

# HERON AND EGRET MONITORING RESULTS AT WEST MARIN ISLAND: 2011 NESTING SEASON

A Report to the San Pablo Bay National Wildlife Refuge

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ACR Technical Report 90-3-24  
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### **INTRODUCTION**

Audubon Canyon Ranch (ACR) has been monitoring the number of nesting herons and egrets on West Marin Island since 1979 and the annual reproductive success of Great Egrets and Great Blue Herons since 1993. Nests are monitored annually during repeated visits, from viewing positions on East Marin Island and by boat. This work is part of a regional study of heron and egret colonies in the northern San Francisco Bay area (Kelly et al. 1993, 2006, 2007, 2008a).

### **METHODS**

Methods for monitoring the numbers of heron and egret nests and estimating reproductive success of Great Egrets and Great Blue Herons are identical each year and are described in detail in Kelly et al. (1996, 2006, 2007). In 2011, we mapped the locations of 43 focal Great Egret nests and ten focal Great Blue Heron nests on panoramic photographs of the nesting colony. We made four visits to East Marin Island (17 March, 1 April, 21 April, and 2 June). From viewing positions on East Marin Island, we used telescopes to monitor the nest survivorship, seasonal timing, and pre fledging brood size of numbered nests. Supplemental (approximately weekly) observations were made from a mainland vantage point on Dunfries Terrace above the Loch Lomond Marina.

On 2 June, we counted the nests of all bird species nesting on West Marin Island. As in other years, the nests were counted from an 18-foot Boston Whaler by drifting and motoring slowly around the islands, from an anchored position on the northeast side of the West Marin island, and from vantage points on East Marin Island. Observers were careful to maintain viewing distances that would avoid disturbance to nesting herons or egrets. No evidence of observer disturbance was detected. Viewing conditions were good.

In recent years, we reported standard errors that measured the precision of annual nest survivorship (chance of raising at least one young) based on the proportion of nests in the colony that were monitored (sampled “without replacement”; Kelly 2007). Therefore, uncertainty declined sharply if most of the nest attempts were followed in a particular year. In 2011, we used more generalized error values (with slightly greater uncertainty), based on the chance of success in any year (sampled “with replacement”).

We estimated the productivity of the Great Egret colony by multiplying the expected number of young fledged per successful nest (mean pre fledging brood size of nests with young 5-7 weeks of age) by the estimated number of successful nests in the colony. We estimated the number of successful nests in the colony as the number of focal nests with young that had reached the minimum fledging age of 7 weeks on or before the 2 June census, plus the number of active nests with young that had not yet reached 7 weeks of age adjusted by the expected stage-specific survivorship of nests. This adjustment involved multiplying overall focal nest survivorship by the expected proportion of overall survivorship at each stage, calculated from intensively monitored nests at ACR’s Picher Canyon Heronry, 1999-2005 (ACR, unpublished data). Means are reported as  $\pm$  standard error (SE).

We reported the apparent rate of Great Blue Heron nest survival (chance of raising at least one young) based on focal nests. We estimated productivity of successful Great Blue heron nests based on pre fledging brood size in nests with young at least 5-7 weeks of age.

We also measured the directions of arrival and departure flights of all herons and egrets (primarily Snowy Egrets and Great Egrets), during a 2-hr observation period, from 11:49 to 13:49 on 2 June 2011, over a range of moderate tide levels approximately 2.4– 4.3 ft above MLLW. Additional flightline results are included in previous reports. As in previous years, observers were stationed on East Marin Island and in a boat on the north side of West Marin Island. Observers partitioned the recording of flights between viewing positions to monitor arrivals and departures in all directions, communicating with radios to clarify the flight bearings when necessary. We used compasses and maps marked with the angles of distant landmarks relative to true north to record the angular trajectories of arrival and departure flights

## **RESULTS AND DISCUSSION**

As in other years, Great Egrets, Great Blue Herons, Snowy Egrets, and Black-crowned Night-Herons nested primarily on the northeast side of West Marin Island (Table 1). No herons or egrets nested on East Marin Island.

Table 1. Number of active nests observed on West Marin Island on 2 June 2011.

