HERON AND EGRET MONITORING RESULTS AT WEST MARIN ISLAND: 2004 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 on West Marin Island since 1979 and the annual reproductive success of Great Egrets and Great Blue Herons since 1993 (Kelly *et al.* 1994-1997, Kelly and Fischer 1998-2004). Nests are monitored during repeated visits each year, 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).

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. Standardized methods are summarized here with information on monitoring in 2004; methods are described in detail in Kelly *et al.* (1996). In 2004, we mapped the locations of 69 focal Great Egret nests and 12 Great Blue Heron nests on panoramic photographs of the nesting colony. We used telescopes to monitor the nest survivorship, seasonal timing, and prefledging brood size of the numbered nests during five visits to East Marin Island (22 March, 7 April, 14 May, and 2 and 14 June). A subset of 9 focal Great Egret nests was monitored more frequently, on 35 observation days from the mainland.

On 2 June, we counted nests of all bird species nesting on all sides of West Marin Island. As in other years, we counted nests on the west side of the Island from an 18-foot Boston Whaler, drifting slowly with the motor off. We counted nests on the south and northeast sides from anchored positions. We then cruised slowly along the northeast side to check for nests that were not seen from our anchored position. Finally, we landed on East Marin Island and rechecked the initial estimates for number of Great Blue Heron nests. Viewing conditions were very good with calm water. We also conducted an earlier count of active Great Egret nests on 7 April, from a viewing position on the wharf at East Marin Island.

We estimated the productivity of Great Egret and Great Blue Heron colonies by summing expected prefledging brood sizes over all successful nests. The number of successful nests was based on counts of active nests in early June and the expected survivorship for each nest stage, using the seasonal survivorship of focal nests in 2004 adjusted by the relative expected survivorship for each stage (unpublished data from ACR's Picher Canyon, 1999-2004). Means are reported as ± standard error (SE).

This year, we also measured the directions of arrival and departure flights during a 2-hr observation period on 2 June 2004. Observations were conducted from 12:50 to 14:50, during falling tide (4.6' to 3.7' at the Golden Gate Bridge; NOAA predictions); the tide flats near the Marin Islands were completely inundated. To establish a complete view of arrival and departure flights, two observers were stationed on East Marin Island and two observers were stationed in a boat on the north side of West Marin Island. Teams partitioned the recording of flights in all directions around West Marin Island and communicated with walkie-talkies to clarify the recording of flights between sub-areas. We used compasses and maps marked with the angles of distant landmarks relative to true north to record the angular trajectories of all arrival and departure flights during the 2-hr observation period, although a few flights were probably missed.

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 2004.

	Number of occupied nests			
	West side	South side	Northeast side	Total nests
Great Egret	0	9	74	83
Snowy Egret	0	0	59	59
Black-crowned Night-Heron	3	3	23	29
Great Blue Heron	0	1	11	12
Western Gull	12	29	5	46
Black Oystercatcher	0	1	0	1

Great Egret

On 2 June 2004, we counted 83 active Great Egret nests, which was close to the colony size of 80 nests indicated by the 7 April count. The colony size in 2004 was similar to the 2003 count of 81 nests (Table 2). However, the colony size remained smaller than the 2002 colony of 121 nests and smaller than colony sizes observed annually over the last decade (Table 2). The lower nesting abundance did not reflect a high rate of nest failure. Nest survivorship (percent of focal nests fledging at least one young) in 2004 was 80% (*n* = 69 focal nests), which was close to the survivorship of nests in 2003 (83%) and 2002 (84%; Figure 1). Observations of raven behavior and surveys of raven prey remains on East Marin Island (see below) suggested that nest predation by ravens was associated with at least some, and possibly most, of the Great Egret nest failures.

