Summer in the city: behaviour of large gulls visiting an urban area during the breeding season

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ABSTRACT

Capsule: Large numbers of Herring Gull Larus argentatus and Lesser Black-backed Gull Larus fuscus from a traditional colony in the Netherlands visit an urban area for food in the chick rearing period, causing nuisance while doing so.

Aims: To assess the potential contribution of large gulls breeding in a traditional colony to gull–human conflicts in cities.

Methods: Colour-ringed gulls from a nearby colony were counted in the study area throughout the 2014 breeding season. The average numbers observed daily per species and sex were compared between different breeding phases.

Results: Fluctuations in numbers of both species could be explained by breeding phase. Numbers of females of both species and male Lesser Black-backed Gulls dropped significantly during laying and incubation. Numbers peaked post-hatching, coinciding with increased engagement in nuisance events and more frequent displacements within the study area.

Conclusion: Large gulls from a traditional colony frequently visited the urban study area, especially when food demand for chick provisioning was high, suggesting that city visits are motivated by accessibility of urban food. The proportion of rooftop breeding gulls in this area is low. Therefore, measures to avoid nuisance should focus on reducing food availability rather than controlling gull breeding.

Most European populations of Lesser Black-backed Gull Larus fuscus and Herring Gull Larus argentatus have increased in the last decades of the 20th century (Rock 2005, Camphuysen 2013), resulting in larger breeding colonies and increased interaction with humans. This population increase was especially observed in urban areas (François 2002, Rock 2005, Haagse Vogelbescherming 2012), and both species have become a common sight in large cities, in some of which they have established rooftop breeding colonies. The increase in urban breeding colonies in the Netherlands may be partly caused by gulls moving to safer breeding grounds after increased predation by Red Fox Vulpes vulpes in some traditional colonies, which are outside of urban areas (Spaans et al. 1996, Stienen et al. 2002, Camphuysen et al. 2010, Strucker et al. 2010). Especially in seaside cities, the increased presence of large gulls causes gull–human conflicts and nuisance (Rock 2005, Coulson & Coulson 2008, Camphuysen 2013, Ross-Smith et al. 2014), such as noise, defecation, aggression and the tearing up of rubbish bags (Rock 2005, Camphuysen 2013). The nature of this nuisance appears to be twofold: part is caused by rooftop breeding by gulls, another part by gulls foraging in urban areas. For effective management of these issues, it is essential to understand the spatial and temporal dynamics of gull presence in urban areas.

Large gulls have been studied thoroughly in the past decades mainly from the perspective of the breeding colonies, both traditional (Bukacińska et al. 1996, Vercruijsse 1999, Camphuysen 2013) as well as rooftop colonies (Raven & Coulson 1997, Rock 2005, Coulson & Coulson 2008, 2009, 2015). The majority of studies on gulls in urban areas have focused on describing rooftop colonies and foraging on landfills, rather than their behaviour in the city (Vercruijsse 1999, Rock 2005, Coulson & Coulson 2008, Lensink et al. 2010). Foraging trips into cities by individual gulls from traditional colonies have been documented (e.g. Verbeek 1977, Bouten et al. 2013), but large-scale studies on the use of cities by gulls breeding in traditional colonies are lacking and the contribution of these gulls in gull–human conflicts remains unclear.

