

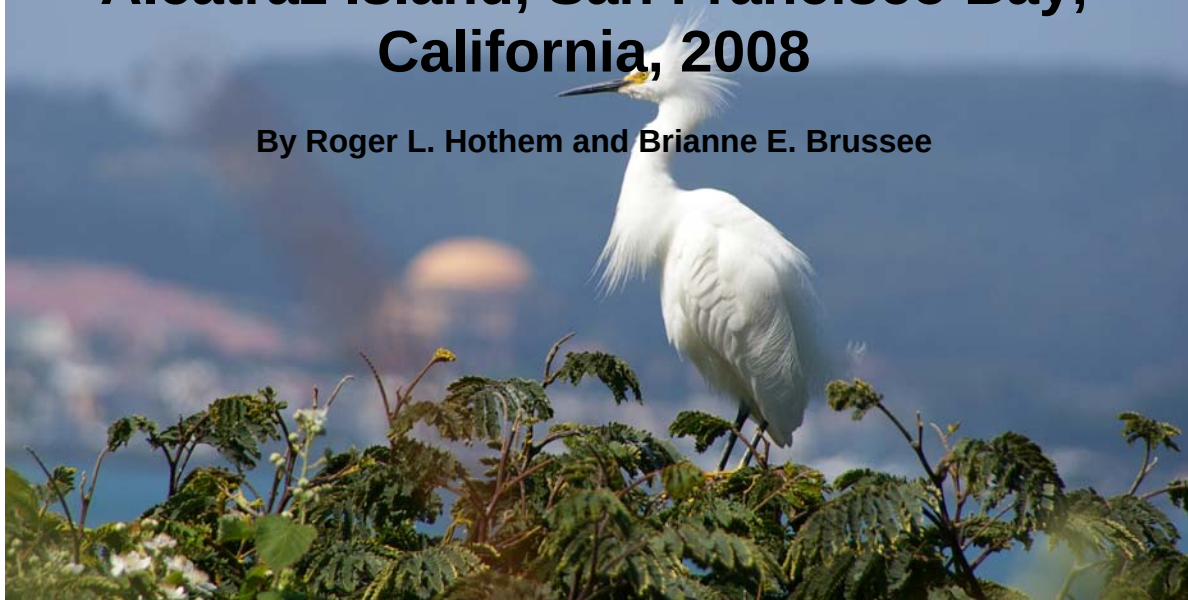


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# **Reproductive Success of Black-crowned Night-Herons and Snowy Egrets at Alcatraz Island, San Francisco Bay, California, 2008**

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**Annual Report 2008**  
Data Summary

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Abstract. — As part of a monitoring program initiated in 1990, we documented nesting chronology, habitat use, subcolony use, and hatchability for black-crowned night-herons (*Nycticorax nycticorax*) and snowy egrets (*Egretta thula*) nesting at Alcatraz Island, San Francisco Bay, California. In 2008, we monitored 101 night-heron nests, a 50% decrease from the 202 nests found in 2007. We monitored 82 snowy egret nests, a number similar to the 79 nests found in 2007. As in the previous 4 years, all snowy egret nests were located in the Greenhouse subcolony. Black-crowned night-heron incubation-period success at Alcatraz Island in 2008 was 39%, nestling-period success was 91%, and overall reproductive success was 35%, all increases from 2007. Incubation-period success and overall success, however, were lower than the 19-year averages. A primary cause of this poor reproductive success was the elevated rate of nest predation (29%), which was higher than the 19-year average (19%). Incubation-period success (86%), nestling-period success (100%), and overall success (86%) for snowy egrets were all similar to rates observed in the previous two years. Predation on snowy egret nests was low (7%). The most common habitats for night-heron nests in 2008 were rubble (concrete, reinforcing rods, and other remnants of demolished buildings) (36%) and English ivy (*Hedera helix*) (26%). Snowy egrets nested primarily in *Albizia* (36%) and fig (*Ficus carica*) (46%). The numbers of breeding gulls on Alcatraz increased for the tenth year in a row, with 1061 Western Gull (*Larus occidentalis*) and 21 California Gull (*Larus californicus*) nests counted. As found in previous years, interspecific competition with gulls was the most likely factor limiting reproductive success of the night-herons on Alcatraz Island in 2008. Common ravens (*Corvus corax*) again nested on Alcatraz and likely contributed to predation on an unknown number of night-heron nests. The total number of night-heron nests found on Alcatraz Island in 2008 represented about 20% of the total North San Francisco Bay population, while the total number of snowy egret nests at Alcatraz comprised about 24% of the North Bay nests.

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We monitored reproduction by black-crowned night-herons and snowy egrets on Alcatraz Island for the 19<sup>th</sup> consecutive year in 2008. The primary objectives of this study were to: 1) conduct baseline monitoring to describe and estimate the distribution and abundance of black-crowned night-herons and snowy egrets nesting on Alcatraz Island; 2) evaluate reproductive parameters,

including nesting chronology, clutch size, incubation-period success, nestling-period success, and overall reproductive success; 3) evaluate the distribution, abundance, productivity, and effects of disturbance on reproduction; and 4) compare annual and long-term variation and trends in the nesting populations.

## **METHODS**

### **Study Area**

Alcatraz Island (37° 49' N, 122° 25' W), a 9.1-ha island and our study area in the San Francisco Bay, is managed as a National Historic Landmark by the National Park Service since 1973 (Howell and Pollak 1991) (Fig. 1).

### **Nest Monitoring**

Nest searching and monitoring techniques followed the methods used in previous years (Hothem and Hatch 2004). We searched each previously occupied nesting subcolony (Fig. 1) and other potential sites for active night-heron and snowy egret nests. Subcolony visits were conducted from 21 April to 21 July (Table 1). The Shower and Wall subcolonies, previously used for nesting by night-herons, were not checked in 2008 (Table 2) because habitat at these two sites is now unsuitable for nesting by wading birds. As in all previous years, except 1990 and 1993, monitoring was terminated early in certain subcolonies to prevent observer-induced adverse interactions between gulls and the wading birds (Table 1). Except for one night-heron nest located near the cellhouse, the Greenhouse colony (with 82 snowy egret nests) was last visited on 27 May. Five subcolonies (Rubble, Bench, Rubble West, Tunnel, Auxiliary Dock, and Dock) with large numbers of nearby gull nests were visited through 16 June. The last visits to the

Recreation Yard and the Warden's House were on 30 June, to the Foghorn was on 16 July, and to the Power Plant was on 21 July. Although early termination of nest monitoring has prevented us from compiling a total census of the numbers of nests on the island, the use of standardized monitoring procedures has produced data on nest numbers and reproductive success that are comparable among years.

### **Estimates of Reproductive Success**

Reproductive success for 2008 was calculated similar to previous years (Hothem and Hatch 2004). Since we delayed our first visits to the subcolonies until many of the birds had begun incubation, and since we did not visit subcolonies daily, it is likely that some nests were initiated and lost between visits. We used the Mayfield method (Mayfield 1961, 1975), a less biased estimator of reproductive success, to calculate incubation-period and nestling-period success. We also calculated apparent rates of predation and other causes of nest failure.

Mean clutch size was calculated based on the nests considered to have completed clutches (i.e., no increase in eggs between successive visits to an active nest). Nests that failed before a full clutch was achieved and those nests first found more than 7 days after hatching were not included in analysis of clutch size. Hatchability (egg success) was calculated by dividing the total number of eggs that hatched by the total number of eggs that were monitored (to hatch or failure). We also calculated apparent egg and chick survival.

## RESULTS and DISCUSSION

### *Black-crowned Night-Herons*

#### **Nest Monitoring**

In 2008, night-herons initiated nests (first egg laid) over a 66-day period from 12 April to 16 June (Table 1; Fig. 2). Based on an analysis of weekly initiation dates, nesting by night-herons at Alcatraz Island ranged from a minimum of 10 weeks in 1992, to a maximum of 19 weeks in 1993 (Fig. 2-4). The median initiation date in 2008 (27 May) was 23 days later than the 19-year average. The earliest documented nest initiation in 2008 occurred 20 days later than the overall average, and the latest initiation was 10 days earlier, resulting in a breeding period 30 days shorter than the long-term (1990-2008) average (Table 1, Fig. 2-3). The number of nests monitored on the island each year has ranged from a low of 68 in 2001 to a high of 341 in 1996 (Fig. 5). The total number of night-heron nests found in 2008 was 50% lower than the total found in 2007 and was the second lowest total for the entire study.

#### **Area Trends**

We considered each nesting subcolony to belong to one of three areas: the South Coast, the Central Island, or the North Coast (Fig. 1; Table 2). Although we found 68 fewer nests in the South Coast subcolonies in 2008 than in 2007, because of the island-wide decline in night-heron nesting, the percentage of the total found in the South Coast area of the island rose from 75% to 83% (Fig. 6 and Table 2). An 18% increase (5 nests) was noted at the Rubble West subcolony compared to 2007, but decreases were noted at all the other South Coast subcolonies (Tunnel [23%], Bench [42%], Rubble [66%], Dock [100%], and Auxiliary Dock [100%]). All of the nests found in the Bench subcolony in 2008 were in the dense *Agave* sp. area down slope from the

Agave Trail steps, an area that is difficult to assess because of the hazard posed by the *Agave*'s spines. Based on the number of night-herons that commonly flushed from the area, however, we estimate that we only were able to monitor about one-half of the nests in this subcolony. We detected no apparent reason for the total desertion of the Dock and Auxiliary Dock subcolonies in 2008 after the high numbers (23 and 8 nests, respectively) observed there in 2007.

Fewer night-heron nests (3) were found in the subcolonies of the Central Island area (3% of the island total) than in any other year of the study (Fig. 6 and Table 2). Most of this was related to the decline in numbers of night-heron nests in the Greenhouse subcolony, from 31 nests in 2007 to only one in 2008 (that nest was actually located north of the sidewalk near the cellhouse). The Central Island area also comprised a low percentage (5 – 10%) of the overall island night-heron breeding population during 1997 – 2002, with the numbers of night-heron nests in the Greenhouse ranging from 0 in 2001 to 13 in 1997. The Recreation Yard had only one nest in 2008, about 25% of the 19-year average, and night-heron nesting at the Warden's House declined from eight nests in 2007 to only one in 2008, less than the average of 4.6 nests per year for the past 9 years.

Fourteen night-heron nests (14% of the island total) were found in the North Coast area in 2008 (Fig. 6 and Table 2), more than in the previous two years, and slightly above the 19-year average of 11.1%. Ten nests were found in the Power Plant subcolony, an increase from 2007 and higher than the 19-year average (7.6 nests). Four nests were found in the Foghorn subcolony, an area that has been sparsely used for nesting during 2000 - 2008. An average of 15.6 nests was found during the first 10 years of the study, while the average per year in the past 9 years has been only 2.1 nests.

## Nesting Habitat

In 2008, rubble, which consisted primarily of the remains of demolished buildings (i.e., concrete, reinforcing rods, metal, scrap wood, and miscellaneous debris), was the most common nesting substrate for night-herons (36.6%), second only to 2002 when 44% of the nests were found in rubble (Fig. 7). Despite being the dominant habitat for nesting by night-herons in the 1990s (Fig. 7), only 5% of the nests were found in mirrorbush (*Coprosma baueri*) in 2008. Plants that have replaced mirrorbush as important nesting habitats include English ivy (26%), rose (*Rosa spp.*) (10%), and *Albizia* (8%). The availability of nesting habitat and its change over the years have not been measured, but it appears that the area of mirrorbush has declined over the course of the study, while the area of ivy has increased. The areas with Figs, roses, *Albizia*, and rubble appear to have changed little over the course of the study.

## Reproductive Success

We estimated that the mean clutch size for black-crowned night-herons in 2008 was 2.67 eggs per nesting attempt, the lowest recorded in the 19-year study (Table 3). The mean for the previous 18 years was 2.89 eggs per nest. The estimated incubation-period success (nests that hatched at least one egg) for night-herons during 2008, as measured by the Mayfield (1961, 1975) method, was 39% (95% confidence interval = 28-54%), which was higher than that estimated in 2007 (29%) but lower than the study average (57.3%) (Table 3, Fig 8). The study average, however, was similar to that estimated by Kelly et al. (2006) for night-herons throughout the San Francisco Bay area during 1993-2005 (62%). The estimated nestling-period success (the percentage of successful nests in which at least one chick survived to 15 days of age) for night-herons during 2008 was 91% (95% confidence interval = 79 – 100%), a value

higher than in the previous 5 years, and higher than the average nestling-period success for the 19-year study (87.4%) (Fig. 9). The overall success (nest and fledge success combined) of nesting night-herons on Alcatraz in 2008 was 35%, a value higher than only two previous years, 2005 and 2007 and far below the 19-year average of 50% (Table 3).

