

LAUGHING GULL NEST POPULATION IN JAMAICA BAY, NEW YORK, 1992-2006

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Biologists from the U.S. Department of Agriculture, National Park Service, Port Authority of New York and New Jersey, and other agencies established plots in Joco Marsh near the approach to Runway 4L, John F. Kennedy International Airport, to ground-truth counts of laughing gull nests from aerial photographs, 6 June 2006.

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Abstract.--We used aerial photography (full coverage from fixed-wing aircraft) to estimate the population of laughing gull (*Larus atricilla*) nests in 4 marshes (Joco, East Joco Island, Silver Hole, East High Meadow) in Jamaica Bay, New York, during June 1992-2006. Based on ground-truth plots (1993-2002 and 2004), we estimated that our counts of nests on photographs differed from the actual number of nests by means of -9% to 14%. Our corrected counts indicate the nest population during 1992-2006 has remained below the 7,629 nests recorded during a ground-based survey in 1990. The estimated nest population in 2006 (2,467 nests with 95% CI = 2,339-2,621) was among the lowest estimates since aerial surveys began in 1992. A major change that has occurred from 1992-2006 is a sharp decline in nesting on East High Meadow (beginning in 1997) and Silver Hole (beginning in 2000) that is likely related to tidal flooding and marsh erosion. We recommend that this nest survey be continued in 2007 as part of the monitoring program for bird hazards at nearby John F. Kennedy International Airport.

INTRODUCTION

Gulls (*Larus* spp.) have frequently been reported as a hazard to aircraft (Seubert 1990, Richardson 1994, Pinos 1996, Cleary et al. 2006). Laughing gull (*L. atricilla*) collisions with aircraft at John F. Kennedy International Airport (JFKIA) increased during the 1980s, related to an expanding nesting colony adjacent to the airport in Jamaica Bay (Dolbeer et al. 1993). This strike increase prompted various management actions including egg oiling, shooting gulls, airport vegetation management, and falconry (Griffin and Hoopes 1991, Dolbeer et al. 1993, Buckley and McCarthy 1994, Dolbeer 1998a, 1999, Barras et al. 2000, Dolbeer et al. 2003). Belant and Dolbeer (1993) and Dolbeer (1998b) predicted that these management programs would have a minimal effect on national laughing gull populations; however, an accurate estimate of the size of the nesting colony in Jamaica Bay was needed annually to assess effects on the local population. A ground-based count of this colony in 1990 totaled 7,629 nests (Griffin and Hoopes 1991).

A review of laughing gull nesting population surveys for the USA revealed that many estimates of colony size have been based on partial ground counts or visual counts from the air that often are subjective, incomplete, and of questionable accuracy (Belant and Dolbeer 1993). Although counting nests from the ground is considered the most reliable technique for estimating or censusing many colonial nesting species (Wilkinson 1991), the technique can be labor intensive and difficult to implement in tidal marshes interspersed with creeks. In addition, ground-based nest counts cause considerable disturbance in nesting colonies (Wilkinson 1991). Aerial surveys have been used frequently to estimate populations of nesting birds (Harris 1991, Hutchinson 1979, Sidle and Ferguson 1982, Wilkinson 1991). Therefore, we used aerial photography to estimate the population of laughing gull nests in Jamaica Bay (Dolbeer et al.

1997).

METHODS

Aerial surveys were conducted in June 1992-2006 over Joco (124 ha), Silver Hole (37 ha), East High Meadow (46 ha), and East Joco Island (36 ha) Marshes within Jamaica Bay Wildlife Refuge, Gateway National Recreation Area, New York. These marshes are interspersed with tidal creeks and mosquito-control ditches. Dominant vegetation includes *Spartina alterniflora*, *S. patens*, and *Distichlis spicata* (Buckley and Buckley 1984, Burger 1983). The dates of our aerial surveys (4-18 June, Table 1) coincided with peak incubation and initial hatching of eggs for laughing gulls on these marshes (Buckley and Gurien 1986, Griffin and Hoopes 1991, Dolbeer and Bernhardt 2003).