The Hague is one of the coastal cities in the Netherlands where large gulls are considered a pest.
The city has an increasing population of roof-breeding Lesser Black-backed Gulls and Herring Gulls (Lensink et al. 2010, Haagse Vogelbescherming 2012), but also receives many visiting gulls from the largest mixed traditional colony of both species in the Netherlands, located 20 km south in the Port of Rotterdam (PoR; 51.8850°N, 04.2867°E). Spread out over sub-colonies in Europoort and Maasvlakte, the PoR colony consists of approximately 24 150 breeding pairs of Lesser Black-backed Gulls and 3100 pairs of Herring Gulls (breeding season of 2012, Strucker et al. 2013), compared to an estimated 166 and 356 rooftop breeding pairs in The Hague of Lesser Black-backed Gulls and Herring Gulls, respectively (Lensink et al. 2010). Since 2010, several thousands of gulls (both adults and juveniles) in the PoR colony have been fitted with colour-rings to study their movement patterns, with a minimum of 750 ringed per year since 2012. Regular observations of colour-ringed gulls from this traditional colony in surrounding urban areas suggest that high numbers of individuals from the colony use the nearby cities (R.J. Buijs unpubl. data). In order to assess the impact of large gulls breeding in a traditional colony on the city environment, we studied the patterns of presence, absence and behaviour of Lesser Black-backed Gulls and Herring Gulls from the PoR colony in The Hague during five consecutive phases of the breeding season. By systematically monitoring the presence of colour-ringed gulls along a fixed trajectory during the breeding season, we assessed differences between species and sexes in the context of their respective roles in the breeding process. Meanwhile, we recorded cases of nuisance caused by gulls and the participation of colour-ringed gulls therein. Based on past observations of colour-ringed large gulls from the PoR colony in The Hague (N. Huig unpubl. data), we expected gull numbers to fluctuate according to the breeding chronology, that is, to be low in the laying period when nesting and incubation are most time consuming, and to peak in the chick rearing period when finding food is a high priority. Accordingly, we expected gulls to be more mobile in search of food after hatching, which may coincide with an increased incidence of nuisance caused by urban foraging.

Materials and methods

Monitoring

To study the fluctuations in presence and numbers of Lesser Black-backed Gulls and Herring Gulls from the PoR colony and to monitor their behaviour during the breeding season, we carried out near-daily surveys along a fixed trajectory from mid-March until mid-August 2014 in search of colour-ringed individuals. This trajectory was 14 km in length and covered the entire study area (Figure 1, OpenStreetMap.org). The trajectory included residential areas, small business districts and a city park in The Hague and the bordering area of Rijswijk. It was covered by bicycle, allowing frequent stops to check side streets for the presence of gulls. All gulls along the trajectory and in side streets were checked for colour-rings. Binoculars and cameras with telephoto lenses were used to identify the codes on the colour-rings. Based on numbers of resting and flying gulls (non-breeders) counted by Lensink et al. (2010), we know that the number of gulls in the study area was similar to other parts of the city. All individuals that were either colour-ringed in the PoR, or had been ringed in other colonies but were known to breed in the PoR colony, were recorded. Only adults of known sex were included in the analyses of city presence and behaviour. Birds were considered adults after their fourth calendar year. Adult birds that were caught and ringed over the course of the 2014 breeding season were not included in the analysis of city presence, as they were not individually identifiable throughout the entire study period.

Breeding and city visits

To assess the relation between gull presence in the study area and the different phases of the breeding season, we divided the breeding season into five periods of four weeks (28 days; Table 1). Each period coincided with a major phase in the breeding season, although the timing of individual pairs may vary (Vercruyssse 1999, Camphuysen 2013). Laying dates for Herring Gulls are generally a week earlier than for Lesser Black-backed Gulls (Camphuysen 2013), but could be expected to fall within the same period for both species. We were unable to visit the breeding colony, because it was on closed terrain. Since there is no literature about the timing of breeding for gulls from the PoR colony, we used literature on other colonies in The Netherlands, such as Schouwen (Vercruyssse 1999) and Texel (Camphuysen 2013) to come to the division of the breeding season. March 23 was set as a starting date of the breeding season (settling period), as this was the first day that courtship behaviour of Lesser Black-backed Gulls was observed. We recorded the location and ring details of all colour-ringed gulls. For each period, we calculated daily mean number of colour-ringed gulls present in the study area for each species and sex separately.
Behaviour

We recorded all nuisance events in which colour-ringed large gulls were involved. Gull behaviour was considered disturbing and recorded as a nuisance event if it involved at least 25 gulls, lasted a minimum of 15 minutes and appeared to be conflicting with human interest. The types of nuisance events that were recorded were: disturbance of rubbish bags, raiding of bread containers, and searching for food scraps or emerging flying ants ('feeding frenzies') at places with many people present, such as residential areas, outdoor barbecue dinners, festivals and markets. These events were considered conflicting with human interest because they left rubbish in the streets or forced people to take (short) detours out of fear of large groups of gulls. Groups of gulls that were resting or preening were not considered a nuisance as these groups always occurred away from people. In order to standardize the encounter probability, we did not actively search for events but only recorded those that were encountered by chance during the monitoring surveys. Occasional feeding by smaller groups of gulls that had been fed deliberately were not recorded as nuisance events, as these were small scale and brief. In order to determine