	Number of occupied nests			
	West side	South side	Northeast side	Total nests
Great Egret	0	17	44	61
Snowy Egret	1	0	88	89
Black-crowned Night-Heron	7	2	39	48
Great Blue Heron	0	0	10	10
Western Gull	25	28	6	59
Black Oystercatcher	0	2	0	2 <sup>a</sup>

<sup>a</sup> Two additional Black Oystercatcher nests were observed on East Marin Island, for a total of four oystercatcher nests observed on the Marin Islands on 2 June.

### Great Egret

On 2 June 2011, we counted 61 Great Egret nests, revealing the fifth consecutive year of low nest abundance after a substantial decline from 126 nests in 2006 and 161 nests in 2005 (Table 2). The percent of nest attempts fledging at least one young in 2011 was  $65 \pm 7.3\%$  (std. error;  $n = 43$  focal nests), revealing a considerable decline from  $85 \pm 6.8\%$  in 2010 and only a slightly higher rate than the relatively low survivorship years of 2008 and 2009 (Figure 1).

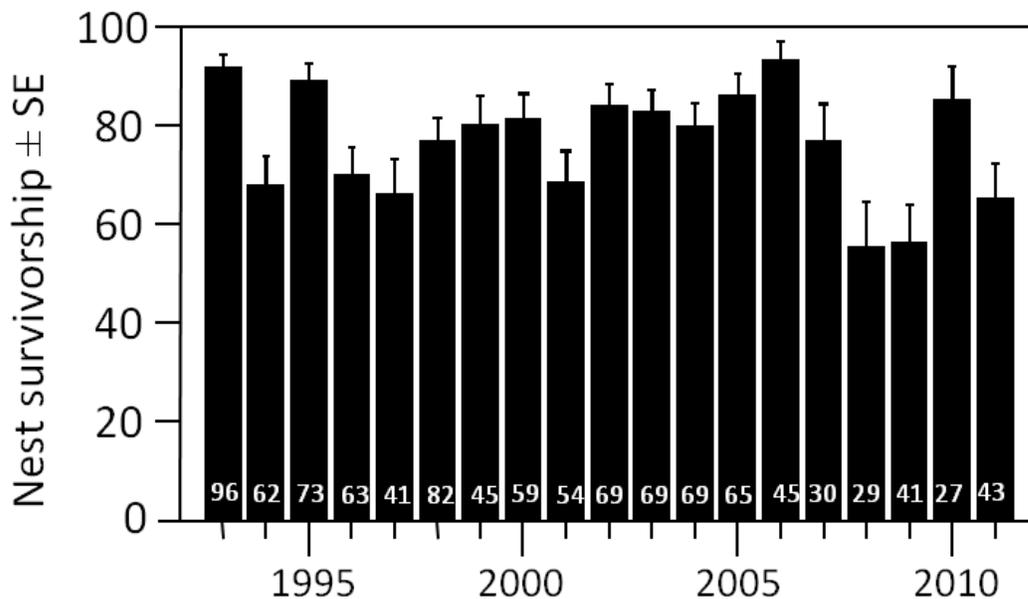


Figure 1. Annual percent survivorship  $\pm$  SE of Great Egret nests at West Marin Island. Numbers on the bars indicate sample size.

Table 2. Annual number of active heron and egret nests on West Marin Island, based on early-June counts conducted by boat and from East Marin Island.

Year	Great Egret	Snowy Egret	Black-crowned Night-Heron	Great Blue Heron
1979	58	262	98	0
1981	75	325	109	0
1982	187	500	80	0
1983	190	345	89	0
1984	139	347	54	0
1985	84	161	79	0
1986	160	126	40	0
1987	89	239	41	0
1988	77	212	35	0
1989	79	245	61	0
1990	119	300	37	1
1991	90	277	45	2
1992	189	220	30	1
1993	120	98	41	0
1994	163	8	32	2
1995	172	16	18 <sup>a</sup>	2
1996	148	36	22	3
1997	167	119	24	5
1998	155	117	53	7
1999	101	84	47	8 <sup>b</sup>
2000	134	156	50	9
2001	94 <sup>c</sup>	217	26	7 <sup>d</sup>
2002	121	204	64	7
2003	81	103	51	10
2004	83	59	29	12
2005	161	91	44 <sup>e</sup>	12
2006	126	116	41	9
2007	60	43	21	10
2008	52	132	40	6
2009	64	175	63	9 <sup>f</sup>
2010	64	102	31	8
2011	61	89	48	10

<sup>a</sup> 115 Black-crowned Night-Herons were present on adjacent mudflats on 17 April 1995.