Using a fixed-wing aircraft, personnel from Aerographics Corporation (Bohemia, NY) or Keystone Photography (Philadelphia, PA) flew 7 transects at approximately 300-m intervals and at 370-m elevation over the marshes in 1992-2004 and 2006. Due to intensive air traffic patterns over the marshes and several days of inclement weather, aerial photography was conducted at 760-m elevation during 2005. Flights were from 1000-1200 EDT with clear sky. Photography personnel took 60 overlapping black and white exposures on the 7 transects each year using a large format camera (Wild RC10 Precision Mapping Camera, 153 mm objective lens, 23 x 23 cm negatives, Kodak 2405 XX aerial film). Each exposure (scale 1:2424) covered approximately 554 x 554 m (30.7 ha). We selected 22-35 of the exposures each year to obtain complete coverage of the 4 marshes.

We obtained 4x enlargement prints during 1992-2004 and 2006 and 10x enlargement prints during 2005 (91 x 91 cm) of the 22-35 exposures and covered each print with clear plastic, gridded in 1.9-ha blocks. The 10x enlargements in 2005 resulted in aerial photographs of the

same scale and quality as the 4x enlargements taken in previous years. Photographs were gridded to assess nest distribution and to avoid duplicate counting in areas of overlap between photographs. All nests observed on each photograph were circled with permanent marker on the plastic overlays by an observer using a magnifying lens. A second observer double-checked each print for nests.

In 1993-2006, we established 7-10, 30- x 30-m plots (5-10 on Joco and 0-3 on Silver Hole marshes) on 3-12 June (1-10 days before the photographs were taken). Plots were delineated with numbered 1- x 1.5-m cardboard markers staked flat to the ground at each corner and white string stretched along the boundaries. Three to six observers searched each plot and marked each nest with a wire survey flag (5 x 8 cm). The number of eggs and approximate location within the plot was recorded for each nest, and the flags and string were removed. The number of nests counted within these plots on the aerial photographs was then compared with the number counted on the ground. Ground counts were not referenced until after nests on aerial photographs were counted.

For each year, 1993-2006, and for all years combined, we determined correction factors by which nest counts from photographs should be multiplied to estimate mean and 95% confidence intervals (CI) for the nest population. These correction factors were based on the standard error of difference in ground and photograph counts for plots and Student $t_{0.05}$ values (Steel and Torrie 1960:44-46). During 2003, 2005, and 2006, aerial photography was not possible until 5 and 10 days after the ground plots were established, respectively. Adverse weather conditions during this period apparently moved or destroyed ground plot markers, making ground-truth correction with these plots unreliable. Consequently, the average mean correction factor for 1993-2002 was used as the correction factor when analyzing the 2003 nest

count data and the average mean correction factor for 1993-2002 and 2004 was used as the correction factor when analyzing the 2005 and 2006 nest count data.

RESULTS

The unenlarged aerial photographs (23 x 23 cm) were inadequate to delineate laughing gull nests. However, nests were usually visible on the 4x (92 x 92 cm) enlargements as light gray- to white-colored circles about 1 mm in diameter, contrasting with the darker vegetation.

In 1992, our unadjusted count totaled 6,875 nests. During 1993-2002 and 2004, our counts of nests in the ground plots from aerial photographs differed from the actual number of nests counted in the plots by means of -9% to 14% (Table 2). After we adjusted the photographic counts in 1993-2006 by these discrepancies (by multiplying the counts by correction factors of 0.87 to 1.09), the estimated mean nest population ranged from a high of 6,654 nests in 1993 to a low of 2,083 nests in 2004 (Table 1). These estimates indicate the population during 1992-2006 has remained below the 7,629 nests recorded during a ground-based survey in 1990 (Figure 1). The estimated population in 2006 (2,467 nests with 95% CI = 2,339-2,621 nests) was 20% lower than the 2005 estimate. The laughing gull nesting colony in Jamaica Bay has shown an overall decline of about 66% from 1990 to 2006.

