San Diego Association of Governments
CA Least Tern Habitat Restoration in Mission Bay

Final Report
Project Period: November 2018 – April 2022
Grant No. 5005518

Prepared by San Diego Audubon Society
July 2022

Contents

Executive Summary

Over the course of this grant, San Diego Audubon staff, volunteers and partners carried out essential conservation and habitat restoration tasks to support nesting California least terns and MSCP-listed Nuttall's Acmispon:

- conducting habitat management events at Mariner's Point, North Fiesta Island, Stony Point, No Man's Land and South Shores with thousands of volunteers,
- refining translocation protocols to establish and maintain a new population of Nuttall's Acmispon in Mission Bay,
- supporting predator control efforts through our TernWatchers program to increase California least tern nesting productivity,
- carrying out research on alternative management efforts to reduce the reliance on herbicides,
- completing Annual and Long-term Management documents to guide continued nesting success in Mission Bay,
- engaging with the community about the importance of protecting the endangered California least tern, and
- supporting threatened sand dune habitat despite the challenges of a pandemic.

This project was a success because of the thousands of hours of time donated by our dedicated volunteers, and the sustained support of our partners and other regional experts on California least tern management and invasive plant control. The management plans which were the final products of this grant will support permanent and visionary improvements to the coastal dune habitat in Mission Bay, creating benefits for the bay's natural resources and the community members who enjoy and appreciate these resources.

Project Background

For over 30 years, San Diego Audubon has worked collaboratively with the City of San Diego, US Fish and Wildlife Service, CA Department of Fish and Game, and the Mission Bay Park rangers to manage habitat for the endangered Nuttall's Acmispon (formerly called Nutall's lotus and abbreviated as NULO) and federally listed endangered California Least Tern (CLTE) in Mission Bay.

The California least tern (*Sterna antillarum browni*) is a migratory, endangered seabird that receives both state and federal endangered species protections. It is classified as "Fully Protected" by the California Department of Fish and Wildlife (CDFW), is a covered species

within the Multiple Species Conservation Program (MSCP) and the San Diego Habitat Conservation Program (MHCP), and is designated as an "SO" species by the San Diego Management and Monitoring Program's Management Strategic Plan (MSP), which indicates that a significant occurrence of the species' population faces potential extinction. Primary threats to the species include fragmented and degraded coastal nesting habitat, invasive plant species, increasing numbers of urban predators, and food availability issues that are tied to a warming ocean. The often co-occurring Nuttall's lotus (*Acmispon prostratus*) faces similar threats, and this spring-blooming annual herb is found only in the narrow band of coastal sand dunes that remain in its original range from San Diego County through northern Baja.

An estimated 60% of the California least tern breeding population can be found in San Diego County from mid-April through mid-September each year. Mission Bay is a key nesting location within the county, and is identified in the US Fish and Wildlife CA Least Tern Recovery Plan as an area of focus for achieving recovered status. Nesting has remained relatively consistent in Mission Bay, with an average of 200 established nests and 55 fledglings produced per year over the last 15 years. Despite this, nesting CA least terns in Mission Bay continue to face numerous threats and often experience high rates of nest abandonment and lower than ideal nesting productivity.

CLTEs are experiencing an ongoing decline, and the estimated population of breeding adults has decreased by roughly 50% since 2009, the height of its recovery. This decline is especially dramatic in San Diego County and Southern California as a whole, where the number of established nests and fledglings has decreased precipitously over the last decade. In light of this, the modest but consistent number of fledglings produced at the Mission Bay sites takes on an elevated level of importance. In 2021, Mission Bay produced roughly 18% of the total number of fledglings recorded throughout the state, a clear sign of its importance for the overall recovery of the species.

Mission Bay is also a key management area for Nuttall's lotus, and it is home to 40% of the recorded occurrences of this species within conserved lands in the county. Unlike in many areas where it is found, these populations are stable or growing in size, and Mariner's Point has remained the largest population of Nuttall's lotus individuals in the county. Because of the large size of this occurrence, it has served as a source of seeds for successful translocation to other parts of the Bay.

Figure 1: Map of CLTE nest sites and NULO sites in Mission Bay which are actively managed by SD Audubon and partners.

Project Goals

Restoration efforts to support CLTE and NULO populations in Mission Bay have included the volunteer-powered physical removal of invasive plants, chemical removal of invasive plants, thinning of native plant species, installation of educational signage, seed collection, translocation and surveying of rare dune plants, repair of protective fencing, volunteer-led predator monitoring via our TernWatchers program and more.

Funding for this work has been provided through several TransNet Environmental Mitigation Program (EMP) grants that were focused on discrete management actions and projects. This grant focused on consolidating these actions into one comprehensive project, and included the creation of several guiding documents which will inform annual and long-term management for years to come. These documents also re-examined how well the goals within the Mission Bay Natural Resource Management Plan and the US Fish and Wildlife CA Least Tern Recovery Plan have been implemented in the last several decades, and point to potential areas of improvement.

The ultimate goal of the project has been to maintain resilient populations of California least terns and Nuttall's lotus in Mission Bay, despite the many threats that these species face, and

to anticipate how expanded or improved management techniques can mitigate these threats while also planning for future threats such as sea level rise and a warming ocean.

Work Performed by Task

Task One: Management Planning

Budget: $15,730.88 (from grant agreement)
Spent: $17,308.38
Match for Task: $9,540.30

An Annual Management Plan was created for the four actively managed nesting sites in Mission Bay – Mariner's Point, North Fiesta Island, FAA Island and Stony Point (see **Appendix A**). San Diego Audubon Society works with the USFWS to manage FAA Island which is not part of this TNEMP grant but the bay and CLTE nesting preserves benefits from the coordinated management. This document describes the necessary management actions over the course of the entire year, including the restoration and nesting season. This includes techniques pertaining to vegetation management, herbicide applications, maintenance of site infrastructure, coordination with collaborating organizations and responsible land managers, and programmatic details regarding the community-led restoration and stewardship efforts that make this work possible. A digital copy has been provided to our partners with the Mission Bay rangers and to the staff at SANDAG, and a physical and digital copy are stored at the San Diego Audubon offices. Creating written guidelines for this management will allow for a smooth transition in the case of staff turnover. We also submitted annual reports about the management steps taken at the CA least tern sites at the end of each restoration season.

Following years of collaborative meetings with partners and experts, a Long-term Management Plan was adopted in April of 2022. Contributing partners to this plan include City of San Diego Park and Rec and Open Space staff, staff with the CA Department of Fish and Game and US Fish and Wildlife Service, long-time CA least tern scientists and biological monitors, Predator Control staff with the US Department of Agriculture, SDMMP coordinating staff with the US Geological Survey, researchers with the San Diego Zoo, and scientists with Point Blue Conservation Science (**Appendix B**). This final document has been shared with SANDAG previously and is available on request.

The Long-term Plan includes detailed recommendations pertaining to site designation for inactive nesting areas, site-specific management recommendations for active sites, explicit productivity goals, outreach plans for engaging with the public, recommendations by predator control staff to streamline policies and improve efficacy, suggested areas for future research, and more. Sources of consistent funding to support annual site maintenance was also a focus of conversations with City staff, and several recommendations laid out in this plan also made it into the final amendment to the Fiesta Island Master Plan Update which was approved by Coastal Commission staff in November

of 2021. This update maintains the current footprint of the Stony Point site while moving the North Fiesta Island site westward, further away from the more vegetated interior of the island and closer to restored wetlands which provide ideal foraging habitat. The supplemental section of the Long-term Plan also consolidates historic information pertaining to CLTE use in Mission Bay.

