



SAN FRANCISCO BAY
BIRD OBSERVATORY

Citizen Science-Based Colonial Waterbird Monitoring 2015 Nesting Summary



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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 (CWB) is one of SFBBO's long-standing citizen science programs, initiated in 1982 to monitor waterbird nesting colonies in the San Francisco Bay. The program has engaged over a hundred citizen scientists in waterbird nest-monitoring activities and introduced hundreds of local community members to the presence of these birds and their needs for protection and management. Trained citizen scientists independently collect observational data on nesting status, timing of breeding, waterbird behavior, and evidence of disturbance at selected colonies each year. Citizen scientists also assist SFBBO staff in conducting annual walkthrough counts of all known California Gull colonies in the South San Francisco Bay (South Bay), which enables comparison of colony size changes over time. This information is shared with landowners, resource agencies, and other conservation organizations and contributes to the conservation and management of these species. In addition to monitoring colonies, many citizen scientists in the program help SFBBO develop relationships with landowners and communities living near the colonies they study and lead presentations and bird viewings to share these birds with the public.

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, human encroachment and habitat degradation 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). SFBBO's colonial waterbird monitoring not only provides information on the health of Bay area 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. In addition, funding and personnel limitations may prohibit professional-level monitoring at the required scale. Citizen science initiatives are excellent methods for contributing to long-term, geographically expansive research goals at low cost (Dickinson et al. 2010; Cooper et al. 2014). Furthermore, citizen science studies provide opportunities for public involvement, which foster local stewardship and environmental appreciation.

Since 1982, SFBBO has annually recruited and trained citizen scientists to monitor nesting herons, egrets, cormorants, gulls, and terns in the San Francisco Bay as part of our CWB Program. The CWB emphasizes community engagement and citizen science in order to: 1) increase monitoring capacity across a large geographic area, and 2) generate public interest in protecting waterbirds and their habitats. Many of the colonies monitored by SFBBO citizen scientists would not otherwise be tracked.

In this report, we summarize results from SFBBO's CWB Program in 2015.

SURVEY METHODS

Study area

Our study area encompasses colonies within the counties of Santa Clara, San Mateo, Alameda, Contra Costa and San Joaquin (Figure 1-Figure 2). Colonies are located as far north as San Francisco, as far east as Brentwood, as far south as Coyote Valley and as far west as Pescadero (Figure 1, Figure 2). [The Audubon Canyon Ranch](#) manages a similar monitoring program for herons and egrets in the North and Central Bays and [Point Blue Conservation Science](#) manages a program in the San Joaquin Valley.

Waterbird colony monitoring

The observational study methods for waterbird colony monitoring have remained largely unchanged since the program's initiation in 1982. Our monitoring efforts are divided based on two guilds: 1) gulls, terns and shorebirds; 2) herons, egrets and cormorants. Our gull, tern and shorebird monitoring includes primarily colonies of California Gull (*Larus californicus*), Forster's Tern (*Sterna forsteri*) and Caspian Tern (*Hydroprogne caspia*), with secondary species, including American Avocet (*Recurvirostra americana*), Black-necked Stilt (*Himantopus mexicanus*), and Black Skimmer (*Rynchops niger*), when nesting with our primary species of interest. Our heron, egret and cormorant monitoring includes primarily colonies of Great Blue Heron (*Ardea herodias*), Great Egret (*A. alba*), Snowy Egret (*Egretta thula*), and Double-crested Cormorant (*Phalacrocorax auritus*). Additionally, we monitor Black-crowned Night Heron (*Nycticorax nycticorax*) and Green Heron (*Butorides virescens*) when nesting with these species. For a list of all species monitored and their 4-letter species code, please see Appendix I.

Each season, citizen scientists receive training in waterbird identification, natural history, proper "etiquette" around nesting birds, and observational study methods through a standardized protocol. Citizen scientists are assigned colonies based on a prioritization method developed by SFBBO staff. Priority for monitoring is based on the number of years the colony has been monitored, date of most recent nesting activity, accessibility and citizen scientist availability. Colonies are located on both public and private lands and are either detected opportunistically or visited with the existing knowledge of nesting activity.

Monitoring occurs from February to August and includes 6-8 survey dates per colony, depending on the species observed. Great Blue Heron colonies are monitored from early February to July, Double-crested Cormorant and egret colonies are monitored from early March to early August, and gull, tern and shorebird colonies are monitored from early May to early August. Our goal is to monitor once a month (first weekend) during the early and late nesting months and twice a month (first and third weekends) during the peak nesting months. During each monitoring session, citizen scientists use binoculars and spotting scopes to estimate the number of breeding adults, active nests and chicks. They also note nesting behaviors, such as incubation, nest-building and courtship displays, and any evidence of human disturbance or predation.

In addition to the above methods, SFBBO surveys California Gulls through a walkthrough method. Walkthrough surveys occur each year in early to mid-May, during the late incubation and early hatching period for the majority of the population. During surveys, teams of observers systematically walk through each colony and visually tally all active nests present. Empty and fully depredated nests are

excluded. To minimize the potential for opportunistic gull predation due to human disturbance, particular areas where conspecifics nest are avoided during walkthroughs. Active nest numbers are estimated from the closest possible vantage point within the colony. California Gull nest counts are multiplied by two birds per nest to produce an estimate of the adult breeding population.

In order to estimate the number of nests of Double-crested Cormorants that nest within California Gull colonies, we survey from kayaks adjacent to the colony. This is done in order to limit disturbance, prevent California Gull predation on nests, and to coincide with our walkthroughs. For this reason, these Double-crested Cormorants are only surveyed once in early May when SFBBO is also counting California Gull nests.