To determine the range of nest populations that encompassed the 95% CI of the mean, correction factors of 0.67-1.00 (lower) and 1.11-1.46 (upper) were derived for individual years, 1993-2002 and 2004 (Table 2). The overall (1993-2002 and 2004) correction factors to estimate the mean and 95% lower and upper CI range of the nest population were 0.96, 0.91 and 1.06, respectively.

For each year, 1992-2006, Joco Marsh contained more nests than the adjacent islands

(Table 3, Figure 1) with the major concentration directly aligned with and about 0.8 km from the end of JFKIA's runway 4L. Joco Marsh has become even more dominant as the focal point of the nesting colony in 2000-2006. In these 6 years, Joco Marsh contained 87-97% of the nest population compared to 64-80% in 1992-1999.

The 11-62 nests recorded in Silver Hole in 2000-2006 was a dramatic decline compared to the 425-1,824 nests estimated in this marsh in 1992-1999. Tidal flooding that has inundated Silver Hole in recent years and likely has reduced the available nesting habitat. For example, on 7 June 2000 and 12 June 2001 at high tide between 11:00-13:00 EDT, we were unable to establish ground plots in Silver Hole because the marsh was partially inundated. On 9 June 2004 at high tide, we visually surveyed Silver Hole from a boat and observed that the marsh was almost completely inundated and observed only a few gulls that appeared to be nesting.

DISCUSSION

Because of low herbaceous cover, lack of overhead cover, and high contrast between nests and adjacent vegetation, aerial photographic surveys are suitable for estimating the number of laughing gull nests in salt marsh habitats such as found in Jamaica Bay (Dolbeer et al. 1997). Also, aerial photography is less expensive and labor intensive than a full ground survey (Dolbeer et al. 1997) and provides a permanent record of nesting by location. We undoubtedly overlooked some nests and miscounted other objects as nests on the aerial photographs; however, counts from ground plots indicated errors were $\leq 14\%$.

Our estimates indicate the nest population during 1992-2006 has remained below the 7,629 nests recorded during a ground-based survey in 1990, with an overall decline to 2,467 nests in 2006. This decline of about 66% is likely a combined result of the gull management

program conducted at JFK International Airport since 1991 (Washburn et al. 2006) and the continued degradation and erosion of the marshes in Jamaica Bay caused by tidal flooding. Despite the gull management program at JFKIA and the tidal flooding and erosion of the marsh habitat, the overall size of the nesting colony has remained relatively stable during 2000-2006 at about 33% of the level recorded in 1990.

A major change that has occurred from 1992-2006 is a sharp decline in nesting on East High Meadow (beginning in 1997) and Silver Hole (beginning in 2000). These declines in nest populations on East High Meadow and Silver Hole are likely related to increased tidal flooding and marsh erosion observed on many marsh islands in Jamaica Bay during the 1990s (Stewart 2001). An ancillary benefit of the nest surveys is that the standardized photographs from 1992-2001 have been used to estimate the rate of marsh erosion (D. Fallon, New York Department of Environmental Conservation, Bureau of Marine Resources, East Setauket, NY).

We recommend that this nest survey be continued in 2007 as part of monitoring programs for bird hazards at JFKIA and marsh erosion in Jamaica Bay. The nest survey, combined with the collection and analysis of bird strike data (Barras and Dolbeer 2000), is critical to evaluate the effectiveness of management programs at JFKIA to reduce bird hazards to aviation (Dolbeer 1999).