Failed eggs have been documented throughout the course of this study. In 2008, we found that only five of the 74 eggs (6.7%) in successful nests failed to hatch (Table 4). Egg hatchability averaged 94.3% during the study, ranging from 89.1% in 2002 to 98.6% in 2006. Of the 69 eggs that hatched in 2008, we observed that 20 chicks (29.8%) in 12 nests survived to at least 15 days; one chick was found dead. Production averaged 0.20 fledglings per monitored nest or 0.61 chicks fledged per hatched nest (Table 4). Bay-wide, the average number of young fledged per nest attempt for 1993-2005 (1.15) was about five times higher than at Alcatraz (0.20) in 2008, and the number of chicks fledged per successful nest was about three times higher in San Francisco Bay (1.82) (Kelly et al. 2006) than at Alcatraz in 2008 (0.61).

As found in other night-heron nesting studies (Wolford and Boag 1971; Tremblay and Ellison 1980; Henny et al. 1984; Blus et al. 1997), predation was a primary limiting factor at Alcatraz in 2008 (Table 5; Fig. 10). Based on apparent nest success, we estimated that eggs in 29% of the nests were destroyed by predators before hatching, similar to the 1998-2007 average (28%) (Table 5) but much higher than the average recorded during 1990-1997 (6.4%). Renesting, often a response to pre-hatching losses to predators, was presumed to have occurred at 11 night-heron nests that had been destroyed by predators.

Predation was likely related to the increased numbers of Western gulls nesting on the island. The number of nests of the Western gull, a predator on nests of night-herons and snowy egrets and a competitor for nest sites in certain subcolonies, has increased by 134%, from an

average of 453 for the period 1990-1998 (Fig. 11) to an all-time high of 1,061 in 2008 (S. Acosta, pers. commun.). In addition, 21 nests of California gulls (*Larus californicus*) were observed nesting near the Rubble West subcolony in 2008. As in previous years, one pair of common ravens (*Corvus corax*) was observed nesting on Alcatraz, and predation on night-heron eggs and chicks was likely. The presumed predation rate for hatched nests was 6%, a number similar to the previous years' average of 5%.

The pre-hatching nest abandonment rate in 2008 was 5%, a number similar to the 19-year average of 3.5%. Because of early termination of subcolony visits, the numbers of nests with unknown hatching (33%) and unknown fledging (55%) fates were much higher than the averages for the study. Unknown fates included those that were either lost or which were not rechecked for any reason (Table 5).

### *Snowy Egrets*

#### **Nest Monitoring**

Since 1997, we have documented 313 snowy egret nests on Alcatraz Island, with annual totals ranging from none in 2002 to 82 in 2008. Since 2004, all snowy egret nests on Alcatraz have been located in the Greenhouse subcolony. In 2008, snowy egret nests were initiated over a 44-day period between 11 April and 25 May, about one-half the initiation period observed in 2007 (77 days) (Fig.2). Snowy egret nesting was earlier and more synchronous than the night-herons in 2008, with 73% of the nests initiated during the period 15 – 29 April. The median initiation date for egrets in 2008 was 21 April, just 3 days earlier than was observed in 2007, but nest initiations in 2007 continued through 18 June, 24 days later than in 2008. The egret median initiation date was 36 days earlier than that observed for the night-herons. The earlier nesting by

the egrets likely served to exclude night-herons from nesting in the Greenhouse subcolony. By the time 67 egret nests (82% of the total) had been initiated in the Greenhouse, only seven night-heron nests (7%) had been initiated on the entire island.

### **Nesting Habitat**

Of the 82 snowy egret nests monitored in 2008, 46% were found in fig trees (*Ficus carica*), and 36% were found in *Albizia*. Himalayan blackberry (*Rubus discolor*) (11%), privet (*Ligustrum vulgare*) (4%), and mirrorbush (2%) comprised the other egret nest substrates in 2008. The number of egret nests found in the figs has increased steadily during 2005-2008, from five nests in 2005, to 18 in 2006, 27 in 2007, and 38 in 2008. However, the numbers of night-heron nests found in the figs has steadily declined, with no night-heron nests found in the figs in 2008.

Before 2004, as many as 36 night-heron nests (1990) were found in fig trees in the Greenhouse, a number similar to the 38 egret nests found there in 2008. In 2005, more night-heron nests (22) than egret nests (17) were counted in the figs.

### **Reproductive Success**

The mean clutch size for snowy egrets was 3.47 eggs per nest (Table 6), higher than each of the means for the previous 4 years and similar to the clutch sizes found in studies cited by Parsons and Master (2000). The mean clutch size for snowy egrets (2004-2008) was 3.33 eggs per nest, higher than the mean for night-herons (2.87) observed in 1990-2008 (Table 3).

As with the night-herons, we used the Mayfield method to calculate incubation-period, nestling-period, and overall success. Incubation-period success was 86% (95% confidence interval: 77-96), nestling-period success was 100%, and overall nest success was 86% (Table 6).

These values were similar to those calculated for the previous three breeding seasons (Table 6), but were far greater than the values found for the night-herons (Table 3). Kelly et al. (2006) reported nest survivorship during 1993-2005 to be 66% for snowy egrets throughout the North San Francisco Bay area, lower than that observed at Alcatraz in 2005 - 2008, but similar to that observed in 2004 (Table 6).

Although there were no night-heron nests monitored in the Greenhouse in 2008, as there were in previous years, the density of the 82 snowy egret nests made unobtrusive monitoring difficult because nests were so close to one another. To prevent observer-caused abandonment and chick mortality, monitoring was terminated early (May 27) in the Greenhouse subcolony, before the fates of all the nests could be determined. Thus, 15% of the incubation-period fates and 34% of the nestling-period fates were unknown (Table 7). Eggs hatched in 62 of the 82 egret nests (76%) in 2008 (Table 7). Predators destroyed six nests (7%), and two nests were abandoned (2%). Of the 62 nests that hatched, none was destroyed by a predator or abandoned, and 41 (66%) were observed to fledge young to 10 days.

As in previous years, Western gulls and common ravens were present in 2008 and were potential predators of snowy egret eggs and chicks, but we only observed predation on six nests (7%) before hatching and one (2%) after hatching. Compared with the 101 night-heron nests found on the island in 2008, the incubation-period predation rate for egrets was about 24% that of the night-herons, and the nestling-period predation rate was about 33% that of the night-herons. These data indicate that the Greenhouse subcolony is a relatively safe nesting site for snowy egrets.

Hatchability (98.0%) of snowy egret eggs was higher than in any of the previous 4 years (Table 8). Four of the 196 eggs observed to hatching date failed, which is 20% of the total that

failed in 2007. Egret hatchability in 2008 was higher than both night-heron hatchability on Alcatraz in 2008 (93.2%) and the average night-heron hatchability for the 19-year study (94.3%) (Table 4). Of the 192 eggs that hatched, we observed that 90 chicks (47%) survived to at least 10 days (1.45 chicks fledged per successful nest; 1.10 chicks fledged per monitored nest), and three chicks were found dead. These rates were lower than we found in 2007 (2.0 chicks fledged per successful nest; 1.6 chicks fledged per found nest), 2005, and 2006 (Table 8). Snowy egret nestling-period success was lower than that reported by Kelly et al. (2006) for the entire San Francisco Bay area (2.5 chicks per successful nest and 1.8 chicks per monitored nest), even though our nestling-period success was based on survival to 10 days of age while Kelly et al. used 14 days.

#### *San Francisco Bay Trends*

Although the total numbers of night-heron nests (absolute numbers) at Alcatraz were 50% lower in 2008 than 2007, data from Audubon Canyon Ranch (C. Rothenbach, pers. commun.) indicate that the total peak number of active nests (including an estimate from a boat survey for West Marin; See Kelly et al. 2006) at all North San Francisco Bay colonies increased by about 7% from 2007. Nests on Alcatraz comprised about 12% of the North Bay population, down from 16% in 2007. However, night-heron nests as a percentage of the nests found within the Central Bay area (West Marin, Yerba Buena, Red Rock, Brooks, and Alcatraz islands) decreased from 39% in 2007 to 20% in 2008, a result of increased nesting at West Marin Island and Red Rock.

Although the total numbers of snowy egret nests (absolute numbers) at Alcatraz remained relatively stable between years, data from Audubon Canyon Ranch (C. Rothenbach, pers. commun.) indicate that the total peak number of active nests (See Kelly et al. 2006) at all North

San Francisco Bay colonies increased by about 47% compared with 2007. Nests on Alcatraz comprised about 20% of the North Bay population, down from 27% in 2007. However, snowy egret nests as a percentage of the nests found within the Central Bay area (West Marin, Yerba Buena, Red Rock, Brooks, and Alcatraz islands) decreased from 59% in 2007 to 34% in 2008, a result of an increase in egret nests from 43 in 2007 to 132 in 2008 at West Marin Island.

## CONCLUSIONS

During 2008, we documented reproduction by black-crowned night-herons and snowy egrets at Alcatraz Island for the nineteenth consecutive year. Night-heron nest numbers had gradually increased since the low of 68 nests in 2001, reaching 202 in 2007, but in 2008, the total declined to 101, the second lowest of the study. Snowy egret nesting in 2008 was similar to 2007, reaching a study high of 82 nests. As in 2007, incubation-period and overall success for night-herons were less than the overall averages for the study, but the nestling-period success was slightly higher than the overall average. All categories of reproductive success were higher for snowy egrets than the night-herons, and snowy egret success rates were similar to those observed in the previous 3 years.

Although the 29% predation rate on night-heron nests for 2008 was lower than the 40% observed in 2007, it was still higher than the overall mean of 19%. As has been noted in previous reports, predation by gulls and ravens, combined with competition with gulls for nesting sites in certain subcolonies, continues to limit night-heron reproductive success on Alcatraz Island. Competition with gulls for nest sites has apparently not been a factor for snowy egrets nesting on Alcatraz. Predation on snowy egret nests was low in 2008 (7%), and the average for 2004-2008 was 4.4%, far lower than the night-heron predation average for the same period (29%). Although

we assumed much of the predation on night-heron nests was by gulls, common ravens were observed taking eggs from night-heron nests, and likely destroyed many nests. The use of remote cameras could help to confirm the role of various species as predators on Alcatraz.

Habitat changes are a major concern on Alcatraz. Mirrorbush has declined precipitously over the course of the study, primarily a result of senescence, and ivy has proliferated in some areas, including the Dock, Rubble, and Foghorn subcolonies, previously dominated by mirrorbush. An increase in the percentage of nests found in ivy reflects this apparent trend.

The Greenhouse subcolony, a relatively small area located adjacent to a walkway open to year-around visitor use, was once home to a significant night-heron population. As of 2008, however, night-herons had been replaced by a snowy egret nesting colony second in size in the North San Francisco Bay area to West Marin Island.. The visual and physical barrier presented by the dense vegetation at the Greenhouse subcolony (fig, rose, *Albizia*) is apparently sufficient to prevent human-caused disturbance of the nesting birds. Barricades and signs alerting visitors to the presence of nesting wading birds have also likely helped reduce visitor disturbance. However, the survival of this vital nesting area for wading birds is highly dependent on the preservation of the physical and visual barriers between humans and birds.

In 2005, the fewest night-heron nests of the study (2) were found in the Rubble subcolony. This low number of nests was surprising, especially since during 1996-1998 an average of 89 nests was found each year in the Rubble. It appeared that some factor had caused night-herons virtually to abandon this nesting site. However, a resurgence of nesting occurred in 2006, with 28 nests being found, followed by 38 nests in 2007. In 2008, the number of night-heron nests in the Rubble once again declined to only 13 nests. We previously hypothesized that the increased density of the vegetation in the Rubble subcolony might have made it difficult for

night-herons to nest there. However, no reduction in vegetation density was detected the years that nesting increased, which seems to discredit the vegetation density theory.