Figure 1. (a) The study area is located in the east of The Hague and borders the city of Rijswijk. It is surrounded by residential areas, although beaches and agricultural land can be found at approximately 10 km distance. (b) The fixed trajectory in the study area is shown as dotted line. Within the study area a city park, some small open areas and fresh water elements were present. This is similar to the surrounding neighbourhoods. Scales are approximate. (Data by OpenStreetMap.org contributors under CC BY-SA 2.0 license.)
if gull mobility changed during the breeding season, we calculated the distance between the locations of each consecutive observation of a colour-ringed individual.

**Statistical analysis**

To detect differences in the number of observed gulls between periods and sexes, we used a generalized linear model with a negative binomial error distribution for both species with number of gulls observed per day as dependent variable, and period, sex and the interaction period:sex as fixed factors. Differences in movement distance were tested using a linear model with log-transformed distances as the dependent variable and period, species and sex as fixed factors. We used Tukey’s honestly significant difference post-hoc tests with Bonferroni correction for pairwise tests between periods. All statistics were performed using the ‘MASS’ (Venables & Ripley 2002) and ‘multcomp’ (Hothorn et al. 2008) packages in R for statistics (R Core Team 2014).

**Results**

**Monitoring**

On 129 days in the study period we made 1234 sightings of 272 individual colour-ringed large gulls from the PoR colony. Of these individuals, 215 were adult (138 Lesser Black-backed Gulls and 77 Herring Gulls), of which 197 were of known sex and thus selected for further analysis. The largest number of adult PoR gulls seen on a single day was 16 for Lesser Black-backed Gull (29 June) and 10 for Herring Gull (28 June). Fifty-seven of the observed individuals were sub-adult during the study period and in none of the periods did the proportion of sub-adult birds reach 20%. Only one colour-ringed juvenile (hatched in spring 2014) from the PoR colony was observed in the study area, and that was in the fledging period.

**Variation in gull numbers**

The number of colour-ringed adult gulls per day in the study area varied significantly through the breeding season in both species (Lesser Black-backed Gull: \( \chi^2 = 42.4, df = 4, P < 0.001 \) and Herring Gull: \( \chi^2 = 10.9, df = 4, P = 0.02 \); Figure 2). Overall, the numbers dropped between the settling and laying periods and were lowest in the incubation period (Figure 2). In the rearing period, the number of ringed individuals increased to levels similar to the settling period and remained high in the fledging period. Numbers of male and female Lesser Black-backed Gulls were similar in the settling period and both decreased during the laying period (territory establishment), but females more steeply than males (Figures 2a and b). During incubation, the number of female Lesser Black-backed Gulls remained stable, but the number of males decreased further. After hatching (rearing period), numbers of both sexes rose again, but in contrast to the males it appeared that females started to leave the study area in the fledging period. Similar to the Lesser Black-backed Gulls, the number of Herring Gulls showed a clear dip during the incubation period. This was, however, exclusively attributed to the females, as the numbers of Herring Gull males in the city remained fairly stable throughout the breeding season (Figures 2c and d). In the rearing period the number of males peaked and number of females were recovering. After fledging, the numbers of both sexes of Herring Gull remained stable. A large proportion of adult colour-ringed individuals was observed only once in the entire study period (42%, 91 individuals), 35 of which were seen exclusively in the rearing period. This peak in single-visit individuals was largest in females of both species and smallest in Herring Gull males.