<sup>b</sup> Number includes one nest on East Marin Island.

<sup>c</sup> Number of active nests during the standard early-June census window, on 5 June 2001. A count on 10 May indicated an earlier peak number of 161 active Great Egret nests.

<sup>d</sup> Number of active nests during the 5 June census, but 8 pairs nested in 2001.

<sup>e</sup> 215 Black-crowned Night-Herons were observed along the shoreline of the West Marin Island on 11 April 2005.

<sup>f</sup> Includes four Great Blue Heron nests on East Marin Island.

We estimated that  $1.8 \pm 0.20$  young were produced per successful nest, although the estimate was based on a small sample of only five nests with clearly observed broods 5-7

weeks of age ( $n = 5$ ). This suggests that the number of young fledged from successful nests may have declined slightly in 2011, compared to 2009 or 2010, but was similar to the productivity of successful nests in most other recent years (Figure 2).

We estimated overall reproductive success (number of young produced per nest attempt) as pre fledging brood size adjusted by focal nest survivorship. In 2011, Great Egrets fledged  $1.17 \pm 0.19$  young per nest attempt, suggesting a decline in reproductive success relative to the previous year and a return to the relatively low rates estimated in 2008 and 2009 (Figure 3). The relatively low overall reproductive success in 2011 reflects primarily the influence of below-average nest survivorship in 2011 (Figure 1), rather than the number of young produced in successful nests which was similar to the average across years (Figure 2).

The relatively low overall reproductive success in 2011 (Figure 3), combined with the continuing low abundance of Great Egrets nesting at Marin Islands (Table 2) led to a continuation of relatively low production for the colony and a long-term decline since the mid-1990s ( $99 \pm 14$  fledged young in 2011; Figure 4).

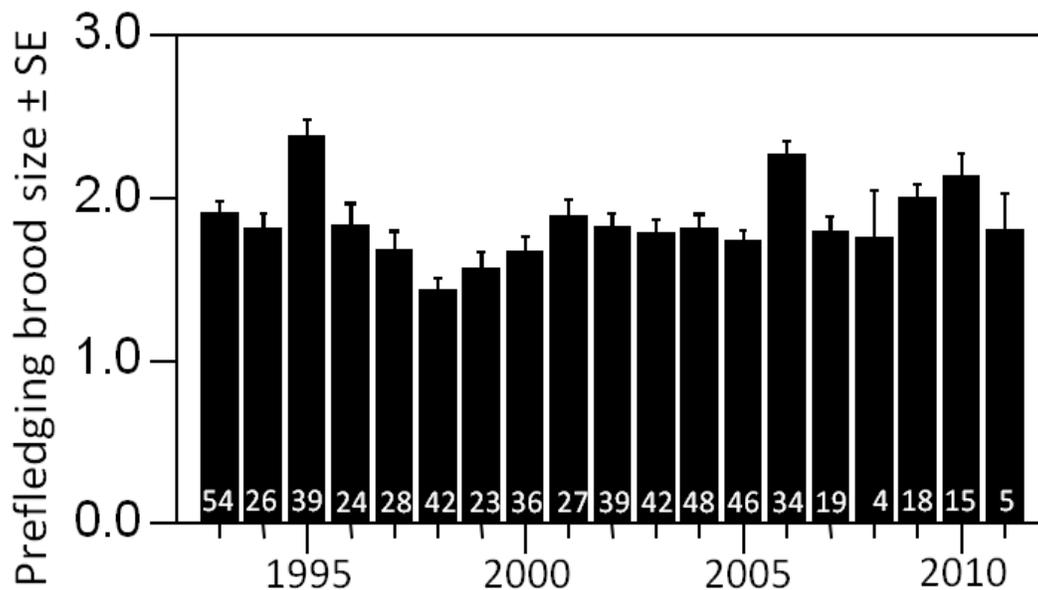


Figure 2. Mean  $\pm$  SE of annual pre fledging brood size in successful Great Egret nests at West Marin Island. Numbers on the bars indicate sample size.

