

Citizen Science-Based Colonial Waterbird Monitoring 2017 Nesting Summary



Prepared By:

Max Tarjan, Waterbird Program Director Kristin Butler, Outreach & Communications Director San Francisco Bay Bird Observatory 524 Valley Way, Milpitas, CA 95035

Funded By:

San Francisco Bay Bird Observatory members and donors

December 31, 2017

Table of Contents

PROGRAM SUMMARY
INTRODUCTION
SURVEY METHODS
Study area4
Waterbird colony monitoring4
RESULTS AND DISCUSSION
Waterbird colonies (observational)5
California Gulls (walkthrough)7
RESEARCH AND MANAGEMENT RECOMMENDATIONS7
COMMUNITY OUTREACH THROUGH CITIZEN SCIENCE9
Mentoring and Scouting9
Citizen Science Website for Data Entry and Visualization9
Elmwood10
Ambassador Program10
NEXT STEPS
ACKNOWLEDGEMENTS
LITERATURE CITED
APPENDICES
Appendix I. Species Code, common name and scientific name for all species monitored23
Appendix II. Colony Report example: Llagas Creek, Morgan Hill24

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 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 2017.

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). <u>The Audubon Canyon Ranch</u> manages a similar monitoring program for herons and egrets in the North and Central Bays and <u>Point Blue Conservation Science</u> 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 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. 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)

SFBBO monitored a total of 82 potential GUTE and HEP colonies across 57 sites, 52 of which became active breeding colonies in 2017 (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 <u>were not</u> monitored this year include: Agua Vista, Lake Chabot, Lake Elizabeth, Moffet A2E, and Bunting Pond. Sites that were not monitored last season, but <u>were</u> monitored this year include: King's Academy, Redwood City Harbor, and St. Francis Yacht Club.

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 (Palace of Fine Arts) to over 100 nests (e.g. Downtown Oakland, Dumbarton Bridge PG&E Towers, Hayward Shoreline, Lake Merritt, and Steinberger Slough). Species composition at the colony sites monitored also varied considerably. In 2016, the Lakeshore Park and Redwood Shores Parkway (Nob Hill Market) colonies were the most species diverse, each with four species. In 2017, 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 16 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 Alviso A16 and New Chicago Marsh. We observed one active Black Skimmer nest at Redwood Shores, Nob Hill Market and five 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 36 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 144 nests, but this species also nested in large numbers on the Dumbarton PG&E towers and Lake Merritt. Great Blue Herons occupied two large colonies (20+ nests) at Bacon Island, Shadow Cliffs and Sunol Water Temple,

with several smaller colonies throughout the region. Similar to 2015-2016, we observed two Green Heron nests at Lake Cunningham this season. We monitored 9 colonies that included Snowy Egret nests. Nesting for this species was most active at Lakeshore Park in Newark, with 46 nests. We monitored 9 colonies that included Black-crowned Night Heron nests. The most active nesting area for this species was Downtown Oakland with 189 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 and SFBBO has been monitoring the growth of the breeding population since 1980. In 2017, SFBBO monitored 10 California Gull colonies via walkthrough surveys from May 8–13 (Table 2). These 10 colonies encompass all known South Bay breeding locations of this species. California Gull colony sizes ranged from 238 breeding birds (Mountain View A1) to 16,180 birds (Palo Alto Flood Control Basin). The Alviso A9/10/11/14 colony was also large, with an estimated 9,868 individuals. The former colony site at Alviso A5/7 was used again this year following two years of disuse. In 2017, 2,226 birds bred at Alviso A5, a significant increase from the 276 birds that nested at this location in 2014.

We estimated a total of 43,570 California Gulls breeding in the San Francisco Bay in 2017, a 7% increase from the 38,040 estimated in 2016, but still lower than the 47,866 estimated in 2015 (Table 2). The magnitude and direction of the change varied greatly by colony, from a 70% decrease at Mowry 3 to a large increase at Alviso A5, where gull counts went from 0 to 2,226 breeding birds. This range indicates that gulls are changing their 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).

