Citizen Science-based Colonial Waterbird Monitoring
2013 Nesting Summary

Prepared By:

Karine Tokatlian, Biologist
Christina Donehower, Former Science Programs Director
San Francisco Bay Bird Observatory
524 Valley Way
Milpitas, CA 95035

Prepared For:

Cheryl Strong, Wildlife Biologist
Eric Mruz, Refuge Manager
Don Edwards San Francisco Bay National Wildlife Refuge

And

John Krause, Wildlife Biologist
Eden Landing Ecological Reserve
California Department of Fish and Wildlife

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Program Summary

The San Francisco Bay Bird Observatory (SFBBO) is a nonprofit organization dedicated to the conservation of birds and their habitats through science and outreach. The Colonial Waterbird Program is one of SFBBO's long-standing citizen science programs, initiated in 1982, and utilizes trained volunteers and staff to monitor waterbird nesting sites in the San Francisco Bay. The program has engaged over a hundred volunteers in waterbird nest-monitoring activities. Trained volunteers independently collect observational data on nesting colony status, timing of breeding, numbers of active nests observed, waterbird behavior, and evidence of nest predation or human disturbance at selected colonies each year. They also assist SFBBO staff in conducting annual walkthrough counts of all known California Gull colonies in the South Bay which provide colony size estimates. This information is shared with landowners and resource agencies and contributes to the conservation and management of these species.

Introduction

Colonial waterbirds are essential components of wetland and aquatic habitats across the globe (Hoffmann et al. 1996). These species play key roles within their ecosystem, require specific habitat types and qualities in order to survive, and thereby can be viewed as biological indicators of environmental health and function (Kushlan 1993). In densely inhabited areas like the San Francisco Bay (MTC-ABAG 2013), human encroachment, habitat degradation and conversion are a few of the many factors that affect wetland habitats (Lotze et al. 2006) and therefore colonial waterbird populations.

Colonial waterbirds are attractive candidates for citizen science monitoring. In addition to their ecological value, they are conspicuous and intriguing animals, especially when aggregated in large breeding groups (Parnell et al. 1988). These species typically attract public interest and appreciation. This research program benefits not only the integrity of wetland ecosystems but also encourages the public sentiment that fuels many of these conservation efforts.

Since colonial waterbird colonies can be comprised of several species utilizing a large geographic area, significant changes within these populations may not be detectable for many years by standard research methods. Funding and personnel limitations by research groups may prohibit professional-level monitoring at the required scale. Citizen science initiatives are excellent methods for contributing to long-term, geographically vast research goals at low cost (Dickinson et al. 2010). Furthermore, citizen science studies provide opportunities for public involvement which in turn foster local stewardship and environmental appreciation.

Since 1982, SFBBO has annually recruited and trained volunteers to monitor nesting waterbirds including herons, egrets, cormorants, gulls, and terns, in the San Francisco Bay. The Colonial Waterbird Program emphasizes community engagement and volunteerism in order to: 1) increase monitoring capacity across a large geographic area in a cost-effective manner and 2) generate public interest in protecting and restoring waterbirds and their habitats. Many of the colonies monitored by SFBBO volunteers would not otherwise be tracked. Volunteers also assist SFBBO staff in conducting walkthrough counts annually of all known California Gull colonies in the South Bay.

In this report, we summarize results from SFBBO's citizen science-based waterbird monitoring program in 2013. We also compile limited nesting information provided to SFBBO by agencies monitoring other waterbird colonies in the San Francisco Bay.

Methods

Study area and focal species:

SFBBO biologists and volunteers monitored active waterbird nesting colonies in the San Francisco Bay from March to August 2013. Most colonies monitored were in South San Francisco Bay, but we also report on several colonies in the Central and North Bay and at inland locations of Contra Costa County. Colonies were located on public and private lands and were either detected opportunistically or visited with the existing knowledge of nesting activity. The Audubon Canyon Ranch manages a similar citizen science program that targets herons and egrets in North and Central Bay locations as does Point Blue Conservation Science (formerly PRBO), which centers on San Joaquin Valley locations.

SFBBO focused principally on colonies of California Gull (*Larus californicus*), Forster's Tern (*Sterna forsteri*), Caspian Tern (*Hydroprogne caspia*), California Least Tern (*S. antillarum browni*), Great Blue Heron (*Ardea herodias*), Great Egret (*A. alba*), Snowy Egret (*Egretta thula*), and Double-crested Cormorant (*Phalacrocorax auritus*). Additionally, we monitored American Avocets (*Recurvirostra americana*), Black-necked Stilts (*Himantopus mexicanus*), Black Skimmers (*Rynchops niger*), and Black-crowned Night Herons (*Nycticorax nycticorax*) when nesting with other species of interest.

Walkthrough counts:

SFBBO biologists led one walkthrough survey of most California Gull colonies (see Table 1 for colonies) between May 18 and May 28, 2013. Trained volunteers accompanied SFBBO staff on these surveys. Observer-teams systematically walked through the colonies with a recorder tallying all nests present and re-sighted field readable band combinations whenever possible. Over a thousand gull adults and chicks were marked with field-readable bands from 2008-2010 as part of an effort to track gull movement and colony re-distribution associated with the South Bay Salt Pond Restoration Project. There was particular interest in understanding where gulls displaced from their primary colony at Alviso salt pond A6 would go following the conversion of that site to tidal marsh in December 2010 (see Robinson-Nilsen and Demers 2010, Schacter et al. 2008 for details).

In this report, we provide the total number of active nests encountered at each gull colony. We excluded empty or depredated nest cups from these estimates. We also refer to the number of breeding gulls in a given area, which represents the nest count multiplied by two. Double-crested Cormorant and Caspian Tern nesting adults were also observed within some California Gull colonies. To minimize the potential for opportunistic gull predation on these species due to human disturbance, these particular areas were avoided during walkthrough counts. Nest numbers are represented as the total number of observed adults divided by two.

Observational study:

SFBBO staff developed monitoring protocols and volunteer training curricula (Robinson-Nilsen and Strong 2013). These observational study methods have remained unchanged since the program's initiation in 1982. Volunteers receive training in waterbird identification, natural history, proper "etiquette" around nesting birds, and observational study methods through a standardized protocol. Volunteers were assigned one or more colonies to monitor during the nesting season and were asked to visit their assigned waterbird site(s) once during each established three-day monitoring window.

In 2013, heron colonies were visited on seven occasions from March 2 to July 8, while cormorant colonies were visited on eight occasions from March 2 to August 5, and gull and tern colonies were visited on six occasions from May 4 to August 5. On each visit, volunteers used binoculars and spotting scopes to estimate the number of adult birds, nests, and chicks present. They also noted nesting behaviors, such as incubation, nest-building and courtship displays, and any evidence of human disturbance or predation. In this report, we provide the peak number of nests observed per species for each colony monitored by SFBBO.

Agency data:

To provide a more complete picture of waterbird monitoring efforts throughout the San Francisco Bay, SFBBO has traditionally compiled and reported nesting data from other agencies in this annual summary. SFBBO no longer reports on these data, with the exception of tern colony information from the East Bay Regional Park District (EBRPD; D. Riensche) and the U.S. Fish and Wildlife Service (USFWS; S. Euing). EBRPD and USFWS use alternative monitoring methods and as a result, these data represent the total number of nests counted throughout the season.

