



SAN FRANCISCO BAY  
BIRD OBSERVATORY

## Citizen Science-Based Colonial Waterbird Monitoring 2018 Nesting Summary



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## Table of Contents

PROGRAM SUMMARY.....	2
INTRODUCTION.....	2
SURVEY METHODS.....	3
Study area.....	3
Waterbird colony monitoring.....	3
RESULTS AND DISCUSSION.....	4
Waterbird colonies (observational).....	4
California Gulls (walkthrough).....	6
RESEARCH AND MANAGEMENT RECOMMENDATIONS.....	7
COMMUNITY OUTREACH THROUGH CITIZEN SCIENCE.....	8
Mentoring and Scouting.....	8
Online Training.....	9
Ambassador Program.....	9
NEXT STEPS.....	9
ACKNOWLEDGEMENTS.....	10
LITERATURE CITED.....	11
Tables.....	13
Figures.....	18
APPENDICES.....	21
Appendix I. Species Code, common name and scientific name for all species monitored. ....	21
Appendix II. Colony Report example: Llagas Creek, Morgan Hill.....	22

## **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 hundreds of citizen scientists in waterbird nest-monitoring activities and introduced thousands 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 sizes and locations 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 2018.

## **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). 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). 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 March 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 biologists and citizen science volunteers survey 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 from the tally. To minimize the potential for opportunistic gull predation on nearby nesting species due to human disturbance, particular areas where sensitive species 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)**

SFBBO monitored a total of 62 potential heron, egret, cormorant (HEP) and gull and tern (GUTE) colonies across 52 sites, 52 of which became active breeding colonies in 2018 (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 comprise: Belmont Slough, Eden Landing E6B, Moffett AB1, Moffett A3W, Lake Merced Boat Docks, and Bacon Island. Sites that were not monitored last season, but were monitored this year comprise: Sandy Wool Lake and Ravenswood.

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 one American Avocet nest (Moffett AB2) to over 100 nests (e.g. Downtown Oakland, Dumbarton Bridge PG&E Towers, Hayward Shoreline, and Steinberger Slough). Species composition at the colony sites monitored also varied considerably. In 2018, both Almaden Lake and Redwood Shores Parkway (Nob Hill Market) had four species actively nesting. Almaden Lake had Great Egrets, Black-crowned Night Herons, Great Blue Herons, and Snowy Egrets. Redwood Shores Parkway (Nob Hill Market) had Forster's Terns, American Avocets, Black-necked Stilts, and Black Skimmers.

We monitored 17 sites with active gull, tern and shorebird colonies (Table 1). Of the species that we monitored using observational methods (i.e. excluding California Gulls), 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, Redwood Shores Parkway, and Nob Hill Market. We observed seven active Black Skimmer nests at Ravenswood and two nests at Hayward Shoreline. Black-necked Stilts were most active at New Chicago Marsh. Caspian Terns again nested on islands at Alviso A16, which was part of a successful Caspian Tern social attraction study initiated in 2015 by USGS and USFWS. The most active nesting sites for Forster's Terns were New Chicago Marsh and Hayward Shoreline.

We monitored 35 sites with active 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 Steinberger Slough with an estimated 161 nests, but this species also nested in large numbers on the Dumbarton PG&E towers and Alviso A5. Great Blue Herons occupied large colonies (20+ nests) at Shadow Cliffs, Sunol Water Temple, and Pescadero Marsh and Ovation Court, with several smaller colonies throughout the region. We observed three Green Heron nests at Lake Cunningham this season. We monitored 11 colonies that included Snowy Egret nests. Nesting for this species was most active at Lakeshore Park in Newark (Salisbury Island), with 54 nests. We monitored 11 colonies that included Black-crowned Night Heron nests. The most active nesting area for this species was Downtown Oakland with 156 nests.