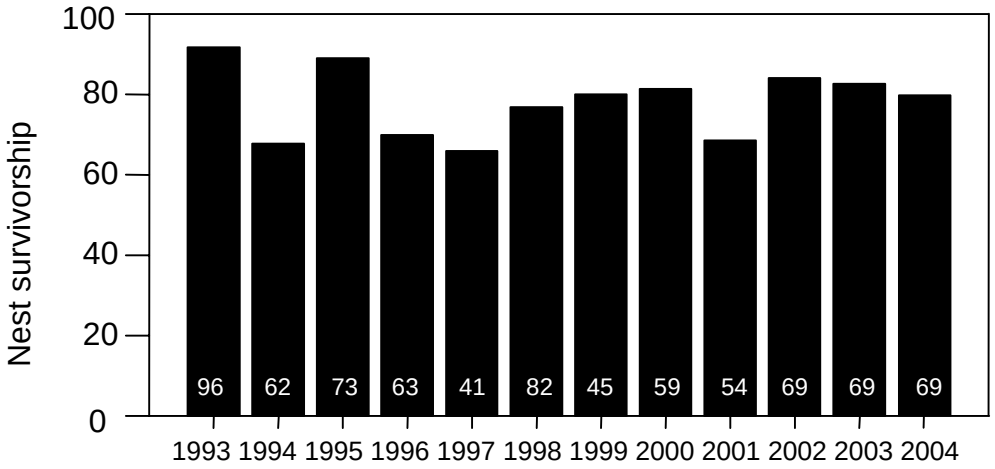

Figure 1. Annual survivorship of Great Egret Nests at West Marin Island. Numbers on the bars indicate sample size.

Mean prefledging brood size in Great Egrets was 1.81 ± 0.09 young per successful nest (*n* = 48), which was similar to 2003 (1.78 ± 0.08, *n* = 42) and 2002 (1.82 ± 0.08, *n* = 39; Figure 2).

We estimated overall reproductive success as prefledging brood size adjusted by focal nest survivorship. In 2004, Great Egret reproductive success was 1.45 ± 0.12 young per nesting attempt (*n* = 60); this estimate was similar to overall success in 2003 (1.47 ± 0.12, *n* = 51) and 2002 (1.54 ± 0.12, *n* = 46; Figure 3).

In 2004, the Great Egret colony produced an estimated 136 young, compared to 133 in 2003 and 203 in 2002 (Figure 4).

Table 2. Number of active heron and egret nests on West Marin Island, based on 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[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

[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 nesting pairs in 2001 was 8.

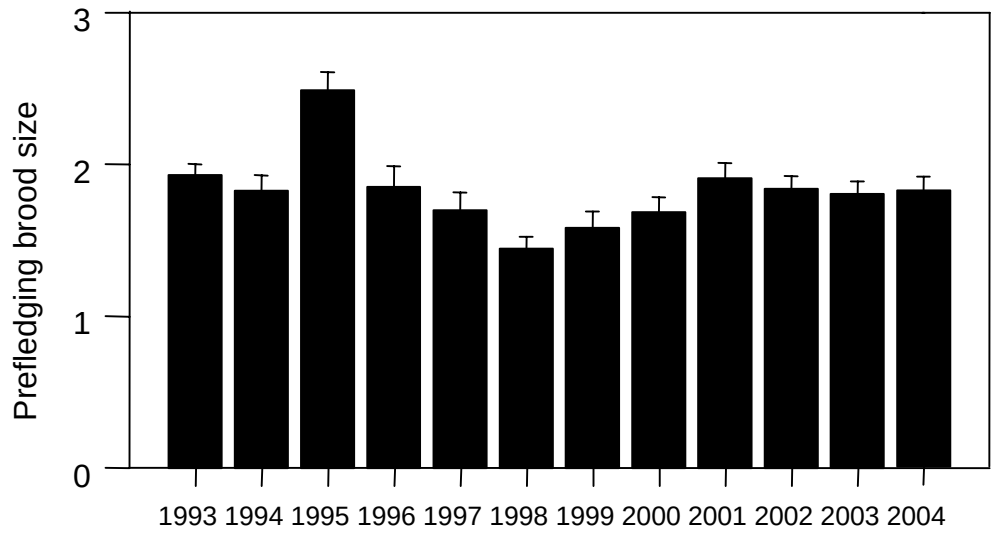

Figure 2. Mean annual prefledging brood size of successful Great Egret nests at West Marin Island. Error bars = SE.