Results and Discussion

Walkthrough counts:

In 2013, SFBBO documented ten active California Gull colonies in the South San Francisco Bay. Colonies were located at Alviso ponds A9/A10/A14 and A5, Mountain View pond A1, Mowry ponds M1/M2, M3 and M4/M5, Moffett pond B2, Coyote Hills ponds N2A/N3A/N4AB and N6/N7, and the Mountain View/Palo Alto Flood Control Channel (Tables 1-2, Fig. 1). Colonies ranged in size from 60 nests at B2 to 7,950 nests at A9/A10/A14. Two other California Gull colonies outside of the South Bay, Alcatraz and Agua Vista, were also monitored (Table 1, Fig. 1).

Altogether, there were an estimated 53,458 California Gulls breeding in the South Bay in 2013, a 3% increase from 2012 (Table 2). Though this overall seasonal increase in breeding gulls is minor compared to previous years, we observed sizeable fluctuations in colony sizes at some locations between 2012 and 2013. In the Mowry complex, the M3 colony grew by 37% (689 nests) from 2012 to 2013 whereas nearby colonies M1/2 and M4/5 decreased by 29% and 23% respectively (a combined 758 nests) from 2012 to 2013 (Fig. 3). The colony within the Palo Alto Flood Control Channel also increased considerably, from 4,600 nests in 2012 to 7,007 nests in 2013 and by over 200% in the past two years. Conversely, the colonies in the Coyote Hills ponds N2A/N3A/N4AB and Alviso pond A9 supported lower nest numbers than in 2012 (Table 2). These changes indicate the potential redistribution of breeding gulls among established colonies, a pattern noted by Ackerman et al. (2013), particularly in response to major pond breaches and habitat restoration.

Over the last 30 years, SFBBO's Colonial Waterbird Program has documented a nearly exponential increase in the number of California Gulls nesting in the San Francisco Bay, from fewer than 20 gulls in 1980 to over 53,000 gulls in 2013 (Fig. 2, see also Strong et al. 2004 and Ackerman et al. 2013). The fluctuation in size and location of active gull colonies over the study period (Table 2) is likely due to a suite of changing environmental and demographic factors. Gulls' use of landfills and other sources of anthropogenic food in the South Bay may be a major contributing factor to such rapid growth

(Ackerman et al. 2006), though the recent implementation of gull abatement programs at several area landfills appears to be reducing gull access to this food source (Donehower and Tokatlian 2012) and may affect gull numbers over the long-term. The restoration actions of the South Bay Salt Pond Restoration Project have begun and will likely continue to affect the availability of nesting habitat for gulls.

There is also a growing concern among many land managers and conservationists that the overabundance of California Gulls in the Bay will impede some goals of the South Bay Salt Pond Restoration Project, particularly the ability of the project to support target levels of other ground-nesting waterbird populations with reduced salt pond acreage. As some gull nesting areas within salt ponds are restored to tidal action, displaced gulls may seek new nesting sites elsewhere, potentially impacting Western Snowy Plovers (*Charadrius nivosus nivosus*), Forster's Terns, or other sensitive waterbird species. California Gulls initiate nests before some other nesting waterbird species (Ackerman et al. 2009) and may exclude them from historical nesting areas (Strong et al. 2004). They are also well-documented predators of waterbird nests and chicks (Ackerman et al. 2013).

In December 2010, Alviso pond A6 was restored to tidal action as part of the South Bay Salt Pond Restoration Project. Since this site was formerly home to the largest California Gull colony in the Bay (23,108 gulls in 2010, Table 2), it provides an opportunity to study gull response and colony redistribution as a result of changing habitat conditions. In 2008, a multi-year project was initiated by SFBBO and U.S. Geological Survey to trap and band California Gulls nesting at pond A6. After this pond was converted to tidal marsh habitat, banded adult gulls that once colonized in A6 were re-sighted at Coyote Hills and neighboring Alviso colonies (Ackerman et al. 2013, Fig. 5), with 42% of re-sightings occurring in adjacent Alviso ponds (Fig. 6). Banded California Gulls continue to be documented opportunistically during field surveys and colony censuses throughout the Bay. The subsequent band re-sighting data gathered through this project, as well as from other long-term banding efforts (Schacter et al. 2008 and Ackerman et al. 2013) provide useful information regarding gull dispersal as a result of the A6 breach and the potential impact of encroachment into breeding areas for other sensitive species.

Given the size and geographic proximity of the affected A6 gull colony to other waterbird nesting habitat, there is an urgent need to protect rare species, such as the Western Snowy Plover, against potential gull impacts. In response, SFBBO in partnership with the U.S. Fish and Wildlife Service initiated intensive surveys of South Bay salt ponds and pursued selective, nonlethal gull hazing during the gull nest initiation stage from 2011 and 2012; the U.S. Fish and Wildlife Service led hazing efforts in 2013. To date, gulls have been successfully deterred from nesting in designated ecologically sensitive areas. Ongoing monitoring, hazing and evaluation of other actions may be required over the long-term to limit gull impacts to sensitive species.

Observational study:

In 2013, SFBBO volunteers monitored 62 waterbird colonies (Tables 1, 3, Figs. 1, 5) using observational methods. Newly discovered and re-initiated colonies monitored by volunteers this season included those at the Sunol Water Temple, Redwood Shores Nob Hill Market, Coyote Creek Field Station and Purissima Canyon in Half Moon Bay. Waterbirds nested in a range of habitats, from salt ponds and levees to parks and residential areas. Colonies varied in size and some colonies supported multiple species (Tables 1, 3). Some colony sites were not accessible this season due to salt pond restoration, levee maintenance or access difficulties, and therefore were not surveyed. These areas include Bair Island, Bunting Pond-Niles, Dumbarton ponds N2/N3, Eden Landing ponds E8A and E9, Elmwood Correctional Facility, Greco Island and Portola Valley.

With the exception of California Gull colonies, the nesting sites monitored by SFBBO (named in Tables 1 and 3) should not be viewed as a comprehensive list of all active waterbird colonies in the region, nor should the peak nest numbers observed be used for population-level trend analyses. More intensive nest-monitoring, a strategic sampling approach, and a broader geographic scope would be better-suited to such goals. While SFBBO volunteers visited some colonies that were also surveyed by other agencies, the data collected by the different entities should not be directly compared due to the difference in monitoring methods used.

While the biased sampling scheme (toward known, occupied, and accessible sites), low frequency of colony visits, and observational methods used as part of the Colonial Waterbird Program have clear limitations, we believe that these data have many values, nonetheless. For example, the existing program could serve as a valuable starting point for the development of a future, more comprehensive regional effort to track population sizes and trends on a larger scale. Some of the data were previously incorporated into a San Francisco Bay heron and egret atlas by Kelly et al. (2007).

In the future, we may incorporate more habitat characterization elements into the protocol. For example, many heron and egret rookeries are located in urban greenspaces (e.g., parks, residential areas, playfields), and many waterbird nests are located on artificial structures, such as blinds and power towers, and in invasive or ornamental vegetation (e.g., Eucalyptus trees). Training citizen scientists to collect some additional information on site characteristics and nesting substrate could heighten our understanding of waterbird use of these highly modified landscapes and landscape features.