The traditional Bench subcolony, formerly occupied by as many as 46 night-heron nests, (1996) remained devoid of nests in 2008 (as it has since 2002). However, large numbers of night-herons were observed to use the nearby Agave area down slope from the Agave Trail. Despite its difficult access, we were able to locate 14 nests there in 2008. As in previous years, the total number of nests in this habitat was difficult to estimate, but the presence of as many as 20-30 adults during the nesting period indicates the presence of an unknown number of additional unmonitored nests in this area. As recommended in recent reports, it is important that the Agave Trail remain closed to visitors during the night-heron breeding season to prevent adverse effects by humans on the nesting night-herons.

The traditional nesting areas used by black-crowned night-herons in the South Coast area of Alcatraz have been closed to visitors for several years. This closure has prevented human disturbance to nesting night-herons and gulls and has minimized the adverse inter-specific conflicts that often result when gulls and night-herons are frightened from their nests and wander into another bird's territory. Seasonal exclusion of visitors from the South Coast nesting area has contributed to the preservation of these subcolonies, which, in 2008, had 83% of the nesting night-herons on the island. Despite a 50% decline in night-heron nests at Alcatraz in 2008, Alcatraz remained a significant breeding site for both night-herons and snowy egrets in North San Francisco Bay.

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Table 1. Black-crowned night-heron reproductive chronology, Alcatraz Island, 1990-2008.

| Year              | Median Initiation Date | Range of Initiation Dates | Colony Visits | Observation dates <sup>1</sup> |
|-------------------|------------------------|---------------------------|---------------|--------------------------------|
| 1990 <sup>2</sup> | 28 Apr                 | 24 March – 11 July        | 16            | 28 April – 9 August            |
| 1991              | 8 May                  | 26 March – 4 July         | 14            | 25 April – 26 Jul              |
| 1992              | 13 Apr                 | 20 March – 28 May         | 3             | 30 April – 28 May              |
| 1993 <sup>2</sup> | 23 Apr                 | 16 March – 24 July        | 15            | 20 April – 20 August           |
| 1994              | 6 May                  | 25 March – 18 July        | 8             | 22 April – 1 August            |
| 1995              | 25 Apr                 | 11 March – 28 June        | 7             | 26 April – 28 June             |
| 1996              | 12 Apr                 | 15 March – 4 June         | 4             | 29 April – 10 June             |
| 1997              | 8 Apr                  | 13 March – 28 May         | 6             | 22 April – 12 June             |
| 1998              | 7 Apr                  | 15 March – 21 June        | 14            | 9 April – 10 July              |
| 1999              | 3 May                  | 27 March – 12 June        | 13            | 13 April – 17 July             |
| 2000              | 13 May                 | 4 April – 16 July         | 16            | 18 April – 8 August            |
| 2001              | 14 May                 | 10 April – 18 June        | 13            | 24 April – 24 July             |
| 2002              | 14 May                 | 16 March – 23 June        | 10            | 22 April – 1 July              |
| 2003              | 18 May                 | 27 March – 20 June        | 11            | 21 April – 14 July             |
| 2004              | 3 May                  | 12 March – 22 June        | 12            | 30 April – 19 July             |
| 2005              | 2 May                  | 23 March – 7 June         | 13            | 22 April – 15 July             |
| 2006              | 16 May                 | 3 April – 14 June         | 12            | 3 May – 20 July                |
| 2007              | 14 May                 | 22 March – 29 June        | 16            | 23 April – 10 August           |
| 2008              | 27 May                 | 12 April – 16 June        | 14            | 21 April – 21 July             |
| Mean              | 4 May                  | 23 March – 26 June        | 11.4          | 23 April – 16 July             |

<sup>1</sup> When present, snowy egret nests were also monitored during these periods.<sup>2</sup> Except in 1990 and 1993, observations were discontinued at most sites before nesting was completed, primarily to prevent adverse interspecific competition with Western Gulls.

Table 2. Number and percentage of black-crowned night-heron nests per subcolony, Alcatraz Island, 1990-2008.

| SUBCOLONY         | 1990       | 1991       | 1992       | 1993       | 1994       | 1995       | 1996       | 1997       | 1998       | 1999       | 2000       | 2001       | 2002       | 2003       | 2004       | 2005       | 2006       | 2007       | 2008       | Mean         | Totals      |
|-------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|--------------|-------------|
| <b>S. COAST</b>   | <b>67</b>  | <b>57</b>  | <b>68</b>  | <b>60</b>  | <b>90</b>  | <b>129</b> | <b>243</b> | <b>240</b> | <b>199</b> | <b>136</b> | <b>90</b>  | <b>51</b>  | <b>115</b> | <b>61</b>  | <b>66</b>  | <b>48</b>  | <b>101</b> | <b>152</b> | <b>84</b>  | <b>108.3</b> | <b>2057</b> |
| <b>% of total</b> | <b>39%</b> | <b>46%</b> | <b>54%</b> | <b>48%</b> | <b>58%</b> | <b>65%</b> | <b>71%</b> | <b>83%</b> | <b>80%</b> | <b>83%</b> | <b>87%</b> | <b>75%</b> | <b>82%</b> | <b>44%</b> | <b>50%</b> | <b>47%</b> | <b>72%</b> | <b>75%</b> | <b>83%</b> | <b>65.3%</b> |             |
| Tunnel            | 19         | 15         | 21         | 24         | 32         | 32         | 57         | 70         | 64         | 39         | 14         | 10         | 33         | 15         | 19         | 16         | 28         | 31         | 24         | <b>29.6</b>  | <b>563</b>  |
| Bench             | 3          | 3          | 7          | 2          | 2          | 13         | 46         | 27         | 16         | 5          | 7          | 2          | 0          | 0          | 0          | 3          | 8          | 24         | 14         | <b>9.6</b>   | <b>182</b>  |
| Rubble            | 11         | 14         | 17         | 19         | 17         | 48         | 85         | 94         | 88         | 48         | 30         | 14         | 34         | 22         | 21         | 2          | 28         | 38         | 13         | <b>33.8</b>  | <b>643</b>  |
| Rubble W.         | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 27         | 29         | 21         | 42         | 24         | 23         | 25         | 32         | 28         | 33         | <b>14.9</b>  | <b>284</b>  |
| Dock              | 24         | 15         | 16         | 7          | 23         | 15         | 23         | 21         | 8          | 3          | 2          | 1          | 1          | 0          | 3          | 0          | 2          | 23         | 0          | <b>9.8</b>   | <b>187</b>  |
| Aux. Dock         | 10         | 10         | 7          | 8          | 16         | 21         | 32         | 28         | 23         | 14         | 8          | 3          | 5          | 0          | 0          | 2          | 3          | 8          | 0          | <b>10.4</b>  | <b>198</b>  |
| <b>CENTRAL</b>    | <b>73</b>  | <b>48</b>  | <b>43</b>  | <b>49</b>  | <b>48</b>  | <b>57</b>  | <b>70</b>  | <b>28</b>  | <b>20</b>  | <b>8</b>   | <b>6</b>   | <b>5</b>   | <b>14</b>  | <b>64</b>  | <b>51</b>  | <b>40</b>  | <b>29</b>  | <b>41</b>  | <b>3</b>   | <b>36.7</b>  | <b>697</b>  |
| <b>% of total</b> | <b>43%</b> | <b>39%</b> | <b>34%</b> | <b>39%</b> | <b>31%</b> | <b>29%</b> | <b>21%</b> | <b>10%</b> | <b>8%</b>  | <b>5%</b>  | <b>6%</b>  | <b>7%</b>  | <b>10%</b> | <b>46%</b> | <b>38%</b> | <b>39%</b> | <b>21%</b> | <b>20%</b> | <b>3%</b>  | <b>23.6%</b> |             |
| Greenhouse        | 38         | 34         | 34         | 30         | 34         | 38         | 36         | 13         | 7          | 2          | 1          | 0          | 11         | 51         | 41         | 34         | 15         | 31         | 1          | <b>23.7</b>  | <b>451</b>  |
| Rec. Yard         | 7          | 4          | 3          | 4          | 7          | 6          | 13         | 4          | 4          | 2          | 1          | 0          | 0          | 8          | 3          | 0          | 9          | 2          | 1          | <b>4.1</b>   | <b>78</b>   |
| Wall              | 24         | 8          | 5          | 9          | 4          | 13         | 20         | 10         | 8          | 4          | 2          | 1          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | <b>5.7</b>   | <b>108</b>  |
| Shower            | 4          | 2          | 1          | 6          | 3          | 0          | 1          | 1          | 1          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | <b>1.0</b>   | <b>19</b>   |
| Warden            | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 0          | 2          | 4          | 3          | 5          | 7          | 6          | 5          | 8          | 1          | <b>2.2</b>   | <b>41</b>   |
| <b>N. COAST</b>   | <b>30</b>  | <b>19</b>  | <b>16</b>  | <b>16</b>  | <b>17</b>  | <b>14</b>  | <b>28</b>  | <b>21</b>  | <b>29</b>  | <b>20</b>  | <b>7</b>   | <b>12</b>  | <b>12</b>  | <b>15</b>  | <b>16</b>  | <b>14</b>  | <b>10</b>  | <b>9</b>   | <b>14</b>  | <b>16.8</b>  | <b>319</b>  |
| <b>% of total</b> | <b>18%</b> | <b>15%</b> | <b>13%</b> | <b>13%</b> | <b>11%</b> | <b>7%</b>  | <b>8%</b>  | <b>7%</b>  | <b>12%</b> | <b>12%</b> | <b>7%</b>  | <b>18%</b> | <b>9%</b>  | <b>11%</b> | <b>12%</b> | <b>14%</b> | <b>7%</b>  | <b>4%</b>  | <b>14%</b> | <b>11.1%</b> |             |
| Foghorn           | 29         | 18         | 13         | 14         | 14         | 8          | 22         | 12         | 14         | 12         | 2          | 0          | 0          | 5          | 2          | 1          | 0          | 5          | 4          | <b>9.2</b>   | <b>175</b>  |
| Power Plant       | 1          | 1          | 3          | 2          | 3          | 6          | 6          | 9          | 15         | 8          | 5          | 12         | 12         | 10         | 14         | 13         | 10         | 4          | 10         | <b>7.6</b>   | <b>144</b>  |
| <b>Total</b>      | <b>170</b> | <b>124</b> | <b>127</b> | <b>125</b> | <b>155</b> | <b>200</b> | <b>341</b> | <b>289</b> | <b>248</b> | <b>164</b> | <b>103</b> | <b>68</b>  | <b>141</b> | <b>140</b> | <b>133</b> | <b>102</b> | <b>140</b> | <b>202</b> | <b>101</b> | <b>161.7</b> | <b>3073</b> |

<sup>1</sup> Numbers of nests estimated in 1991 and 1992 based on numbers monitored in 1990 and in 1993-1996.

<sup>2</sup> Total nests in Greenhouse include nests on north side of walk near cell house: 5 in 2004, 7 in 2005, 3 in 2006, 1 in 2007, and 1 in 2008.