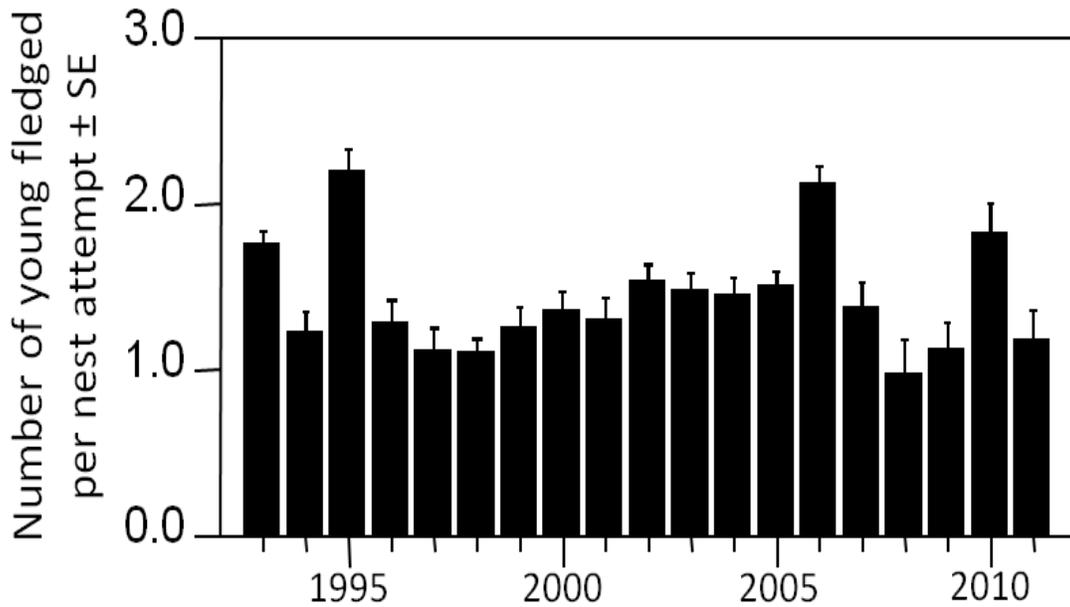


Figure 3. Overall reproductive success of Great Egrets (mean  $\pm$  SE young fledged per nest attempt) at West Marin Island, based on the pre fledging brood size of successful nests adjusted for overall nest survivorship.

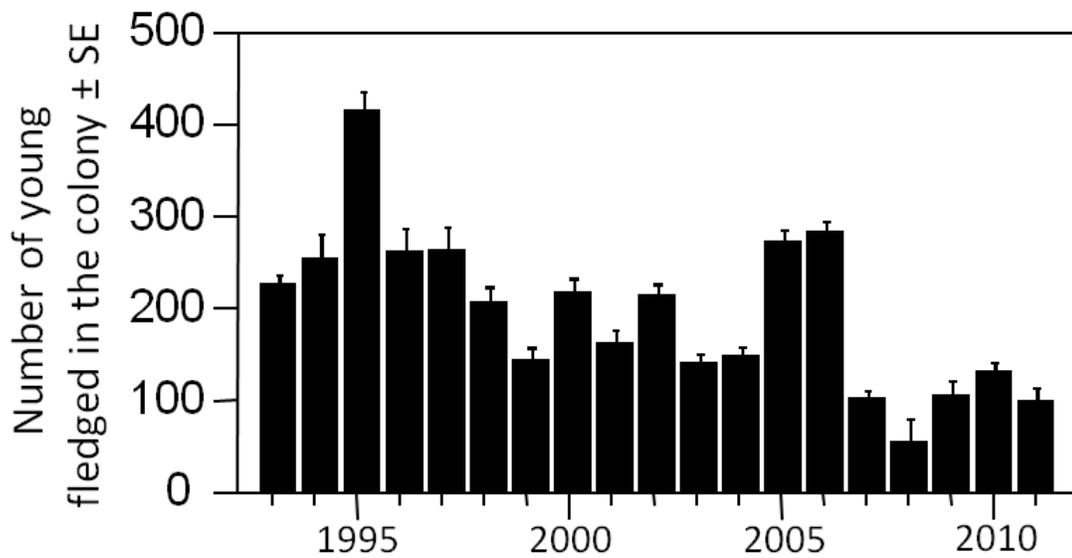


Figure 4. Annual productivity of Great Egrets (estimated number of young fledged in the colony  $\pm$  SE) at West Marin Island.