In addition, SFBBO has consistently monitored many sites for 20-30 years (see Llagas Creek example, Appendix I), which provides a detailed account of activity within and around these localized populations. For example, areas adjacent to the Llagas Creek heronry in the city of Morgan Hill experienced high levels of human disturbance for several years as a result of residential development. While there are no direct observations of detrimental effects from construction activity on the active heron colony, certain changes have been seen in the size and species composition of the colony since the start of development in 2003. This may be related to increased human disturbance in the area, or to other factors such as the difference in tolerance or habituation to disturbances between species, or the response to different types of disturbances between species, as noted in Carney and Sydeman (1999).

Focusing on these long term sites, in addition to urban habitat characterization and documenting breeding responses to habitat changes would greatly increase our understanding of waterbird ecology and would further assist resource managers in making well informed decisions related to valuable breeding locations throughout the San Francisco Bay.

Agency data:

We did not include data from other agencies, with the exception of those included in Table 4. Due to the different monitoring methods used, we advise against direct comparisons of agency nest numbers with SFBBO nest numbers.

Volunteer participation:

In 2013, 56 SFBBO volunteers contributed 616 volunteer hours to the Colonial Waterbird Program. If valued at a rate of $15 per hour, this amounts to $9,240 in donated labor. Levels of volunteer

participation have remained steady in recent years, and we expect an increase in participation as community involvement initiatives are implemented in the future. Many volunteers are long-term participants and supporters, highlighting the interest in and value of this citizen science program.

Moving forward, we aim to continue utilizing the unique values of this citizen science program. We envision the future of the Colonial Waterbird Program to have a predominantly educational objective while maintaining a scientific foundation, ensuring the collection of meaningful data. Citizen science experiences may have deeper and more positively significant socioecological impacts than are currently recognized, that affect not only the quality of scientific studies but also the function of members within their social community (Jordan et al. 2012). The nature of this program, and much of our organization as a whole, is rooted in community involvement. We plan to expand these avenues, using the activity of colony monitoring as a vehicle for providing these beneficial outreach opportunities, thereby strengthening the community of which we are a part. In 2014, in addition to ongoing monitoring activities, volunteers will have the opportunity to serve as "ambassadors" for SFBBO to help educate and inform the community about waterbird ecology. Ambassador activities may include leading a bird viewing or giving a presentation about a particular colony, organizing presentations for SFBBO staff to discuss our work with local groups or businesses, or sharing SFBBO documents with interested individuals that volunteers meet while conducting surveys.

Recommendations

1. Regulatory agencies, such as the U.S. Fish and Wildlife Service and California Department of Fish and Wildlife, should work directly with private landowners to protect colonies on privately-owned land. In the case of wading birds, Kelly et al. (2007) urged prioritized protection for larger, more stable colonies of 20 or more nests, and especially of 100 or more nests. Since many small colonies (5-50 active nests) exist in the South Bay, and small colonies can be more vulnerable to human disturbance and abandonment than larger colonies, protection and management efforts should take these factors into consideration (Kelly et al. 2007).

2. It is unknown if the population growth of California Gulls in San Francisco Bay is due to local breeding success or recruitment from colonies outside of the Bay Area. We recommend further study of California Gull demographics. Enhanced monitoring of gull nest success, breeding site fidelity/movement, chick survival, and adult and chick diets (to assess use and importance of "natural" vs. landfill-derived food items) could be especially informative. Ackerman et al. (2006) indicated plans to use stable isotopes to examine marine and terrestrial inputs to California Gull diet and advocated for more direct diet studies incorporating "regurgitates, collections, and prey deliveries".

3. There were no known instances of California Gulls successfully nesting in sensitive habitats in 2013. Presumably, this was due to the intensive surveys and hazing activities led by the U.S. Fish and Wildlife Service, with SFBBO support (methods used in 2013 followed those of Robinson-Nilsen and Demers 2012). In the future, without these activities, gulls will likely colonize Western Snowy Plover or other sensitive waterbird nesting habitat, such as the newly-created islands at Alviso pond A16. Therefore we strongly recommend the continuation of this hazing regime in 2014.

4. Decreases in the number of California Gulls using the Newby Island Landfill have been recorded in response to on-site abatement programs. Controlling access to anthropogenic food sources may affect the location and size of active gull colonies and, over time, could reduce the number of nesting California Gulls in the San Francisco Bay. We recommend the implementation of gull abatement programs at other refuse management locations.

5. Continued monitoring of South Bay waterbirds, from broad topics of study to focused, localized populations will be crucial as the South Bay Salt Pond Restoration Project looks toward its Phase Two actions. This includes construction activity near or at waterbird colony sites and conversion of some habitats currently supporting breeding waterbirds to tidal marsh. We believe that the combined efforts of professional scientists and citizen scientists alike are needed in this endeavor. However, we advise against direct comparisons of waterbird nesting data collected using different methods and encourage future collaboration and communication among different entities collecting these data in the South Bay.

6. The scientific and social benefits that these educational opportunities provide, not only to our research but also to our citizens, are still not fully understood (Jordan et al. 2012). We encourage community engagement in ecological research and recommend that scientists work to develop multi-disciplinary measures of success for such programs.

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Table 1. Nests observed within American Avocet (AMAV), Black-necked Stilt (BNST), California Gull (CAGU), Caspian Tern (CATE), Forster's Tern (FOTE), Least Tern (LETE), and Black Skimmer (BLSK) colonies monitored in 2013 as part of SFBBO's citizen science-based Colonial Waterbird Program in the San Francisco Bay, CA. Nest counts represent the peak number of active nests observed during the breeding season from levees or areas adjacent to colonies (observations) or the total nests found on a single walkthrough of the colony led by SFBBO staff in May (walkthrough). Dashes (-) indicate that no nesting birds were reported.

Site	Landowner/ operator	Pond/tower	AMAV	BNST	CAGU	CATE	FOTE	LETE	BLSK	Method	Map ID
Agua Vista	other	n/a	-	-	-	6	-	-	-	observations	1
Alcatraz	NPS	n/a	-	-	58	-	-	-	-	walkthrough	2
Alviso	DESFBNWR	A5	-	-	119	-	-	-	-	walkthrough	3
Alviso	DESFBNWR	A6	-	-	-	-	-	-	-	observations	4
Alviso	DESFBNWR	A7	5	-	-	-	58	-	1	observations	5
Alviso	DESFBNWR	A8	-	-	-	-	11	-	-	observations	6
Alviso	DESFBNWR	A9/A10/A11/A14	-	-	7950	20	-	-	-	walkthrough	7
Alviso	DESFBNWR	A12	-	-	-	-	-	-	-	observations	8
Belmont Slough	other	n/a	-	-	-	-	4	-	-	observations	9
Charleston Slough Island	other	n/a	-	-	-	-	9	-	-	observations	10
Coyote Hills	DESFBNWR	N2A/N3A/N4A	-	-	3128	70	-	-	-	walkthrough	11
Coyote Hills	DESFBNWR	N6/N7	-	-	3457	-	-	-	-	walkthrough	12
Eden Landing	CDFW	Turk	-	-	-	-	-	-	-	observations	13
Hayward Shoreline	other	n/a	-	-	-	-	-	-	1	observations	14
Moffett	DESFBNWR	A2W	6	-	-	-	115	-	1	observations	15
Moffett	DESFBNWR	A3W	-	-	-	-	-	-	-	observations	16
Moffett	DESFBNWR	A2E	-	-	6	-	-	-	-	observations	17
Moffett	DESFBNWR	B1	1	-	35	-	56	-	-	observations	18
Moffett	DESFBNWR	B2	4	-	60	-	18	-	-	walkthrough (CAGU), observations (AMAV)	19
Mountain View	DESFBNWR	A1 NW Island	-	-	135	-	-	-	-	walkthrough	20
Mountain View	DESFBNWR	A1 SE Island	2	-	-	-	6	-	-	observations	21