**Nuisance and mobility**

We recorded 49 nuisance events, in which 59 individual colour-ringed gulls were involved. Nineteen individuals were involved in more than one event and two individuals were observed in as many as five nuisance events (both Herring Gull males). In the settling and laying periods combined, only four nuisance events were observed, but the number of nuisance events increased steeply from the end of the incubation, as the
first eggs hatched (Figure 3a). The mean number of colour-ringed gulls in these events increased from 1.0 in the first two periods to 2.4 individuals in the rearing period, with a maximum of nine individuals in a swarming ant feeding event on 4 July. Two-thirds of the colour-ringed individuals involved in nuisance events were Herring Gulls and in both species males were involved more than twice as often as females. Interestingly, Lesser Black-backed Gull females only participated in nuisance events in the rearing period and were seen in just two types of event (Figure 3b).

For a remarkably high proportion of individuals the observation on the event was the only sighting in the entire study period (from 33% for female Herring Gulls to over 60% for male Herring Gulls and female Lesser Black-backed Gulls).

The mobility of large gulls in The Hague also changed through the season. Whereas early in the breeding season (settling, laying and incubation) only 5.5–7.0% of the ring sightings within the period involved displacement (a resighting at another location than the previous observation), resightings within the rearing and fledging periods included 14.3% and 13.9% displacements, respectively. Similarly, the proportion of individuals that showed mobility within the separate periods peaked in the second half of the breeding season, with 29.2–34.2% of the resighted gulls showing displacement in the rearing and fledging periods, respectively. This increase was mostly caused by the females of both species, which showed particularly high mobility in the rearing and fledging period (Figure 4). Herring Gull males also showed increased mobility in these periods, but not as strongly as the females. The mobility of Lesser Black-backed Gull males remained fairly stable over the breeding season. The overall mean distance of displacements was 768 ± 62 m (± se) and did not differ significantly between periods (Linear model, $F_{1,62} = 0.61$, $P = 0.44$), species ($F_{1,60} = 0.002$, $P = 0.97$) or sex ($F_{1,61} = 0.28$, $P = 0.61$).

**Discussion**

Conflicts between gulls and humans have become a highly debated topic, with a primary focus on rooftop breeding gulls. The contribution to such conflicts of gulls breeding in traditional colonies, but foraging in
urban areas, has received much less attention. Without disregarding the importance of rooftop breeders (Lensink et al. 2010), we studied the presence and behaviour of gulls from the traditional PoR colony visiting the city of The Hague over the course of the breeding season. Monitoring colour-ringed gulls along a fixed trajectory proved to be a good means of detecting fluctuations in gull numbers and provided insights about the scale and possible causes of disturbing behaviour. We found that the number of gulls visiting the city from the PoR colony was strongly dependent on the advancement of the breeding season, with a clear dip during the incubation period and a strong increase in numbers after hatching. Mobility and disturbing behaviour also increased sharply during the chick rearing period.

**PoR gulls in the study area**

The coincidence of an increase in gull–human conflicts in urban areas and the establishment of rooftop colonies suggests a direct relationship between the two. However, before implementation of measurements to reduce nuisance, it is essential to first determine the origin of the gulls that are involved. In our study area, we identified a total of 215 adult colour-ringed large gulls from the PoR colony during the breeding season of 2014. What does this tell us about the absolute number of gulls from the PoR colony visiting the study area and how does this relate to the number of rooftop breeding gulls? Based on ringing data, population estimates of the PoR colony (24 150 pairs of Lesser Black-backed Gull and 3100 pairs of Herring Gull in 2012; Strucker et al. 2013) and the annual survival rates of adult large gulls (91% for adult Lesser Black-backed Gulls, 86% for adult Herring Gull males and 79% for adult Herring Gull females; Camphuysen 2013), we calculated that the proportion of colour-ringed adult gulls from the PoR colony that visited the

![Figure 3.](image-url) (a) Number of large gulls engaged in nuisance events in the study area in the five periods, separated by species and sex. (b) Number of large gulls involved in different types of nuisance events per species and sex. HG, Herring Gull and LBBG, Lesser Black-backed Gull. Period numbers correspond to subsequent stages in the breeding process (Table 1).