RESULTS AND DISCUSSION

Waterbird colonies (observational)

In 2015, SFBBO monitored a total of 62 waterbird colonies using observational methods (Table 1, Table 3). Some known colony sites were not surveyed due to access issues or observer availability. Sites that were monitored last season, but were not monitored this year include: Artesian Slough, Alviso A12, Eden Landing Turk, Mundy Marsh, Coyote Parkway Lakes, Palace of the Fine Arts, and Palo Alto Baylands Duck Pond. Sites that were not monitored last season, but were monitored this year include: Downtown Oakland (new colony location), Elmwood Correctional, Alviso A16 and Alviso A18. The Lakeshore Park and Redwood City Harbor colony sites were split into three subcolonies this season, in order to allow for full coverage of the nesting area.

Waterbirds nested in a variety of habitats, including islands within former salt ponds at Alviso A16, power towers along the Dumbarton Bridge, and eucalyptus trees within a residential neighborhood at Ruus Park. The number of nests at each colony site varied from 1 Great Blue Heron nest (Stow Lake) to over 100 nests (Lake Merced, Lakeshore Park, Steinberger Slough, Alviso A9/10/11/14 and New Chicago Marsh). Species composition at the colony sites monitored also varied considerably. The Lakeshore Park colony was the most species diverse, containing Great Blue Heron, Great Egret, Snowy Egret, and Black-crowned Night Heron nests all on a single island.

We monitored 15 gull, tern and shorebird colonies using observational methods (Table 1). Forster's Terns were the most abundant nesting species at the sites that we monitored. American Avocet nesting was most active at New Chicago Marsh and Hayward Shoreline. We observed only 1 active Black Skimmer nest at Redwood Shores, Nob Hill Market. Black-necked Stilts were most active at New Chicago Marsh. Caspian Terns nested on islands at Alviso A16 and at the Ravenswood complex of Don Edwards San Francisco Bay National Wildlife Refuge, which were not surveyed by SFBBO (Cheryl Strong, personal communication). These two colony sites were also part of a successful Caspian Tern social attraction study this season done by USGS and USFWS. The two previous Caspian Tern colony sites at Alviso A9/10/11/14 (75 nesting birds in 2014) and Coyote Hills N3A/4AB (25 nesting birds in 2014) were abandoned this season. The most active nesting sites for Forster's Terns were New Chicago Marsh, followed by Moffett A2W and Moffett B1.

We monitored 47 heron, egret and cormorant colonies using observational methods (Table 3). Double-Crested Cormorants were the most abundant nesting species at these sites. The largest cormorant colony monitored was at Alviso A9/10/11/14 with an estimated 343 nests, but this species also nested in

large numbers on the Dumbarton PG&E towers and Steinberger Slough. Great Blue Herons occupied two large colonies (20+ nests) at Lakeshore Park and Shadow Cliffs, with several smaller colonies throughout the region. We observed only two Green Heron nests at Lake Cunningham this season. We monitored 7 colonies that included Snowy Egret nests. Nesting for this species was most active at Lakeshore Park in Newark, but was also active at Ruus Park and Shorebird Way. We monitored 8 colonies that included Black-crowned Night Heron nests. The most active nesting area for this species was the three islands of Lakeshore Park, followed by Los Gatos Creek Park.

With the exception of California Gulls, the nesting sites monitored here **should not be viewed as a comprehensive list of all active waterbird colonies for these species in the region; nor should the peak nest numbers observed be used for Bay-wide 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 citizen scientists 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 CWB Program have their limitations, these data have many values, nonetheless. Due to the consistency of data collection over the course of the program, this dataset can be used to track colonies over time and provide local managers with information on the histories of particular colony sites. Additionally, this program provides essential data that serves as a valuable starting point for the development of more comprehensive regional efforts to track population sizes and trends on a larger scale. Additionally, some of SFBBO's CWB data were previously incorporated into a San Francisco Bay heron and egret atlas by Kelly et al. (2007). SFBBO has also partnered with the U.S. Fish and Wildlife Service in their effort to understand and manage the relationship between Double-crested Cormorants and special status fish species along the Pacific Flyway (Adkins et al. 2014).

In the future, we hope to 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, and athletic fields), and many waterbird nests are located on artificial structures, such as old hunting 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 features.

In addition, SFBBO has consistently monitored many sites for 20-30 years, 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 (Appendix II). While there are no direct observations of detrimental effects from construction activity on the active heron colony, we have documented changes in the size and species composition of the colony since the start of development in 2003. This may be related to natural species composition changes over time, or to other factors such as the differential tolerance of, response to, or habituation to disturbances by 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 maintaining valuable breeding locations throughout the San Francisco Bay.

California Gulls (walkthrough)

California Gulls are the most abundant nesting waterbird in the South San Francisco Bay and SFBBO has been monitoring the growth of the breeding population since 1980. In 2015, SFBBO monitored 9 California Gull colonies via walkthrough surveys from May 6-13 (Table 2). These 9 colonies encompass all known South Bay breeding locations of this species (Figure 1, Figure 3). California Gull colony sizes ranged from 142 breeding birds (Moffett B2) to 13,784 birds (Palo Alto Flood Control Basin). The Alviso A9/10/11/14 colony was nearly as large, with an estimated 13,204 individuals. The former colony site at Alviso A5/7 was not used for nesting this year (in 2014, 276 birds nested at this location). Several gulls initiated nests in April, but all were abandoned by early May, likely due to high water levels limiting access to dry nesting sites.

We estimated a total of 47,866 California Gulls breeding in the San Francisco Bay in 2015, a 10% decrease from the 53,026 estimated in 2014 (Table 2). Although we observed a decrease in gulls across all colonies combined, we observed fluctuations in the size of several individual colonies. The sharpest decline was observed at the Coyote Hills N2A/3A/4AB colony site (64% decline). The greatest increase was observed at the Mowry M4/5 colony (35% increase; Table 2). The fluctuation in size and location of active gull colonies over the study period is likely due to a suite of changing environmental and demographic factors (Table 2).