During this time, San Diego Audubon staff also played an important role in the creation of a Management Strategic Plan for Seed Collection, Banking, and Bulking Plan for Nuttall's lotus, providing guidance based on the successful translocation efforts carried out in Mission Bay. The final document was created by AECOM and the San Diego Management and Monitoring Program and finalized in March of 2020.

Task Two: Site Management

Budget: $94,906.39 (from grant agreement)
Spent: $102,402.68
Match for Task: $168,231.24

Four restoration seasons took place during the duration of the grant, with SD Audubon staff overseeing 83 volunteer restoration events in total. These events engaged 1,860 community volunteers, who donated 5,778 hours of their time and removed tens of thousands of pounds of vegetation. This includes three cohorts of "Conservation Team Leaders" – trained volunteers who take on leadership roles at our public volunteer events. A total of 43 CTLs participated in the 2019, 2020 and 2022 programs.

Public events were on hiatus due to COVID-19 from mid-March of 2020 until November of 2021, which necessitated the hiring of part-time staff to support our work. This presented the unique opportunity to develop a new position, Restoration Assistant, which has provided part-time learning and career development opportunities to students that are pursuing natural science degrees. These part-time staff helped to carry out 40+ staff only work events from late 2020 to late 2021, filling the gap before volunteer events were reinstated.

Other essential site management tasks that took place during this time included working with interns with the City of San Diego's Parks and Recreation department to carry out GIS mapping of the CLTE nests (**Appendices C-J**), and this grant enabled us to take over the spatial data gathering and mapping of the vegetation and tern nesting locations over the course of the grant. In the appendices, the progress of our mapping is evident, with the City doing the mapping in 2019, and then our maps in 2020 and improved maps in 2021. We also carried out visual assessments of the sites to create a restoration schedule based on rainfall and weed growth, worked with City staff to plan for mechanized scraping and herbicide applications, repaired and maintained chick fencing and perimeter fencing, installed educational 'Sharing our Shores' signs on exterior fencing, and scheduled pre- and post-season meetings with our partners to discuss any needed management actions.

Lastly, we carried out spring and fall vegetation surveys. Those vegetation surveys were then analyzed in partnership with the US Geological Survey, creating standardized photo monitoring protocols.

Over the course of the 2020-2021 restoration season, a study was initiated at the North Fiesta Island nesting site which focused on the use of alternative management techniques for reducing the cover of invasive plants. The study design was created in partnership with the US Fish and Wildlife Service, and it included the use of sand amendment, solarization and salt application, as well as combinations of these treatments with pre-emergent herbicides. Final results of this study are described in greater detail in the conclusion section of this document.

We also continued to collect and analyze vegetation data over this time, building off of established protocols and monitoring points that have been in use since 2012. Overall vegetation cover remained consistent at most of the sites, averaging at or below our goal of 20% total cover and 30% invasive cover. A more thorough discussion of our monitoring results can be found in the conclusion section of this document.

We also focused efforts to support Nuttall's lotus populations at two coastal sand dune sites in Mission Bay Park that aren't active CA least tern nesting areas, No Man's Land and South Shores. A total of five events were carried out here over the lifetime of the grant, and they focused on removing encroaching invasive plants from around the NULO populations and allowing for it to expand. Staff with the San Diego Management and Monitoring Program noted how much the invasive removal had benefitted the areas. This work was especially productive at No Man's Land, where the number of individual plants increased from 30 in 2017 to 428 in 2020. South Shores saw a less consistent increase, up from a low of 19 in 2014 to a high of 333 individuals in 2019, with a few years of lower population estimates in between. Invasive ice plant has continued to pose a significant threat to this population, unfortunately.

Nuttall's lotus seeds were also collected from Mariner's Point and successfully translocated to the southern extent of Stony Point in the winter of 2018 and 2019. The Stony Point location is now an officially registered occurrence within the MSPA, with 60 plants recorded in 2020. The population at Mariner's Point has remained very high, estimated at over 96,000 individuals during the last survey in 2020. Conversations with City staff about thinning of Nutall's lotus at Mariner's Point has taken place over the last several years, as the amount of growth is now creating problems for the nesting least terns. A plan to remove and potentially relocate Nutall's lotus will take shape over the course of the 2022-2023 restoration season.

Task Three: Predator Management Through Community Science

Budget: $42,280.34 (from grant agreement)
Spent: $28,880.16

Match for Task: $22,155.78

San Diego Audubon's TernWatchers program (initially funded by a 2013 SANDAG TransNet grant) is a volunteer-based predator monitoring program that seeks to increase the efficacy of predator control efforts at Mission Bay's CLTE nesting sites. This community science program trains volunteers on the protocols of monitoring, how to identify potential predator species, and how to report predation events to the US Department of Agriculture's APHIS Predator Control Specialist. Volunteers then conduct 2-4 hour long monitoring shifts from the nesting site buffer zones, recording predation and disturbance incidents and contacting the Predator Control Specialist when a predation event appears imminent.

A total of 60 volunteer TernWatchers carried out 180 monitoring shifts over the course of this grant, donating an estimated 500 hours of time to these efforts. Training and field protocols were updated over the course of the grant (**Appendix K)**. Data sheets were compiled and submitted to the APHIS Predator Control Specialist on a weekly or bi-weekly basis, and more pressing updates about predator sightings were also recorded in an on-site log book which was accessible to the Predator Control staff and other volunteer TernWatchers. The Predator Control staff members were also invited to all of the pre- and post- nesting season coordination meetings to report back any novel predator sightings and to ensure that their concerns were addressed in the following season.

In 2019, TernWatchers provided over 202 hours of observations regarding predator sightings, potential and confirmed predation events, and CLTE responses to predators. This includes over 27 predator sightings and 11 contacts with the Predator Control Specialist regarding an imminent predation event. Nine of these sightings were of Peregrine falcons, a voracious predator of adult and fledgling least terns, and a major cause of nesting site abandonment due to predation issues. Participation went down significantly in 2020 due to concerns regarding the COVID-19 pandemic, but volunteers still carried out 50 hours of monitoring shifts and reported several predators (mostly great blue herons) to APHIS staff. Participation saw an uptick in 2021, with 133 hours donated and 31 predators reported. This included several sightings of Peregrine falcons and the influx of a new predator to the area, gull-billed terns. Several of our Restoration Assistants helped to analyze trends in predator sightings over the lifetime of the TernWatcher program, with some interesting results. These are discussed in greater depth in the concluding section of this report.

Throughout the course of the grant, TernWatchers also contacted Mission Bay Park Rangers regarding enforcement issues, ranging from visitors and/or dogs within the nesting sites to the use of motorized drones and para-gliders over off-limits areas.

Task Four: Grant Administration

Budget: $5,371.86 (from grant agreement)
Spent: $5,955.06
Match for Task: $0

San Diego Audubon staff submitted quarterly invoices, receipts, participant sign in sheets and reports throughout the lifetime of the grant, which included detailed summaries of the work carried out under each of Task. In Spring 2020, COVID safety protocols and uncertainty resulted in us not being able to use volunteers to finish the restoration season, and that continued through the fall of 2021. Working closely with the City of San Diego, this grant enabled us to get a Right of Entry Permit for this work on City lands, and that allowed us to re-launched in-person group volunteer events in partnership with the City of San Diego and Mission Bay Park Rangers in late October 2021. We endeavoured to minimize the impact of COVID to CLTEs and the nesting preserves, and with newly hired positions we were able to keep up with the deliverables on this grant. We did ask for and get a 6-month grant extension, and we did reallocate funds between tasks, with a less than 10% budget reallocation in the last invoices of the project.