Table 3. Estimates of clutch size and reproductive success (and 95% CI) of the black-crowned night-heron at Alcatraz Island, 1990-2008<sup>1</sup>.

| Year | Clutch size | Nests found | Mayfield nests <sup>2</sup> | Exposure days | Reproductive success            |                              |                      |
|------|-------------|-------------|-----------------------------|---------------|---------------------------------|------------------------------|----------------------|
|      |             |             |                             |               | Incubation-period <sup>3</sup>  | Nestling-period <sup>4</sup> | Overall <sup>5</sup> |
| 1990 | 3.01        | 170         | 140                         | 1840          | 70 ABCD <sup>6</sup><br>(60-80) | 90<br>(84-95)                | 63                   |
| 1991 | 2.86        | 90          | 81                          | 1230          | 64 ABCDF<br>(52-76)             | 82<br>(72-92)                | 52                   |
| 1992 | 3.04        | 93          | 54                          | 351           | 81 ABC<br>(61-100)              | 88<br>(77-99)                | 71                   |
| 1993 | 2.92        | 125         | 96                          | 1178          | 77 AB<br>(66-89)                | 99<br>(96-100)               | 76                   |
| 1994 | 2.84        | 155         | 117                         | 969           | 81 A<br>(70-93)                 | 94<br>(88-100)               | 77                   |
| 1995 | 2.78        | 200         | 142                         | 1257          | 77 AB<br>(66-88)                | 92<br>(86-98)                | 71                   |
| 1996 | 2.85        | 341         | 179                         | 1441          | 67 ABCDF<br>(56-78)             | 79<br>(71-87)                | 53                   |
| 1997 | 2.87        | 289         | 173                         | 1502          | 64 ABCDF<br>(53-74)             | 72<br>(64-80)                | 46                   |
| 1998 | 2.79        | 248         | 203                         | 2352          | 46 BCDEF<br>(37-54)             | 78<br>(70-86)                | 36                   |
| 1999 | 2.87        | 164         | 155                         | 2052          | 55 ABCDF<br>(45-64)             | 91<br>(85-97)                | 50                   |
| 2000 | 2.83        | 103         | 87                          | 1073          | 52 ABCDEF<br>(39-64)            | 87<br>(77-98)                | 45                   |
| 2001 | 3.00        | 68          | 61                          | 576           | 45 CDEF<br>(29-62)              | 95<br>(85-100)               | 43                   |
| 2002 | 2.96        | 141         | 125                         | 1507          | 54 ABCDEF<br>(43-64)            | 93<br>(86-100)               | 50                   |
| 2003 | 2.84        | 140         | 131                         | 1482          | 50 BCDEF<br>(39-60)             | 90<br>(82-98)                | 45                   |
| 2004 | 2.90        | 133         | 113                         | 1240          | 42 DEF<br>(32-55)               | 90<br>82-97                  | 38                   |
| 2005 | 2.92        | 102         | 85                          | 846.5         | 42 DEF<br>(29-55)               | 81<br>(69-94)                | 34                   |
| 2006 | 2.96        | 140         | 126                         | 1287.5        | 54 ABCDEF<br>(44-68)            | 84<br>(72-96)                | 46                   |
| 2007 | 2.71        | 202         | 176                         | 1705          | 29 E<br>(22-38)                 | 84<br>(75-93)                | 24                   |
| 2008 | 2.67        | 101         | 91                          | 868.5         | 39 EF<br>(28-54)                | 91<br>(79-100)               | 35                   |
| Mean | 2.87        | 158.2       | 122.9                       | 1303.0        | 57.3                            | 87.4                         | 50                   |

<sup>1</sup> Based on days of nest exposure (see Hensler and Nichols 1981).

<sup>2</sup> Nests included in the analysis (Mayfield 1961, 1975), deleting nests that had either hatched or failed before found.

<sup>3</sup> Percentage of monitored nests in which one or more eggs hatched.

<sup>4</sup> Percentage of nests that hatched in which one or more chicks reached at least 15 days of age.

<sup>5</sup> Predicted percent of monitored nests in which one or more chicks reached at least 15 days of age, calculated by multiplying incubation-period success by nestling-period success.

<sup>6</sup> Incubation-period success rates among years were different (One way ANOVA;  $P < 0.001$ ); Means not sharing a common letter were different ( $P < 0.05$ ) by Holm-Sidak multiple comparison method. Nestling-period success rates were not different among years ( $P > 0.05$ ).

Table 4. Egg and chick survival of the black-crowned night-heron at Alcatraz Island, 1990-2008.

|                               | Year |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      | Total | Mean  |
|-------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|-------|-------|
|                               | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 |       |       |
| Monitored nests               | 170  | 90   | 93   | 125  | 155  | 200  | 341  | 289  | 248  | 164  | 103  | 68   | 141  | 140  | 133  | 102  | 140  | 202  | 101  | 3,005 | 158.2 |
| Successful nests <sup>1</sup> | 127  | 62   | 67   | 94   | 88   | 116  | 239  | 193  | 146  | 94   | 50   | 25   | 71   | 67   | 71   | 54   | 62   | 82   | 33   | 1,741 | 91.6  |
| Eggs observed to hatching (A) | 339  | 155  | 169  | 265  | 199  | 279  | 540  | 446  | 372  | 254  | 144  | 61   | 165  | 167  | 187  | 126  | 139  | 208  | 74   | 4,289 | 225.7 |
| Failed eggs (B)               | 19   | 7    | 4    | 17   | 10   | 23   | 20   | 28   | 16   | 11   | 9    | 5    | 18   | 17   | 14   | 5    | 2    | 16   | 5    | 246   | 12.9  |
| % Hatchability ((A-B)/A)      | 94.4 | 95.5 | 97.6 | 93.6 | 95.0 | 91.8 | 96.3 | 93.7 | 95.7 | 95.7 | 93.8 | 91.8 | 89.1 | 89.8 | 92.5 | 96.0 | 98.6 | 92.3 | 93.2 |       | 94.3  |
| Hatched eggs/monitored nest   | 1.88 | 1.64 | 1.77 | 1.98 | 1.22 | 1.28 | 1.52 | 1.45 | 1.44 | 1.48 | 1.31 | 0.82 | 1.04 | 1.07 | 1.30 | 1.19 | 0.98 | 0.95 | 0.68 |       | 1.32  |
| Hatched eggs/successful nest  | 2.52 | 2.39 | 2.46 | 2.64 | 2.15 | 2.21 | 2.18 | 2.17 | 2.44 | 2.59 | 2.70 | 2.24 | 2.07 | 2.24 | 2.44 | 2.24 | 2.21 | 2.34 | 2.09 |       | 2.33  |
| Nests with fledged chicks     | 102  | 42   | 34   | 72   | 56   | 76   | 118  | 96   | 76   | 62   | 25   | 16   | 43   | 38   | 42   | 32   | 34   | 57   | 12   | 1,033 | 54.4  |
| Fledged chicks <sup>2</sup>   | 210  | 81   | 56   | 159  | 101  | 122  | 232  | 183  | 148  | 145  | 48   | 31   | 92   | 82   | 88   | 61   | 88   | 103  | 20   | 2,050 | 107.9 |
| Fledged chicks/monitored nest | 1.24 | 0.9  | 0.6  | 1.27 | 0.65 | 0.61 | 0.68 | 0.63 | 0.6  | 0.88 | 0.47 | 0.46 | 0.65 | 0.59 | 0.66 | 0.6  | 0.63 | 0.51 | 0.20 |       | 0.68  |
| Fledged chicks/hatched nest   | 1.65 | 1.31 | 0.84 | 1.69 | 1.15 | 1.05 | 0.97 | 0.95 | 1.01 | 1.54 | 0.96 | 1.24 | 1.3  | 1.22 | 1.24 | 1.13 | 1.42 | 1.26 | 0.61 |       | 1.19  |
| % hatched eggs that fledged   | 65.6 | 54.7 | 33.9 | 64.1 | 53.4 | 47.7 | 44.6 | 43.8 | 41.6 | 59.7 | 35.6 | 55.4 | 62.6 | 54.7 | 50.9 | 50.4 | 64.2 | 53.6 | 29.0 |       | 50.7  |

<sup>1</sup> Successful nests were those with at least one egg that was confirmed to have hatched.

<sup>2</sup> Fledged chicks: the number of chicks observed to have survived to 15 days of age or more.

Table 5. Fates of black-crowned night-herons at Alcatraz Island, 1990-2008.

| Nesting outcome                      | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | Total | Mean  |
|--------------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|-------|-------|
| Monitored nests                      | 170  | 90   | 93   | 125  | 155  | 200  | 341  | 289  | 248  | 164  | 103  | 68   | 141  | 140  | 133  | 102  | 140  | 202  | 101  | 3005  | 158.2 |
| % predation <sup>1</sup>             | 13   | 19   | 2    | 7    | 1    | 2    | 4    | 3    | 22   | 27   | 32   | 28   | 29   | 26   | 26   | 31   | 21   | 40   | 29   |       | 19.0  |
| % destroyed (other) <sup>1</sup>     | 2    | 3    | 0    | 2    | 1    | 4    | 1    | 4    | 2    | 0    | 0    | 0    | 0    | 0    | 3    | 0    | 2    | 1    | 1    |       | 1.3   |
| % abandoned <sup>1</sup>             | 3    | 7    | 3    | 2    | 3    | 2    | 1    | 3    | 7    | 4    | 3    | 7    | 1    | 3    | 6    | 2    | 1    | 4    | 5    |       | 3.5   |
| % unknown <sup>1</sup>               | 8    | 2    | 23   | 14   | 37   | 34   | 23   | 23   | 10   | 12   | 17   | 28   | 20   | 26   | 12   | 14   | 31   | 15   | 33   |       | 20.1  |
| % hatched <sup>1</sup>               | 75   | 69   | 72   | 75   | 57   | 58   | 70   | 67   | 59   | 57   | 49   | 37   | 50   | 48   | 53   | 53   | 44   | 41   | 33   |       | 56.1  |
| Number of hatched nests <sup>2</sup> | 127  | 62   | 67   | 94   | 88   | 116  | 239  | 193  | 146  | 94   | 50   | 25   | 71   | 67   | 71   | 54   | 62   | 83   | 33   | 1742  | 91.7  |
| % predation <sup>3</sup>             | 8    | 13   | 1    | 0    | 0    | 1    | 0    | 4    | 13   | 5    | 8    | 0    | 6    | 8    | 6    | 13   | 0    | 10   | 6    |       | 5.3   |
| % destroyed (other) <sup>3</sup>     | 2    | 2    | 6    | 1    | 2    | 3    | 8    | 13   | 4    | 2    | 2    | 4    | 0    | 0    | 0    | 0    | 11   | 0    | 0    |       | 3.2   |
| % abandoned <sup>3</sup>             | 0    | 3    | 0    | 0    | 1    | 1    | 0    | 0    | 0    | 0    | 2    | 0    | 0    | 0    | 4    | 0    | 0    | 4    | 0    |       | 0.8   |
| % unknown <sup>3</sup>               | 10   | 15   | 42   | 22   | 33   | 29   | 42   | 33   | 31   | 27   | 38   | 32   | 34   | 36   | 31   | 28   | 34   | 18   | 55   |       | 31.1  |
| % fledged <sup>3</sup>               | 80   | 68   | 51   | 77   | 64   | 66   | 49   | 50   | 52   | 66   | 50   | 64   | 61   | 57   | 59   | 59   | 55   | 69   | 39   |       | 59.7  |
| Number of fledged nests <sup>4</sup> | 102  | 42   | 34   | 72   | 56   | 76   | 118  | 96   | 76   | 62   | 25   | 16   | 43   | 38   | 42   | 32   | 34   | 57   | 13   | 1034  | 54.4  |

<sup>1</sup> Fate of monitored nests (%).<sup>2</sup> Nests observed with at least one egg that hatched.<sup>3</sup> Fate of hatched nests (%).<sup>4</sup> Nests observed with at least one chick that survived to age 15 days.

Table 6. Estimates of clutch size and percentage nesting success (and 95% CI) of the snowy egret at Alcatraz Island, 2004-2008<sup>1</sup>.

| Year | Clutch Size | Nests Found | Mayfield Nests <sup>2</sup> | Exposure days | Nest Success          |                       |                      |
|------|-------------|-------------|-----------------------------|---------------|-----------------------|-----------------------|----------------------|
|      |             |             |                             |               | Hatching <sup>3</sup> | Fledging <sup>4</sup> | Overall <sup>5</sup> |
| 2004 | 3.00        | 32          | 20                          | 152.5         | 61<br>(34-1.1)        | 84<br>(68-1.0)        | 51.2                 |
| 2005 | 3.45        | 36          | 26                          | 279.5         | 91<br>(76-1.1)        | 100<br>(100-100)      | 91.0                 |
| 2006 | 3.41        | 35          | 35                          | 594.5         | 92<br>(82-1.0)        | 100<br>(100-100)      | 92.0                 |
| 2007 | 3.34        | 79          | 75                          | 1058          | 89<br>(80-99)         | 98<br>(95-100)        | 87.2                 |
| 2008 | 3.47        | 82          | 79                          | 1302.5        | 86<br>(77-96)         | 100<br>(100-100)      | 85.7                 |
| Mean | 3.33        | 46          | 47                          | 677.4         | 83.8                  | 96.4                  | 81.4                 |

<sup>1</sup> Based on days of nest exposure (see Hensler and Nichols 1981).

