

HERON AND EGRET MONITORING RESULTS AT MARIN ISLANDS NATIONAL WILDLIFE REFUGE: 2012 NESTING SEASON

A Report to the San Pablo Bay National Wildlife Refuge

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INTRODUCTION

Audubon Canyon Ranch (ACR) has been monitoring the number of nesting herons and egrets at Marin Islands since 1979 and the annual reproductive success of Great Egrets and Great Blue Herons there since 1993. Nests are monitored annually, during repeated visits, from viewing positions on East Marin Island and by boat. This work is part of an ongoing, 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 2012, we mapped the locations of 40 focal Great Egret nests and eight focal Great Blue Heron nests on panoramic photographs of the nesting colony. We made five visits to East Marin Island (12 March [observations by boat only], 5 April, 10 May, 4 June, and 18 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 4 June, we counted the nests of all herons and egrets, gulls, and Black Oystercatchers on West Marin Island, and the nests of herons and oystercatchers on East 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.

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 4 June census, plus the number of active nests on 4 June with young that had not yet reached 7 weeks of age, adjusted for stage-specific nest survivorship. This adjustment was made by multiplying the number of active nests within each nest stage by the expected nest survivorship for that 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 (proportion of nests that raised at least one young) based on focal nests followed through the nesting cycle. 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. Overall nest success was calculated as the product of nest survivorship and the average number of young in successful nests.

In recent years (annual reports, 2004-2011), we measured the angles of arrival and departure flights, or "flight lines," to evaluate the foraging patterns of nesting herons and egrets. However, we did not measure flight lines in 2012.

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). In 2012, Great Blue Herons once again established nests on East Marin Island. Documented nesting by Great Blue Herons on East Marin Island has occurred in three years since 1979; one nest in 1999, four nests in 2009, and two nests in 2012 (Table 2).

Table 1. Number of active nests observed on West Marin Island and East Marin Island on 4 June 2012.

	Number of occupied nests				Total nests
	West side	West Marin Island South side	Northeast side	East Marin Island	
Great Egret	1	15	37	0	53
Snowy Egret	1	0	120	0	121
Black-crowned Night-Heron	1	2	23	0	26
Great Blue Heron	0	0	6	2	8
Western Gull	18	39	1	(not counted)	58
Black Oystercatcher	1	1	0	0 ^a	2 ^a

^a Two additional adult Black Oystercatchers, but no nests, were observed on East Marin Island on 4 June,. A total of six Black Oystercatcher nests were observed on Marin Islands in 2012 (Meg Marriott, San Pablo Bay National Wildlife Refuge, personal communication, 26 July, 2012).

Great Egret

On 4 June 2012, we counted 61 Great Egret nests, revealing the sixth 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 2012 was $57.5 \pm 7.8\%$ (SE; $n = 40$ focal nests), revealing two years of dramatic decline from $85 \pm 6.8\%$ in 2010, with a rate of nest survival as low as the two lowest records for nest survivorship (2008 and 2009) that we have measured since we began monitoring survivorship in 1993 (Figure 1).

We estimated that 1.7 ± 0.14 young were produced per successful nest, based on a small sample of 11 successful nests with clearly observed broods 5-7 weeks of age ($n = 11$). This suggests that the number of young fledged from successful nests remained low relative 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 2012, Great Egrets fledged 0.99 ± 0.16 young per nest attempt, suggesting a slight decline in reproductive success relative to the previous year, to a level comparable to 2008 which is the lowest since we began monitoring overall success in 1993 (Figure 3). The relatively low overall reproductive success in 2012 reflects the combined influence of below-average nest survivorship (Figure 1) and a relatively low number of young produced in successful nests (Figure 2).