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. SFBBO has been monitoring the growth of the breeding population since 1980 as it grew from 24 breeding adults in 1980 to over 50,000 at its peak in 2013. In 2018, SFBBO monitored 10 California Gull colonies via walkthrough surveys from May 9–15 (Table 2). These colonies encompass all known South Bay breeding locations of this species. California Gull colony sizes ranged from 172 breeding birds (A1) to 19,350 birds (PAFCC). The Alviso A9/10/11/14 colony was the second largest colony in previous years, but shrank significantly to an estimated 1420 individuals. The former colony site at Alviso A5/7 was used again to a greater extent this year following two years of disuse. In 2018, 5984 birds bred at Alviso A5, a significant increase from the 276 birds that nested at this location in 2014.

We estimated a total of 46766 California Gulls breeding in the San Francisco Bay in 2018, a 4% increase from the 43570 estimated in 2017, but still lower than the 53,466 estimated in 2013 (Table 2). The magnitude and direction of the change varied greatly by colony, from a -85% decrease at Alviso A9/A10/A14 to a 750% increase at Mowry M3 from 2017 to 2018. This range indicates that gulls continue to change their year-by-year distribution and selection of breeding sites (Figure 3). 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).

From 1982-2010, Alviso pond A6 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, pond A6 was restored to tidal action as part of the South Bay Salt Pond Restoration Project. Band re-sightings in subsequent years show that gulls redistributed to several nearby colonies, particularly A9/10/11/14 and the Palo Alto Flood Control Basin (Figure 3). In 2018, we re-sighted 32 banded gulls on our walkthrough counts. Thirty-one of these birds were banded at the A6 colony from 2008–2010. One gull was banded at A6 in 1985 and it is currently being considered by U.S. Geological survey for the oldest California Gull record. In 2018, thirteen California Gulls were re-sighted at colony A5/A7, eight at the Palo Alto Flood Control Channel Colony, and seven in the Mowry complexes. Four California Gulls were re-sighted approximately 13 km north of A6 at the Newark colonies. The subsequent band re-sighting data gathered through this project, as well as from other long-term banding efforts (Schacter et al. 2008, Robinson-Nilsen et al. 2010, 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 of the South Bay gull colonies and their geographic proximity to other sensitive species' nesting habitats, it is necessary at times to protect rare species, such as the Western Snowy Plover, against potential gull impacts (Robinson-Nilsen et al. 2011). For example, SFBBO and the U.S. Fish and Wildlife Service pursued selective, nonlethal gull hazing during the gull nest initiation stage from 2011-

2015. In 2018, the U.S. Fish and Wildlife Service removed 33 California Gull nests from habitats proximate to colonies of sensitive shorebird species, specifically Moffett AB2. 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 overall rapid population growth and the recent stabilization of the California Gull population 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. In 2018, California gulls attempted to nest in new sensitive habitats, specifically at Moffett AB2, but removal of nest bowls by the USFWS proved a successful deterrent. In the future, without these activities, gulls may colonize nesting habitats preferred by Western Snowy Plovers or other sensitive waterbird species. Therefore, we recommend the continuation of this monitoring and nest-removal regime in 2019.
4. Significant decreases in the number of California Gulls using the Newby Island Landfill have been recorded in response to on-site abatement programs (Tarjan et al. 2017). 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 (Ackerman et al. 2009). While abatement has been effective at reducing food availability locally, the degree to which individual gulls move between anthropogenic sources of food is unknown. We recommend the implementation of gull abatement programs at other refuse management locations should be informed by ongoing and future studies of gull movements and the impact of coordinated control efforts on gull populations.
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 participated in 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, and address common issues people experience in the field. Following training, 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 2018, 67 SFBBO citizen scientists contributed 912 volunteer hours to the CWB Program. This includes office work, colony monitoring, and California Gull walkthrough counts. If valued at a rate of \$16 per hour, this amounts to \$14,592 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 and Scouting**

We continued our mentoring and scouting activities in 2018. Our Mentoring Program gives new citizen scientists an opportunity to learn the monitoring protocols from our veterans. 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.