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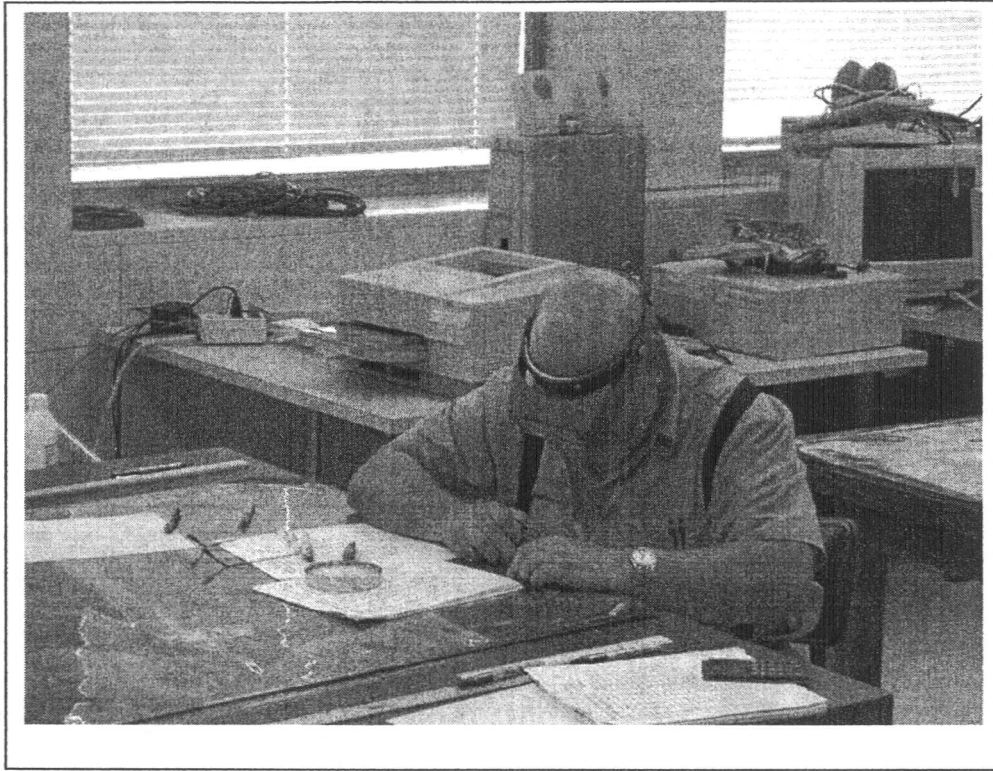


Figure 1. The aerial photographs of Joco, Silver Hole, East High Meadow, and East Joco Island taken in June 1992-2006 were enlarged (91 x 91 cm), and each print was covered with clear plastic, gridded in 1.9-ha blocks. An observer using a magnifying lens carefully examined each photograph and circled with permanent marker on the plastic overlay all nests detected.

Table 1. Estimated number of laughing gull nests on 4 marshes (Joco, Silver Hole, East High Meadow and East Joco Island) in Jamaica Bay, New York, from aerial photography surveys, June 1992-2006.

Year	Date of survey	Nests counted on photographs ^b	Corrected ($\bar{x} \pm 95\%$ CI) nest count ^a		
			$\bar{x}$	Lower	Upper
1992	4 June	6,875	6,875		
1993	8 June	6,277	6,654	5,524	8,285
1994	9 June	4,894	5,334	4,894	5,824
1995	16 June	5,753	5,695	4,775	7,134
1996	15 June	5,655	5,033	4,185	6,277
1997	11 June	3,723	3,872	2,941	5,026
1998	17 June	5,908	5,613	4,785	6,794
1999	9 June	4,580	4,076	3,069	5,954
2000	9 June	3,020	2,718	2,114	3,775
2001	18 June	4,898	4,310	3,625	5,290
2002	17 June	3,113	3,238	2,522	4,545
2003	10 June	2,263	2,195	2,082	2,331
2004	9 June	2,395	2,083	1,820	2,443
2005	7 June	3,216	3,087	2,927	3,280
2006	13 June	2,570	2,467	2,339	2,621

^aIn 1992, no ground counts were made. In 1993-2002 and 2004, a comparison of ground counts and aerial photograph counts of nests within 30- x 30-m plots indicated photography counts

Table 1 (con't).

differed from the actual number of nests by a mean of -9% (1994) to 14% (2001) (see Table 2).

^b Aerial photographs for 1992-1999 were reexamined in 2000-2001 to reformat nest counts into a standardized grid format; these recounts resulted in minor changes in nest numbers for 1992-1998 from those reported in Dolbeer and Bernhardt (2000).

Table 2. Mean differences in number of laughing gull nests counted from ground and from aerial photographs in 30- x 30-m plots and estimated correction factors for adjusting aerial photograph counts to estimate mean number of nests (and 95% Confidence Intervals [CI]), Jamaica Bay, New York, June 1993-2006.