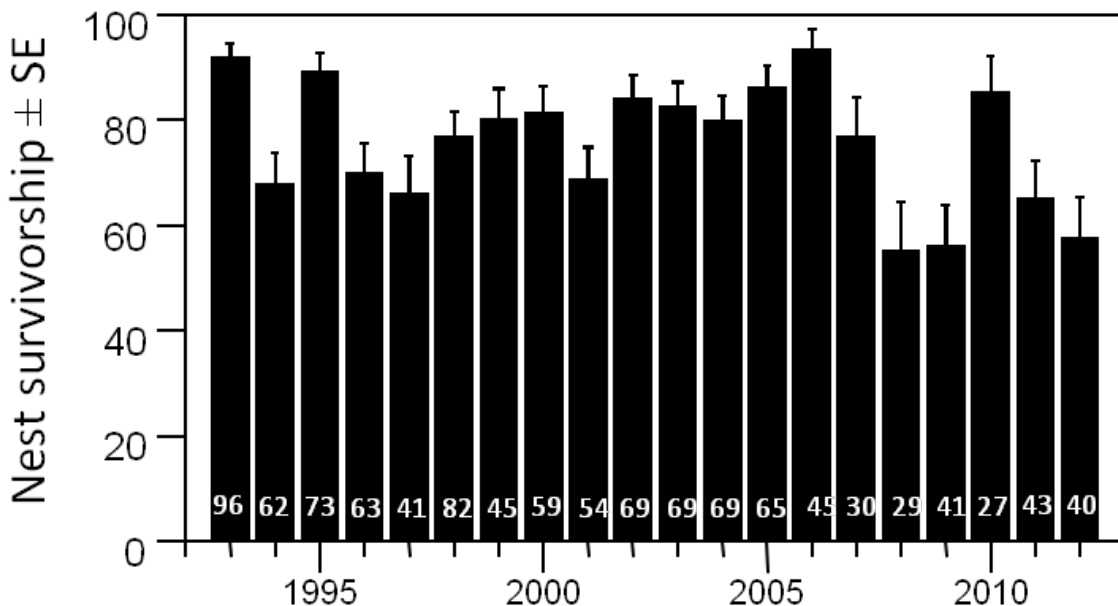


Figure 1. Annual percent survivorship \pm SE of Great Egret nests at West Marin Island.

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. Occasional nesting by Great Blue Herons on East Marin Islands is included, as indicated in the table notes.

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 ^a	2
1996	148	36	22	3
1997	167	119	24	5
1998	155	117	53	7
1999	101	84	47	8 ^b
2000	134	156	50	9
2001	94 ^c	217	26	7 ^d
2002	121	204	64	7
2003	81	103	51	10
2004	83	59	29	12
2005	161	91	44 ^e	12
2006	126	116	41	9
2007	60	43	21	10
2008	52	132	40	6
2009	64	175	63	9 ^f
2010	64	102	31	8
2011	61	89	48	10
2012	53	121	26 ^g	8 ^h

^a 115 Black-crowned Night-Herons were present on adjacent mudflats on 17 April 1995.

^b Number includes one nest on East Marin Island.

^c 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.

^d Number of active nests during the 5 June census, but 8 pairs nested in 2001.

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

^f Includes four Great Blue Heron nests on East Marin Island.

^g Approximately 100 Black-crowned Night-Herons were observed in a fly-up from the colony on 5 April, 2012.

^h Includes two Great Blue Heron nests on East Marin Island.