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 3). 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 2017, we re-sighted 31 banded gulls on our walkthrough counts. Thirty of these birds were banded at the A6 colony from 2008–2010. 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 of 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. In 2017, SFBBO monitored 82 current and former salt ponds in the South Bay and reported instances of gulls exhibiting nesting behaviors. The U.S. Fish and Wildlife Service removed over 147 California Gull nests from habitats proximate to colonies of sensitive shorebird species, such as Western Snowy Plovers. 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 slight decline 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 2017. Presumably, this was due to the intensive surveys and removal of nest bowls from sensitive habitats by the U.S. Fish and Wildlife Service and SFBBO. In the future, without these activities, gulls may colonize nesting habitats preferred by Western Snowy Plovers or other sensitive waterbird species, such as the islands at Alviso pond A16. Therefore, we recommend the continuation of this monitoring and nest-removal regime in 2018.
- 4. Significant 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. While abatement has been effective at decreasing gulls 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. We also recommend a study to describe the movement of gulls between sites 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.
- 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, 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 2017, 61 SFBBO citizen scientists contributed 810 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 \$12,150 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 2017. 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/. These online training materials will be expanded upon for upcoming seasons.

Citizen Science Website for Data Entry and Visualization

In 2017, SFBBO partnered with CitSci.org to pilot an online database for the Colonial Waterbird Program. The website allows volunteers of the Colonial Waterbird Program to enter their datasheets into an online form from any computer with internet access. This helped SFBBO biologists save time and gave citizen scientists a chance to work with the data they helped collect in the field. SFBBO staff is collecting feedback about the user experience and plans to work with CitSci.org to improve the user experience for next season. In the future, citizens will be able to use the website to create visualizations of our data as they are entered in real time. These visualizations include plots of colony size over multiple years, which can be broken down by species.

Elmwood

In 2016, SFBBO began partnering with the Milpitas Unified School District and Elmwood Correctional Facility to offer training and mentorship for inmates at the correctional facility. Participants worked with an SFBBO citizen scientist each month to collect data on a large colony of Great Egrets, Snowy Egrets, and Black-crowned Night Herons that nest at the facility. We continued this program during the 2017 season.

Ambassador Program

In 2017, 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 2017 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 mini-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 and the East Bay Regional Park District. 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 2018.

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 Campbell, Cupertino, Fremont, Marin, Menlo Park, Milpitas, and San Jose.

3. *Fundraising:* A number of participants in our CWB also helped us conduct fundraising in 2017 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 2017, 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.

ACKNOWLEDGEMENTS

Thank you to SFBBO's Nicole Tomes-Orlale who provided logistical support with data proofing and volunteer coordination and Josh Scullen who assisted with data management. Cheryl Strong, Rachel Tertes and Joy Albertson of the Don Edwards San Francisco Bay National Wildlife Refuge (DESFBNWR) and John Krause of the California Department of Fish and Wildlife (CDFW) provided access permits, field and logistical support. Thank you also to San Francisco Public Utilities Commission, East Bay Regional Park District, Elmwood Correctional Facility and Don Edwards San Francisco Bay National Wildlife Refuge for working with us to allow permission for monitoring.

We could not have accomplished this monitoring without the long-term support of SFBBO's many members and donors. We wish to thank the following citizen scientists especially for their hard work and dedication to this project in 2017: Tonya Anderson, Laurie Bechtler, Dolores Bengston, Charles Coston, Deanna de Castro, Betty DeLuco, Nancy DeStefanis, Michael Dodson, Vickie Eggert, Jeff Englander, Tom Goodier, Michael Grunow, Peter Grunow, Jean Halford, Candace Harvey, Diane Heckman, Jan Hintermeister, Carole Hutchinson, Rita Jennings, Beth Kean, Stephanie Klein, Jennifer Litteral, Cathy Loewen, Nelle Lyons, Mike Mammoser, Larry Manning, Mary Marsiglio, Deborah Murakami, Hiroshi Murakami, Dan Murphy, Donna Nicoletti, Janna Pauser, Jean Perata, Lynn Porcedda, Barbara Robeson, John Robeson, Bill Rose, Bob Richmond, Tina Silverstein, Christine Slocomb-Zack, Gail Stevens, Tom Stewart, John Toms, Nancy Teater, Susan Teefy, Bill Teefy, Ricci Teefy, Nicole Tomes-Orlale, Jackie Vargo, and Carolyn Wong. Thank you to staff members Victoria Heyse and Cole Jower for conducting field surveys.