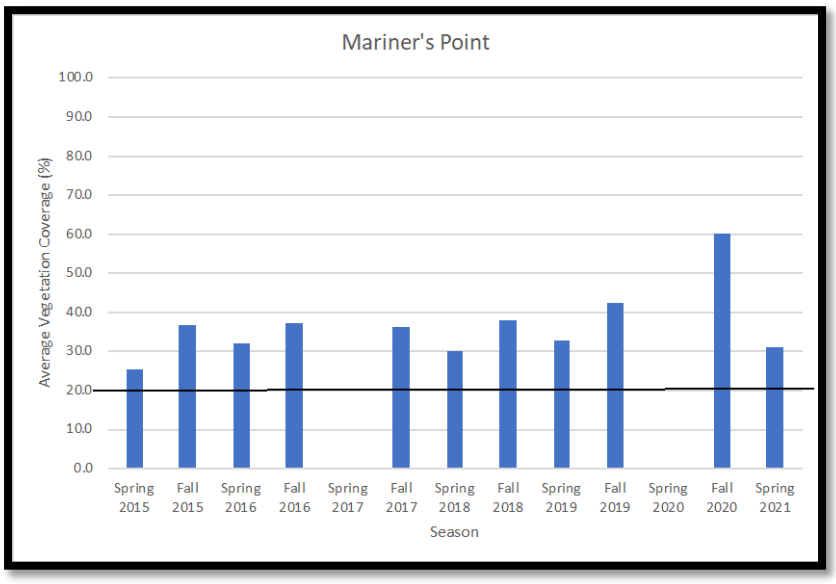
Conclusion

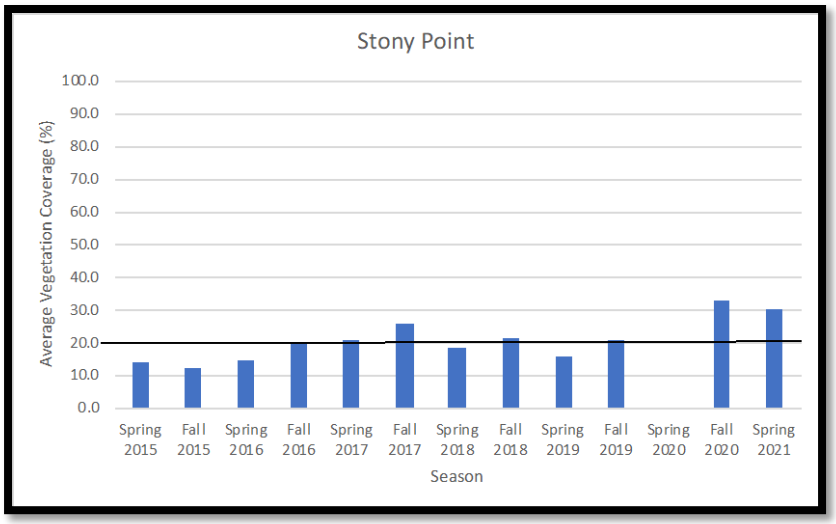
This grant provided much needed funding to continue ongoing efforts to restore coastal dune habitat in Mission Bay, in support of two endangered species. One of those species, the California Least Tern, has experienced a significant decline over the last decade throughout its range, due in part to the compounding effects of climate change and pressure from increasing populations of urban predators. With both of these threats worsening, it is of utmost importance that management efforts meet and mitigate these issues as much as possible, and regional sources of conservation funding such as this one are a key tool in ensuring that happens. This grant also allowed us to develop new management tools and experiment with new management techniques for restoring coastal dune habitat. Our management planning documents have set the groundwork for future habitat restoration efforts, and helped us obtain a new round of funding to support these efforts for the next several years. We have also obtained a more comprehensive Right of Entry permit with the City of San Diego which allows us to carry out this work with reduced City oversight, and are meeting with City staff once a month to discuss this project and potential funding routes in the future. With the assistance of staff from the US Geological Survey, our long-running vegetation data set was analyzed for the first time, and we established a novel experiment to explore the use of less invasive management techniques. Both of these studies provided important information to land managers about how best to extirpate non-native species and maintain a low overall cover of vegetation.

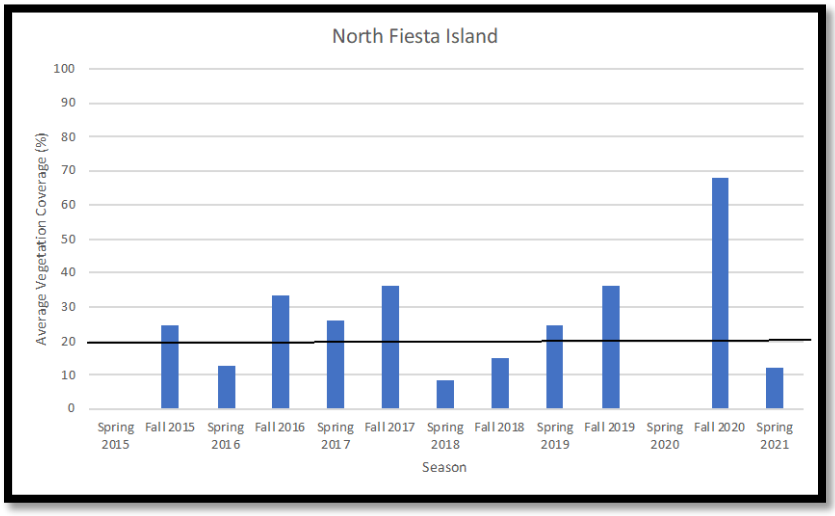
Vegetation data analysis

Overall vegetation cover averaged at or below our goal of 20% total cover at Stony Point, and fluctuated significantly at North Fiesta Island and Mariner's Point (see **Figures 2-4**). Cover was highest in the fall due to summer regrowth, during which the nesting sites were inaccessible for any habitat management. Mariner's Point did have numerous years of higher than ideal total vegetation cover, averaging closer to 36%. Invasive cover was lowest here, however (see **Figure 5**), and this average was also slightly skewed by the very high vegetation cover that was recorded in the fall of 2020. This isn't surprising given the reduction in weeding capacity due to the COVID-19 pandemic. Despite this higher than ideal vegetation cover, CA least terns

continued to use Mariner's Point in large numbers, with no significant change in the number of established nests. While Fish and Wildlife agency staff have suggested that the terns can likely tolerate more vegetation than normal at this site (and have also suggested that this might provide shelter from predators and the heat), SD Audubon staff plan on thinning out the vegetation here significantly over the course of the 2022-2023 restoration season, with a focus on plant species that pose entrapment threats to the chicks (*Abronia umbellata*, Pink Sand Verbena and *Ambrosia chamissonis*, Silver Beach Burr).







Figures 2-4: Average vegetation cover per season from 2015-2021 at Mariner's Point, Stony Point and North Fiesta Island. The black line demarcates the goal of 20% or lower vegetation.