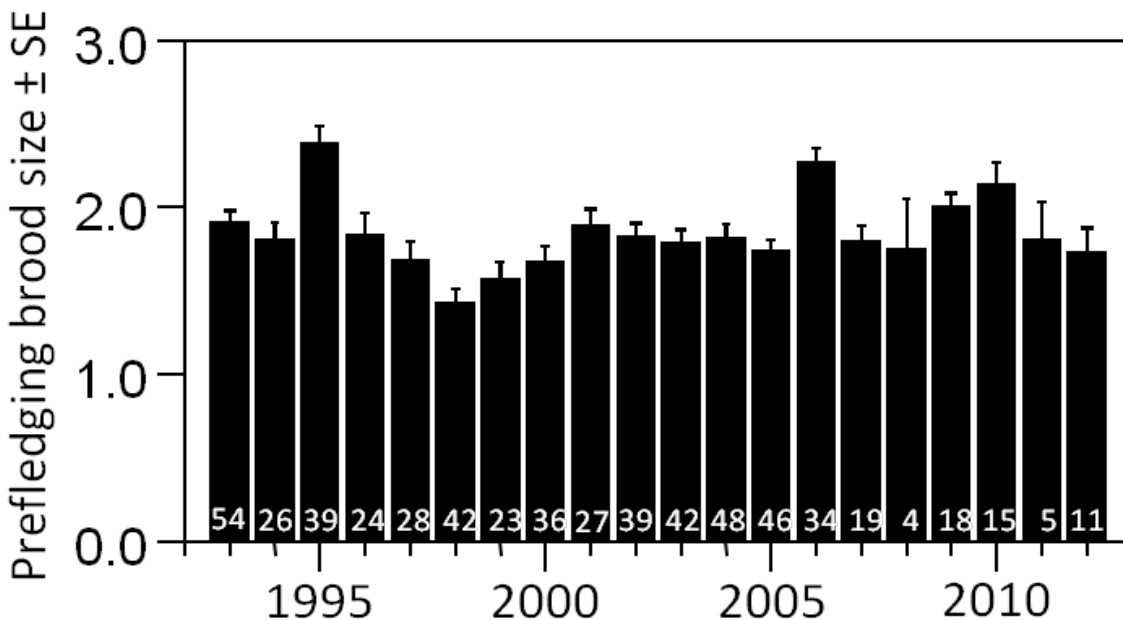


Figure 2. Mean \pm SE of annual prefledging brood size in successful Great Egret nests at West Marin Island. Numbers on the bars indicate sample size.

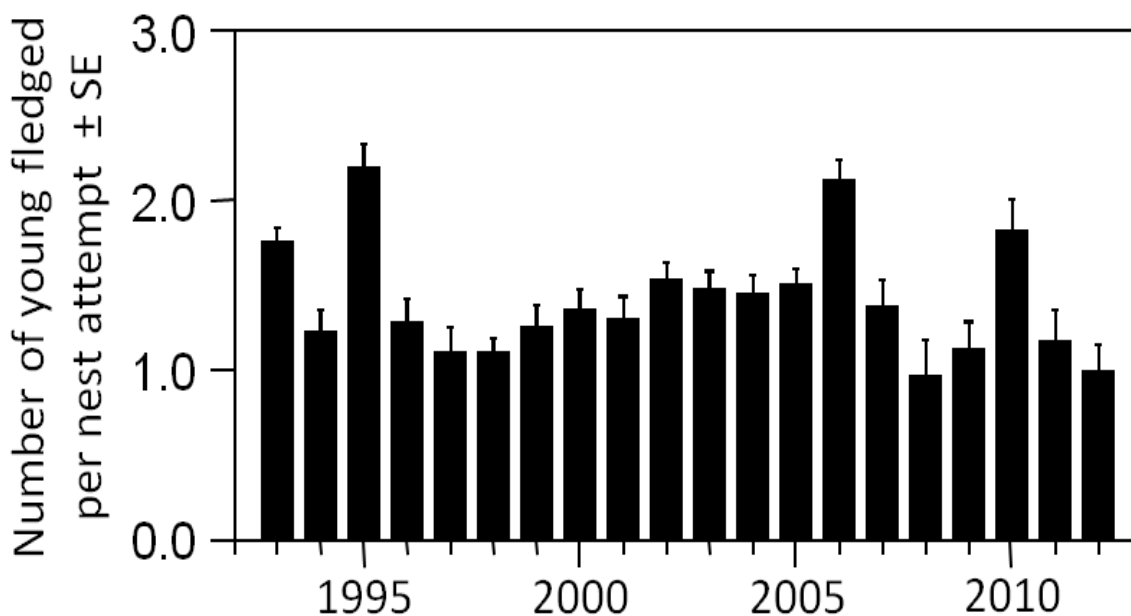


Figure 3. Overall reproductive success of Great Egrets (mean \pm SE young fledged per nest attempt) at West Marin Island, based on the prefledging brood size of successful nests adjusted for overall nest survivorship.

