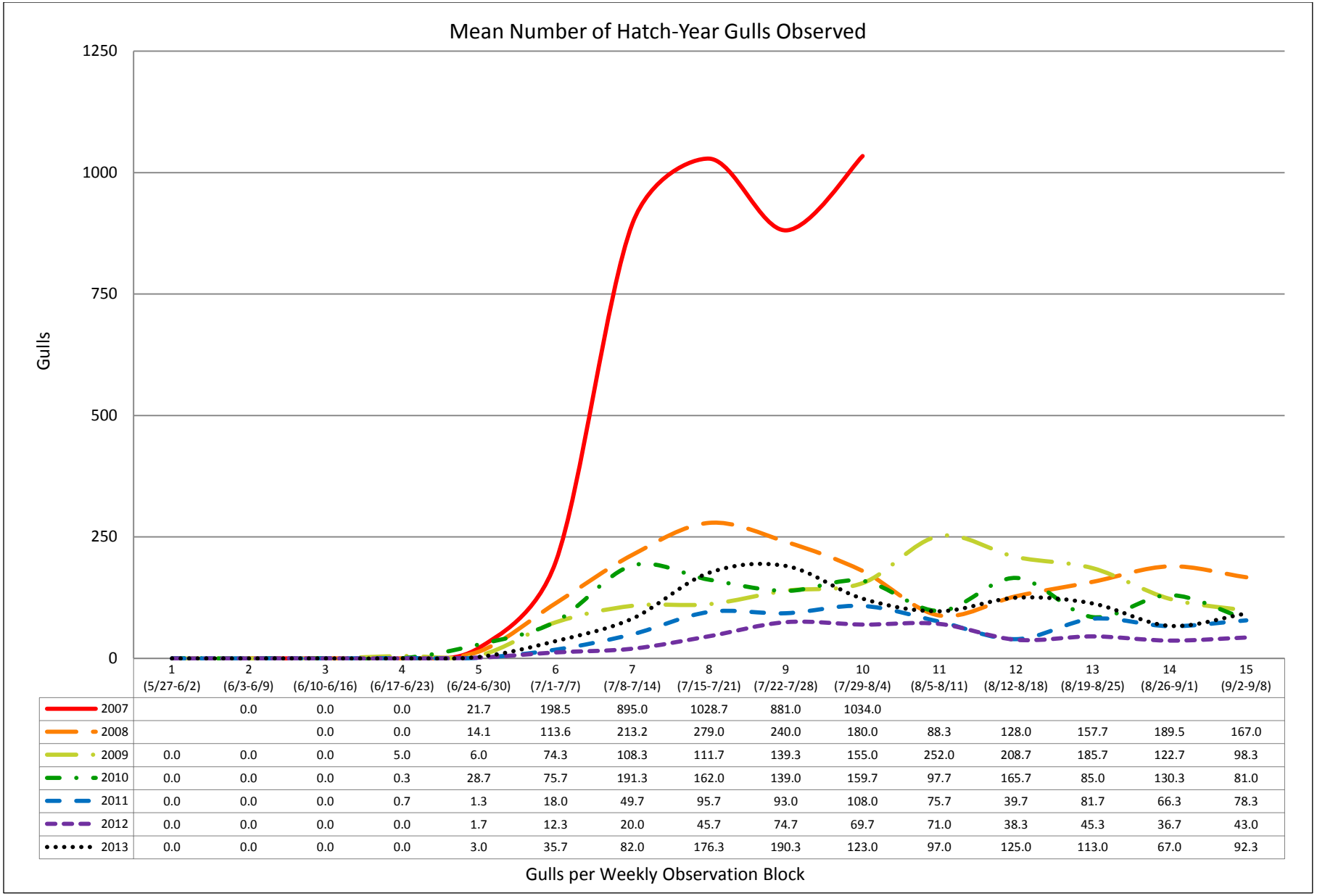


Figure 2. Observation points in Chicago, Illinois and ring-billed gull colony locations (Map courtesy of Google Earth).