## Snowy Egret

The number of Snowy Egrets nests on West Marin Island in early June 2011 (89 nests) declined by 13% since 2010 (102 nests) and by 49% since 2009 (175 nests). The number of Snowy nesting Egrets at the Marin Islands declined in spite of an apparent region-wide increase, suggesting that decline in Snowy Egret nests at the Marin Islands was associated with an intraregional shift in nesting distribution rather than a regional decline in nesting abundance in the northern San Francisco Bay area (Figure 5, top).

Reasons for the decline in the Snowy Egret nest abundance since 2009 are unknown (Figure 5). The dramatic decline in 1994-1995, was apparently related to repeated disturbance by a juvenile Red-tailed Hawk (Kelly et al. 1995, Kelly and Fischer 1996). The nesting decline in 2001-2004 was apparently related to loss of shrub cover on the north side of the West Marin Island and associated disturbance by predatory Common Ravens (Kelly and Fischer 2004b; Figure 5, bottom).

We emphasize that considerable annual variation in Snowy Egret nest abundance (Figure 5) may partly reflect difficulty in detecting nests in inconspicuous locations. In addition, our results reflect only the number of active nests detected on observation days and may have overlooked nests that were established but failed before they could be counted. Therefore, our results do not directly reflect the number of breeding pairs. In addition, annual regional variation in nest numbers and differences between regional abundance and the number of Snowy Egret nests at West Marin Island could be influenced by differences in the extent or timing of nest failure among colony sites or years, relative to our observation dates. We did not monitor the survivorship or productivity of Snowy Egret nests.

## Great Blue Heron

The peak number of active Great Blue Heron nests in 2011 was ten, observed on 2 June (Table 2). All of the observed Great Blue Heron nests were on West Marin Island. We followed the fates of ten focal nest attempts. Five of them successfully raised at least one young to minimum fledging age (8 weeks). Therefore, percent nest survivorship was  $50 \pm 15.8\%$  ( $n = 10$ ). We were able to measure the number of young produced in three of these successful nests, each of which produced two young.