The relatively low overall reproductive success in 2012 (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 in colony productivity since the mid-1990s (74 ± 15 fledged young in 2012; Figure 4).

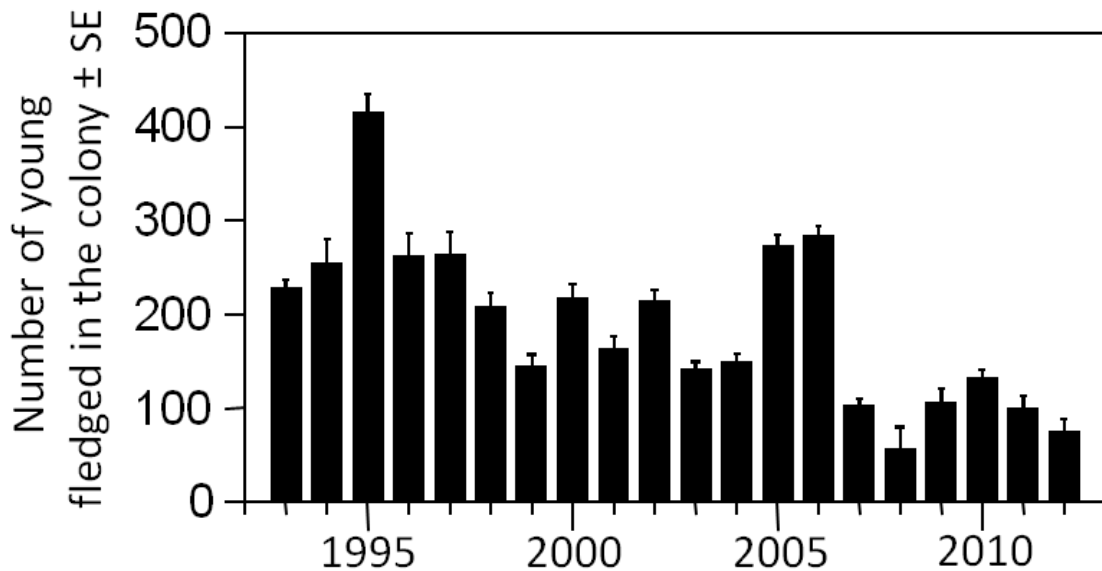


Figure 4. Annual productivity of Great Egrets (estimated number of young fledged in the colony \pm SE) at West Marin Island.

Snowy Egret

The number of Snowy Egrets nests on West Marin Island in early June 2012 (121 nests) increased by 36% since 2011 (89 nests) and by 19% since 2010 (102 nests), but was still 31% lower than the number of nests in 2009 (175 nests). The number of nesting Snowy Egrets at the Marin Islands increased slightly in spite of an apparently slight, region-wide decline, suggesting that the increase was associated with an intraregional shift in nesting distribution rather than a regional increase in nesting abundance in the northern San Francisco Bay area (Figure 5, top).

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).

The 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, differences in the extent or timing of nest failure among colony sites or years, relative to our observation dates, could influence our estimates of (1) annual variation in Snowy Egret nest abundance and (2) changes in Snowy Egret nest abundance at the Marin Islands relative to changes the northern San Francisco Bay region. We did not monitor the survivorship or productivity of Snowy Egret nests.