![Figure 4.](image-url) Proportion of resightings within each period involving displacement (i.e. a resighting at another location than the previous sighting within the same period), providing a measure of mobility. Note the high mobility of female gulls after hatching. Period numbers correspond to subsequent stages in the breeding process (Table 1).
study area was approximately 18% for Lesser Black-backed Gulls and 30% for Herring Gulls. Assuming that carrying colour-rings has no effect on the probability of visiting the city, this implies that an estimated 8785 Lesser Black-backed Gulls and 1885 Herring Gulls from the PoR colony visited our study area over the course of the breeding season of 2014. These numbers greatly exceed the estimated numbers of roof-breeding large gulls in The Hague (approximately 200 breeding pairs of Lesser Black-backed Gulls and 400 pairs of Herring Gulls), most of which breed in a different part of the city (Lensink et al. 2010). Since this study covered only a relatively small part of The Hague, true numbers of visiting gulls from the PoR colony are probably higher than the numbers presented here. This clearly implies that most large gulls found in this urban area are not local breeding birds and therefore reducing the number of rooftop breeding gulls in The Hague would have limited effect on the occurrence of gull–human conflicts.

**Gull numbers and breeding**

Another fundamental element of understanding gull–human conflicts in urban areas is knowledge of the seasonal variation in gull numbers. Due to the spatial heterogeneity of the study area, local factors that were unrelated to gull breeding stage (e.g. children playing soccer) strongly affected the numbers of gulls at separate flocking sites. We therefore treated the entire 14 km trajectory as a single observation and compared the number of colour-ringed gulls observed per day between periods. The resulting spatial pseudoreplication should be taken into account when interpreting and extrapolating our results. The near-daily monitoring of colour-ringed Lesser Black-backed Gulls and Herring Gulls from the PoR colony revealed a clear decrease in their numbers in the urban environment during the laying and incubation phase of the breeding season. Numbers of females decreased more than males in this period, especially in Herring Gulls. The observation that the number of male Lesser Black-backed Gulls started off high and decreased in the first half of the breeding season, while male Herring Gulls remained stable at an already low number, may be explained by the fact that male Herring Gulls start territorial behaviour in the colony as early as January (R.J. Buijs unpubl. data). This suggests that they already had stronger ties to the colony in the settling period, while Lesser Black-backed Gulls first spent some time in the city upon returning from their wintering grounds, before moving to the colony. It is remarkable that the disappearance of females from the city at the start of breeding occurred earlier in Lesser Black-backed Gulls than in Herring Gulls, while Herring Gulls normally start laying eggs approximately one week earlier (Vercruysse 1999, Camphuysen 2013). Future studies should verify if this is also the case inside the PoR colony.

The dip in numbers of adult gulls from the PoR colony during laying and incubation was followed by an abrupt peak in the rearing period, after hatching of the chicks. Many of the birds that appeared in the study area after hatching were individuals that had not been observed earlier in the study period (especially females). Literature shows that, in Herring Gulls, urban food sources are relatively important to raise chicks successfully, especially for larger broods (Spaans 1971, Vercruysse 1999), which could explain the high number of adult gulls in The Hague in the rearing period. The individual identification by colour-rings revealed that a large proportion of the gulls visiting the study area during the post-hatching period appeared just once, targeting events providing high food abundance and accessibility. Interestingly, in contrast to the gull species in this study, Skorka & Wójcik (2008) found that Caspian Gulls Larus cachinnans in Poland forage less on urban food sources in the rearing period than in the periods before.

The proportion of sub-adult gulls in the study area remained fairly constant (between 10% and 20% of all observed individuals) over the course of the breeding season. An increase in the proportion of sub-adults was expected in the fledging period due to the entry of juveniles into the population, but did not occur. Only a single colour-ringed juvenile was observed in the study area, while 21 were seen on nearby beaches in the same period (pers. obs.). A remarkable finding was a slight drop in the number of sub-adult Herring Gulls in the incubation period, which may indicate that some fourth calendar year birds of the population did attempt to breed. In the PoR, at least two ringed fourth calendar year Lesser Black-backed Gulls were found on nests with eggs in 2014, but no fourth calendar year Herring Gulls were found breeding that year (R.J. Buijs unpubl. data).