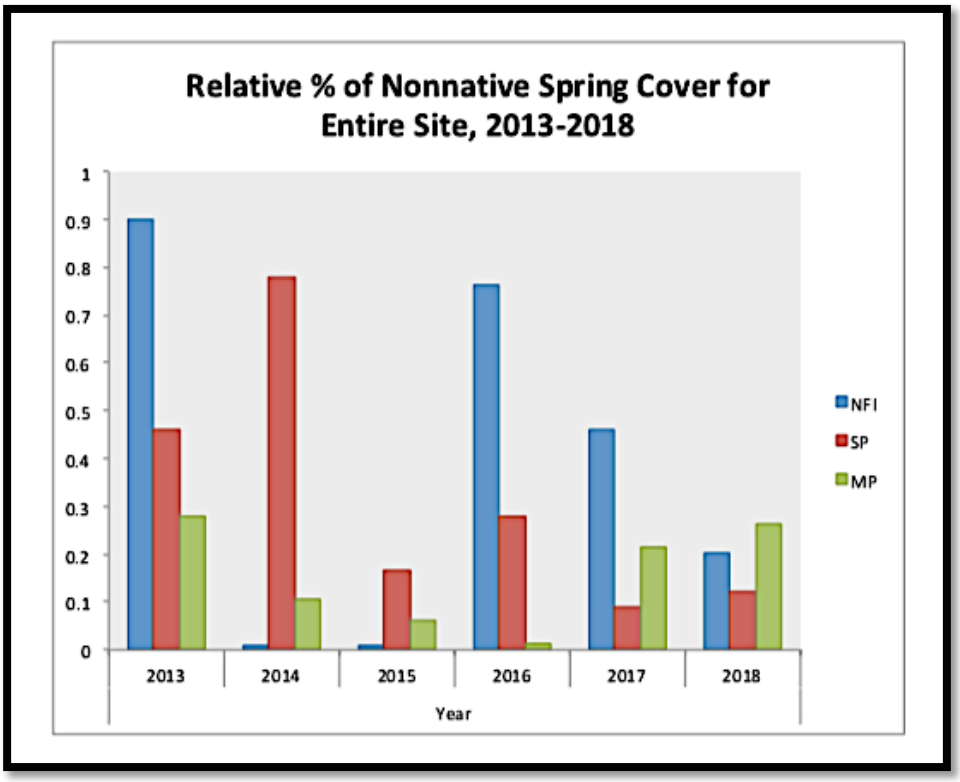


Figure 5: Relative percentage of non-native vegetation cover in the spring of 2013-2018. The goal was at or less than 30% cover.

North Fiesta Island management study

The original timeline for this study was over the course of the 2020-2021 and 2021-2022 restoration seasons, but staffing capacity related to the return of volunteer events in fall of 2021 prevented it from being executed the second year. Despite that, some interesting results were obtained from the first year of the study (see **Figure 6 and 7**). The application of pre-emergent herbicides was found to be most effective in inhibiting the growth of native plants rather than invasive plants, at least in combination with the three alternative treatment types. Sand amendment did appear to increase the suitability of the substrate, but also introduced seeds from novel species, some of which were invasive. Several Red Sand Verbena (*Abronia maritima*) individuals were also introduced, a rare coastal dune species in the area. Solarization did not appear to be as effective as we were hoping, likely due to the shortened period of implementation (tarping was down from mid-February through early April). This management technique is most effective during the hottest time of the year, which is also the CLTE nesting season. It appeared as though solarization actually encouraged the growth of the highly invasive Puncturevine (*Tribulus terrestris*), likely due to the large size of the seed. Salt application appeared relatively effective in preventing invasive growth, but not total overall growth.

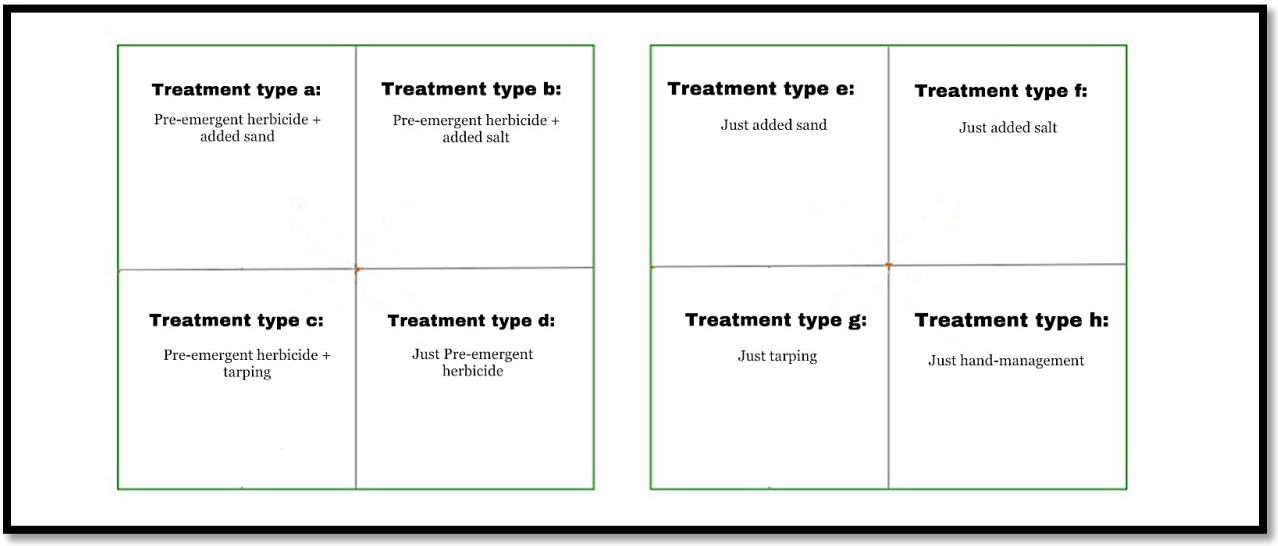


Figure 6: Treatment types for the North Fiesta Island alternative management study.

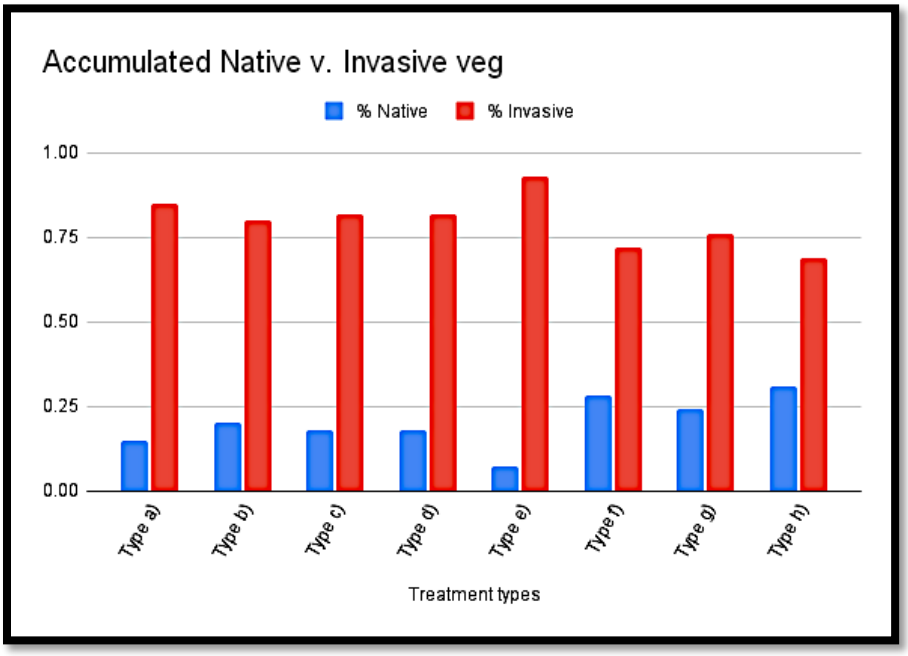


Figure 7: Percentage of native vs. invasive vegetation growth per treatment type for the North Fiesta Island alternative management study.

TernWatcher program

Despite the challenges of COVID-19, our TernWatchers program continued to see a high level of engagement during the majority of this grant. Sixty members of the public signed up for this program and contributed hours of their time in observing, recording and reporting predators. Thanks to the help of our part-time staff, data going back to 2014 was analyzed for the first time. Results showed a high level of Peregrine falcon activity, a key species that causes direct and indirect loss to nesting CA least terns.