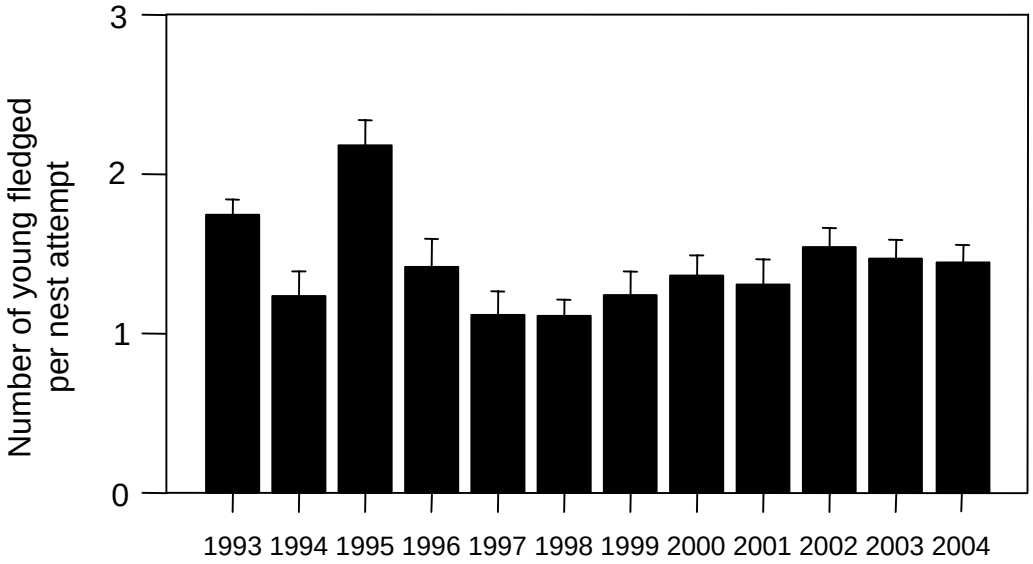

Figure 3. Overall reproductive success (mean number of young per Great Egret nest attempt) at West Marin Island, based on the prefledging brood size of successful nests adjusted for overall nest survivorship. Error bars = SE.

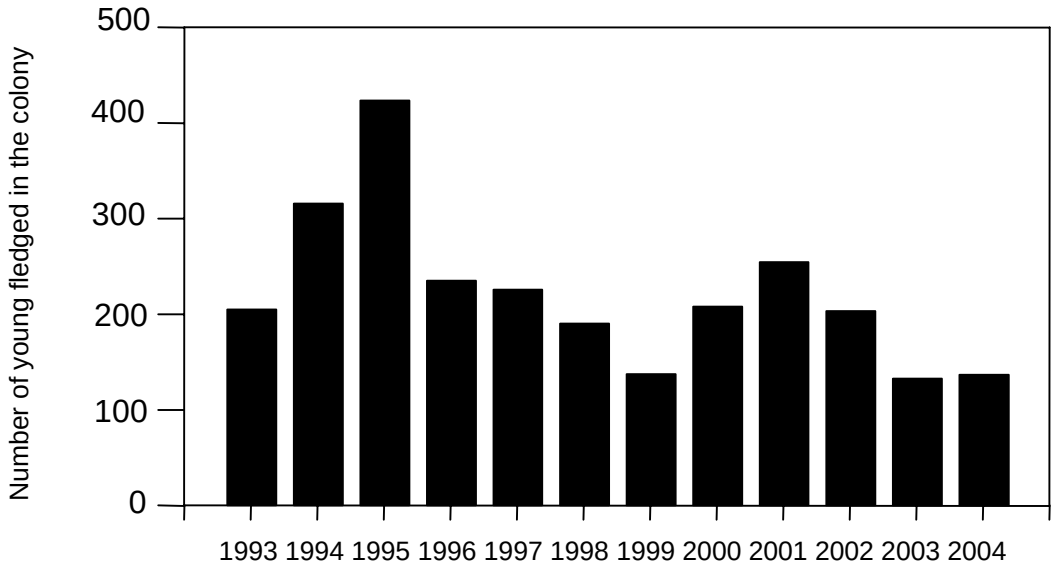

Figure 4. Productivity (number of young produced) of the Great Egret colony at West Marin Island, 2004.