Alviso pond A6 formerly held an average of 76% of the breeding population of California Gulls in San Francisco Bay (Strong et al. 2004, Table 2). In December 2010, A6 was restored to tidal action as part of the South Bay Salt Pond Restoration Project. Gulls appear to have redistributed to several nearby colonies, particularly A9/10/11/14 and the Palo Alto Flood Control Basin (Figure 4). In 2008, a multi-year project was initiated by SFBBO and the U.S. Geological Survey to trap and band California Gulls nesting at pond A6. Banded California Gulls continue to be re-sighted during colony walkthroughs. In 2015, we re-sighted 51 banded gulls on our walkthrough counts. Forty-seven of these birds were banded at the A6 colony from 2008 – 2010, two were banded in the South Bay in 1986 and two were banded in 1985. 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 life span, dispersal, and the potential impact of encroachment into breeding areas for other sensitive species.

Given the size and geographic proximity South Bay gull colonies to other sensitive species' nesting habitats, there is an urgent need to protect rare species, such as the Western Snowy Plover, against potential gull impacts. In response, SFBBO and the U.S. Fish and Wildlife Service pursued selective, nonlethal gull hazing during the gull nest initiation stage from 2011-2015. Gulls have been successfully deterred from nesting in designated ecologically sensitive areas. SFBBO's Snowy Plover Program deployed nest cameras at Western Snowy Plover several nests in 2015 and observed no California Gulls depredating nests: only Common Raven and Peregrine Falcon were observed (Karine Tokatlian, personal communication). Ongoing monitoring, hazing and evaluation of other actions will be required over the long-term to limit gull impacts to sensitive species.

RESEARCH AND MANAGEMENT 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 for those with 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 remains largely unknown what factors, or interactions of factors, are influencing the rapid population growth of California Gulls in San Francisco Bay. No systematic study of California Gull reproductive success has been conducted – as a result, **we recommend a comprehensive study of California Gull demographics in San Francisco Bay**. 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.
3. There were no known instances of California Gulls successfully nesting in new sensitive habitats in 2015. 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 2014 followed those of Robinson-Nilsen and Demers 2012). In the future, without these activities, gulls may colonize nesting habitats preferred by Western Snowy Plovers or other sensitive waterbird species, such as the newly-created islands at Alviso pond A16. Therefore, **we recommend the continuation of this hazing regime in 2016**.
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 progresses 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.

COMMUNITY OUTREACH THROUGH CITIZEN SCIENCE

Since the establishment of SFBBO's CWB Program in the early 1980s, hundreds of citizen scientists have helped carry out this research to help us better understand how birds in the Bay Area are doing. Each nesting season, around 50 new and veteran citizen scientists receive the CWB Volunteer Manual and then attend a special training and orientation with SFBBO staff. At this meeting, staff give citizen scientists an overview of SFBBO and the CWB Program, highlight the results from the previous season's efforts, go over monitoring protocols, answer questions, lead the group through a troubleshooting discussion to address common issues in the field, invite veteran citizen scientists to share their experiences, and connect citizen scientists with one another. Then, the citizen scientists spend one or two mornings each month (from February through August) monitoring their colony.

Citizen scientists observe breeding activity; count birds, nests, and chicks; and record environmental conditions and human impacts. The commitment of this strong network of citizen scientists has produced a valuable, long-term dataset that helps land managers, organizations, and the public make informed decisions to conserve birds. In addition to providing valuable scientific data, SFBBO's CWB Program is one of the strongest parts of SFBBO's Outreach Program. By engaging people from the community in avian research, we build their awareness about birds and conservation and nurture their understanding of and appreciation for science. In turn, our citizen scientists carry their experiences and passion for birds, conservation, and science into the wider community.

Several years ago, we channeled our citizen scientists' expression of passion and experience into new avenues of action by adding several initiatives to the CWB. These new components augment the ways citizen scientists in the program support each other, grow our scientific reach, educate the community, and impact bird conservation. These changes came about in response to ideas from some of our most active citizen scientists and from feedback that we collected from the group through a survey in late 2013. We are excited about the direction our citizen scientists are helping SFBBO take the CWB Program and are very grateful for their energy and dedication. Each of these new components is described briefly below.

In 2015, 67 SFBBO citizen scientists contributed 751 volunteer hours to the CWB Program. This includes office work, colony monitoring, and California Gull walkthrough counts. If valued at a rate of \$15 per hour, this amounts to \$11,266.50 in donated labor. Many CWB citizen scientists are long-term participants and supporters, highlighting the interest in and value of this citizen science program.

Mentoring

To give new citizen scientists an opportunity to learn from our veterans, we launched a Mentoring Program. In 2015, 8 veteran citizen scientists served as mentors in the field and helped a number of our new recruits learn the monitoring protocol.

Scouting

Several citizen scientists took on an additional role in scouting this year. Scouting is a less directed survey method where citizen scientists visit either previously un-surveyed potential nesting sites or previously surveyed abandoned colony sites. This allows our staff to reduce their time commitments and also allows the program to grow through the discovery of new colony sites. This year, three citizen scientists scouted potential sites in addition to their normal monitoring activities.

Data Entry

In 2015, two citizen scientists in the CWB Program assisted with data entry from our datasheets into our Microsoft Access database. This helped SFBBO biologists save time and gave citizen scientists a chance to work with the data they helped collect in the field.

High School Outreach

In 2015, a high school group from Cupertino's Homestead High again monitored a colony of Great Blue Herons in Los Gatos.