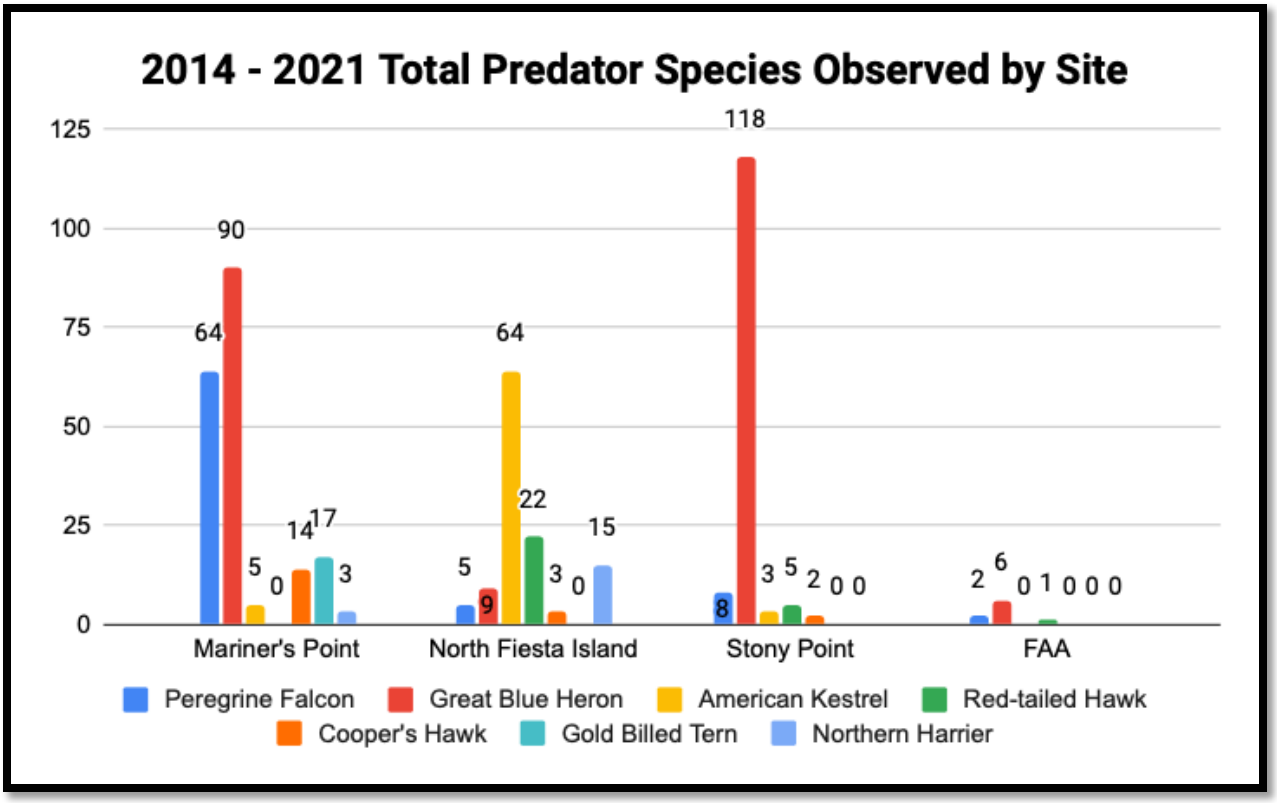


Figure 8: Summary of predators seen per nesting site by TernWatchers from 2014-2021. Note: The TernWatcher program does not occur at FAA Island and these sightings are solely from biological monitors.

Overall nesting productivity

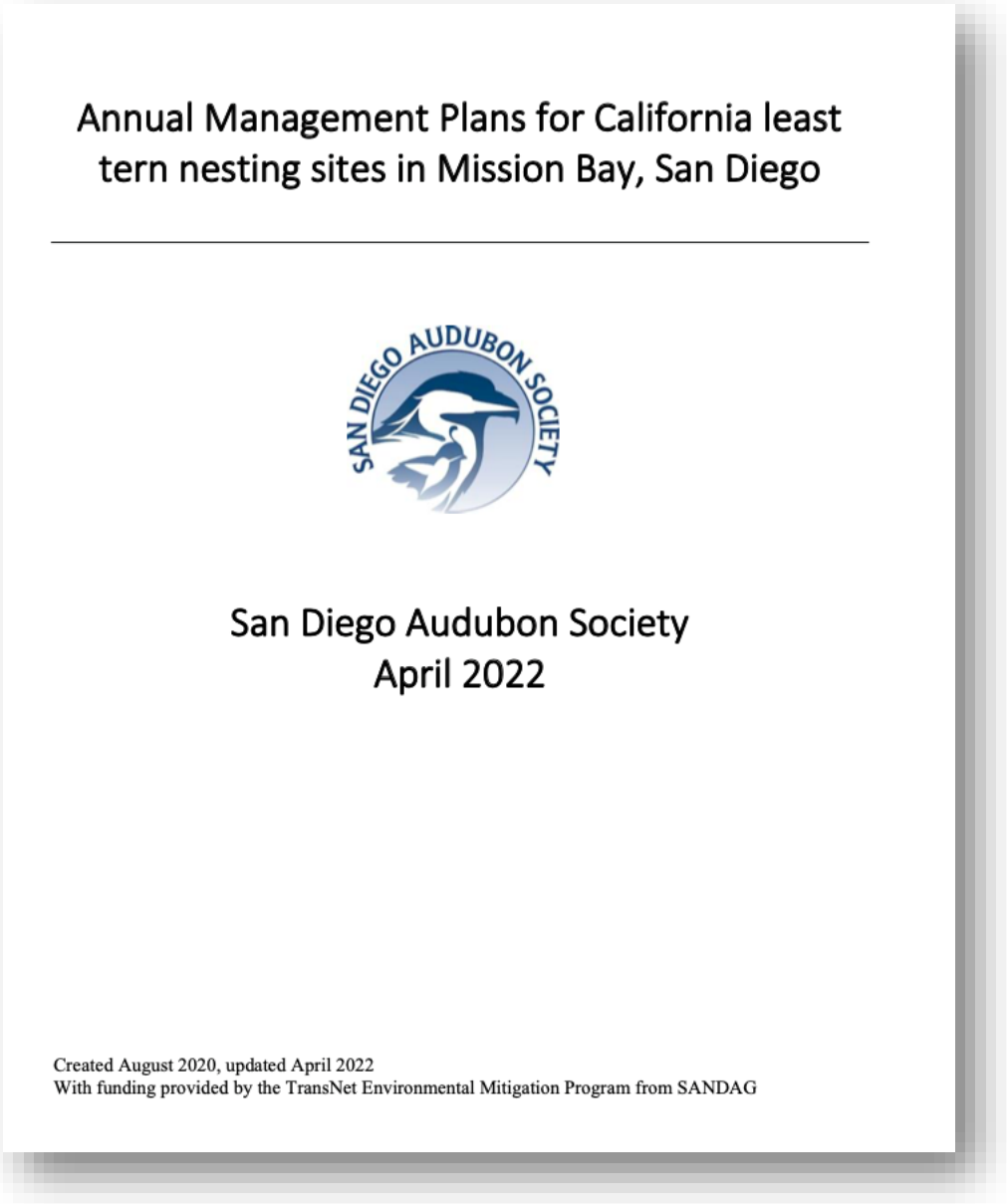
All three of the nesting seasons that took place over the course of this grant (2019, 2020 and 2021) were relatively successful in comparison to the success rate of other southern CA sites during these years. There was a total of 162 nests established in 2019, with the majority at Mariner's Point. From these nests, 133 chicks hatched and 39 chicks fledged. In 2020, 196 nests were established in total, with the majority again being found at Mariner's Point. From these nests, 166 chicks hatched and an estimated 68-76 chicks fledged. 2021 was more successful, with 208 nests initiated in Mission Bay (all at Mariner's Point and FAA Island). From these nests, 200 chicks hatched and an estimated 88-91 chicks fledged. In comparison, many other San Diego and Southern California sites saw no to low productivity in 2021.