Snowy Egret

We counted only 59 Snowy Egret nests on West Marin Island in 2004, indicating a continuing decline from 103 in 2003 and 204 in 2002. Nest densities dropped below this level in the mid-late 1990s, apparently because of repeated disturbance by a Red-tailed Hawk (Table 1; Kelly et al. 1995, 1996). The current decline did not seem to be caused by Red-tailed Hawk disturbance but was associated with reduced blackberry cover where Snowy Egret normally concentrate their nests. We also noticed increased Snowy Egret use of other taller vegetation where Great Egrets generally nest. The thinning of blackberry cover may have reduced protection from predation by resident Common Ravens. While the number of Snowy Egret nests at West Marin Island declined, the number of nesting Snowies increased in two nearby colonies, at Alcatraz and the Las Gallinas sewage ponds (Table 3). Regional nesting abundance apparently declined this year, but our results reflect only the number of active nests on observation days; our results do not directly reflect the number of breeding pairs, and apparent changes in the regional breeding population could be influenced by differences in the extent or timing of nest failure among colony sites or years (Table 3). Therefore, changes in regional population size should be evaluated over several years, and an overall regional trend is

not apparent. We were unable to monitor nest survivorship or productivity on West Marin Island because Snowy Egrets generally conceal their nests.

Table 3. Number of active Snowy Egret nests in the northern San Francisco Bay area from 1991 to 2002; nv = not visited.

Colony Site	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Brooks Island	7	5	26	95	89	0	0	0	0	8	0	0	0	0
Napa State Hospital	0	6	15	114	92	40	100[a]	160	85	117	129	233	278	202
Picher Canyon, ACR	5	3	11	10	4	4	10	6	5	4	9	1	9	5
Penngrove	2	7	13	2	0	0	2	7	2	1	4	2	10	12
Santa Rosa Creek	0	1	9	8	37	18	27	24	7	48	43	41	37	36
Gold Hill, Suisun Marsh	0	0	0	2	0	0	0	0	0	0	0	0	0	3
Red Rock	0	5	20	65	80	30	10	23	17	2	0	0	0	0
West Marin Island	**277**	**220**	**98**	**8**	**16**	**36**	**119**	**117**	**84**	**156**	**217**	**204**	**103**	**59**
Alcatraz Island	0	0	0	0	0	0	3	11	8	17	2	0	7	29
Bodega Harbor	0	0	0	0	0	0	0	0	0	9	3	7	4	13
Petaluma Wastewater	0	0	0	0	0	0	0	0	0	12	7	14	0	0
Shollenberger Park	0	0	0	0	0	0	0	0	0	0	0	0	18	12
Campbell Ranch	0	0	0	0	0	0	0	0	0	0	0	0	10	0
Las Gallinas West	nv	nv	nv	nv	nv	nv	nv	nv	nv	nv	nv	nv	11	28
Total	291	247	192	302	318	128	271[a]	348	208	374	414	502	487	399

[a]Estimate only; nests not individually counted at the Napa State Hospital in 1997.

Prey remains near the Common Raven nest site on East Marin Island suggested that ravens consumed at least 2 adult Snowy Egrets in 2004. Mark McCaustland saw a raven chase and kill an adult Snowy Egret in 2001. Observations since 1999 suggested increases in raven predation on adult Snowies through 2002, followed by a decline in 2003 and 2004 (Figure 5). This decline was associated with a strong decline in nesting abundance (Table 2) and loss of blackberry cover in the nesting area.

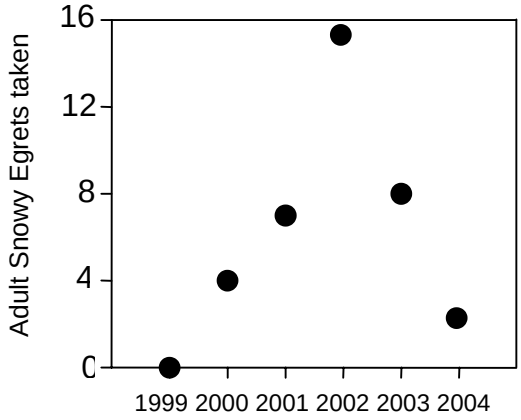

Figure 5. Number of adult Snowy Egrets recovered in raven prey remains found on East Marin Island.