### **Online Training**

Program participants are spread out geographically, and many expressed the desire to minimize the driving time required for the in-person training. In 2017, SFBBO hosted its first virtual training in the format of a live online webinar. Volunteers logged in from any computer or called in over the phone to learn about the program and participate in a question-and-answer session with SFBBO staff. A video recording of the webinar was later viewable for all program participants on a pilot training website: <https://colonialwaterbirdprogram.weebly.com/>. In 2018, SFBBO converted the training into a multi-part video series and posted them to the training website. These online training materials will be expanded upon in future seasons.

### **Ambassador Program**

In 2018, 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 2018 with 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 reports (see example in Appendix II) on specific colonies in response to requests from landowners and community members; including **the San Francisco Public Utilities Commission, the Community of Harbor Bay Isle, and Santa Clara County Parks**. 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 2019.
2. **Special Events:** SFBBO also engaged CWB citizen scientists in SFBBO outreach efforts, including SFBBO Family Science Night events, bird walks, and participation in various community events in **Fremont, Livermore, Menlo Park, Milpitas, Newark, Pleasanton, Redwood City, San Jose, Santa Clara, Santa Cruz, and Saratoga**.
3. **Fundraising:** A number of participants in our CWB also helped us conduct fundraising in 2018 to benefit the program. Many volunteers took leadership roles in our California Fall Challenge by serving as fundraisers, judges for our Click Off photo contest, leading guided birding trips, 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 2018, 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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## TABLES

Table 1. Nests observed within gull, tern and shorebird nesting colonies in 2018; San Francisco Bay, CA. Nest counts represent the peak number of active nests observed for each species and colony in 2018. 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	Organization Name	AMAV	BLSK	BNST	CAGU	CATE	FOTE	LETE	Method
<b>Alviso A16</b>	DESFBNWR	0	0	0	0	34	0	0	observational
<b>Alviso A5</b>	DESFBNWR	0	0	0	2992	0	0	0	walkthrough
<b>Alviso A9</b>	DESFBNWR	0	0	0	710	0	0	0	walkthrough
<b>Coyote Hills N2A/N3A/N4AB</b>	DESFBNWR	0	0	0	1132	0	0	0	walkthrough
<b>Coyote Hills N6/7</b>	DESFBNWR	0	0	0	3839	0	0	0	walkthrough
<b>Hayward Shoreline</b>	EBRPD	2	2	0	0	0	440	0	observational
<b>Moffett A2W</b>	DESFBNWR	0	0	0	1	0	0	0	observational
<b>Moffett AB2</b>	DESFBNWR	1	0	0	0	0	0	0	observational
<b>Moffett AB2</b>	DESFBNWR	0	0	0	150	0	0	0	walkthrough
<b>Mountainview A1</b>	DESFBNWR	0	0	0	86	0	0	0	walkthrough
<b>Mowry M1/2</b>	DESFBNWR	0	0	0	757	0	0	0	walkthrough
<b>Mowry M3</b>	DESFBNWR	0	0	0	1684	0	0	0	walkthrough
<b>Mowry M4/5</b>	DESFBNWR	0	0	0	2358	0	0	0	walkthrough
<b>New Chicago Marsh</b>	DESFBNWR	33	0	13	0	0	127	0	observational
<b>Palo Alto Flood Control Basin</b>	City of Mountain View	0	0	0	9675	0	0	0	walkthrough
<b>Ravenswood</b>	Other	0	7	0	0	0	0	0	observational
<b>Redwood Shores Parkway, Nob Hill Market</b>	Other	11	1	7	0	0	54	0	observational
<b>TOTAL</b>		<b>47</b>	<b>10</b>	<b>20</b>	<b>23384</b>	<b>34</b>	<b>621</b>	<b>0</b>	