Table 1 continued

Site	Landowner/ operator	Pond/tower	AMAV	BNST	CAGU	CATE	FOTE	LETE	BLSK	Method	Map ID
Mountain View - Palo Alto Flood Control Channel	other	n/a	-	-	7007	-	-	-	-	walkthrough	22
Mowry	DESFBNWR	M1/M2	-	-	630	-	-	-	-	walkthrough	23
Mowry	DESFBNWR	M3	-	-	2539	-	-	-	-	walkthrough	24
Mowry	DESFBNWR	M4/M5	-	-	1704	-	-	-	-	walkthrough	25
Mundy Marsh	other	n/a	-	-	-	-	-	-	-	observations	26
New Chicago Marsh	DESFBNWR	n/a	97	36	-	-	90	-	1	observations	27
Redwood Shores Water Treatment Plant	other	n/a	-	-	-	-	-	-	-	observations	28
Redwood Shores, Nob Hill Market	other	n/a	4	-	-	-	-	-	1	observations	29
TOTAL			**119**	**36**	**26828**	**96**	**367**	**0**	**5**		

Table 2. Number of breeding California Gulls by colony in the South San Francisco Bay from 1980-2013. Estimates were generated by doubling nest counts obtained from walkthrough surveys in late spring, except where otherwise noted. Dashes (-) indicate that colonies were not surveyed.

Year	Alviso A6	Newark	Alviso A9/A10/A14	Mountain View A1	Mowry M4/M5	Mowry M1/M2	Mowry M3	Moffett B2	Alameda NAS	Brooks Island	Coyote Hills N3A/N4AB	Coyote Hills N6/N7	Palo Alto Flood Control Channel	Alviso A5	Alviso A5/A7	A3W Boardwalk	South Bay Total
1980	24	-	-	0	-	-	-	0	0	0	0	-	-	-	-	-	**24**
1981	60	-	-	0	-	-	-	0	0	0	0	-	-	-	-	-	**60**
1982	412	-	434	0	-	0	-	0	0	0	0	-	-	-	-	-	**846**
1983	1342	46	-	0	-	0	-	0	0	0	0	-	-	-	-	-	**1388**
1984	2000	44	150	0	-	0	-	0	0	0	0	-	-	-	-	-	**2194**
1985	3000	554	374	0	-	0	-	0	0	0	0	-	-	-	-	-	**3928**
1986	3000	398	97	0	-	0	-	0	0	0	0	-	-	-	-	-	**3495**
1987	4000	22	100	0	-	0	-	0	0	0	0	-	-	-	-	-	**4122**
1988	4600	30	180	0	-	0	-	0	0	0	0	-	-	-	-	-	**4810**
1989	5310	0	434	0	-	0	-	0	0	0	0	-	-	-	-	-	**5744**
1990	7600	0	122	2	-	0	-	0	0	0	0	-	-	-	-	-	**7724**
1991	5250	0	0	0	-	0	-	0	0	0	0	-	-	-	-	-	**5250**
1992	5500	0	200	0	-	1294	-	0	0	0	0	-	-	-	-	-	**6994**
1993	6912	0	234	200	-	415	-	82	6	0	0	-	-	-	-	-	**7849**
1994	9000	0	300	350	-	1540	-	556	20	0	0	-	-	-	-	-	**11766**
1995	7236	0	4	74	-	2009	-	300	100	0	0	-	-	-	-	-	**9723**
1996	6558	0	1410	0	-	174	-	282	200	0	0	-	-	-	-	-	**8624**
1997	6256	0	1722	164	-	3000	-	1000	200	0	0	-	-	-	-	-	**12342**
1998	6562	0	1628	0	-	480	-	400	200	-	0	-	-	-	-	-	**9270**
1999	9380	0	2117	145	-	475	-	248	50	-	0	-	-	-	-	-	**12415**
2000	11482	0	1986	0	-	2526	-	254	80	10	0	-	-	-	-	-	**16338**
2001	11216	0	3056	278	-	1824	-	624	-	-	0	-	-	-	-	-	**16998**
2002	11302	0	3590	510	-	3120	-	712	-	486	0	-	-	-	-	-	**19720**

Table 2 continued

Year	Alviso A6	Newark	Alviso A9/A10/A14	Mountain View A1	Mowry M4/M5	Mowry M1/M2	Mowry M3	Moffett B2	Alameda NAS	Brooks Island	Coyote Hills N3A/N4AB	Coyote Hills N6/N7	Palo Alto Flood Control Channel	Alviso A5	Alviso A5/A7	A3W Boardwalk	South Bay Total
2003	13644	0	1010	862	-	4310	-	384	-	896	0	-	-	-	-	-	**21106**
2004	8600[A]	0	1047[A]	321[A]	-	2233[A]	-	219[A]	0	270[A]	0	-	0	-	-	-	**12690**
2005	18418	-	426	1664	-	3044	-	830	-	800	5370	-	-	-	-	-	**30552**
2006	19456	0	234	380	-	5068	-	374	0	-	7442	-	-	84	-	-	**33038**
2007	24696	-	0	92	-	7384	-	-	105	-	4384	-	206	-	-	-	**36867**
2008	26366[B]	-	0	616	5934	8224	-	-	135	-	4952	-	690	30	-	-	**46947**
2009	24190	0	0	446	3640	8842	-	8	87	1577	4944	-	1164	110	-	-	**45008**
2010	23108	0	0	428	4780	6020	-	20	54	-	6594	2506	1704	174	716	-	**46104**
2011	0	0	11956	390	6068	4164	-	112	0	-	6394	4110	4478	156	0	2	**37830**
2012	0	0	18328	422	4414	1770	3700	122	-	-	7248	6738	9200	230	0	0	**52172**
2013	0	-	15900	270	3408	1260	5078	120	0	-	6256	6914	14014	238	0	-	**53458**

[A]Count is from a single flight over the colony and is likely conservative.

[B]USGS contributed supplemental information about this colony.

Table 3. Peak nests observed for Double-crested Cormorant (DCCO), Great Blue Heron (GBHE), Great Egret (GREG), Snowy Egret (SNEG), and Black-crowned Night Heron (BCNH) colonies monitored in 2013 as part of SFBBO's citizen science-based Colonial Waterbird Program in the San Francisco Bay, CA. Dashes (-) indicate that no nesting birds were reported.