Great Blue Heron

The number of Great Blue Heron nests has increased gradually since they colonized West Marin Island in 1990, with a seasonal peak of 12 active nests in 2004. Three of 11 focal Great Blue heron nests failed, resulting in an estimated nest survivorship of 73%. Two additional nests established late in the season may have represented second attempts. The average prefledging brood size was 2.43 ± 0.37 young per successful Great Blue Heron nest (*n* = 7 visible broods). We estimated overall reproductive success, accounting for the failure of three nests, at 1.70 ± 0.45 young per nest attempt (*n* = 10).

Black-crowned Night-Heron

The estimated number of active Black-crowned Night-Heron nests on 2 June was 29, which was a substantially lower count than in 2003 (51) and 2002 (64) but comparable to other recent years (Table 2). These estimates have shown considerable variation over the course of this study. This variation probably reflects 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.

The number of night-heron nests on nearby Red Rock dropped to zero this year from 36 nests in 2003 and 48 in 2002. In addition, night-herons did not nest this year at Skaggs Island in the Napa Marsh, where in 2003 we flushed 31 adults and 2 juveniles from the

nesting area in a cattail pond. At nearby Alcatraz Island, the peak number of active nests also declined slightly, from 75 in 2003 to 64 in 2004, although numbers were similar to other recent years. In contrast, we estimated an increase in night-heron nests at Las Gallinas sewage ponds from 8 nests in 2003 to 52 in 2004. Such changes are consistent with annual shifts in the regional distribution of nests. The declines at some sites in 2004, however, suggested that night-herons may have either reduced their overall nesting abundance or colonized a new (unknown) location in 2004. We emphasize, that differences in peak numbers of active nests may not accurately reflect differences in the actual number of breeding pairs. This is because the peak number of active nests is influenced by the extent of synchrony of nest initiations, which may vary considerably among colony sites and years.

Flight directions

The angles of arrival and departure flights indicated differences in the use of surrounding feeding areas by Great Egrets and Snowy Egrets (Figure 6). Great Egrets strongly concentrated their movements in two directions: (1) northward toward the western side of San Pablo Bay, the northern bay shoreline of Marin County, and the Petaluma Marsh and (2) northwest toward shoreline areas near the mouth of San Rafael Creek. Great Egrets rarely flew to or from other directions (Figure 6). Snowy Egrets also concentrated their movements in the northward direction of western San Pablo Bay, but exhibited a greater diversity of directions than Great Egrets, including a range of movements to and from the nearby San Rafael shoreline and southward toward the mouth of Corte Madera Creek. We observed virtually no movements by either species directly toward Suisun Marsh, the East Bay shoreline, or South San Francisco Bay. We emphasize that these patterns represent observations during a falling tide on a single day (see methods) and might differ considerably on other days or tides.

Common Raven

The level of raven nest predatory activity at West Marin Island was similar to recent years. Ravens nested successfully on East Marin Island, frequently spent time in the heron and egret colony on West Marin Island, and rarely if ever left the vicinity of Marin Islands. On 14 June, the resident ravens had successfully fledged three young. The young ravens remained primarily in the vicinity of East Marin Island but were quite mobile and flew, perhaps for the first time, over to West Marin Island. As in previous years, the fledgling ravens probably spent extended periods of time in the heronry, possibly for several weeks (Boarman and Heinrich 1999), before leaving the area.