Table 2. Number of breeding adult California Gulls by colony in the South San Francisco Bay from 1980-2018. 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/A10/A14	Mountain View A1	Mowry M4/M5	Mowry M1/M2	Mowry M3	Moffett AB2	Coyote Hills N3A/N4AB	Coyote Hills N6/N7	PAFCC	Alviso A5	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
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

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Year	Alviso A6	Newark	Alviso A9/A10/A14	Mountain View A1	Mowry M4/M5	Mowry M1/M2	Mowry M3	Moffett AB2	Coyote Hills N3A/N4AB	Coyote Hills N6/N7	PAFCC	Alviso A5	A3W Boardwalk	South Bay Total
2016	0	-	10086	344	3640	1382	2218	260	1472	5880	12758	0	-	38040
2017	0	-	9868	238	5246	2738	396	324	1156	5198	16180	2226	0	43570
2018	0	0	1420	172	4716	1514	3368	300	2264	7678	19350	5984	0	46766



Table 3. Nests observed within heron, egret and cormorant nesting colonies in 2018; San Francisco Bay, CA. Nest counts represent the peak number of active nests observed for each species and colony in 2018. 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 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	Organization Name	BCNH	DCCO	GBHE	GREG	GRHE	SNEG	Method
<b>Almaden Lake</b>	City of San Jose	2	0	1	5	0	7	observational
<b>Alviso A18</b>	City of San Jose	0	12	0	0	0	0	observational
<b>Alviso A5</b>	DESFBNWR	0	157	0	0	0	0	observational
<b>Bay Farm Island,</b>	Other	0	0	0	20	0	6	observational
<b>Coyote Hills 2A/3A/4A</b>	DESFBNWR	0	56	0	0	0	0	observational
<b>Coyote Ranch Rd Colony</b>	Santa Clara County	0	0	14	0	0	0	observational
<b>Don Castro</b>	EBRPD	5	0	7	0	0	0	observational
<b>Downtown Oakland</b>	City of Oakland	156	0	0	0	0	22	observational
<b>Dumbarton PG&amp;E Towers</b>	Other	0	112	0	0	0	0	observational
<b>Grant Lake</b>	Santa Clara County	0	0	4	0	0	0	observational
<b>Kings Academy</b>	NA	6	0	0	0	0	0	observational
<b>Lake Cunningham</b>	City of San Jose	7	0	1	0	3	0	observational
<b>Lake Merced Mesa</b>	San Francisco Recreation & Parks	0	106	5	0	0	0	observational
<b>Lake Merced North</b>	San Francisco Recreation & Parks	0	16	0	0	0	0	observational
<b>Lake Merritt</b>	City of Oakland	0	58	0	0	0	0	observational
<b>Lakeshore Park, Newark (Channel Island)</b>	Other	5	0	0	18	0	12	observational
<b>Lakeshore Park, Newark (no subcolony identified)</b>	Other	0	0	0	0	0	14	observational
<b>Lakeshore Park, Newark (Ramsgate Island)</b>	Other	13	0	0	1	0	17	observational
<b>Lakeshore Park, Newark (Salisbury Island)</b>	Other	35	0	0	0	0	54	observational
<b>Livermore VA Park &amp; Moffett A2W</b>	Other	0	0	6	0	0	0	observational
<b>Moffett AB2</b>	DESFBNWR	0	53	0	0	0	0	observational
<b>Moffett AB2</b>	DESFBNWR	0	3	0	0	0	0	observational
<b>Newark</b>	Other	34	0	0	0	0	9	observational
<b>Ovation Court</b>	City of San Jose	0	0	20	0	0	0	observational
<b>Palace of Fine Arts</b>	Other	0	0	1	0	0	0	observational
<b>Pescadero Marsh</b>	Other	0	4	20	0	0	0	observational
<b>Redwood Shores Water Treatment Plant</b>	Other	42	0	0	0	0	21	observational
<b>Ruus Park</b>	Other	0	0	0	32	0	43	observational