Thank you also to the following people for providing their field skills to the California Gull walkthrough counts in 2017: staff members Victoria Heyse, Cole Jower, Ben Pearl, Lani Renshaw, Alex Rinkert, Max Tarjan, Karine Tokatlian, and Dan Wenny, and volunteers Anqi Chen, Gina Barton, Byron Chin, Joanna Chin, Vickie Eggert, Jeanne Fasan, Michelle Kim, Sami Michishita, Kristen Richardson, Byron Ryono, Rachel Tertes, Ray Thro, and Carly Tolle.

LITERATURE CITED

Ackerman, J. T., J. Y. Takekawa, C. Strong, N. Athearn, and A. Rex. 2006. California Gull distribution, abundance, and predation on waterbird eggs and chicks in South San Francisco Bay. Final report. U.S. Geological Survey, Western Ecological Research Center, Davis and Vallejo, CA.

Ackerman, J. T., C. A. Eagles-Smith, J. Y. Takekawa, J. Bluso-Demers, D. Tsao, and D. LeFer. 2009. California Gull movements in relation to nesting waterbirds and landfills: implications for the South Bay Salt Pond Restoration Project. Data summary. U.S. Geological Survey, Western Ecological Research Center, Davis, CA.

Ackerman, J. T., M. P. Herzog, G. Herring, C. A. Hartman, J. Bluso-Demers, and C. Robinson-Nilsen. 2013. Impact of salt pond restoration on California Gull displacement and predation on breeding waterbirds. U.S. Geological Survey Report prepared for the South Bay Salt Pond Restoration Project and Resources Legacy Fund.

Adkins, J. Y., D. D. Roby, D. E. Lyons, K. N. Courtot, K. Collis, H. R. Carter, W. D. Shuford and P. J. Capitolo, 2014. Recent population size, trends, and limiting factors for the double-crested cormorant in western North America. The Journal of Wildlife Management 78: 1131–1142.

Carney, K. M. and W. J. Sydeman. 1999. A review of human disturbance effects on nesting colonial waterbirds. Waterbirds: The International Journal of Waterbird Biology 22(1): 68-79.

Cooper, C.B., J. Shirk, B. Zuckerberg. 2014. The Invisible Prevalence of Citizen Science in Global Research: Migratory Birds and Climate Change. PLoS ONE 9(9): e106508.

Demers, S.A., C.W. Robinson-Nilsen. 2012. Monitoring Western Snowy Plover nests with remote surveillance systems in San Francisco Bay, California. Journal of Fish and Wildlife Management 3:123-32.

Dickinson, J. L., B. Zuckerberg, and D. N. Bonter. 2010. Citizen science as an ecological research tool: challenges and benefits. Annual Review of Ecology, Evolution and Systematics 41: 149-172.

Hoffmann, L., H. Hafner, and T. Salathé. 1996. The contribution of colonial waterbird research to wetland conservation in the Mediterranean region. Colonial Waterbirds 19: 12-30.

Jordan, R. C., H. L. Ballard and T. B. Phillips. 2012. Key issues and new approaches for evaluating citizenscience learning outcomes. Frontiers in Ecology and the Environment 10: 307–309.

Kelly, J. P., K. Ettiene, C. M. Strong, M. McCaustland, and M. L Parkes. 2007. Status, trends and implications for the conservation of heron and egret nesting colonies in the San Francisco Bay Area. Waterbirds 30: 455-478.

Kushlan, J. A. 1993. Colonial waterbirds as bioindicators of environmental change. Colonial Waterbirds 16: 223-25.