[1] 52 percent of the total nests in 2007 were estimated. During 2008 through 2013 all nests were physically counted
[2] The "Number of Known Ring-billed Gull Nests" and "Number of Nests Removed or Oiled" in 2011, 2012, and 2013 is likely greater than the actual colony size due to gulls renesting during the removal period

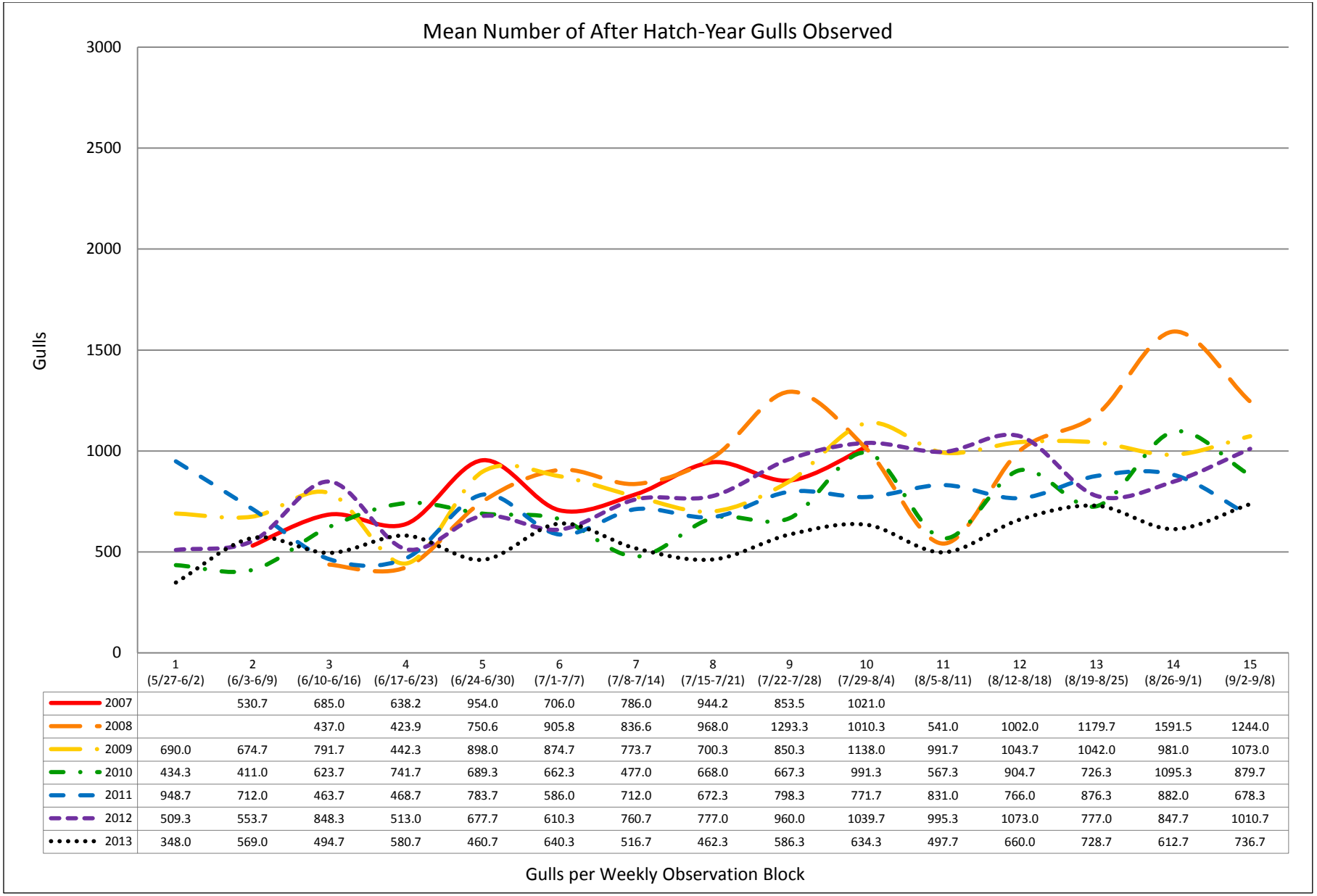
Figure 3. Total number of nests and eggs removed or treated in Chicago between 2007 and 2013.