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Colony Name	Organization Name	BCNH	DCCO	GBHE	GREG	GRHE	SNEG	Method
<b>Sandy Wool Lake</b>	NA	0	0	1	0	0	0	observational
<b>Shadow Cliffs</b>	EBRPD	0	29	25	6	0	0	observational
<b>Shorebird Way</b>	Other	19	0	0	27	0	27	observational
<b>St. Francis Yacht Club</b>	NA	0	0	8	0	0	0	observational
<b>Steinberger Slough</b>	DESFBNWR	0	161	7	0	0	0	observational
<b>Sunol Water Temple</b>	SFPUC	0	0	21	0	0	0	observational
<b>Vasona County Park SW</b>	Santa Clara County	0	0	1	0	0	0	observational
<b>TOTAL</b>		<b>324</b>	<b>767</b>	<b>142</b>	<b>109</b>	<b>3</b>	<b>232</b>	

## FIGURES

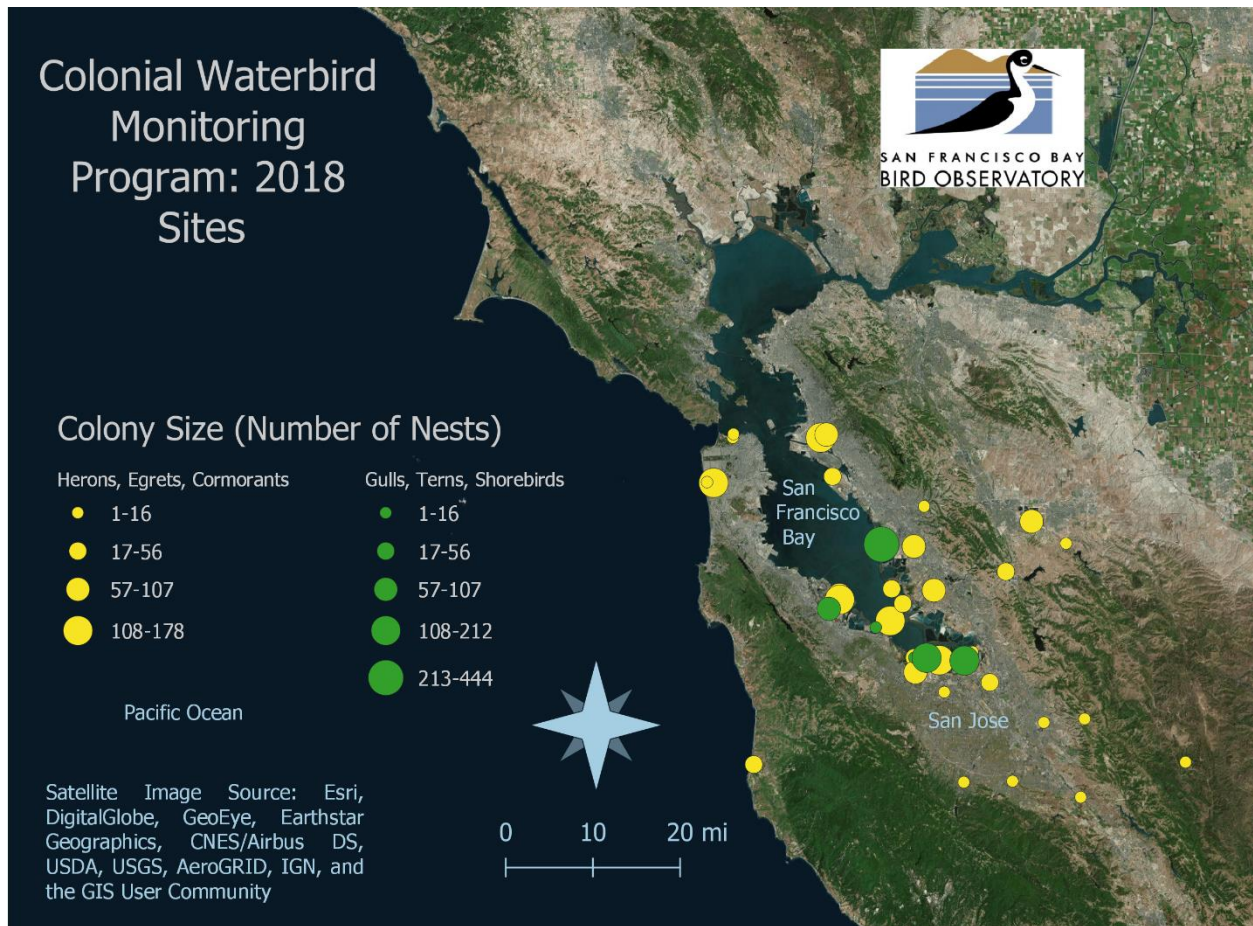


Figure 1. Locations and peak nest counts of colonies monitored as part of SFBBO's Colonial Waterbird Program, San Francisco Bay, CA. Circle sizes represent the peak nest counts of each colony in 2018. Green circles show colonies of gulls, terns, and shorebirds, and yellow circles show colonies of herons, egrets, and cormorants. Data include colonies monitored using observational methods only (i.e. California Gull walkthrough data are not included).

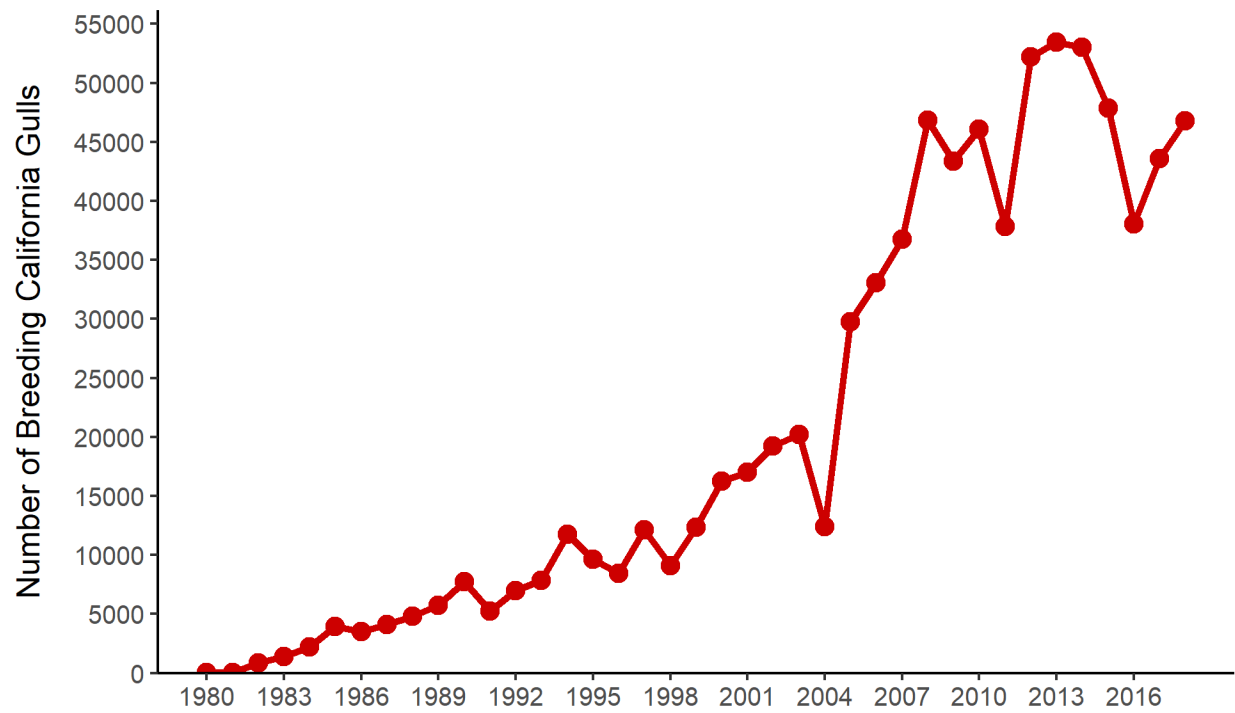


Figure 2. Estimated number of breeding California Gulls in the South San Francisco Bay, CA from 1980-2018.