Site	Landowner/ operator	Pond/tower	DCCO	GBHE	GREG	SNEG	BCNH	Method	Map ID
Almaden Lake	other	n/a	-	-	8	15	3	observations	1
Alviso	DESFBNWR	A9/A10	160	-	-	-	-	walkthrough	2
Alviso	DESFBNWR	A18	14	-	-	-	-	observations	3
Bay Farm Island - Alameda	other	n/a	-	-	12	10	-	observations	4
Calaveras Reservoir	other	n/a	-	-	-	-	-	observations	5
Chesapeake-Saginaw / Redwood City Harbor	other	n/a	-	-	8	18	49	observations	6
Coyote Hills	DESFBNWR	N2A/N3A/N4A	10	-	-	-	-	walkthrough	7
Coyote Creek Tree (CCFS)	other	n/a	-	-	1	-	-	observations	8
Coyote Parkway Lakes	other	n/a	-	1	-	-	-	observations	9
Coyote Ranch Road	other	n/a	-	4	-	-	-	observations	10
Don Castro	other	n/a	-	8	-	-	-	observations	11
Dumbarton	DESFBNWR	PG&E towers	66	-	-	-	-	observations	12
Eden Landing	CDFW	Heron House	-	7	-	-	-	observations	13
Eden Landing	CDFW	E9	-	3	-	-	-	observations	14
Grant Lake	other	n/a	-	2	-	-	-	observations	15
Hayward Shoreline	other	n/a	-	-	-	-	-	observations	16
Lake Chabot	other	n/a	-	6	-	-	-	observations	17
Lake Cunningham	other	n/a	-	1	-	-	12	observations	18
Lake Elizabeth[A]	other	n/a	-	-	-	-	-	observations	19
Lake Merced Mesa	other	n/a	47	5	-	-	-	observations	20
Lake Merced - North	other	n/a	76	4	-	-	-	observations	21
Lake Merced - South	other	n/a	29	-	-	-	-	observations	22
Lake Merritt	other	n/a	142	-	-	-	-	observations	23
Lakeshore Park Newark	other	n/a	-	-	11	102	72	observations	24

Table 3 continued

Site	Landowner/ operator	Pond/tower	DCCO	GBHE	GREG	SNEG	BCNH	Method	Map ID
Livermore VA Hospital	other	n/a	-	6	-	-	-	observations	25
Llagas Creek, Morgan Hill	other	n/a	-	6	13	-	-	observations	26
Moffett	DESFBNWR	Towers in A2W	17	-	-	-	-	observations	27
Moffett	DESFBNWR	Towers in A3W	6	-	-	-	-	observations	28
Moffett	DESFBNWR	Towers in B2	16	-	-	-	-	observations	29
Ovation Court	other	n/a	-	19	-	-	-	observations	30
Palace of Fine Arts	other	n/a	-	-	-	-	-	observations	31
Palo Alto Baylands Duck Pond	other	n/a	-	-	-	-	7	observations	32
Pescadero Marsh	other	n/a	4	13	3	-	-	observations	33
Purissima Canyon		n/a	-	2	-	-	-	observations	n/a[B]
Quarry Lakes	other	n/a	-	-	-	-	-	observations	34
Redwood Shores Sewage Plant	other	n/a	-	-	-	-	-	observations	35
Ruus Park	other	n/a	-	-	25	20	-	observations	36
Shadow Cliffs	other	n/a	23	9	3	-	-	observations	37
Shorebird Way	other	n/a	-	-	22	21	-	observations	38
Steinberger Slough	other	n/a	170	6	-	-	-	observations	39
Stow Lake	other	n/a	-	4	-	-	-	observations	40
Sunol Water Temple	other	n/a	-	19	-	-	-	observations	41
Vasona County Park	other	n/a	-	5	2	-	-	observations	42
Vasona Reservoir	other	n/a	-	-	-	-	-	observations	43
TOTAL			**780**	**130**	**108**	**186**	**143**		

[A] Volunteer conducted "beaks only" counts at this site. Lack of nest numbers observed does not necessarily indicate a lack of nesting activity.

[B] Site is on privately owned property, location is not shared at owner's request.

Table 4. Total number of nests reported for selected Forster's Tern (FOTE) and Least Tern (LETE) colonies monitored by other agencies in the San Francisco Bay, CA, 2013. Agencies included the U.S. Fish and Wildlife Service (USFWS) and the East Bay Regional Park District (EBRPD).

Site	Landowner/operator	Pond/tower	FOTE	LETE	Method
Alameda Point	other	n/a	-	292	USFWS
Hayward Shoreline	other	n/a	-	85	EBRPD

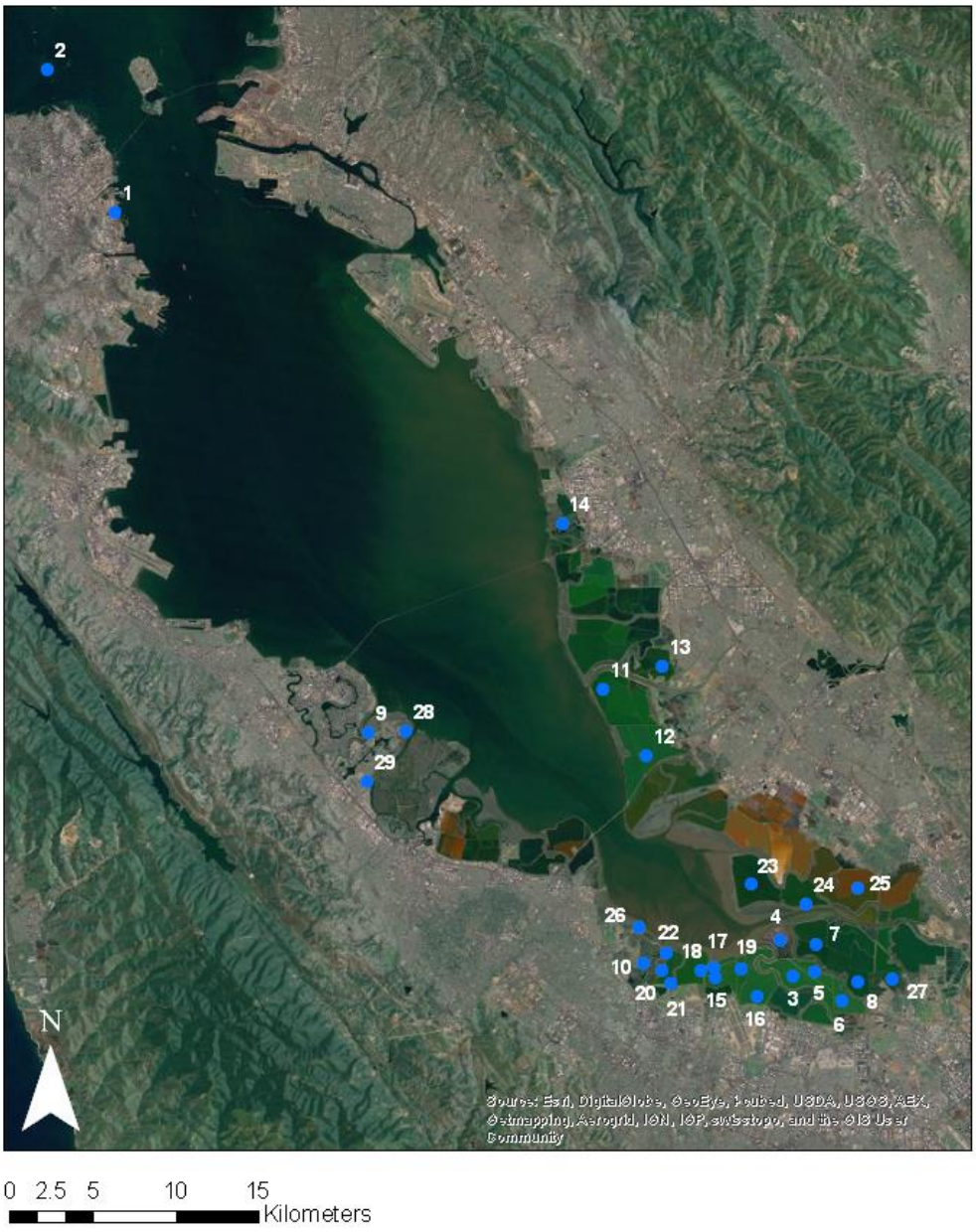


Figure 1. Locations of gull and tern colonies monitored in 2013 as part of SFBBO's citizen science-based Colonial Waterbird Program in the San Francisco Bay, CA. Labels correspond to the Map ID listed in Table 1.