	1 (5/27-6/2)	2 (6/3-6/9)	3 (6/10-6/16)	4 (6/17-6/23)	5 (6/24-6/30)	6 (7/1-7/7)	7 (7/8-7/14)	8 (7/15-7/21)	9 (7/22-7/28)	10 (7/29-8/4)	11 (8/5-8/11)	12 (8/12-8/18)	13 (8/19-8/25)	14 (8/26-9/1)	15 (9/2-9/8)
2007		0.0	0.0	0.0	21.7	198.5	895.0	1028.7	881.0	1034.0					
2008			0.0	0.0	14.1	113.6	213.2	279.0	240.0	180.0	88.3	128.0	157.7	189.5	167.0
2009	0.0	0.0	0.0	5.0	6.0	74.3	108.3	111.7	139.3	155.0	252.0	208.7	185.7	122.7	98.3
2010	0.0	0.0	0.0	0.3	28.7	75.7	191.3	162.0	139.0	159.7	97.7	165.7	85.0	130.3	81.0
2011	0.0	0.0	0.0	0.7	1.3	18.0	49.7	95.7	93.0	108.0	75.7	39.7	81.7	66.3	78.3
2012	0.0	0.0	0.0	0.0	1.7	12.3	20.0	45.7	74.7	69.7	71.0	38.3	45.3	36.7	43.0
2013	0.0	0.0	0.0	0.0	3.0	35.7	82.0	176.3	190.3	123.0	97.0	125.0	113.0	67.0	92.3

Note observations were not conducted for the entire swim season in 2007 and 2008

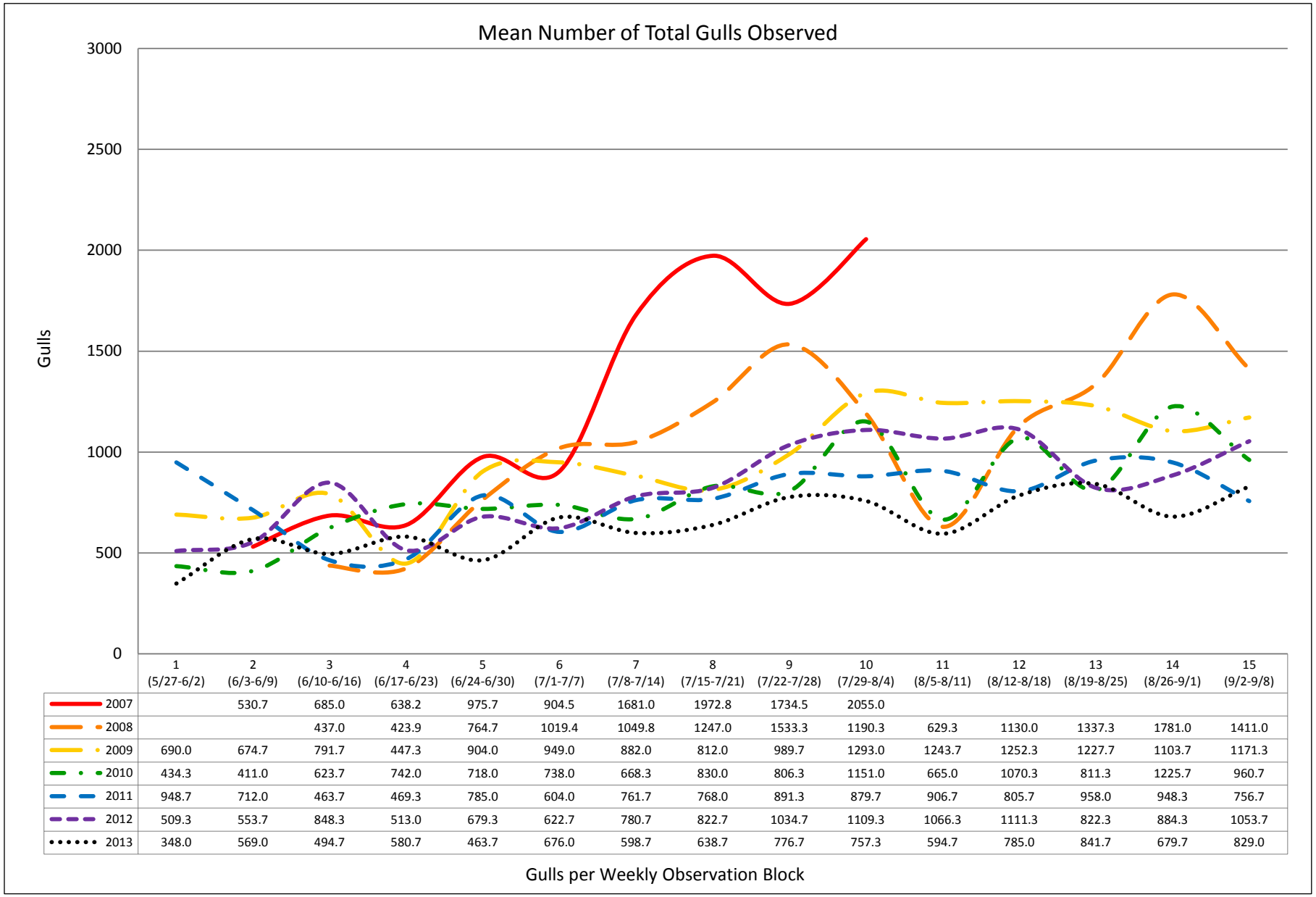
Figure 4. Mean number of hatch-year ring-billed gulls observed at nine Chicago beaches per weekly observation block during 2007-2013.