Ambassador Program

In 2015, citizen scientists in our CWB participated as ambassadors in the following SFBBO activities:

1. *Community Partnerships*: Our CWB citizen scientists helped SFBBO share our data in 2015 with more land managers and others working to conserve Bay Area birds. In addition to writing this Annual Report, throughout the season SFBBO staff wrote and shared several mini-reports (see example in Appendix II) on specific colonies in response to requests from landowners and community members; including Santa Clara Valley Audubon Society, Golden Gate Audubon Society, Sequoia Audubon Society, Lake Cunningham Regional Park, and the Rotary Nature Center and Lake Merritt Wildlife Refuge. These requests for information grew from relationships that were developed and nurtured by our citizen scientists as they worked in the field, and with their help, we plan to build on this process and provide more site-specific information for people in the community in 2016.

2. *Birds in Your Neighborhood Events*: In 2015, SFBBO staff and CWB citizen scientists also engaged the public through 13 (up from five in 2014) free "Birds in Your Neighborhood" Events in the following cities: Alameda, Alviso, Campbell, Fremont (2), Los Gatos, Livermore, Mountain View, Newark, Pleasanton, Redwood City, San Francisco, and San Jose.

3. *Special Events*: In addition to creating new outreach opportunities built around the Colonial Waterbird colonies, SFBBO also engaged CWB citizen scientists in other SFBBO outreach efforts, including five SFBBO Family Science Night and Women in Science events, and participation in various community events, including CuriOdyssey's Lift Off Festival, the East Bay Regional Park District's Butterfly and Bird Festival, Santa Clara Valley Audubon Society's Wingding Family Bird Fest and Wildlife Education Day, and the AAAS National Conference Family Science Days.

4. *Fundraising*: A number of participants in our CWB also helped us conduct fundraising in 2015 to benefit the program in 2015. One citizen scientist organized our monthly membership renewal mailings, and others took leadership roles in our California Fall Challenge by serving as judges for our Click Off photo contest, leading guided birding trips, donating silent auction prizes, and organizing fundraising teams.

From collecting data and strengthening the field training program to educating the public and raising funds, these citizen scientists continue to be an invaluable asset that allows SFBBO to achieve our mission to conserve birds and their habitats through science and outreach.

NEXT STEPS

Moving forward, we aim to continue utilizing the unique values of this citizen science program. We envision the future of the CWB to have a predominantly outreach/educational objective while maintaining a strong 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. As in 2015, next year we will continue to expand the community outreach component of our CWB, using the activity of colony monitoring as a vehicle for providing beneficial outreach and educational opportunities, thereby strengthening community connections to local wildlife and habitats.

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Table 1. Nests observed within gull, tern and shorebird nesting colonies in 2015; San Francisco Bay, CA. Nest counts represent the peak number of active nests observed for each species and colony in 2015. The observational method indicates that nests were counted from an area adjacent to the colony via binoculars or spotting scope. The walkthrough method indicates that the nests were counted while walking through the colony. DESFBNWR = Don Edwards San Francisco Bay National Wildlife Refuge, EBRPD = East Bay Regional Park District.

Colony Name	Landowner	AMAV	BLSK	BNST	CAGU	CATE	FOTE	LETE	Method	Map ID
Agua Vista	Port of San Francisco	0	0	0	0	0	0	0	observational	1
Alviso A16	DESFBNWR	1	0	0	0	17	0	0	observational	<i>n/a</i>
Alviso A5/A6/A7/A8	DESFBNWR	0	0	0	0	0	0	0	observational	145
Alviso A9/A10/A11/A14	DESFBNWR	0	0	0	6602	0	0	0	walkthrough	146
Belmont Slough	Other	0	0	0	0	0	11	0	observational	14
Charleston Slough	City of Mountain View	0	0	0	0	0	7	0	observational	136
Coyote Hills N3A/4AB	DESFBNWR	0	0	0	1075	0	0	0	walkthrough	18
Coyote Hills N6/7	DESFBNWR	0	0	0	4148	0	0	0	walkthrough	147
Hayward Shoreline	EBRPD	21	0	4	0	0	0	0	observational	33
Moffett A2E	DESFBNWR	0	0	0	0	0	0	0	observational	104
Moffett A2W	DESFBNWR	5	0	2	0	0	58	0	observational	46
Moffett A3N	DESFBNWR	0	0	0	0	0	0	0	observational	103
Moffett A3W	DESFBNWR	0	0	0	0	0	0	0	observational	148
Moffett B1	DESFBNWR	2	0	0	0	0	30	0	observational	149
Moffett B2	DESFBNWR	2	0	0	71	0	7	0	observational (AMAV, FOTE), walkthrough (CAGU)	150
Mountain View A1	DESFBNWR	0	0	0	202	0	0	0	walkthrough	50
New Chicago Marsh	DESFBNWR	46	0	33	0	0	238	0	observational	56
Mowry M1/2	DESFBNWR	0	0	0	893	0	0	0	walkthrough	54
Mowry M3	DESFBNWR	0	0	0	1607	0	0	0	walkthrough	151
Mowry M4/5	DESFBNWR	0	0	0	2443	0	0	0	walkthrough	53

Table 1. Nests observed within gull, tern and shorebird nesting colonies in 2015; San Francisco Bay, CA. Nest counts represent the peak number of active nests observed for each species and colony in 2015. The observational method indicates that nests were counted from an area adjacent to the colony via binoculars or spotting scope. The walkthrough method indicates that the nests were counted while walking through the colony. DESFBNWR = Don Edwards San Francisco Bay National Wildlife Refuge, EBRPD = East Bay Regional Park District.

Colony Name	Landowner	AMAV	BLSK	BNST	CAGU	CATE	FOTE	LETE	Method	Map ID
Palo Alto Flood Control Basin	City of Mountain View	0	0	0	6892	0	0	0	walkthrough	51
Redwood Shores	Other	0	0	2	0	0	17	0	observational	152
Redwood Shores, Nob Hill Market	Other	3	1	3	0	0	0	0	observational	142
TOTAL		80	1	44	23933	17	368	0		

Table 2. Number of breeding adult California Gulls by colony in the South San Francisco Bay from 1980-2015. Estimates were generated by doubling nest counts obtained from walkthrough surveys in late spring, except where otherwise noted. In 2004, several colonies were counted from a single flight over the area and are likely conservative. Dashes (-) indicate that colonies were not surveyed.