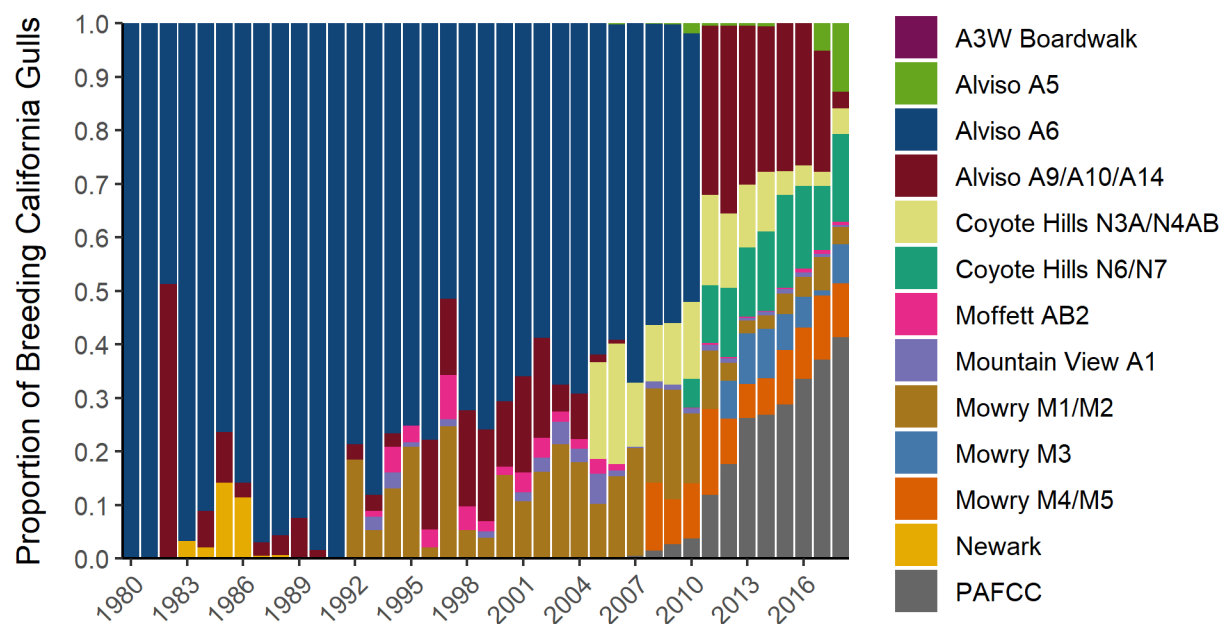


Figure 3. Percentage of breeding California Gulls within each colony site, 1980-2018, South San Francisco Bay, CA. PAFCC = Palo Alto Flood Control Channel Alviso A6 provided dry habitat suitable for nesting gulls until 2010 when the levees were breached and the site was opened to tidal action. Following the loss of Alviso A6 as suitable nesting habitat, gulls redistributed to other nesting sites in the South Bay.

## 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: 1993-2018

Site Description: The colony was 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 had 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. In 2018 one pair of Red-Tailed Hawks fought with a Great Blue heron for a nesting site in the tree. The hawks succeeded and nested at the site for the remainder of the season.

Peak number of active nests observed for Great Blue Heron and Great Egret at Llagas Creek, Morgan Hill, CA from 1993-2018