<sup>2</sup> Nests included in the analysis (Mayfield 1961, 1975). Nests that had either hatched or failed before they were found were rejected from the analysis; such nests would have no exposure days.

<sup>3</sup> Predicted percent of monitored nests in which one or more eggs hatched.

<sup>4</sup> Predicted percent of nests that hatched in which one or more chicks reached at least 10 days of age.

<sup>5</sup> Predicted percent of monitored nests in which one or more chicks reached at least 10 days of age, calculated by multiplying Incubation-period success by Nestling-period success.

Table 7. Fates of snowy egret nests at Alcatraz Island, 2004-2008.

| Nesting Outcome                            | Year |      |      |      |      | Totals | Mean |
|--------------------------------------------|------|------|------|------|------|--------|------|
|                                            | 2004 | 2005 | 2006 | 2007 | 2008 |        |      |
| <b>Monitored Nests</b>                     | 32   | 36   | 35   | 79   | 82   | 264    | 52.8 |
| % predation <sup>1</sup>                   | 6    | 0    | 3    | 6    | 7    |        | 4.4  |
| % destroyed (other) <sup>1</sup>           | 3    | 0    | 0    | 1    | 0    |        | 0.8  |
| % abandoned <sup>1</sup>                   | 0    | 3    | 3    | 0    | 2    |        | 1.6  |
| % unknown <sup>1</sup>                     | 22   | 17   | 11   | 11   | 15   |        | 15.2 |
| % hatched <sup>1</sup>                     | 69   | 81   | 83   | 81   | 76   |        | 77.8 |
| <b>Number of hatched nests<sup>2</sup></b> | 22   | 29   | 29   | 64   | 62   | 206    | 41.2 |
| % predation <sup>3</sup>                   | 0    | 0    | 0    | 2    | 0    |        | 0.4  |
| % destroyed (other) <sup>3</sup>           | 5    | 0    | 0    | 0    | 0    |        | 1.0  |
| % abandoned <sup>3</sup>                   | 9    | 0    | 0    | 0    | 0    |        | 1.8  |
| % unknown <sup>3</sup>                     | 50   | 14   | 24   | 22   | 34   |        | 28.8 |
| % fledged <sup>3</sup>                     | 36   | 86   | 76   | 77   | 66   |        | 68.2 |
| <b>Number of fledged nests<sup>4</sup></b> | 8    | 25   | 22   | 49   | 41   | 145    | 29.0 |

<sup>1</sup> Fate based on monitored nests (%)<sup>2</sup> Nests observed with at least one egg that hatched.<sup>3</sup> Fate based on hatched nests (%)<sup>4</sup> Nests observed with at least one chick that survived to age 10 days.

Table 8. Egg and chick survival of the snowy egret at Alcatraz Island, 2004-2008.

|                                 | Year  |       |       |       |       | Totals | Mean   |
|---------------------------------|-------|-------|-------|-------|-------|--------|--------|
|                                 | 2004  | 2005  | 2006  | 2007  | 2008  |        |        |
| Monitored nests                 | 32    | 36    | 35    | 79    | 82    | 264    | 52.8   |
| Successful nests <sup>1</sup>   | 22    | 29    | 29    | 64    | 62    | 206    | 41.2   |
| Eggs observed to hatching (A)   | 62    | 93    | 85    | 193   | 196   | 629    | 125.8  |
| Failed eggs (B)                 | 4     | 9     | 3     | 20    | 4     | 40     | 8.0    |
| % Hatchability ((A-B)/A)        | 93.5% | 90.3% | 96.5% | 89.6% | 98.0% |        | 93.59% |
| Hatched eggs/monitored nest     | 1.81  | 2.33  | 2.34  | 2.19  | 2.34  |        | 2.20   |
| Hatched eggs/successful nest    | 2.64  | 2.90  | 2.83  | 2.70  | 3.10  |        | 2.83   |
| Nests with fledged chicks       | 8     | 25    | 22    | 49    | 41    | 145    | 29.0   |
| Fledged chicks <sup>2</sup>     | 18    | 54    | 63    | 126   | 90    | 351    | 70.2   |
| Fledged chicks/ monitored nest  | 0.56  | 1.5   | 1.8   | 1.59  | 1.10  |        | 1.31   |
| Fledged chicks/ successful nest | 0.82  | 1.86  | 2.17  | 1.97  | 1.45  |        | 1.65   |
| % hatched eggs that fledged     | 31.0% | 64.3% | 76.8% | 72.8% | 46.9% |        | 58.4%  |

<sup>1</sup> Successful nests were those with at least one egg that was confirmed to have hatched.

<sup>2</sup> Fledged chicks were those chicks observed to have survived to 10 days of age or more.

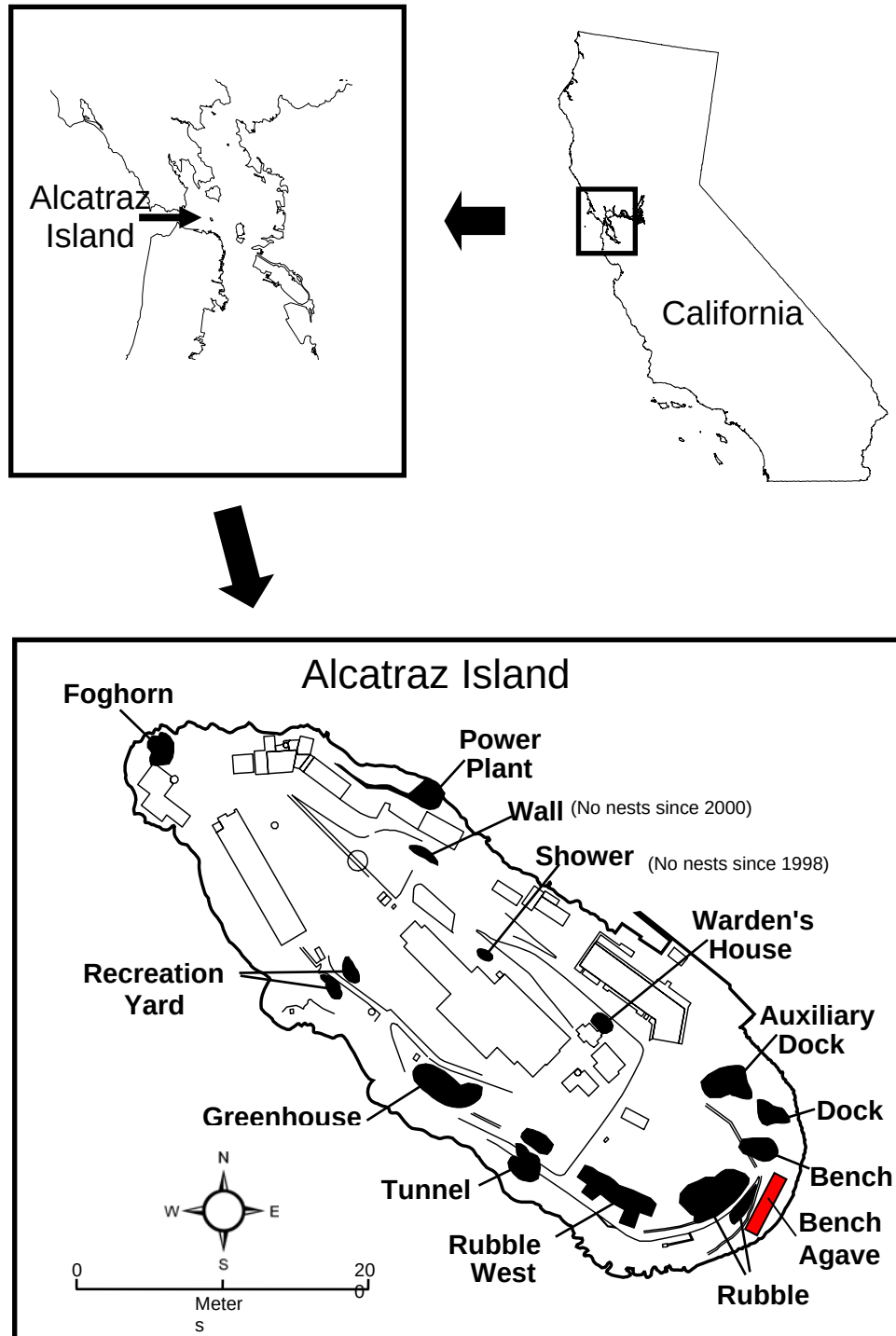


Figure 1. Black-crowned night-heron nesting subcolonies on Alcatraz Island, San Francisco Bay, California, during 1990-2008; Snowy egrets nested only in the Greenhouse subcolony in 2008

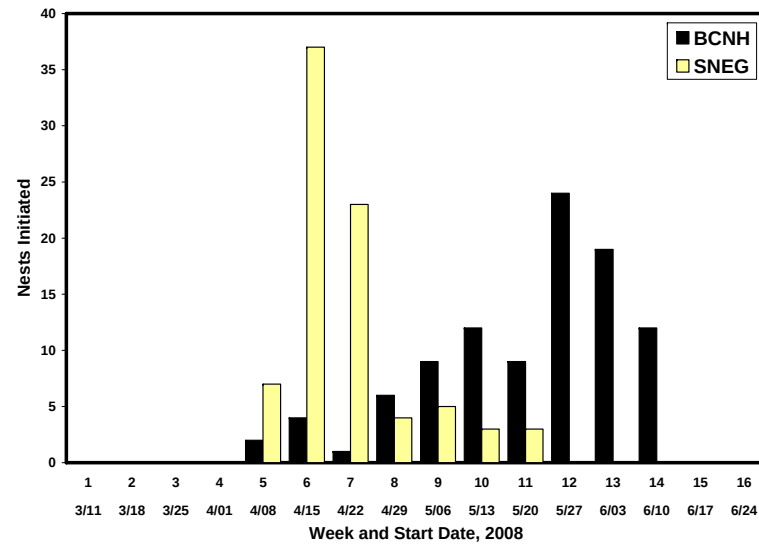
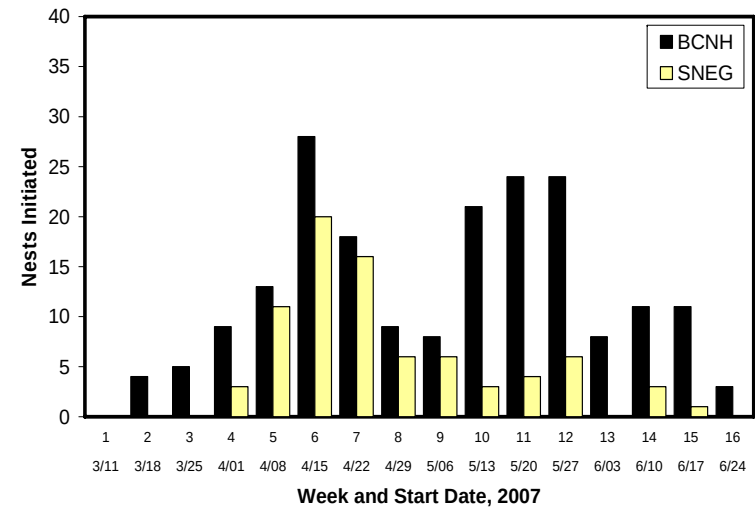
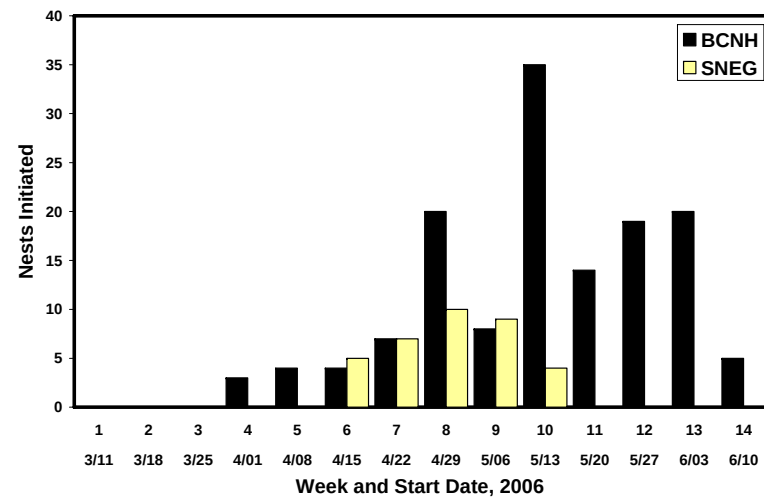


Figure 2. Comparison of black-crowned night-heron and snowy egret nest initiations at Alcatraz Island in 2006, 2007 and 2008.