Year	Alviso A6	Newark	Alviso A9/10/11/14	Moffett A1	Mowry M4/M5	Mowry M1/M2	Mowry M3	Moffett B2	Coyote Hills N3A/N4AB	Coyote Hills N6/N7	Palo Alto Flood Control Basin	Alviso A5/A7	A3W Boardwalk	South Bay Total
1980	24	-	-	0	-	-	-	0	0	-	-	-	-	24
1981	60	-	-	0	-	-	-	0	0	-	-	-	-	60
1982	412	-	434	0	-	0	-	0	0	-	-	-	-	846
1983	1342	46	-	0	-	0	-	0	0	-	-	-	-	1388
1984	2000	44	150	0	-	0	-	0	0	-	-	-	-	2194
1985	3000	554	374	0	-	0	-	0	0	-	-	-	-	3928
1986	3000	398	97	0	-	0	-	0	0	-	-	-	-	3495
1987	4000	22	100	0	-	0	-	0	0	-	-	-	-	4122
1988	4600	30	180	0	-	0	-	0	0	-	-	-	-	4810
1989	5310	0	434	0	-	0	-	0	0	-	-	-	-	5744
1990	7600	0	122	2	-	0	-	0	0	-	-	-	-	7724
1991	5250	0	0	0	-	0	-	0	0	-	-	-	-	5250
1992	5500	0	200	0	-	1294	-	0	0	-	-	-	-	6994
1993	6912	0	234	200	-	415	-	82	0	-	-	-	-	7843
1994	9000	0	300	350	-	1540	-	556	0	-	-	-	-	11746
1995	7236	0	4	74	-	2009	-	300	0	-	-	-	-	9623
1996	6558	0	1410	0	-	174	-	282	0	-	-	-	-	8424
1997	6256	0	1722	164	-	3000	-	1000	0	-	-	-	-	12142
1998	6562	0	1628	0	-	480	-	400	0	-	-	-	-	9070
1999	9380	0	2117	145	-	475	-	248	0	-	-	-	-	12365
2000	11482	0	1986	0	-	2526	-	254	0	-	-	-	-	16248

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Year	Alviso A6	Newark	Alviso A9/10/11/14	Moffett A1	Mowry M4/M5	Mowry M1/M2	Mowry M3	Moffett B2	Coyote Hills N3A/N4AB	Coyote Hills N6/N7	Palo Alto Flood Control Basin	Alviso A5/A7	A3W Boardwalk	South Bay Total
2001	11216	0	3056	278	-	1824	-	624	0	-	-	-	-	16998
2002	11302	0	3590	510	-	3120	-	712	0	-	-	-	-	19234
2003	13644	0	1010	862	-	4310	-	384	0	-	-	-	-	20210
2004	8600	0	1047	321	-	2233	-	219	0	-	0	-	-	12420
2005	18418	-	426	1664	-	3044	-	830	5370	-	-	-	-	29752
2006	19456	0	234	380	-	5068	-	374	7442	-	-	84	-	33038
2007	24696	-	0	92	-	7384	-	-	4384	-	206	-	-	36762
2008	26366	-	0	616	5934	8224	-	-	4952	-	690	30	-	46812
2009	24190	0	0	446	3640	8842	-	8	4944	-	1164	110	-	43344
2010	23108	0	0	428	4780	6020	-	20	6594	2506	1704	890	-	46050
2011	0	0	11956	390	6068	4164	-	112	6394	4110	4478	156	2	37830
2012	0	0	18328	422	4414	1770	3700	122	7248	6738	9200	230	0	52172
2013	0	-	15900	278	3408	1260	5078	120	6256	6914	14014	238	0	53466
2014	0	-	14414	404	3616	1314	4878	82	5914	7864	14264	276	0	53026
2015	0	-	13204	404	4886	1786	3214	142	2150	8296	13784	0	0	47866

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

Table 3. Nests observed within heron, egret and cormorant nesting colonies in 2015; San Francisco Bay, CA. Nest counts represent the peak number of active nests observed for each species and colony in 2015. The observational method indicates that nests were counted from an area adjacent to the colony via binoculars or spotting scope. Asterisks (*) indicate that the colonies were only surveyed once during California Gull walkthrough counts in early May and may not reflect the peak nesting for this species. DESFBNWR = Don Edwards San Francisco Bay National Wildlife Refuge, EBRPD = East Bay Regional Park District, SFPUC = San Francisco Public Utilities Commission.