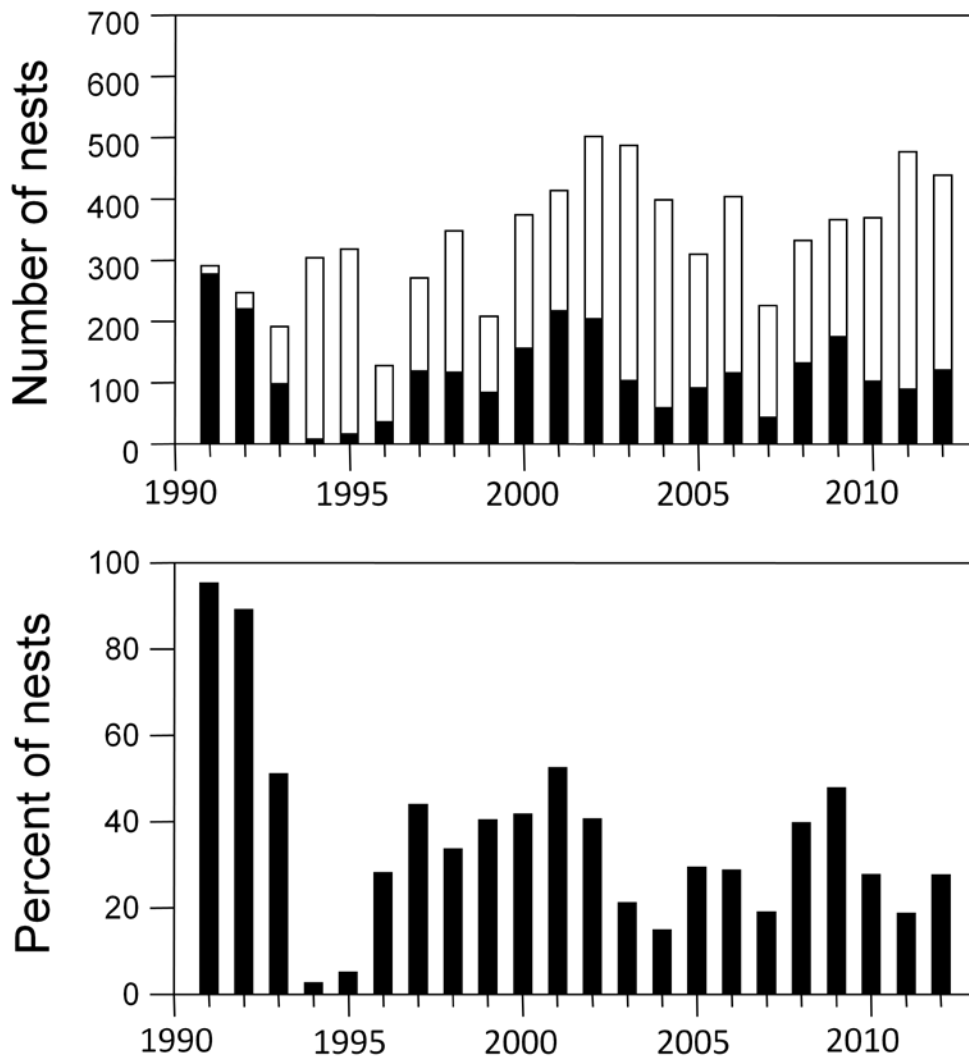


Figure 5. Annual number of Snowy Egret nests (top graph) at West Marin Island (solid bars) and at other colony known colony sites in the northern San Francisco Bay area (open bars), and the associated regional percent of nests that occurred at West Marin island (bottom graph).

Great Blue Heron

The peak number of active Great Blue Heron nests in 2012 was eight, observed on 4 June (Table 2). At least six Great Blue Heron nests were initiated on West Marin Island and three on East Marin Island. We followed the fates of five focal nest attempts on West Marin Island and all three nest attempts on East Marin Island. Four of the five on West Marin Island were successful, with two nests raising one young to minimum fledging age (8 weeks) and two nests fledging two young each. Two of three nests on East Marin Island were successful but we could not determine the number of young fledged from those nests. Therefore, the estimated percent nest survivorship of Great Blue Heron nests at Marin Islands was $75 \pm 15.3\%$ ($n = 8$) and the average number of young produced in successful Great Blue Heron nests was 1.5 ± 0.3 ($n = 4$).