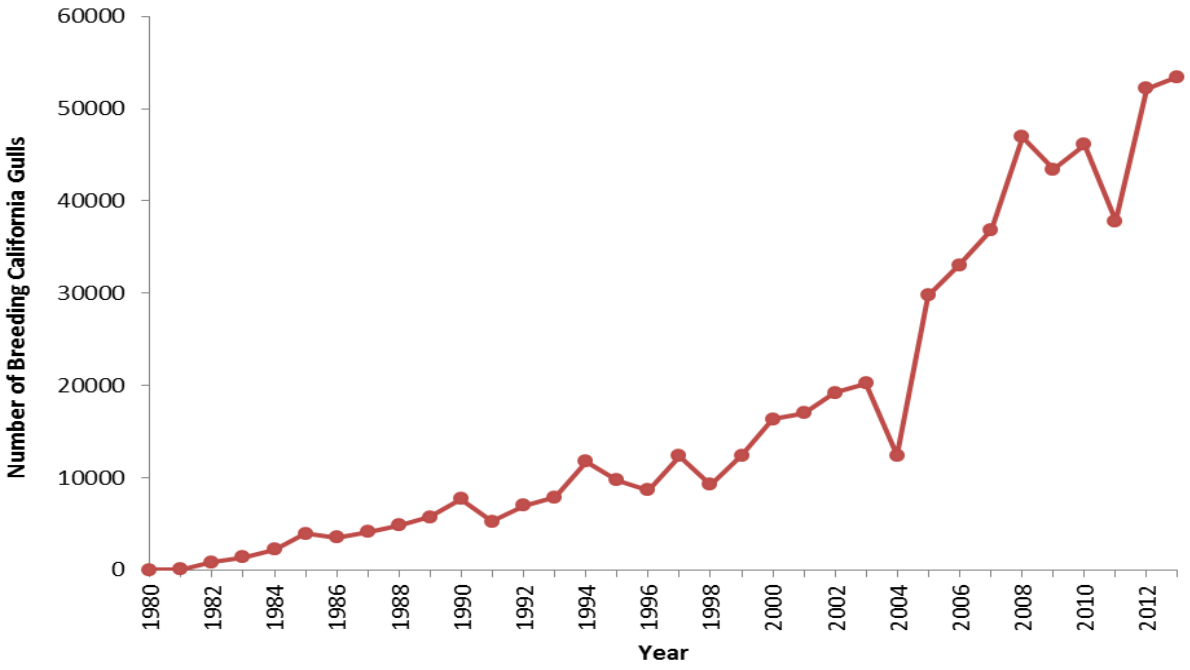


Figure 2. Estimated number of breeding California Gulls in the South San Francisco Bay, CA from 1980-2013.

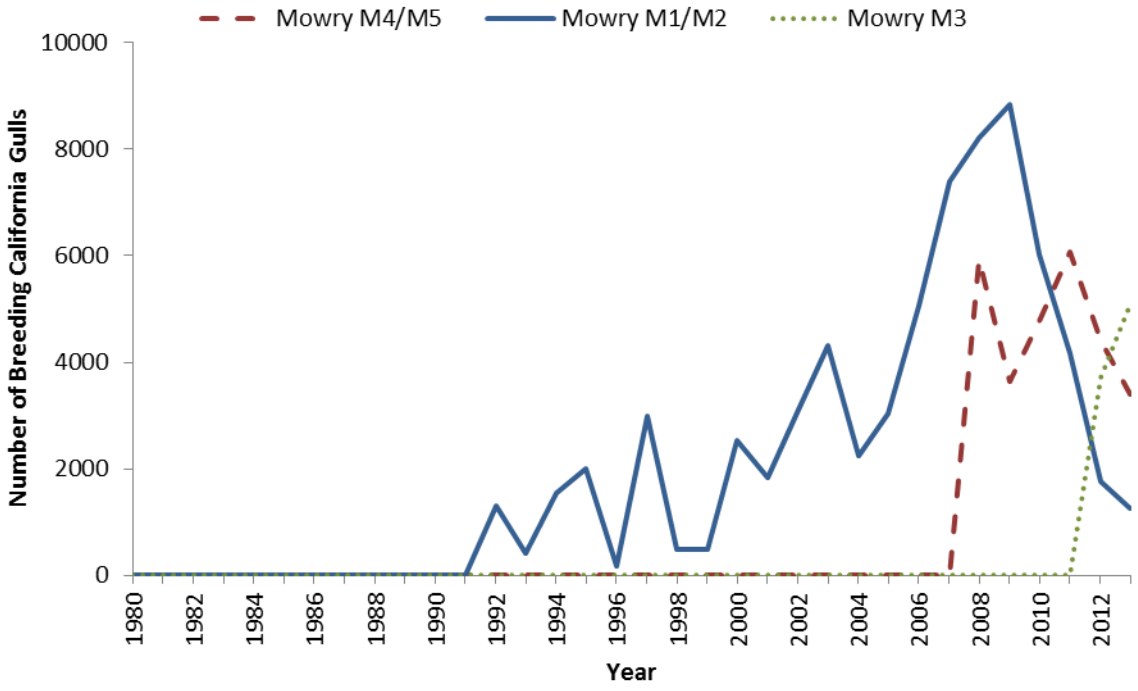


Figure 3. Estimated number of breeding California Gulls within the Mowry pond complex, South San Francisco Bay, CA from 1980-2013.