Colony Name	Landowner	DCCO	GBHE	GREG	GRHE	SNEG	BCNH	Method	Map ID
Almaden Lake	City of San Jose	0	0	7	0	10	4	observational	4
Alviso A18	City of San Jose	15	0	0	0	0	0	observational	n/a
Alviso A9/A10/A11/A14	DESFBNWR	343*	0	0	0	0	0	observational	146
Bacon Island	Other	5	15	0	0	0	0	observational	144
Bay Farm Island, Alameda	Other	0	0	17	0	13	0	observational	13
Coyote Hills 2A/3A/4A levees	DESFBNWR	46*	0	0	0	0	0	observational	18
Coyote Ranch Rd Colony	Santa Clara County	0	3	0	0	0	0	observational	130
Don Castro	EBRPD	0	7	0	0	0	0	observational	21
Downtown Oakland	City of Oakland	0	0	0	0	5	30	observational	n/a
Dumbarton PG&E Towers	Other	101	0	0	0	0	0	observational	88
Eden Landing E6B	CDFW	0	8	0	0	0	0	observational	25
Elmwood Correctional	Santa Clara County	0	0	26	0	26	15	observational	n/a
Grant Lake	Santa Clara County	0	2	0	0	0	0	observational	30
Lake Chabot	EBRPD	0	0	0	0	0	0	observational	34
Lake Cunningham	City of San Jose	0	0	0	2	0	2	observational	35
Lake Elizabeth	City of Fremont	0	0	0	0	0	0	observational	37
Lake Merced Boat Docks	SF Recreation & Parks	0	1	0	0	0	0	observational	143
Lake Merced Mesa	SF Recreation & Parks	105	8	0	0	0	0	observational	39
Lake Merced North	SF Recreation & Parks	23	0	0	0	0	0	observational	38
Lake Merced South	SF Recreation & Parks	18	0	0	0	0	0	observational	40
Lake Merritt	City of Oakland	78	0	0	0	0	0	observational	41
Lakeshore Park (Channel Isl)	Other	0	21	20	0	17	2	observational	42
Lakeshore Park (Ramsgate Isl)	Other	0	0	2	0	24	19	observational	42
Lakeshore Park (Salisbury Isl)	Other	0	0	0	0	23	27	observational	42

Table 3. Nests observed within heron, egret and cormorant nesting colonies in 2015; San Francisco Bay, CA. Nest counts represent the peak number of active nests observed for each species and colony in 2015. The observational method indicates that nests were counted from an area adjacent to the colony via binoculars or spotting scope. Asterisks (*) indicate that the colonies were only surveyed once during California Gull walkthrough counts in early May and may not reflect the peak nesting for this species. DESFBNWR = Don Edwards San Francisco Bay National Wildlife Refuge, EBRPD = East Bay Regional Park District, SFPUC = San Francisco Public Utilities Commission.

Colony Name	Landowner	DCCO	GBHE	GREG	GRHE	SNEG	BCNH	Method	Map ID
Livermore VA Park & Hospital	Other	0	7	0	0	0	0	observational	44
Llagas Creek, Morgan Hill	Other	0	4	15	0	0	0	observational	45
Los Gatos Creek Park	Other	0	0	0	0	1	13	observational	102
Moffett A2E	DESFBNWR	0	0	0	0	0	0	observational	104
Moffett A2W	DESFBNWR	35	0	0	0	0	0	observational	46
Moffett A3N	DESFBNWR	0	0	0	0	0	0	observational	103
Moffett A3W	DESFBNWR	12	0	0	0	0	0	observational	148
Moffett B1	DESFBNWR	0	0	0	0	0	0	observational	149
Moffett B2	DESFBNWR	16	0	0	0	0	0	observational	150
Ovation Court	City of San Jose	0	28	0	0	0	0	observational	57
Pescadero Marsh	Pescadero State Beach	4	12	0	0	0	0	observational	113
Purissima Canyon	Other	0	0	0	0	0	0	observational	n/a
Redwood City Harbor (E)	Other	0	0	0	0	0	0	observational	140
Redwood City Harbor (NW)	Other	0	0	1	0	1	5	observational	140
Redwood City Harbor (SW)	Other	0	0	0	0	0	1	observational	140
Redwood Shores	Other	0	0	0	0	0	0	observational	152
Ruus Park	Other	0	0	27	0	30	0	observational	63
Shadow Cliffs	EBRPD	28	13	5	0	0	0	observational	64
Shorebird Way	Other	0	0	17	0	16	1	observational	65
Steinberger Slough	DESFBNWR	95	5	0	0	0	0	observational	66
Stow Lake	SF Recreation & Parks	0	2	0	0	0	0	observational	67
Sunol Water Temple	SFPUC	0	17	0	0	0	0	observational	129
Vasona County Park SW	Santa Clara County	0	5	2	0	0	0	observational	68
TOTAL		924	168	139	2	166	119		



Figure 1. Locations of gull, tern and shorebird colonies monitored as part of SFBBO's Colonial Waterbird Program, San Francisco Bay, CA. Labels correspond to the Map ID listed in Table 1 and Table 3.