Black-crowned Night-Heron

We counted 26 active Black-crowned Night-Heron nests on 4 June, 2012. This result suggests a declining trend consistent with a slight decline in numbers of nesting Snowy Egrets since 2009 (Figures 5 and 6). 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 20-25 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) indicated 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, roughly, that as many as 140 Black-crowned Night-Heron nests may have been established on the island in 2012.

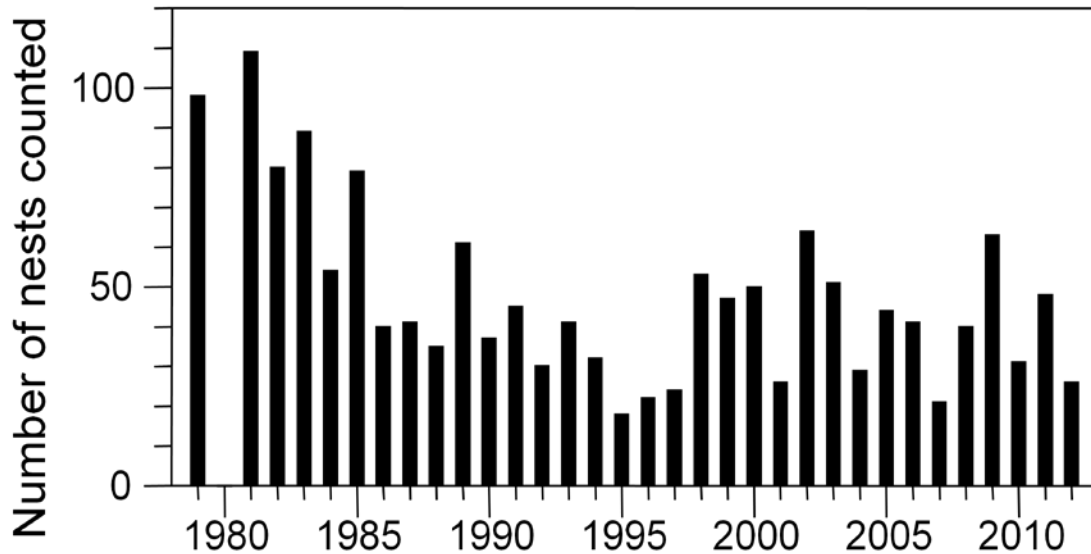


Figure 6. Number of Black-crowned Night-Heron nests counted during annual surveys of West Marin Island. See text regarding overall nest abundance.

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). We observed nest disturbance by the resident ravens resulting in behavioral responses by nesting birds, and it is likely that nest predation by ravens was a key cause of nest failure in the heronry. However, we did not quantify the extent to which nest losses resulted specifically from raven predation. Nest mortality among Great Egret nests was greater than in most other years (Figure 1), suggesting considerable raven predation. The observed failure rate among Great Blue Heron nests ($25 \pm 15.3\%$, $n = 8$) did not differ significantly from expected rates in the San Francisco Bay area (Kelly et al. 2007). The rates of nest mortality and nest predation in other heron or egret species were not measured. On 18 June, we observed four dependent, fledgling ravens and two adult ravens on East Marin Island, suggesting that the resident ravens fledged four young in 2012. This result is consistent with our previous finding that such successful production by ravens is associated with relatively high rates of nest failure in Great Egrets (Kelly et al 2005).

Other Species

On 4 June, we found two active Black Oystercatcher nests just above the shoreline splash zone of West Marin Island (Table 1). Four adult oystercatchers were present on West Marin Island on 4 June, and two additional adult Black Oystercatchers, but no nests, were observed on East Marin Island. However, On 26 July, 2012, a total of six Black Oystercatcher nests were observed on the Marin Islands by Meg Marriott (San Pablo Bay National Wildlife Refuge, personal communication, 26 July, 2012). As in the previous four years, an adult male Harlequin Duck occupied the waters and shorelines of the Marin Islands through the nesting season.

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