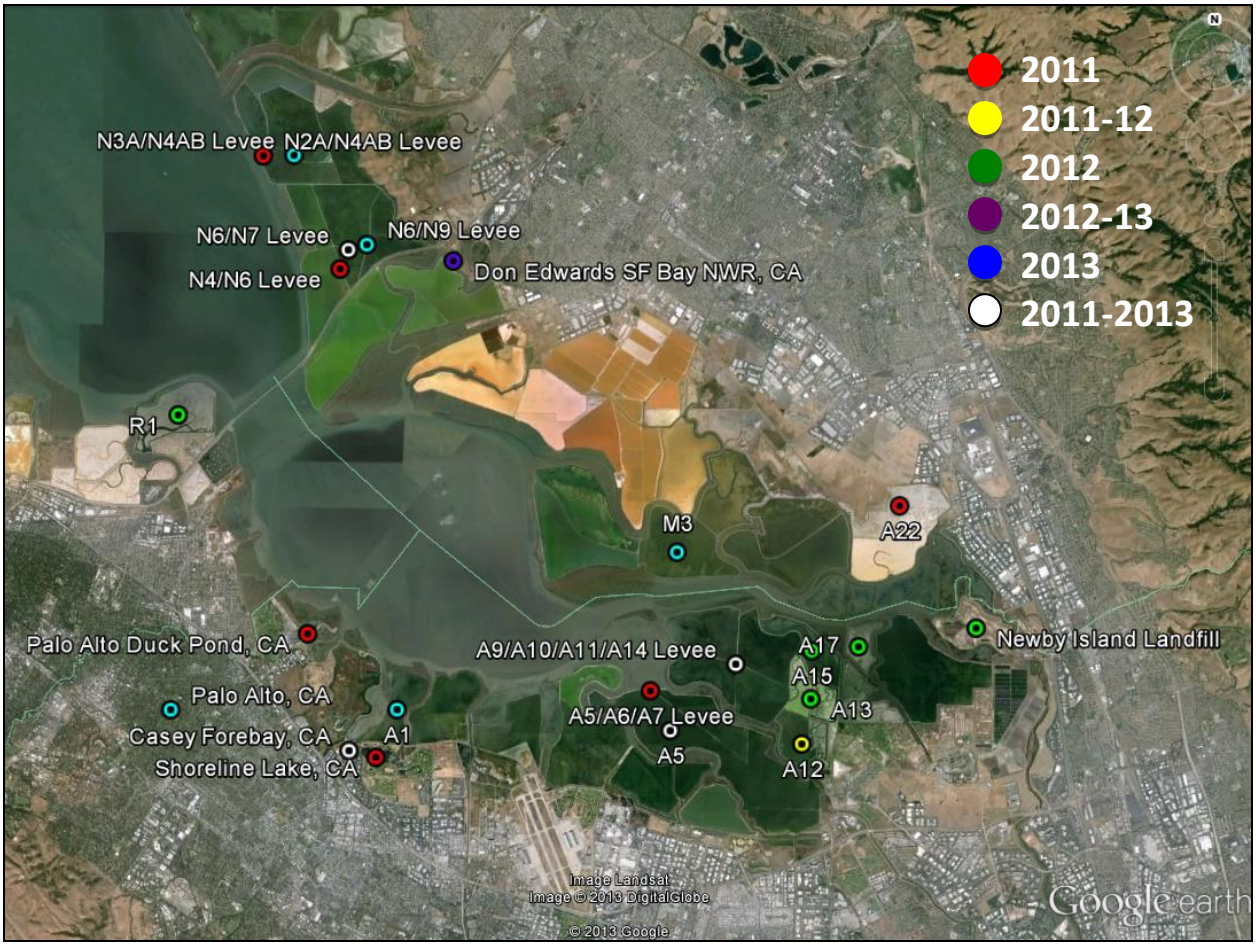


Figure 5. Locations of re-sighted California Gulls banded or observed breeding at Alviso salt pond A6 before its breach in December 2010 as part of the South Bay Salt Pond Restoration Project. Locations are categorized by year of re-sight from 2011 to 2013 in the South San Francisco Bay, CA.

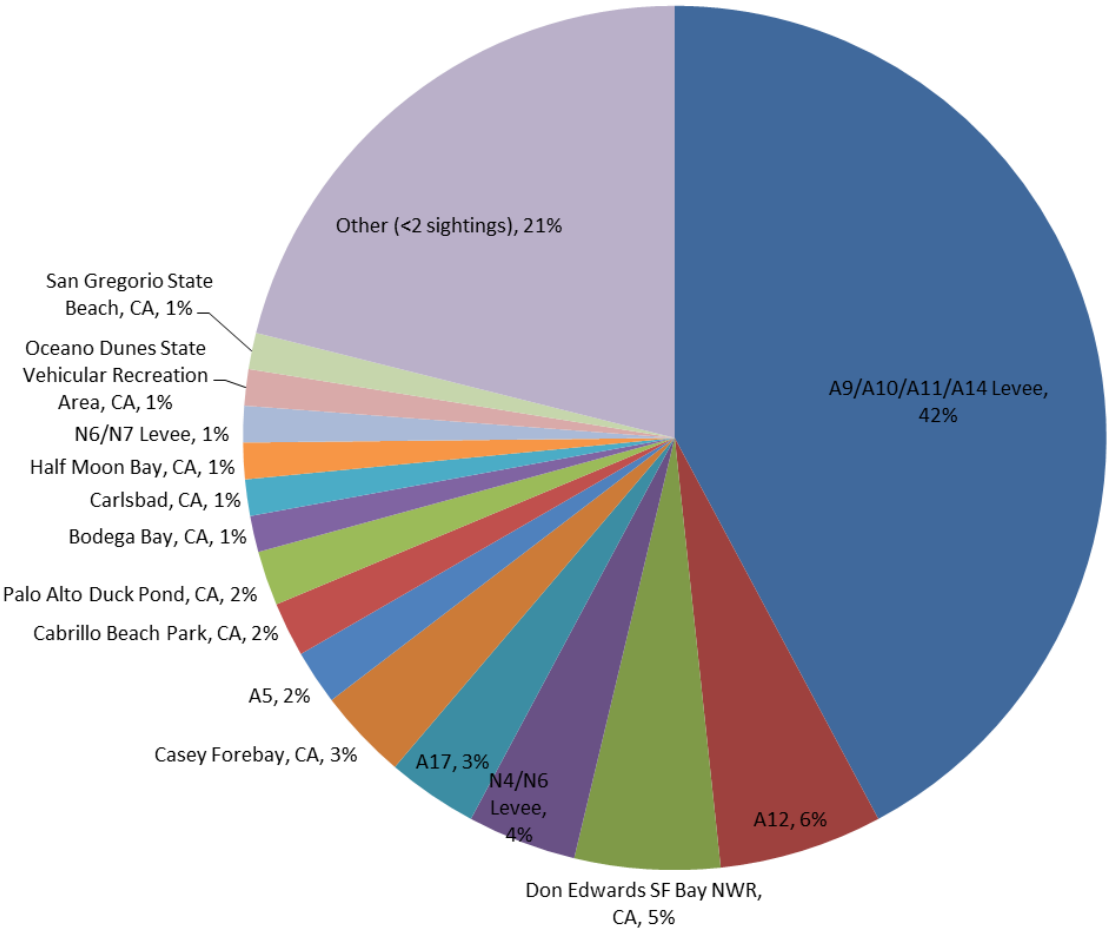


Figure 6. Percentages of re-sighted California Gulls that were previously banded or observed breeding at Alviso salt pond A6. Re-sightings are categorized by location in the San Francisco Bay, CA from 2011 to 2013.