Engagement with the public

Volunteer engagement is an essential part of this work, and we had to get creative about how to stay engaged with the public while gatherings were prohibited. We increased our social media presence and encouraged our volunteers to find socially distanced ways to stay involved

in our work. Because of this effort, we were able to reinitiate our volunteer work in the fall of 2021 with only a moderate amount of volunteer loss.

Appendices A-K

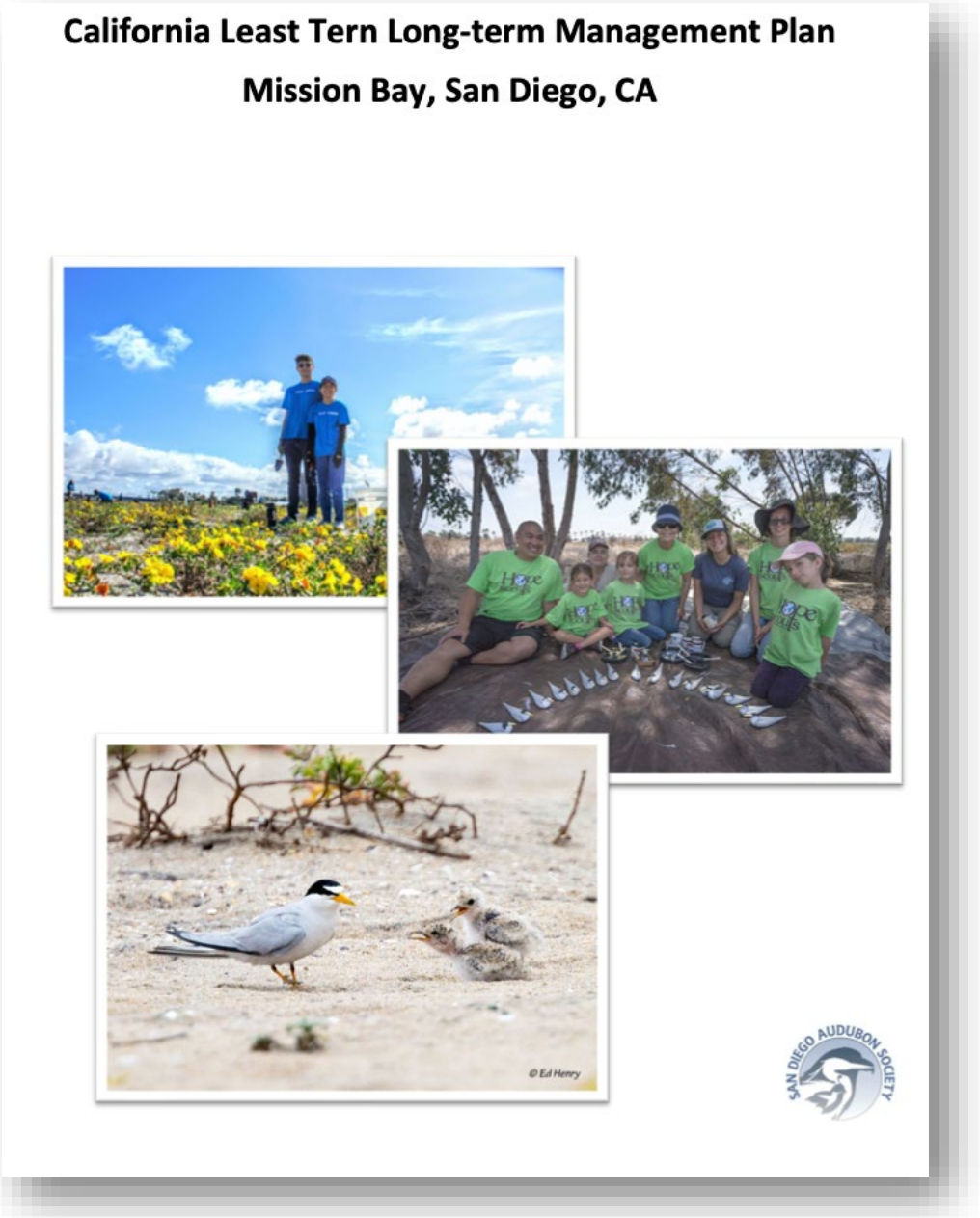


Annual Management Plans for California least tern nesting sites in Mission Bay, San Diego

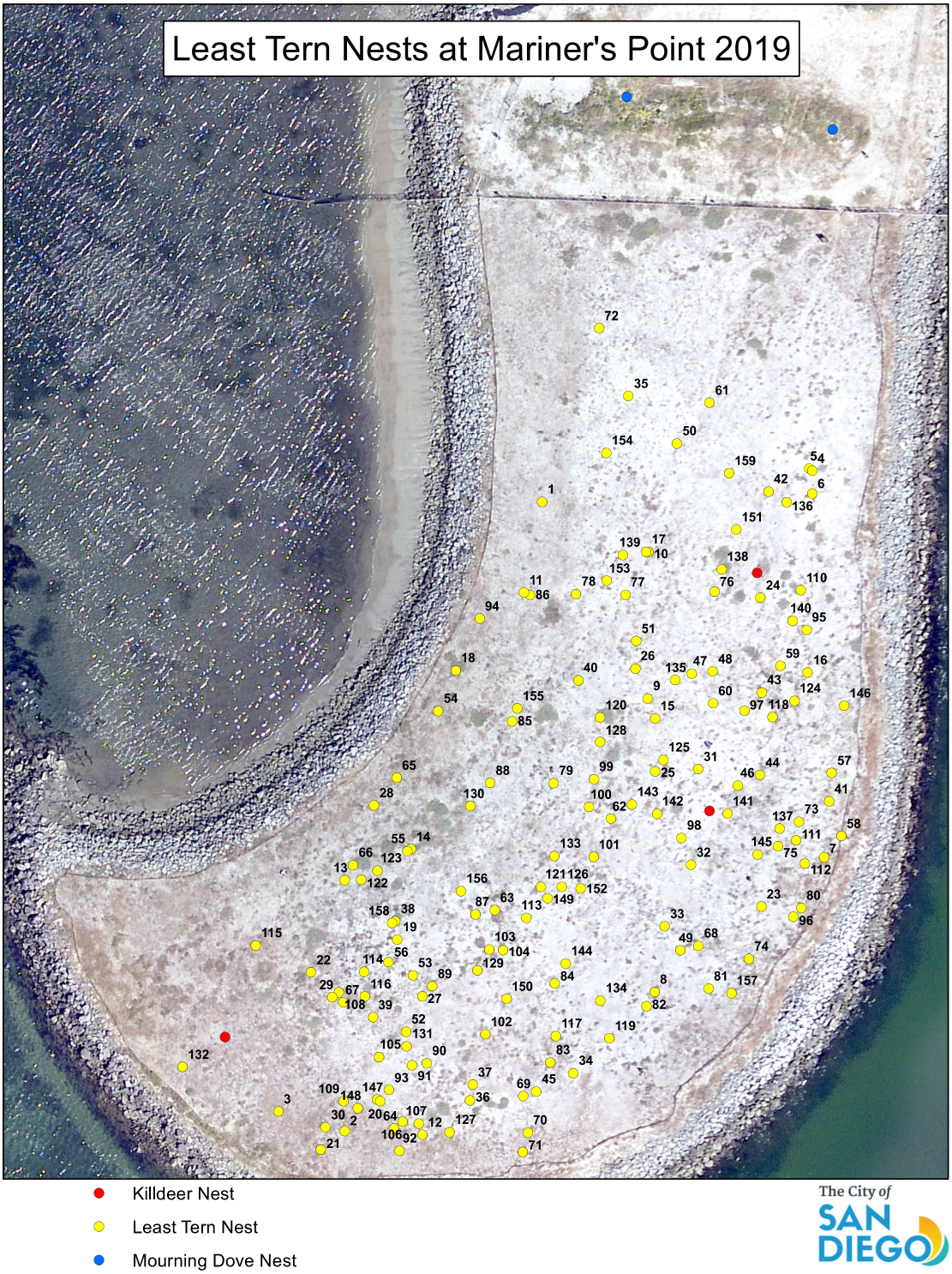
San Diego Audubon Society
April 2022

Created August 2020, updated April 2022
With funding provided by the TransNet Environmental Mitigation Program from SANDAG

Appendix A: cover of the Annual Management Plan for CLTE nesting sites in Mission Bay. A full copy has been provided along with previous quarterly reports.