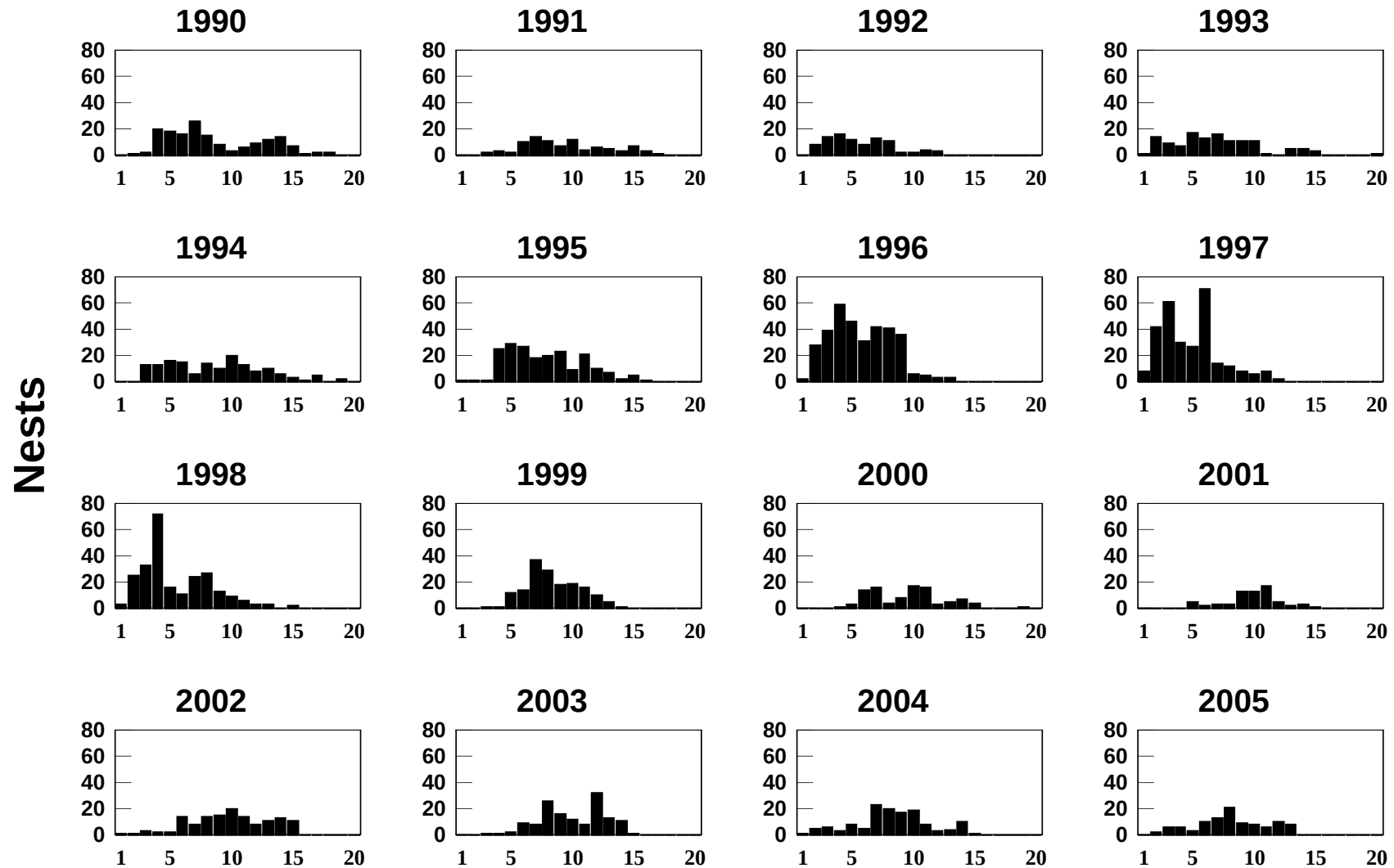


Figure 3. Weekly nest initiation dates by year for black-crowned night-heron nests found at Alcatraz Island, during weeks beginning March 11 – July 22, 1990-2005.

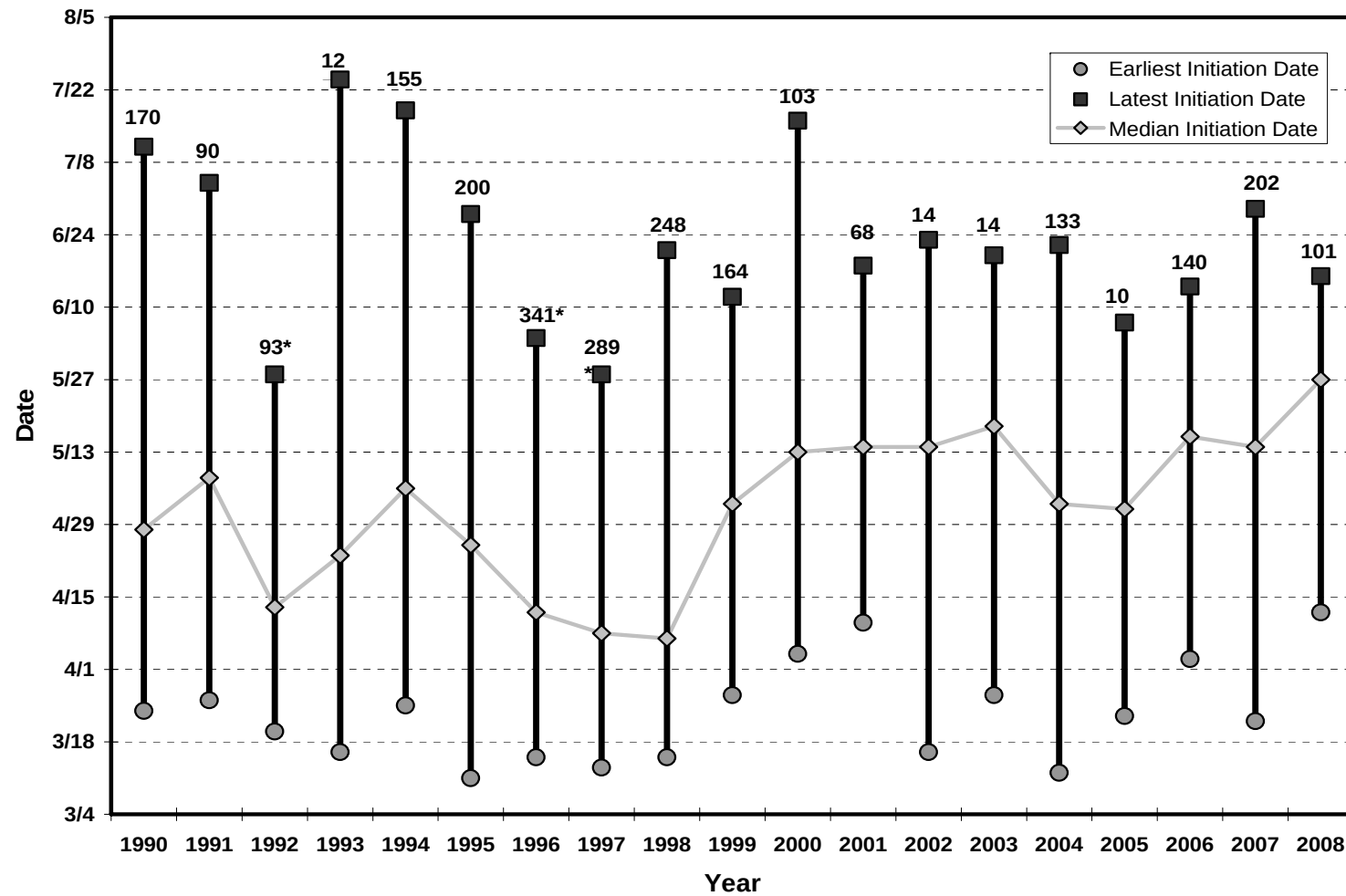


Figure 4. Range of initiation dates, median initiation dates, and numbers of nests monitored for black-crowned night-herons at Alcatraz Island, 1990-2008. (\*Observations in 1992, 1996 and 1997 were terminated 4-6 weeks early because of excessive interspecific conflict between night-herons and Western gulls)

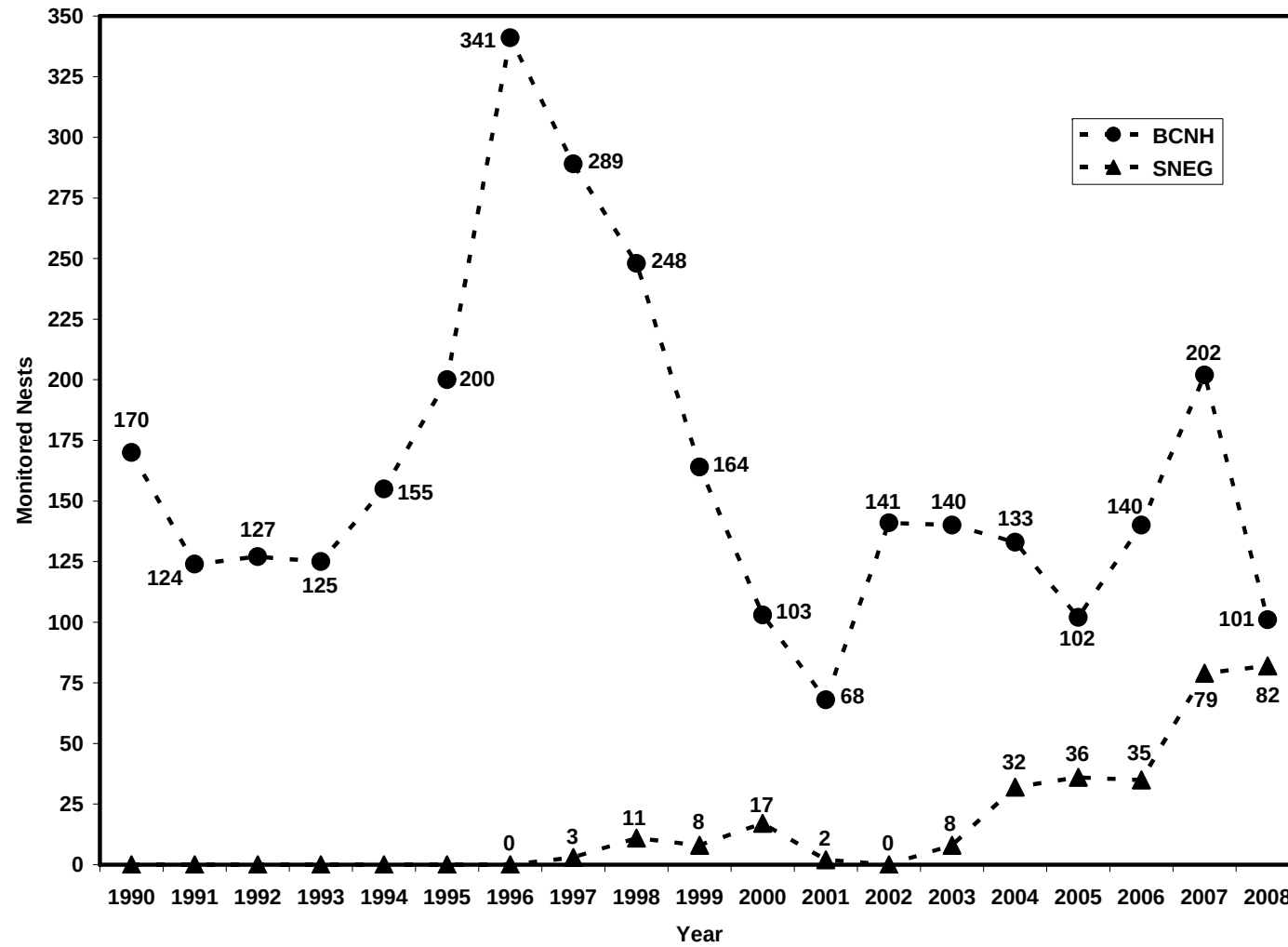


Figure 5. Total black-crowned night-heron and snowy egret nests monitored at Alcatraz Island during 1990-2008. Totals include estimated 34 nests of black-crowned night-herons in 1991 and 1992.