As indicated above, prey remains found near the Common Raven nest site indicated that ravens ate at least 2 adult Snowy Egrets in 2004. This suggests a decline in predation of adult Snowy Egrets (Figure 5). However, this might have resulted from the decline in the number of Snowy Egrets nesting on the Island, especially in the area of the Island with reduced shrub cover. In addition, results from West Marin Island and other sites suggest that raven nest predatory behaviors, such as raven patrol frequency, occupancy rate, and interactions with herons and egrets, may increase as ravens gain foraging experience in heronries, even though the actual levels of nest predation may be limited by other processes (Kelly et al. 2005). For example predation rates increase significantly with increasing raven productivity (food demand) and may be reduced in years when they fledge fewer young (Kelly et al. 2005). Shell fragments found near the raven nest further suggested a decline in predation of heron and egret eggs from 250

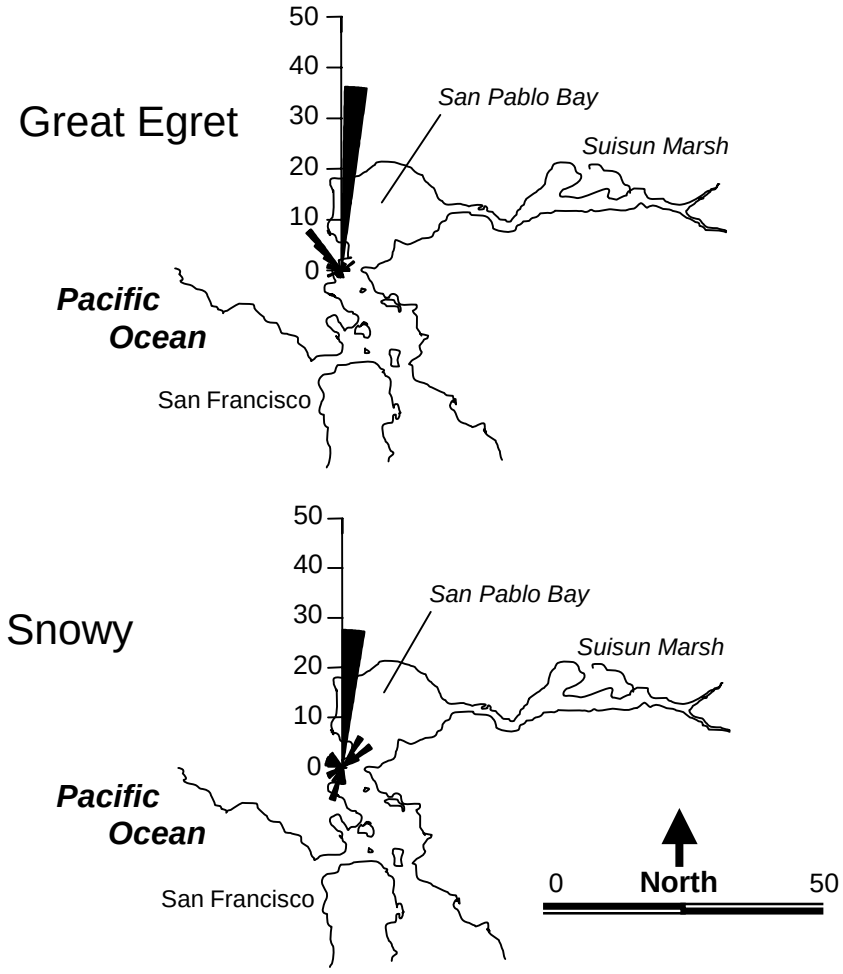

Figure 6. Percent of observed arrival and departure flight (pooled) of Great Egrets (*n* = 69) and Snowy Egrets (*n* = 29) at West Marin Island during high tide on 2 June 2004.

eggs in 2003 to only 61 in 2004; however, the ravens did not use the previous shell dump area (on the roof of the northeast building) and it is possible that they cached eggs or discarded additional egg shells in areas where we could not detect them. As in previous years most of the recovered eggs that could be identified to species were from Black-crowned Night-Herons (2004: 74%, *n* = 67; 2003: 78%, *n* = 18; 2001: 58%, *n* = 65).

Other Species

We counted 46 Western Gull nest sites on West Marin Island on 2 June (Table 1). On 14 May we observed an active Black Oystercatcher nest on the south side of West Marin Island. We observed at least one Canada Goose nest on West Marin Island.

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