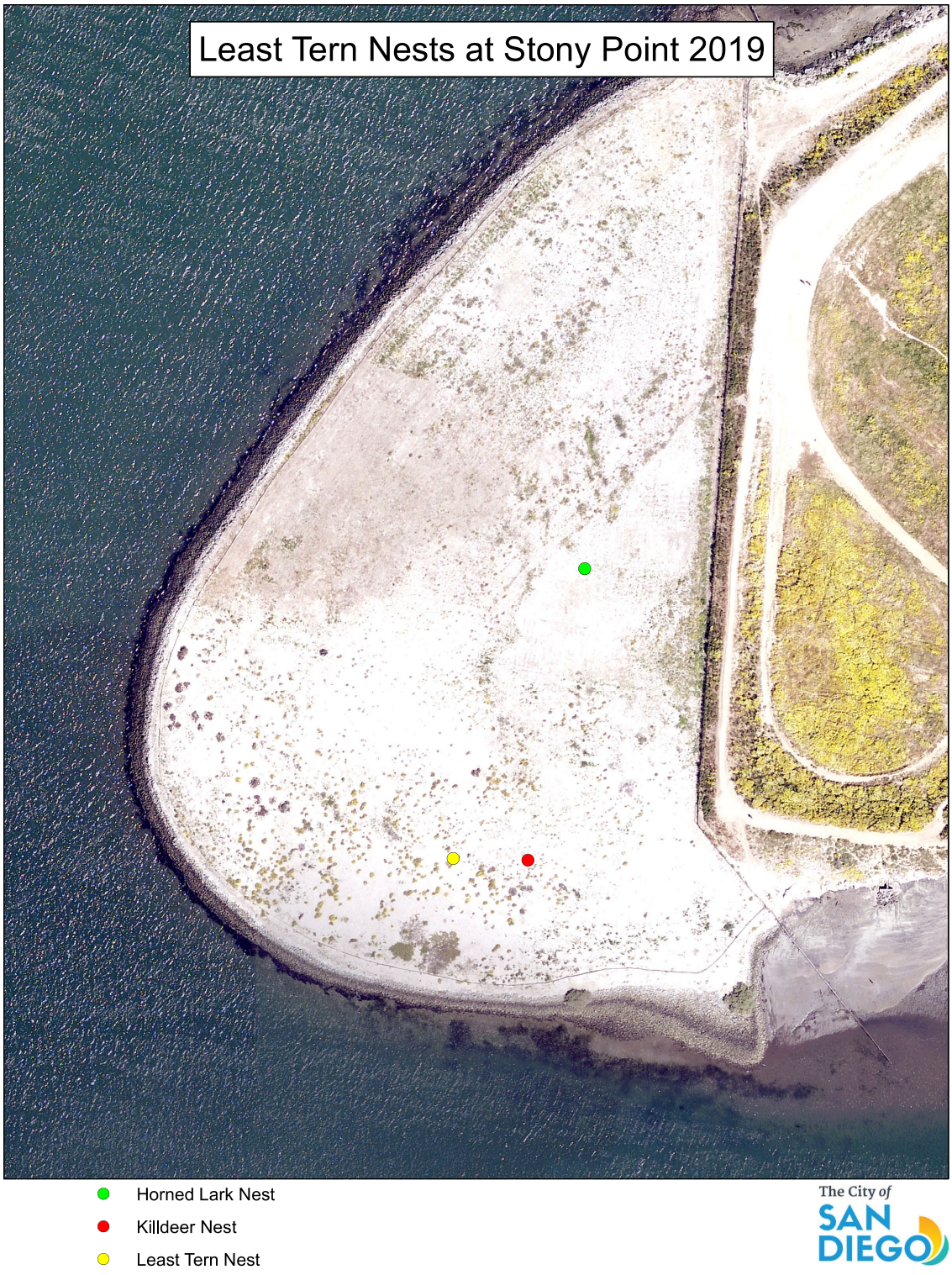


Appendix B: cover of the Long-term Management Plan for CLTE nesting sites in Mission Bay. A full copy has been provided along with previous quarterly reports.



Appendix C: CLTE nests at Mariner's Point, 2019.

Appendix D: CLTE nests at North Fiesta Island, 2019.



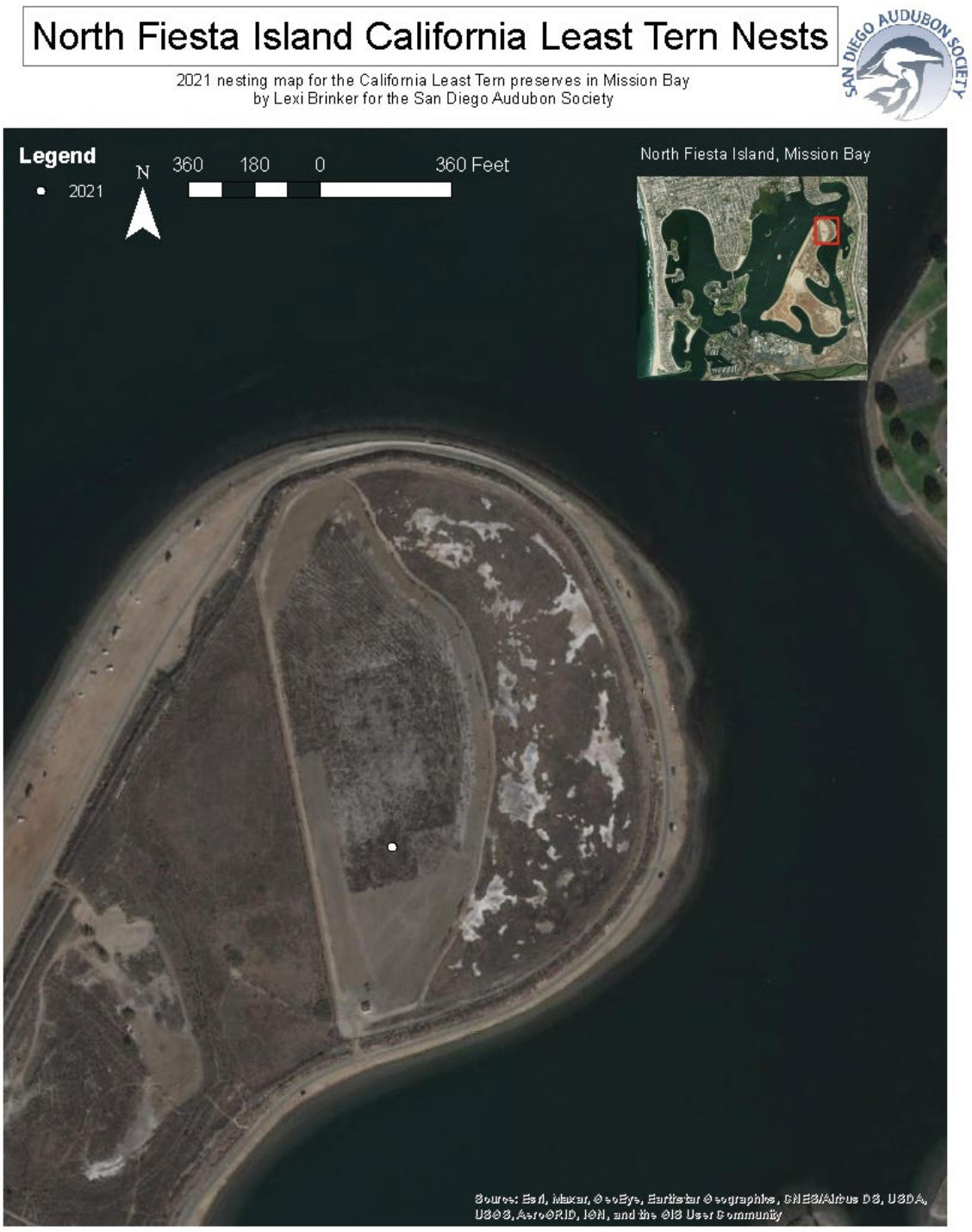
Appendix E: CLTE nests at Stony Point, 2019.