Year	No. of plots (n)	No. of nests counted from ground ^a		Nest count difference: photographs minus ground		Correction factor for photograph count ($\bar{x}$ and 95% CI) ^b		
		$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	Lower	Upper
1993	7	15.71	7.29	-0.86	3.18	1.06	0.88	1.32
1994	10	25.00	12.32	-2.00	2.79	1.09	1.00	1.19
1995	10	23.40	12.97	0.20	6.60	0.99	0.83	1.24
1996	8	13.00	7.87	1.63	3.46	0.89	0.74	1.11
1997	10	13.50	8.94	-0.50	4.70	1.04	0.79	1.35
1998	7	21.43	6.43	1.14	3.56	0.95	0.81	1.15
1999	10	15.70	6.43	2.00	7.80	0.89	0.67	1.30
2000	7	19.43	12.98	2.14	6.54	0.90	0.70	1.25
2001	7	22.43	11.12	3.14	5.21	0.88	0.74	1.08
2002	7	16.86	9.89	-0.71	4.99	1.04	0.81	1.46
2003	7	18.14	8.55	---- ^c	----	----	----	----
2004	9 ^d	19.11	10.83	2.78	4.21	0.87	0.76	1.00
2005	9	32.67	15.30	---- ^e	----	----	----	----
2006	10	19.40	16.39	---- ^e	----	----	----	----
Total	118	19.67	10.52	0.75	5.13	0.96	0.91	1.02

^a In 1993-2006, there were 34, 200, 741, and 1,363 nests with 0, 1, 2, and ≥ 3 eggs,

respectively.

Table 2. (con't).

^b Amount by which nest counts from photographs should be multiplied to estimate mean and 95% CI for nest population (Table 1), based on standard error of difference in ground and photograph counts for plots and Student $t_{0.05}$ values with $n-1$ df.

^c The 2003 actual nest count was corrected using the average correction factor for 1993-2002.

^d During 2004, although 10 ground-truth plots were established on 9 June 2004, one was excluded from the analysis due to our inability to accurately count nests from this plot on the aerial photographs (perhaps due to excessive disturbance of vegetation or some other factor).

^e The 2005 and 2006 actual nest count was corrected using the average correction factor for 1993-2002 and 2004.

Table 3. Estimated number^a (percent of total) of laughing gull nests on 4 marshes from aerial photography surveys, Jamaica Bay, New York, June 1992-2006.

Year	Joco (124 ha)	Silver Hole (37 ha)	East High Meadow (46 ha)	East Joco Island (36 ha)	Total (243 ha)
1992	5,461(79)	718 (10)	645 (9)	51 (1)	6,875
1993	4,579 (69)	1,481 (22)	524 (8)	70 (1)	6,654
1994	3,585 (67)	1,179 (22)	436 (8)	134 (3)	5,334
1995	4,567 (80)	425 (7)	479 (8)	224 (4)	5,695
1996	3,277 (65)	1,131 (22)	519 (10)	106 (2)	5,033
1997	2,720 (70)	602 (16)	326 (8)	224 (6)	3,872
1998	3,664 (65)	1,824 (33)	80 (1)	45 (1)	5,613
1999	2,607 (64)	1,188 (29)	115 (3)	166 (4)	4,076
2000	2,372 (87)	28 (1)	161 (6)	157 (6)	2,718
2001	4,089 (95)	37 (1)	123 (3)	61 (1)	4,310
2002	3,149 (97)	11 (<1)	78 (2)	0 (0)	3,238
2003	2,004 (91)	36 (2)	64 (3)	91 (4)	2,195
2004	1,906 (91)	33 (2)	116 (6)	29 (1)	2,083
2005	2,917 (95)	62 (2)	74 (2)	34 (1)	3,087
2006	2,368 (96)	26 (1)	90 (3)	0 (0)	2,467

^a Estimated mean values based on correction values in Table 2.