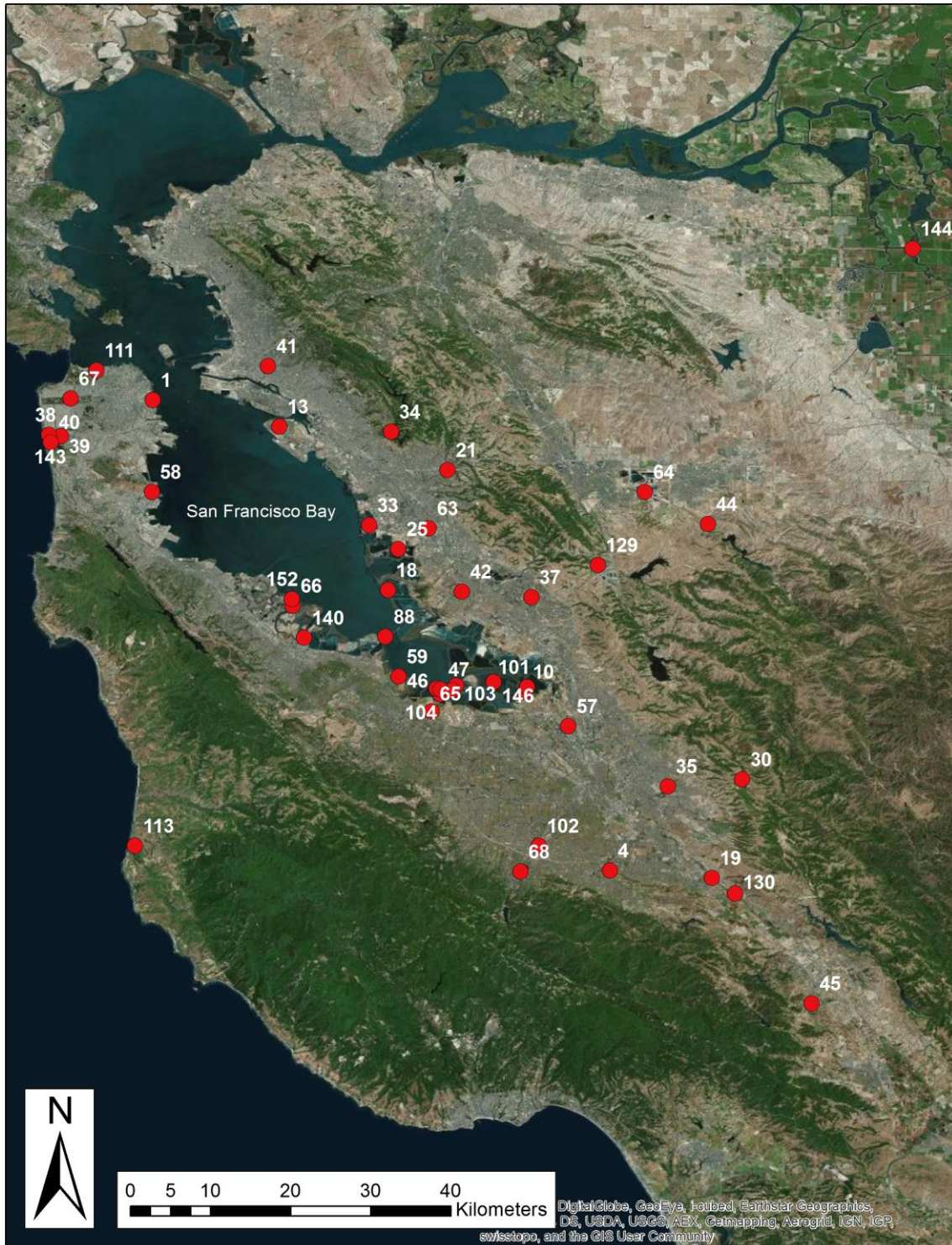


Figure 2. Locations of heron, egret and cormorant colonies monitored as part of SFBBO's Colonial Waterbird Program, San Francisco Bay, CA. Labels correspond to the Map ID listed in Table 1 and Table 3.

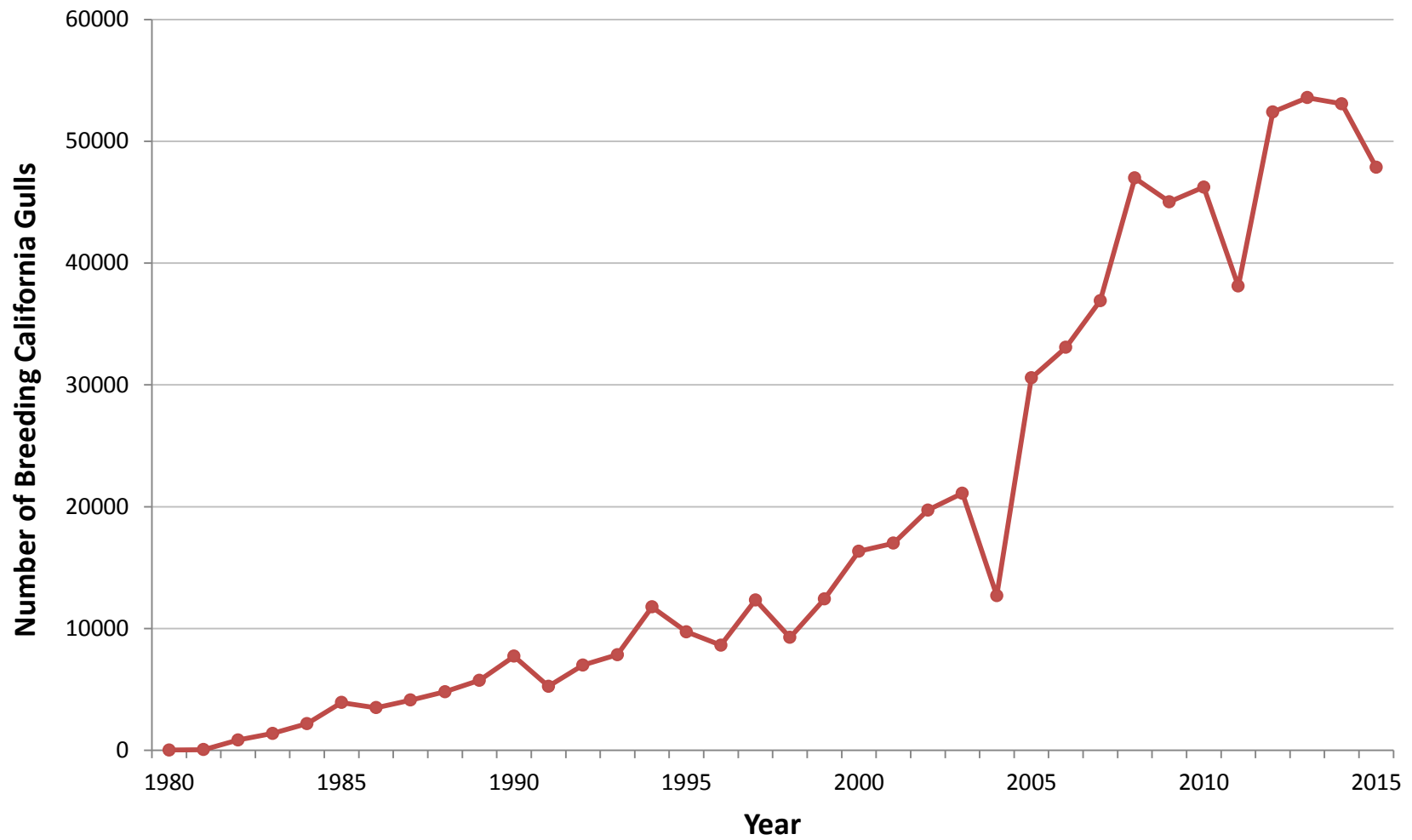


Figure 3. Estimated number of breeding California Gulls in the South San Francisco Bay, CA from 1980-2015.