Appendix F: CLTE nests at Mariner's Point, 2020.

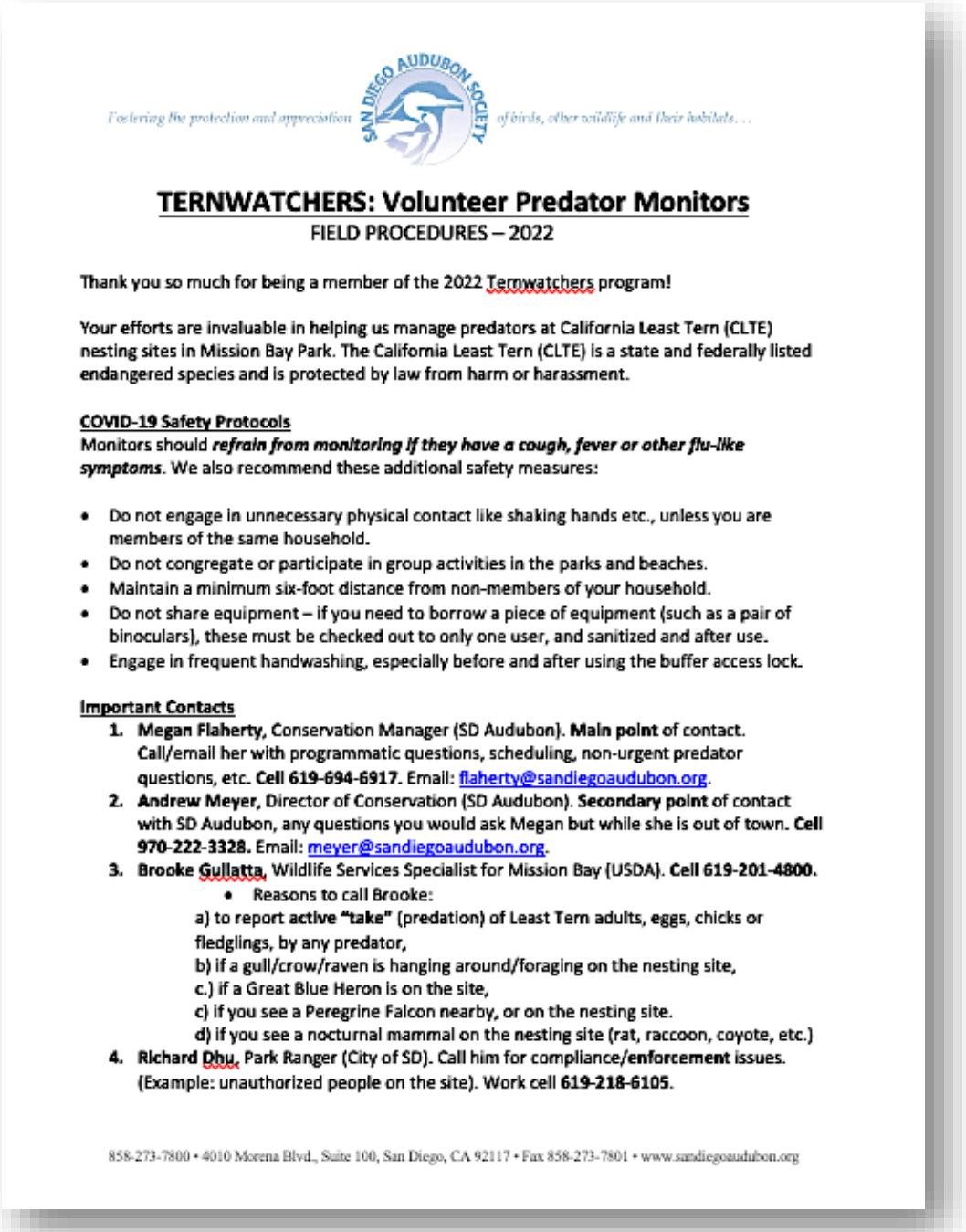
Appendix G: CLTE nests at North Fiesta Island, 2020.

Appendix H: CLTE nests at Mariner's Point, 2021.

Appendix I: CLTE nests at FAA Island, 2021.



Appendix J: CLTE nests at North Fiesta Island, 2021.



Fostering the protection and appreciation SAN DIEGO AUDUBON SOCIETY *of birds, other wildlife and their habitats . . .*

TERNWATCHERS: Volunteer Predator Monitors

FIELD PROCEDURES – 2022

Thank you so much for being a member of the 2022 Ternwatchers program!

Your efforts are invaluable in helping us manage predators at California Least Tern (CLTE) nesting sites in Mission Bay Park. The California Least Tern (CLTE) is a state and federally listed endangered species and is protected by law from harm or harassment.

COVID-19 Safety Protocols

Monitors should ***refrain from monitoring if they have a cough, fever or other flu-like symptoms***. We also recommend these additional safety measures:

- Do not engage in unnecessary physical contact like shaking hands etc., unless you are members of the same household.
- Do not congregate or participate in group activities in the parks and beaches.
- Maintain a minimum six-foot distance from non-members of your household.
- Do not share equipment – if you need to borrow a piece of equipment (such as a pair of binoculars), these must be checked out to only one user, and sanitized and after use.
- Engage in frequent handwashing, especially before and after using the buffer access lock.

Important Contacts

1. **Megan Flaherty**, Conservation Manager (SD Audubon). **Main point** of contact. Call/email her with programmatic questions, scheduling, non-urgent predator questions, etc. **Cell 619-694-6917.** Email: flaherty@sandiegoaudubon.org.
2. **Andrew Meyer**, Director of Conservation (SD Audubon). **Secondary point** of contact with SD Audubon, any questions you would ask Megan but while she is out of town. **Cell 970-222-3328.** Email: meyer@sandiegoaudubon.org.
3. **Brooke Gullatta**, Wildlife Services Specialist for Mission Bay (USDA). **Cell 619-201-4800.**
   - Reasons to call Brooke:

   a) to report **active "take"** (predation) of Least Tern adults, eggs, chicks or fledglings, by any predator,
   b) if a gull/crow/raven is hanging around/foraging on the nesting site,
   c.) if a Great Blue Heron is on the site,
   c) if you see a Peregrine Falcon nearby, or on the nesting site.
   d) if you see a nocturnal mammal on the nesting site (rat, raccoon, coyote, etc.)
4. **Richard Dhu**, Park Ranger (City of SD). Call him for compliance/**enforcement** issues. (Example: unauthorized people on the site). Work cell **619-218-6105**.

858-273-7800 • 4010 Morena Blvd., Suite 100, San Diego, CA 92117 • Fax 858-273-7801 • www.sandiegoaudubon.org

Appendix K: cover of the updated TernWatcher program protocols.