Lotze, H. K., H. S. Lenihan, B. J. Bourque, R. H. Bradbury, R. G. Cooke, M. C. Kay, S. M. Kidwell, M. X. Kirby, C. H. Peterson, and J. B. C. Jackson. 2006. Depletion, degradation, and recovery potential of estuaries and coastal seas. Science 312: 1806-1809.

Parnell, J. F., D. G. Ainley, H. Blokpoel, B. Cain, T. W. Custer, J. L. Dusi, S. Kress, J. A. Kushlan, W. E. Southern, L. E. Stenzel, and B. C. Thompson. 1988. Colonial waterbird management in North America. Colonial Waterbirds 11: 129-169.

Robinson-Nilsen, C., and J. Demers. 2010. Banding and re-sighting California Gulls in the South San Francisco Bay, 2010. Unpublished report. San Francisco Bay Bird Observatory, Milpitas, CA.

Robinson-Nilsen, C., and J. Demers. 2012. California Gull breeding surveys and hazing project, 2012. Unpublished report. San Francisco Bay Bird Observatory, Milpitas, CA.

Robinson-Nilsen, C., J. Demers and C. Strong. 2011. Western Snowy Plover numbers, nesting success, fledging success and avian predator surveys in the San Francisco Bay, 2011. Unpublished report. San Francisco Bay Bird Observatory, Milpitas, CA.

St. Pierre, J., Burns, C.E., Washburn, N. 2015. Nuisance Species Abatement Plan, 2014 Annual Report, Newby Island Landfill & Recyclery. Unpublished report. San Francisco Bay Bird Observatory, Milpitas, CA

Strong, C. M., L. B. Spear, T. P. Ryan, and R. E. Dakin. 2004. Forster's Tern, Caspian Tern, and California Gull colonies in the San Francisco Bay: habitat use, numbers, and trends, 1982-2003. Waterbirds 27: 411-423.

Table 1. Nests observed within gull, tern and shorebird nesting colonies in 2017; San Francisco Bay, CA. Nest counts represent the peak number of active nests observed for each species and colony in 2017. 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
Alviso A16	DESFBNWR	26	0	10	0	42	0	0	observational
Alviso A5	DESFBNWR	0	0	0	1113	0	0	0	walkthrough
Alviso A9	DESFBNWR	0	0	0	4934	0	0	0	walkthrough
Coyote Hills N2A/N3A/N4AB	DESFBNWR	0	0	0	578	0	0	0	walkthrough
Coyote Hills N6/7	DESFBNWR	0	0	0	2599	0	0	0	walkthrough
Hayward Shoreline	EBRPD	0	5	0	0	0	650	0	observational
Moffett AB2	DESFBNWR	0	0	0	0	0	15	0	observational
Moffett AB2	DESFBNWR	0	0	0	162	0	0	0	walkthrough
Mountain View A1	DESFBNWR	0	0	0	119	0	0	0	walkthrough
Mowry M1/2	DESFBNWR	0	0	0	1369	0	0	0	walkthrough
Mowry M3	DESFBNWR	0	0	0	198	0	0	0	walkthrough
Mowry M4 Levee	DESFBNWR	0	0	0	1	0	0	0	walkthrough
Mowry M4/5	DESFBNWR	0	0	0	2622	0	0	0	walkthrough
New Chicago Marsh	DESFBNWR	22	0	21	0	0	52	0	observational
Palo Alto Flood Control Basin	City of Mountain View	0	0	0	8090	0	0	0	walkthrough
Redwood Shores Parkway, Nob Hill Market	Other	2	1	1	0	0	24	0	observational
	TOTAL	50	6	32	21785	42	741	0	

Table 2. Number of breeding adult California Gulls by colony in the South San Francisco Bay from 1980-2017. 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
2001	11216	0	3056	278	-	1824	-	624	0	-	-	-	-	16998
2002	11302	0	3590	510	-	3120	-	712	0	-	-	-	-	19234

Table 2. Number of breeding adult California Gulls by colony in the South San Francisco Bay from 1980-2017. 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
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
2016	-	-	10086	344	3640	1382	2218	260	1472	5880	12758	0	-	38040
2017	-	-	9868	238	5246	2738	396	324	1156	5198	16180	2226	0	43570