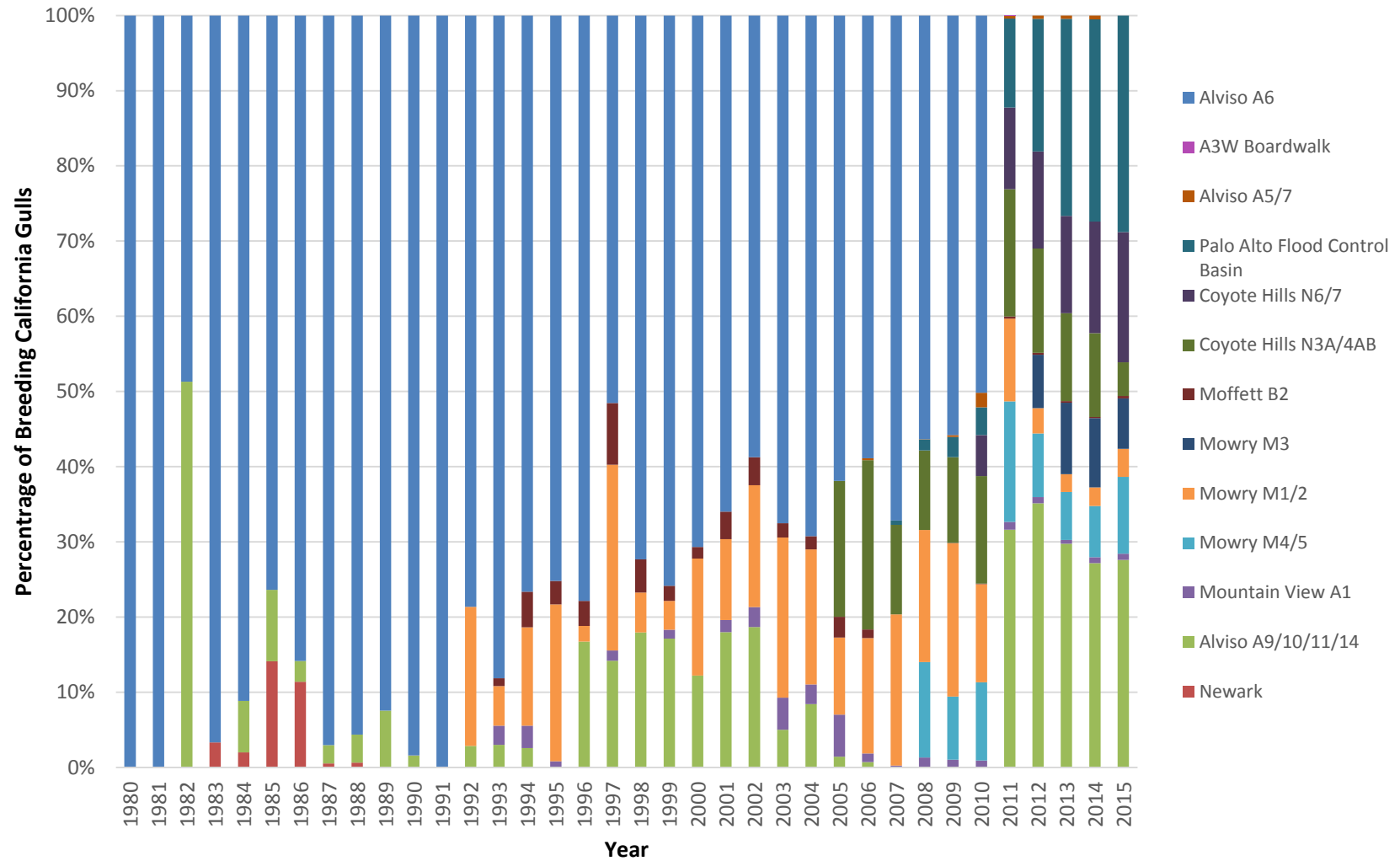


Figure 4. Percentage of breeding California Gulls within each colony site, 1980-2015, South San Francisco Bay, CA.

APPENDICES

Appendix I. Species Code, common name and scientific name for all species monitored.

Species Code	Common Name	Scientific Name
AMAV	American Avocet	<i>Recurvirostra americana</i>
BLSK	Black Skimmer	<i>Rhynchops niger</i>
BCNH	Black-crowned Night-Heron	<i>Nycticorax nycticorax</i>
BNST	Black-necked Stilt	<i>Himantopus mexicanus</i>
CAGU	California Gull	<i>Larus californicus</i>
CATE	Caspian Tern	<i>Sterna caspia</i>
FOTE	Forster's Tern	<i>Sterna forsteri</i>
GBHE	Great Blue Heron	<i>Ardea herodias</i>
GREG	Great Egret	<i>Ardea alba</i>
GRHE	Green Heron	<i>Butorides virescens</i>
LETE	Least Tern	<i>Sterna antillarum browni</i>
SNEG	Snowy Egret	<i>Egretta thula</i>
WEGU	Western Gull	<i>Larus occidentalis</i>

Appendix II. Colony Report example: Llagas Creek, Morgan Hill

Species Monitored: Great Blue Heron, Great Egret

Years Monitored: 1993-2015

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, CA. 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 Heron and Great Egret at Llagas Creek, Morgan Hill, CA from 1993-2015