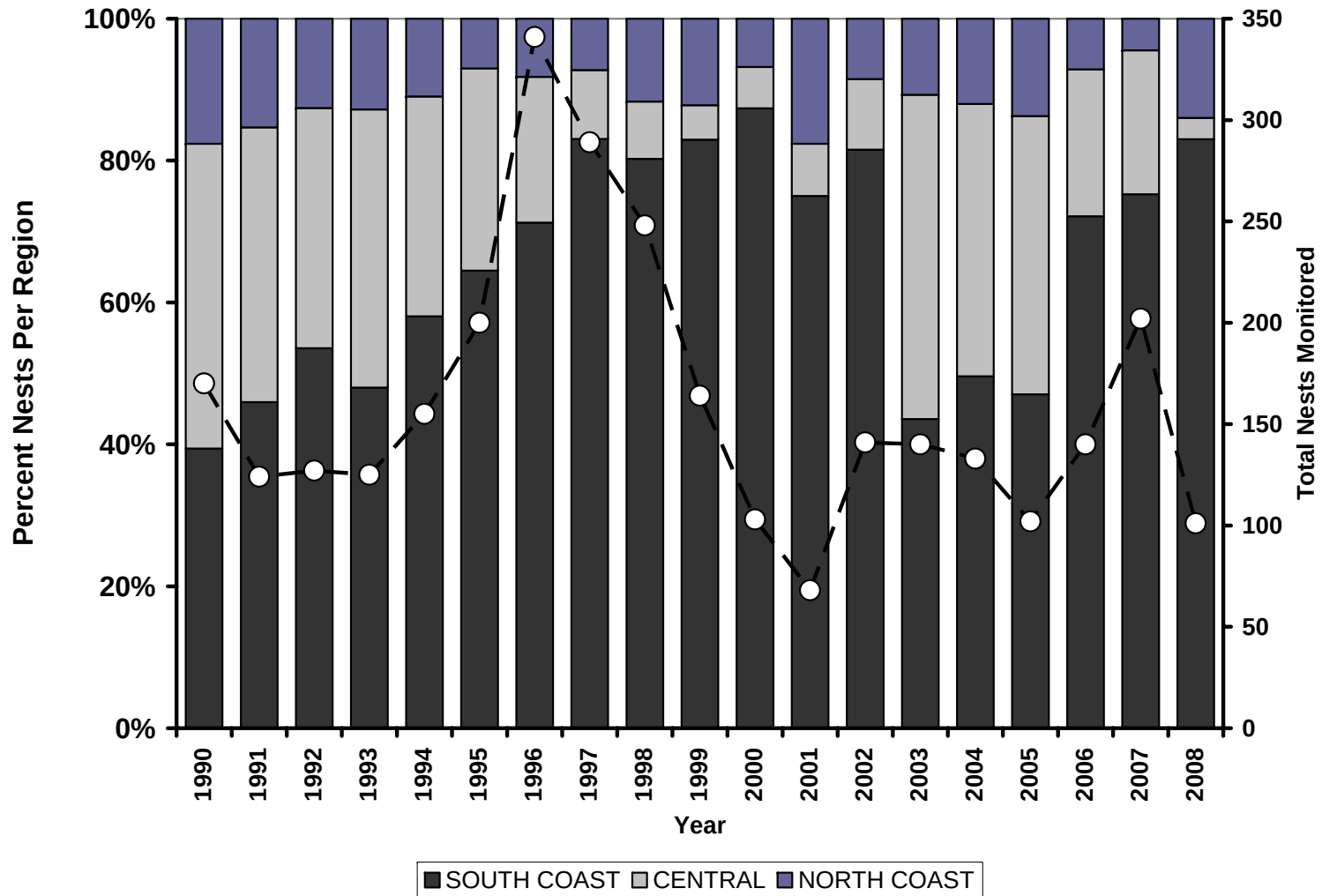


Figure 6. Total black-crowned night-heron nests (circles; right y-axis) and spatial trends (bars; left y-axis) at Alcatraz Island, 1990-2008: North Coast Area = Foghorn and Power Plant; Central Area = Wall, Shower, Greenhouse, Recreation Yard, and Warden's House; South Coast Area = Auxiliary dock, Dock, Bench, Rubble West and Tunnel Bush (See Fig. 1).

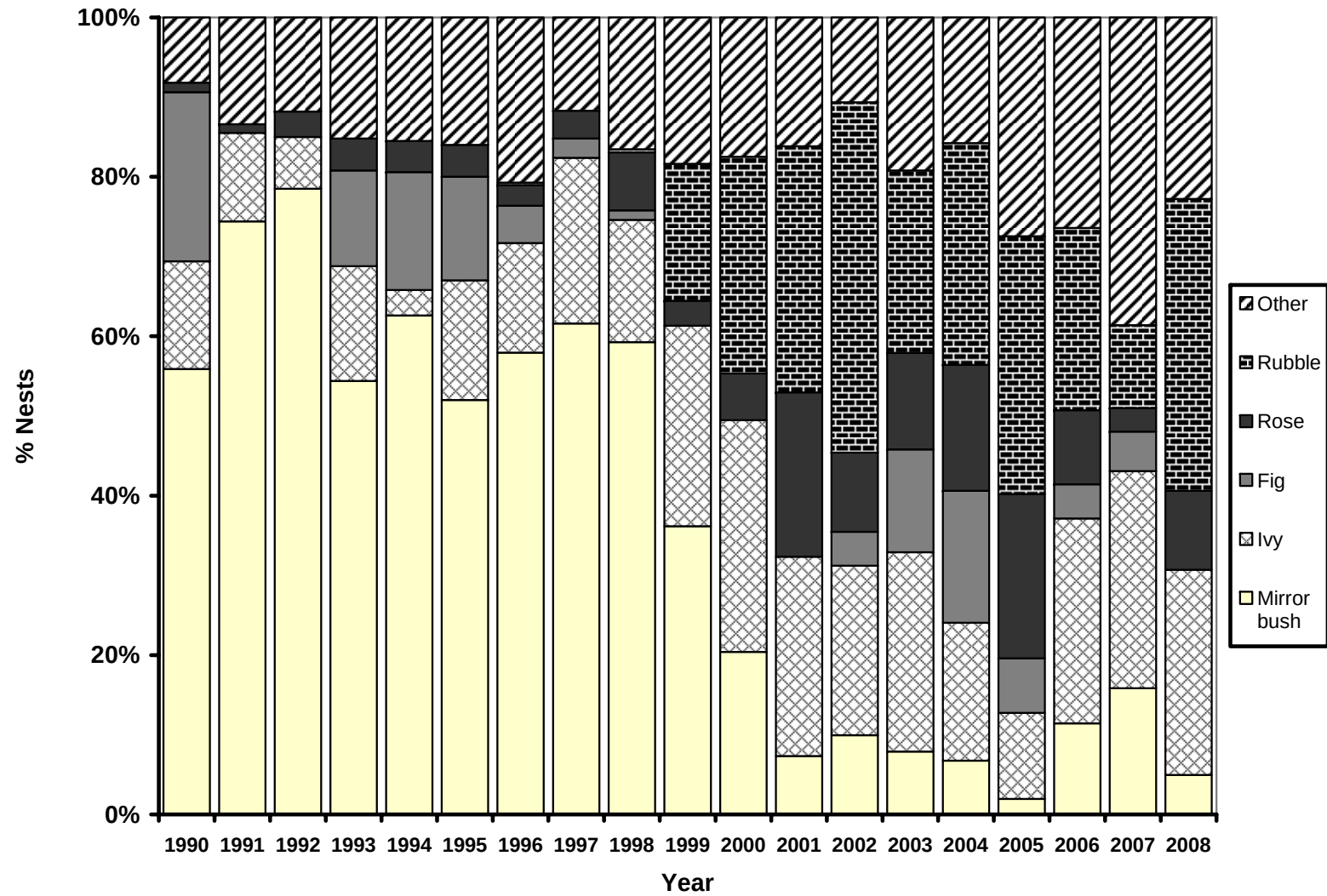


Figure 7. Nesting habitat used by black-crowned night-herons at Alcatraz Island, 1990-2008.

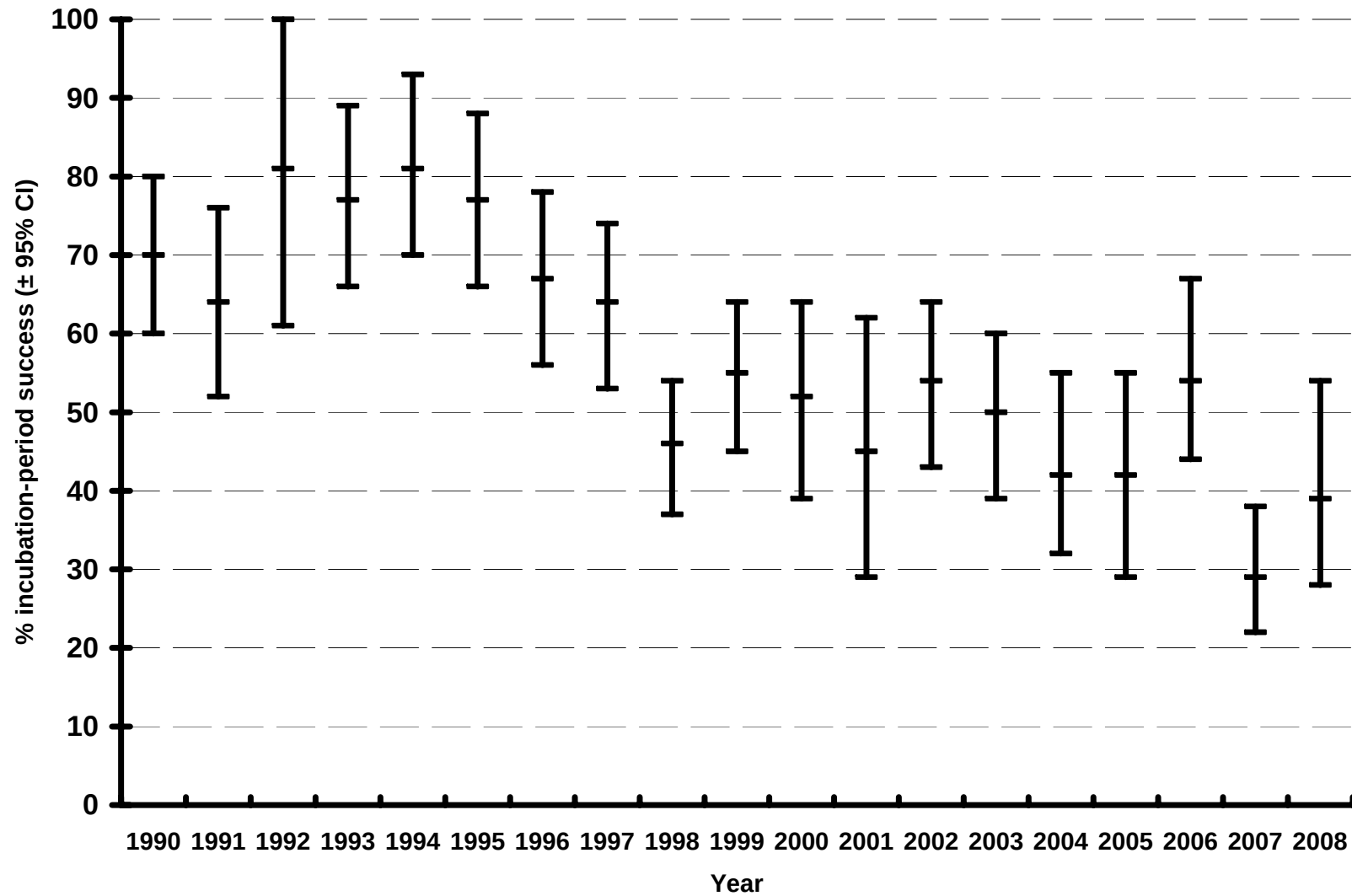


Figure 8. Mean incubation-period success and 95% confidence interval for Black-crowned Night-Herons at Alcatraz Island, 1990-2008.