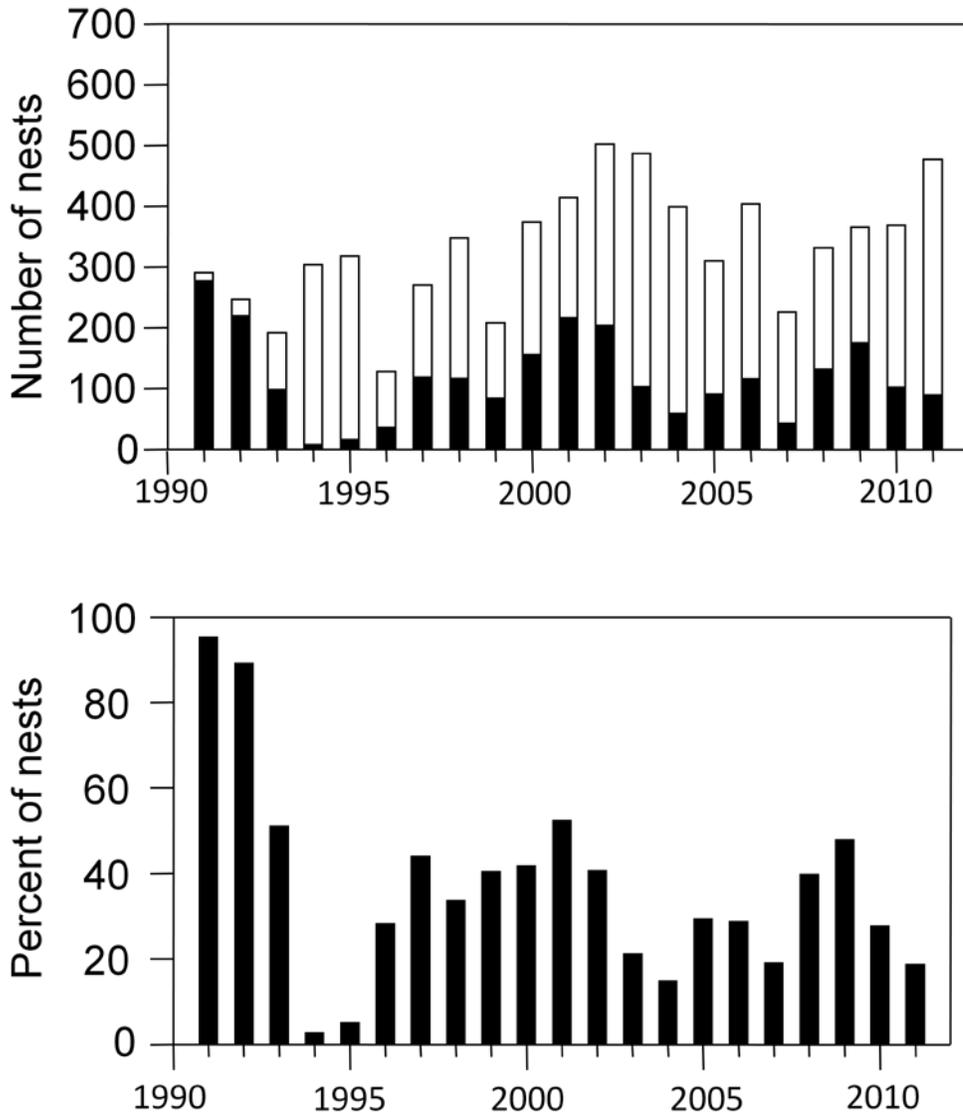


Figure 5. Annual number of Snowy Egret nests (top graph) at West Marin Island (solid bars) and at other colony known colony sites in the northern San Francisco Bay area (open bars), and the associated regional percent of nests that occurred at West Marin island (bottom graph).

### Black-crowned Night-Heron

We counted 48 active Black-crowned Night-Heron nests on 2 June, 2011. Our counts of Black-crowned Night-Heron nests at West Marin Island fluctuate substantially among years, but the absence of a long-term trend suggests that the colony size has been generally stable over

the last 20 years (Figure 6). It is important to recognize that the substantial variation in our results over the course of this study may include considerable sampling error associated with conducting the counts from remote positions by boat. Because night-herons often conceal their nests in dense vegetation, our estimates provide only a rough index of trends in colony size.

Ground-based nest counts conducted on West Marin Island in 1990 and 1991 (R. Hothem, pers. communication) indicate that counts conducted by boat underestimate the actual number of night-heron nests by a factor of approximately 5.4. The magnitude of this bias is consistent with large numbers of adult night-herons observed occasionally along the shoreline, possibly in response to disturbance events (Table 2). Comparisons with counts made from aerial photographs, as well as ground-based counts, substantiate the value of non-intrusive counts conducted by boat for long-term monitoring, as a rough index of trends in nest abundance. Adjusting the boat-based count by a factor of 5.4 suggests that as many as 259 Black-crowned Night-Heron nests could have been established in 2011.