**Disturbing behaviour and mobility**

With changing needs across the annual cycle, animal behaviour may vary over time. In the case of large gulls in the city, we found that both the number of nuisance events and the mobility of individuals increased strongly after the hatching of the chicks. This is most likely due to a high demand of easily accessible food for chick provisioning, which is in line with the
findings of Noordhuis & Spaans (1992), that the proportion of rubbish in chick regurgitations in Herring Gulls in the traditional colony of Terschelling was greater than the proportion of rubbish in adult pellets. Although most studies relate the use of urban food sources to foraging on landfill sites (Pons & Migot 1995, Vercruyssse 1999), similar food types can be found in other urban areas (Verbeek 1977). The observed higher mobility of gulls in the rearing period is also an indication of increased search behaviour to find food for chicks.

Although more colour-ringed Herring Gulls than Lesser Black-backed Gulls were seen in nuisance events, the above described proportions of colour-ringed gulls indicate that the absolute numbers of Herring Gulls and Lesser Black-backed Gulls involved in events were quite similar. This seems to contradict several studies that show hardly any overlap in spatial foraging niches between the two species (Verbeek 1977, Camphuysen 1995, Kubetzki & Garthe 2003). Verbeek (1977) found that both species foraged in urban areas, but Herring Gulls favouring fish halls and harbours while Lesser Black-backed Gulls were seen in streets and gardens. In our study both species were involved in disturbing behaviour in streets and on the fish market. A large proportion of the gulls involved in events consisted of individuals that were seen only once in the entire study period, suggesting that large-scale events, such as when food is abundant and easily accessible, attract individuals from outside the study area.

The increased mobility of gulls after hatching is consistent with the high food demand of the chicks and may indicate a more intensified search for food. Only three individuals (all male Herring Gulls) seemed to move from event to event, showing up at three to five different locations. All three were observed foraging naturally on beaches after the study period, indicating that their disturbing behaviour was related to the post-hatching phase in which chicks are reared.

The peak in displacements by female Lesser Black-backed Gulls in the fledging period coincides with a drop in the participation in events, potentially indicating pre-migratory wandering as the average number of individuals seen per day was already decreasing, and many of them were not seen again in the second half of the period. This suggests that these birds had started migrating south, which is supported by observations of some of these individuals in Northern France within the same time frame in 2013 (R.J. Buijs unpubl. data). The declining number of Herring Gulls in the fledging period could be explained by favourable alternative feeding opportunities on the coast. In late summer, directly after the study period, Herring Gull numbers at the coast rose rapidly (pers. obs.). In fact, in August 2014 alone (within a month after the study period) 18% of all adult Herring Gulls that had been observed in the city were seen on beaches in The Hague (Huig et al. in prep).

**Conclusion**

Overall, we conclude that monitoring colour-ringed gulls can provide interesting insights in the patterns of presence and behaviour of gulls in an urban area. In The Hague, many gulls from the nearby PoR colony visit the city during the breeding season in addition to local rooftop breeding gulls. The observed influx of large gulls in the city during the breeding season appears to be twofold: first there is a small pre-breeding peak that can be attributed exclusively to Lesser Black-backed Gulls returning from their wintering grounds, and later there is a large post-hatching peak that is caused by an influx of many individuals of both species that seem to pay brief visits to the city in search of urban food. Over the course of the breeding season, the number of individuals from the PoR colony visiting the city is far greater than the number of individuals breeding on rooftops in the city. Nonetheless, no more than a few per cent of the gulls from the PoR colony visit the study area per day. Disturbing behaviour seems highly opportunistic and driven by a high demand for food for chick provisioning. Very few individuals appear to be specialized in disturbing behaviour and even they seem to switch to more natural food sources after the chicks have fledged.

Since most of the nuisance from foraging gulls seemed to occur where rubbish was accessible, measures to make it less accessible in the critical two months of the year (e.g. by storing it underground) should be effective to prevent a large proportion of the gull–human conflicts. As a consequence, this will reduce the food availability for gulls during the chick rearing period. Studies inside the colony should reveal how dependent large gulls in the PoR are on food from urban areas.

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