	1 (5/27-6/2)	2 (6/3-6/9)	3 (6/10-6/16)	4 (6/17-6/23)	5 (6/24-6/30)	6 (7/1-7/7)	7 (7/8-7/14)	8 (7/15-7/21)	9 (7/22-7/28)	10 (7/29-8/4)	11 (8/5-8/11)	12 (8/12-8/18)	13 (8/19-8/25)	14 (8/26-9/1)	15 (9/2-9/8)
2007		530.7	685.0	638.2	954.0	706.0	786.0	944.2	853.5	1021.0					
2008			437.0	423.9	750.6	905.8	836.6	968.0	1293.3	1010.3	541.0	1002.0	1179.7	1591.5	1244.0
2009	690.0	674.7	791.7	442.3	898.0	874.7	773.7	700.3	850.3	1138.0	991.7	1043.7	1042.0	981.0	1073.0
2010	434.3	411.0	623.7	741.7	689.3	662.3	477.0	668.0	667.3	991.3	567.3	904.7	726.3	1095.3	879.7
2011	948.7	712.0	463.7	468.7	783.7	586.0	712.0	672.3	798.3	771.7	831.0	766.0	876.3	882.0	678.3
2012	509.3	553.7	848.3	513.0	677.7	610.3	760.7	777.0	960.0	1039.7	995.3	1073.0	777.0	847.7	1010.7
2013	348.0	569.0	494.7	580.7	460.7	640.3	516.7	462.3	586.3	634.3	497.7	660.0	728.7	612.7	736.7

Note observations were not conducted for the entire swim season in 2007 and 2008

Figure 5. Mean number of after hatch-year ring-billed gulls observed at nine Chicago beaches per weekly observation block during 2007-2013.



	1 (5/27-6/2)	2 (6/3-6/9)	3 (6/10-6/16)	4 (6/17-6/23)	5 (6/24-6/30)	6 (7/1-7/7)	7 (7/8-7/14)	8 (7/15-7/21)	9 (7/22-7/28)	10 (7/29-8/4)	11 (8/5-8/11)	12 (8/12-8/18)	13 (8/19-8/25)	14 (8/26-9/1)	15 (9/2-9/8)
2007		530.7	685.0	638.2	975.7	904.5	1681.0	1972.8	1734.5	2055.0					
2008			437.0	423.9	764.7	1019.4	1049.8	1247.0	1533.3	1190.3	629.3	1130.0	1337.3	1781.0	1411.0
2009	690.0	674.7	791.7	447.3	904.0	949.0	882.0	812.0	989.7	1293.0	1243.7	1252.3	1227.7	1103.7	1171.3
2010	434.3	411.0	623.7	742.0	718.0	738.0	668.3	830.0	806.3	1151.0	665.0	1070.3	811.3	1225.7	960.7
2011	948.7	712.0	463.7	469.3	785.0	604.0	761.7	768.0	891.3	879.7	906.7	805.7	958.0	948.3	756.7
2012	509.3	553.7	848.3	513.0	679.3	622.7	780.7	822.7	1034.7	1109.3	1066.3	1111.3	822.3	884.3	1053.7
2013	348.0	569.0	494.7	580.7	463.7	676.0	598.7	638.7	776.7	757.3	594.7	785.0	841.7	679.7	829.0

Note observations were not conducted for the entire swim season in 2007 and 2008

Figure 6. Mean number of total ring-billed gulls observed at nine Chicago beaches per weekly observation block during 2007-2013.