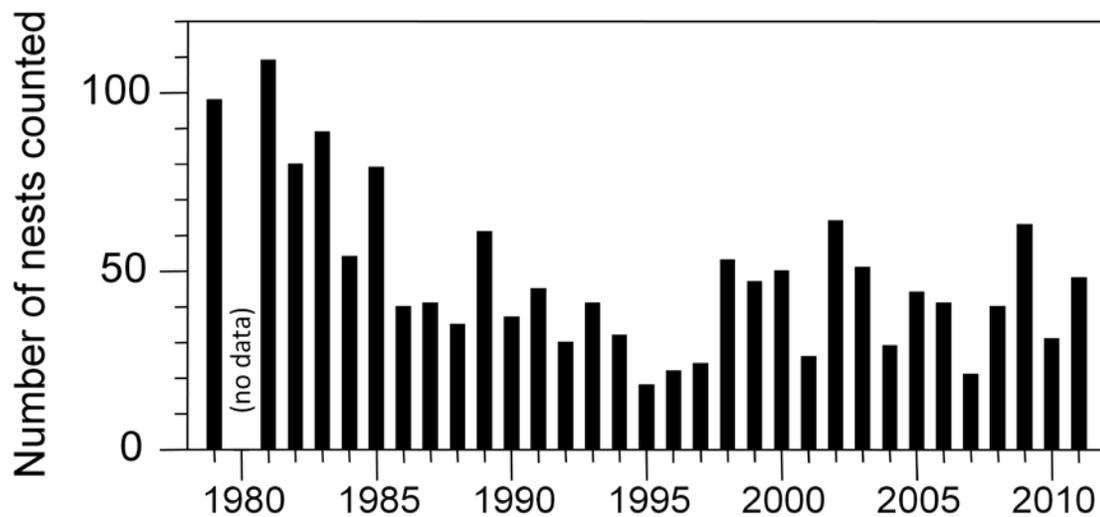


Figure 6. Number of Black-crowned Night-Heron nests counted during annual surveys of West Marin Island. See text regarding overall nest abundance.

### Common Raven

As in other years, a pair of ravens nested on East Marin Island and frequently spent time in the heron and egret colony on West Marin Island (Kelly et al. 2005). Nest disturbance by the resident ravens was observed, resulting in behavioral responses by nesting birds, but we did not

quantify the extent to which nest losses resulted from predation by ravens. Nest mortality among Great Egret nests was similar to other years (Figure 1), although half of the focal Great Blue Heron nest attempts ( $n = 10$ ) led to failure that could have been caused by nest predation. Rates of nest mortality and nest predation in other heron or egret species are unknown. Observations of three dependent, fledgling ravens and two adult ravens on East Marin Island on 2 June suggested that the resident ravens fledged three young in 2011.

### **Other Species**

On 2 June, we observed four active Black Oystercatcher Nests in a survey of the shorelines of East and West Marin islands. One incubating adult and a second, nearby adult was associated with each nest site. We did not see any nestlings or juveniles and we could not determine the contents of any of the nests. This suggests that the presence of additional nesting pairs of oystercatchers suspected in recent years may have been accurate; if so, the number of nests reported in recent years may have underestimated the actual number of nesting pairs. As in the previous three years, an adult male Harlequin Duck occupied the waters and shorelines of the Marin Islands through the nesting season.

### **Flightlines**

As in previous years, we quantified the angles of arrival and departure flights from the heronry. In 2011, we observed a moderate number of arriving or departing birds or groups of birds, with a total of 38 Great Egret flights (58 in 2009 and 38 in 2010) and 42 Snowy Egret flights (49 in 2009 and 10 in 2010). The majority of flights of both species (44% of observed Great Egret flights and 62% of observed Snowy Egret flights) were arriving from or departing to the area north of West Marin Island (Figure 7). The remainder of Great Egret flights were directed roughly to the northwest, and the remaining Snowy Egret flights were in a north-easterly direction.

Northerly flights are likely to correspond to feeding areas in the Petaluma Marsh, the western shore of San Pablo Bay, and Suisun Bay and are consistent with observations made at other tide levels in previous years (Kelly et al. 2011; Figure 7). Birds making southerly flights (as observed during survey periods in other years) may have been heading toward foraging grounds on the Marin County shoreline south of Marin Islands and the southern or central portions of San Francisco Bay. We emphasize that these flightlines represent foraging patterns observed during a single period and might differ considerably from flights observed on other days or tides.