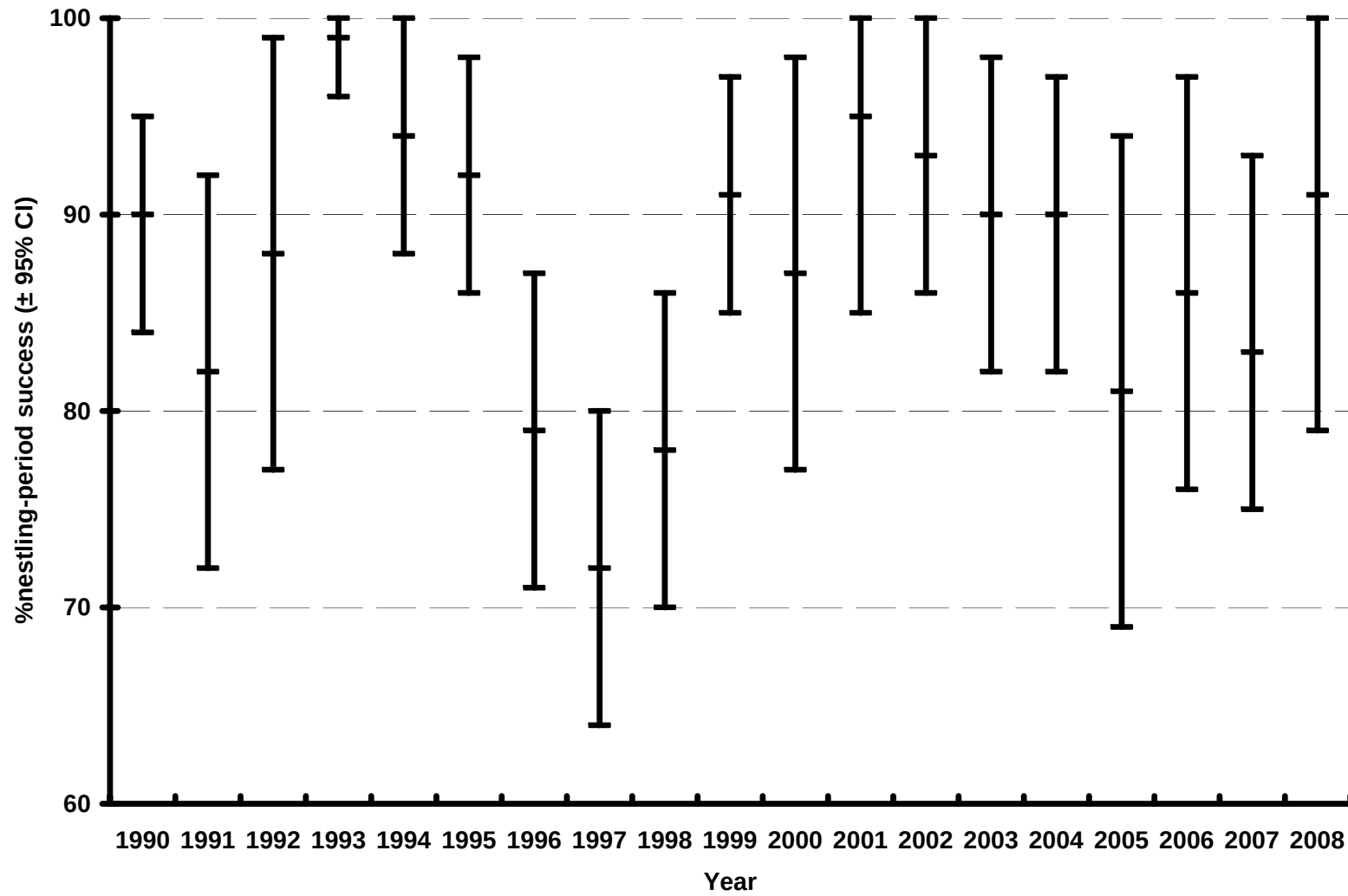


Figure 9. Mean nestling-period success and 95% confidence interval for Black-crowned Night-Herons at Alcatraz Island, 1990-2008.

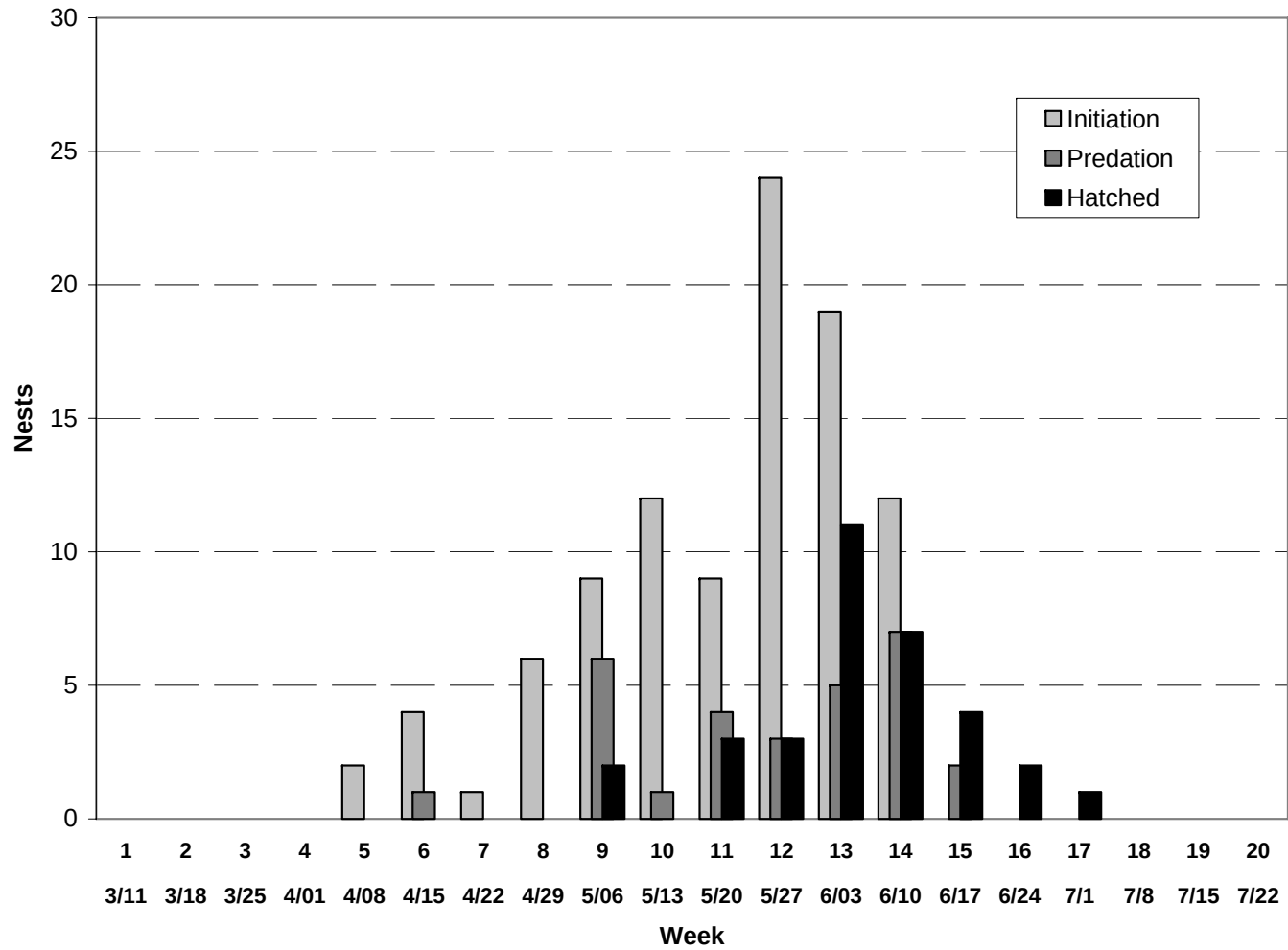


Figure 10. Black-crowned night-heron nests: Initiations, hatching and predation, Alcatraz Island, 2008

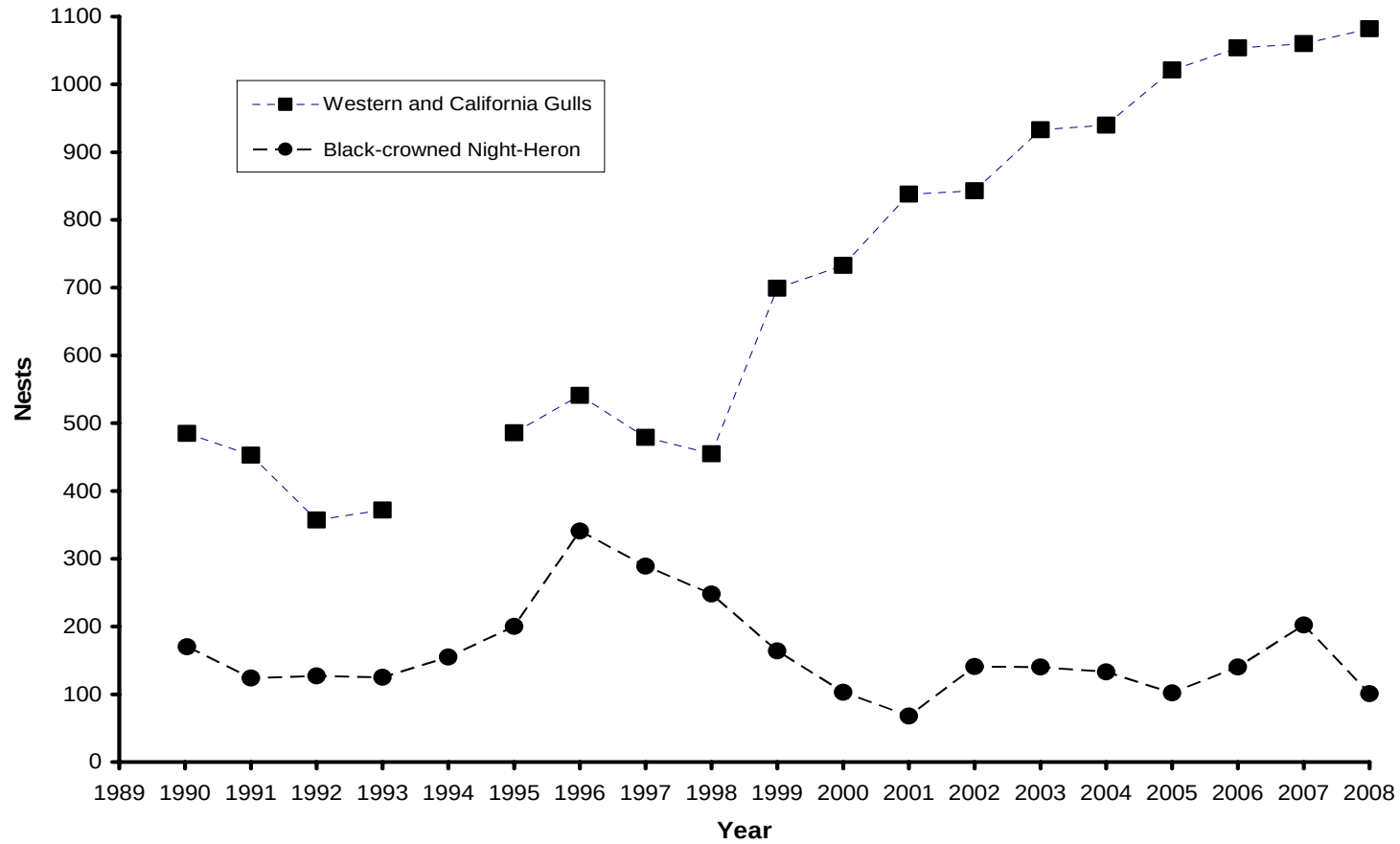


Figure 11. Trends of gull (Western and California Gulls) (Acosta et al. 2006 and S. Acosta, pers. comm.) and black-crowned night-heron nests on Alcatraz Island, 1990-2007. Gull totals include 5 (2004), 14 (2005), 21 (2006), 23 (2007) and 21 (2008) California gull nests.