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 2017; San Francisco Bay, CA. Nest counts represent the peak number of active nests observed for each species and colony in 2017. 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	Landowner	BCNH	DCCO	GBHE	GREG	GRHE	SNEG	Method
Almaden Lake	City of San Jose	8	0	1	7	0	9	observational
Alviso A18	City of San Jose	0	15	0	0	0	0	observational
Alviso A9/A10/A11/A14	DESFBNWR	0	56	0	0	0	0	walkthrough
Bacon Island	Other	0	3	25	0	0	0	observational
Bay Farm Island, Alameda	Other	0	0	0	16	0	8	observational
Coyote Hills 2A/3A/4A levees	DESFBNWR	0	44	0	0	0	0	walkthrough
Coyote Ranch Rd Colony	Santa Clara County	0	0	11	1	0	0	observational
Don Castro	EBRPD	0	0	7	0	0	0	observational
Downtown Oakland	City of Oakland	189	10	0	0	0	13	observational
Dumbarton PG&E Towers	Other	0	107	0	0	0	0	observational
Grant Lake	Santa Clara County	0	0	2	0	0	0	observational
Kings Academy	NA	1	0	0	0	0	0	observational
Lake Cunningham	City of San Jose	7	0	1	0	2	0	observational
	San Francisco							
Lake Merced Mesa	Recreation & Parks	0	95	5	0	0	0	observational
	San Francisco	_			_	_	_	
Lake Merced North	Recreation & Parks	0	18	1	0	0	0	observational
Lake Merritt	City of Oakland	0	107	0	0	0	0	observational
Lakeshore Park, Newark								
(Channel Island)	Other	3	0	0	11	0	2	observational
Lakeshore Park, Newark								
(Ramsgate Island)	Other	25	0	0	0	0	31	observational
Lakeshore Park, Newark								
(Salisbury Island)	Other	48	0	0	0	0	46	observational
Livermore VA Park & Hospital	Other	0	0	6	0	0	0	observational
Llagas Creek, Morgan Hill	Other	0	0	3	17	0	0	observational

Table 3. Nests observed within heron, egret and cormorant nesting colonies in 2017; San Francisco Bay, CA. Nest counts represent the peak number of active nests observed for each species and colony in 2017. 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	Landowner	BCNH	DCCO	GBHE	GREG	GRHE	SNEG	Method
Moffett A2W	DESFBNWR	0	45	0	0	0	0	observational
Moffett A3W	DESFBNWR	0	1	0	0	0	0	observational
Moffett AB2	DESFBNWR	0	13	0	0	0	0	observational
Ovation Court	City of San Jose	0	0	19	0	0	0	observational
Palace of Fine Arts	Other	0	0	1	0	0	0	observational
Pescadero Marsh	Other	0	4	18	15	0	0	observational
Redwood Shores Water								
Treatment Plant	Other	10	0	0	0	0	17	observational
Ruus Park	Other	0	0	0	28	0	27	observational
Shadow Cliffs	EBRPD	0	30	24	14	0	0	observational
Shorebird Way	Other	12	0	0	30	0	30	observational
St. Francis Yacht Club	Other	0	0	3	0	0	0	observational
Steinberger Slough	DESFBNWR	0	144	3	0	0	0	observational
	San Francisco							
Stow Lake	Recreation & Parks	0	0	8	0	0	0	observational
Sunol Water Temple	SFPUC	0	0	23	0	0	0	observational
Vasona County Park SW	Santa Clara County	0	0	2	0	0	0	observational
	TOTAL	303	692	163	139	2	183	



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 2017. Blue circles show colonies of gulls, terns, and shorebirds, and red 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 1980-2017.



Figure 3. Percentage of breeding California Gulls within each colony site, 1980-2017, South San Francisco Bay, CA. PAFCB = Palo Alto Flood Control Basin. 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

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

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

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

Species Monitored: Great Blue Heron, Great Egret

Years Monitored: 1993-2017

<u>Site Description</u>: 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

<u>Conservation Concerns</u>: 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 1993-2017