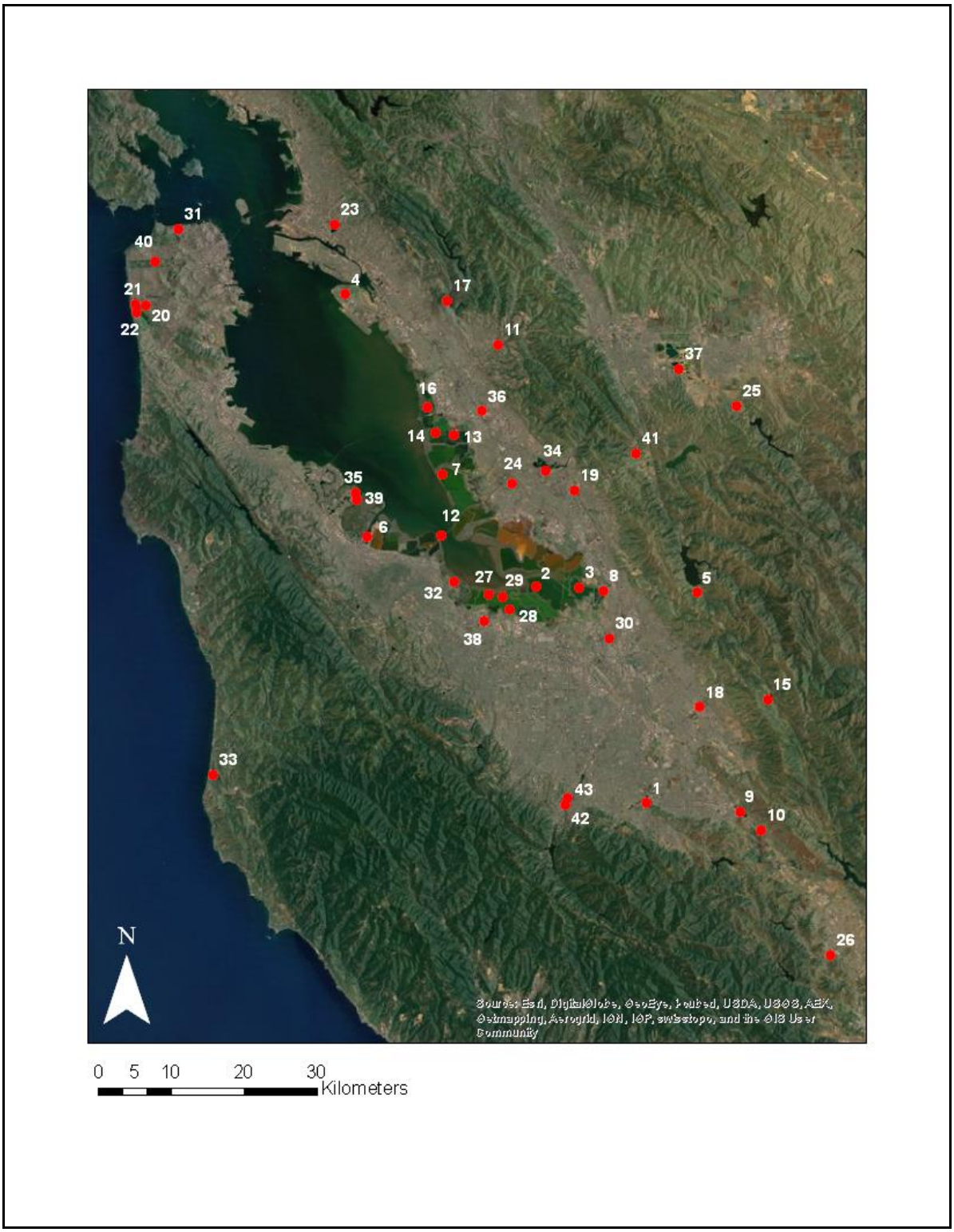


Figure 5. Locations of heron, egret and cormorant colonies monitored in 2013 as part of SFBBO's citizen science-based Colonial Waterbird Program in the San Francisco Bay, CA. Labels correspond to the Map ID listed in Table 3.

Appendix I. Colony Profile: Llagas Creek, Morgan Hill, CA

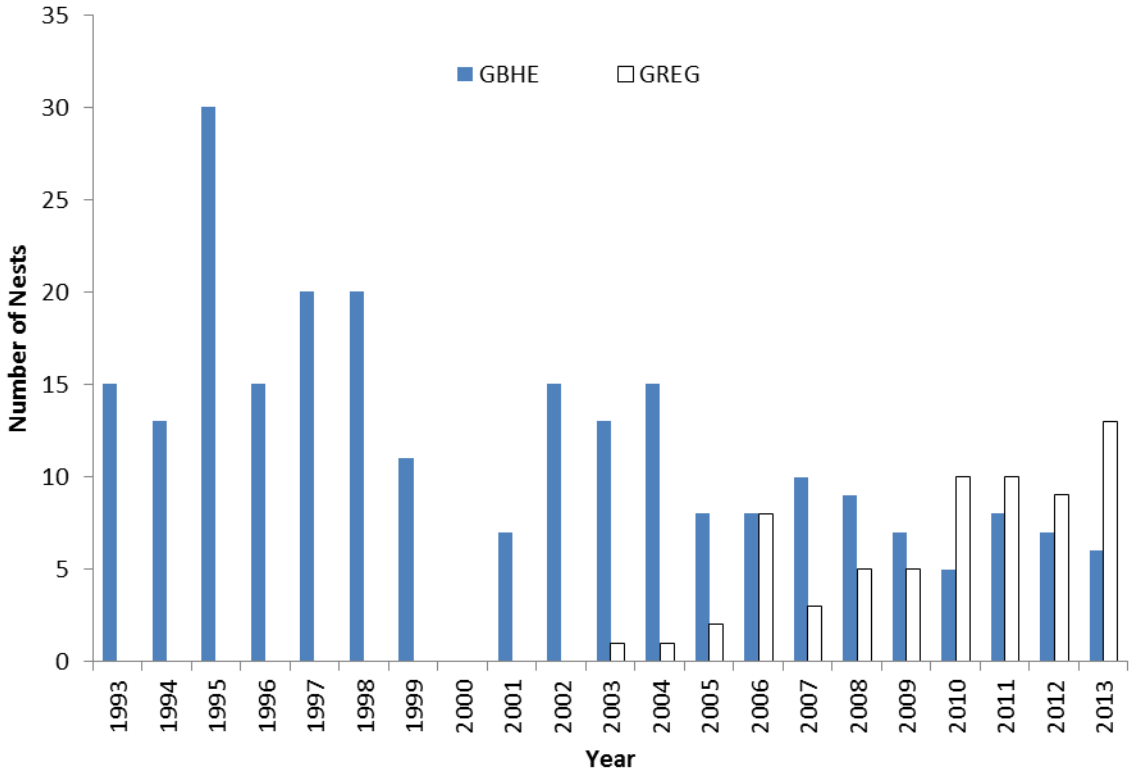
Species Monitored: Great Blue Herons and Great Egrets

Dates Monitored: 1993-2013

Site Description: The colony is in a large *Eucalyptus* tree near the intersection of Watsonville Road and Santa Theresa Ave in the city of Morgan Hill. The only water in the immediate vicinity is the small Llagas Creek. It is believed that this colony has been active since the 1970s.

Colony Coordinates: 37.090864 -121.644832

Conservation Concerns: In 2003, the development of a residential area began in the parcel of land directly adjacent to the Llagas Creek heronry. Construction activity continued in this area until this individual building's completion in 2006. The remaining complex homes continue to be developed.



Peak number of active nests observed for Great Blue Herons (GBHE) and Great egrets (GREG) at Llagas Creek, Morgan Hill, CA from 1993-2013.