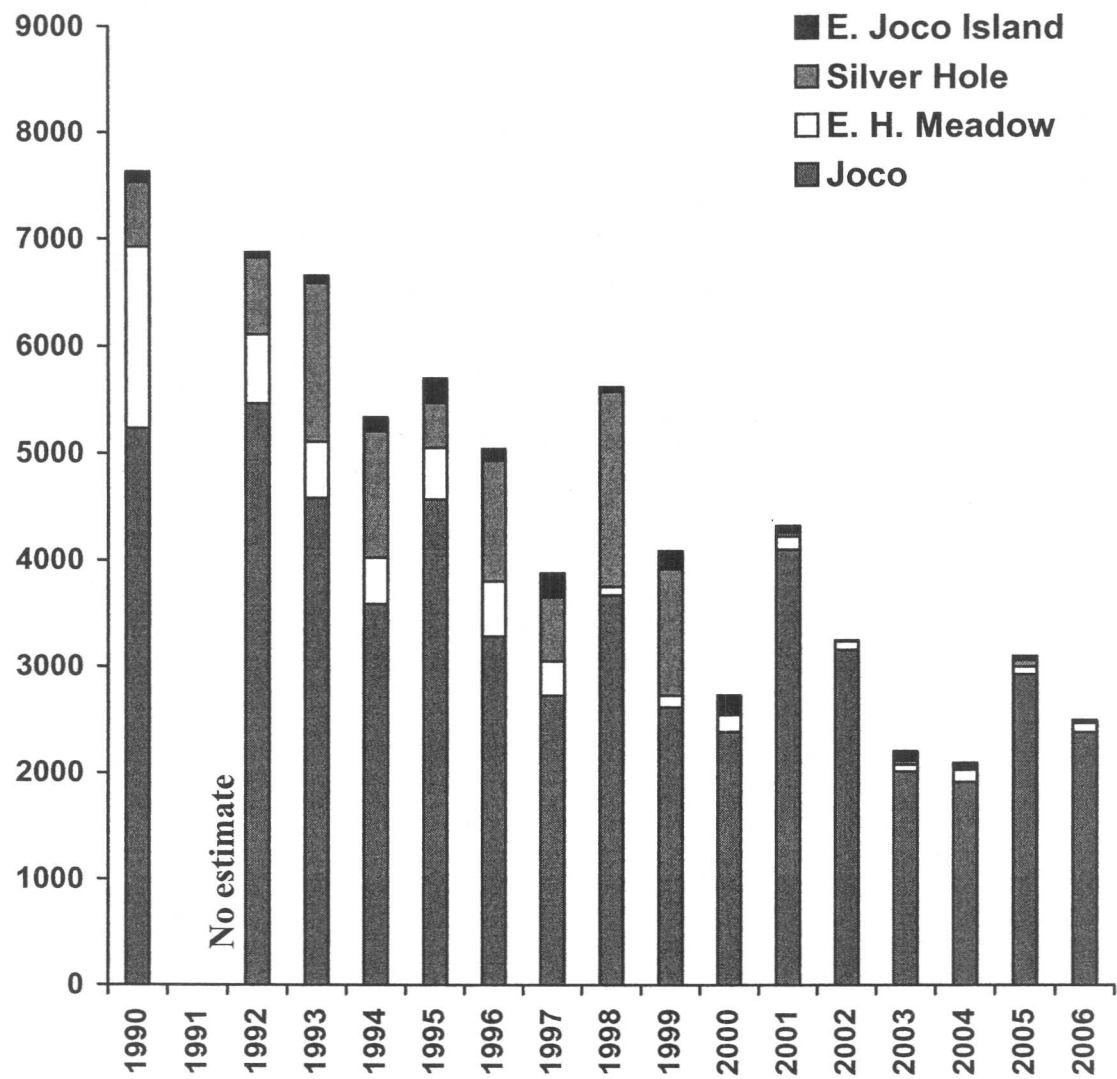


Figure 1. Number of laughing gull nests on 4 marshes (Joco, East High Meadow, Silver Hole, East Joco Island) in Jamaica Bay, New York, as estimated from a ground count (1990, Griffin and Hoopes 1991) and aerial photography (1992-2006).