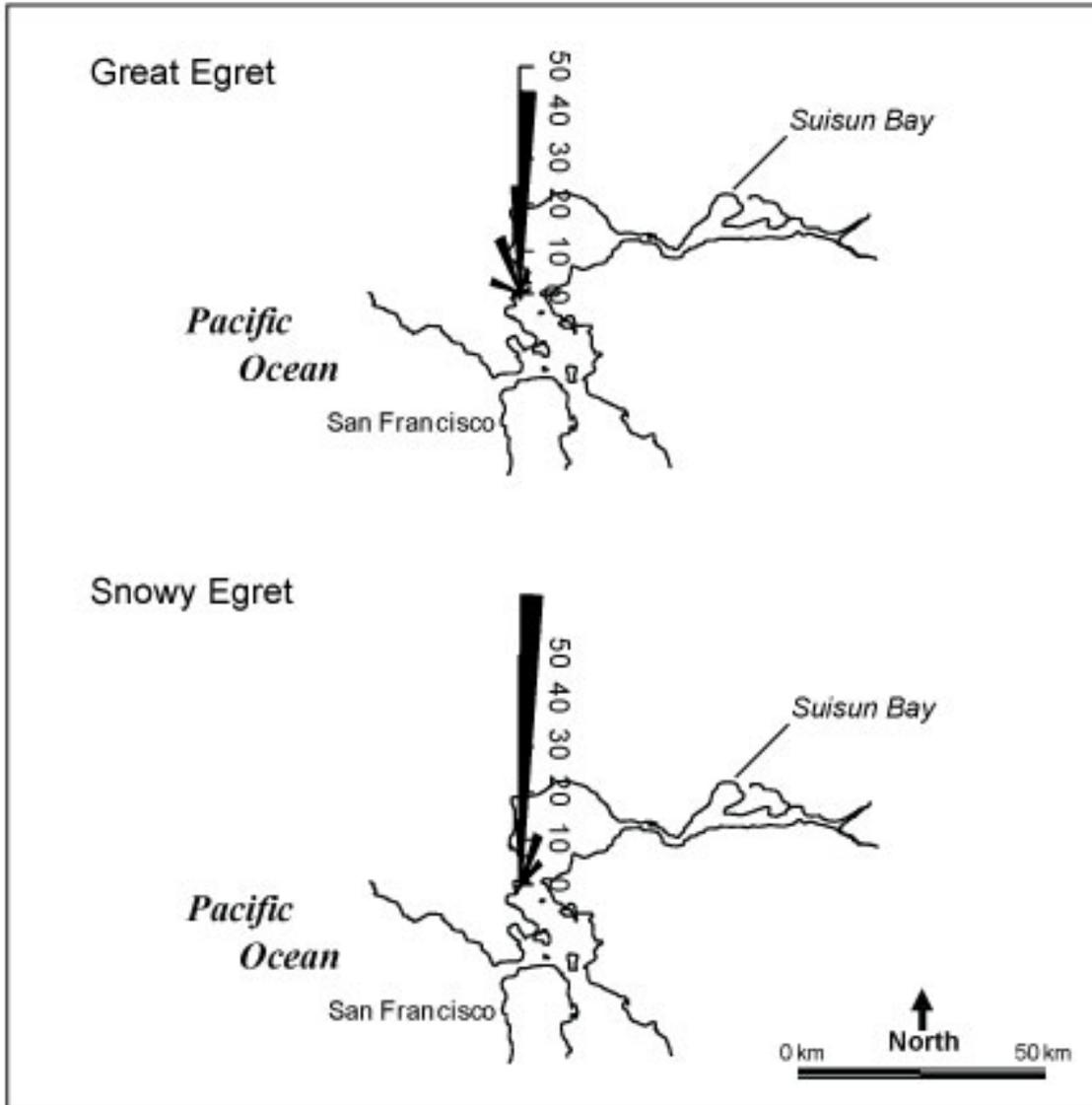


Figure 7. Angular distribution of arrival and departure flights (pooled) of Great Egrets ( $n = 38$ ) and Snowy Egrets ( $n = 43$ ) at West Marin Island, by percent of flights among 16 compass sectors. Flights were observed from 11:49 to 13:49 on 2 June 2011, over a tide range of approximately 2.4– 4.3 ft above MLLW (rising, based on NOAA tide predictions for Point Orient, 4.3 km west of Marin Islands).

## ACKNOWLEDGEMENTS

We thank Sarah Millus and Patrick Woodworth for valuable assistance in the field. The San Pablo Bay National Wildlife Refuge provided access to the Marin Islands. We thank the Loch Lomond Marina in San Rafael for generously providing use of their boat launching facility.

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