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Site Management Plan for the Venice Beach Least Tern Colony Marina Del Rey, California

by
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Site Management Plan
for the Venice Beach Least Tern Colony
Marina Del Rey, California

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INTRODUCTION

California least terns (*Sternula antillarum browni*) have nested near Venice Beach since 1894 (Western Foundation of Vertebrate Zoology records). In the early 1920's Lamb (1922) noted them as nesting among sand dunes. Nesting in the area from that time through 1976 was poorly documented. The Venice Beach Least Tern Colony was established in 1977, when three pairs of least terns nested on the sand at Venice Beach north of the Ballona Creek mouth (Atwood et al. 1977). Beach managers placed emergency fencing around the area to protect the nests and an enclosure has remained in the same general location.

This fence has allowed the colony to continue nesting with minimal human disturbance (Comrack 2001). Since 1977, Venice Beach has supported up to 16.6 percent of the pairs of breeding least terns and over 30 percent of fledglings statewide (Ryan et al. 2009). However, during the past ten years, the percentage of statewide pairs contributed by the Venice Beach colony has declined from a maximum of 12.4 percent in 1994 to 0.4 percent in 2004. Additionally, the proportion of fledglings produced at the Venice Beach colony declined from 12.4 percent in 1994 to 6.9 percent in 2003, with no productivity in 2003, 2004, 2005, and 2009 (Ryan et al. 2009). Since the establishment of the colony, many biologists have monitored and studied it, and several papers have been published on studies done here in the 1970's and 1980's (Atwood 1986, Atwood and Kelly 1982, Atwood and Massey 1988, Massey et al. 1992, Massey and Fancher 1989). Details of the tern's population and productivity have also been summarized in annual reports produced by the California Department of Fish and Game.

Throughout past decades, terns have dealt with a variety of threats. Initially, there were impacts from recreational activities and off-leash dogs, and later, predation from American kestrel (*Falco sparverius*) and peregrine falcon (*Falco peregrinus*). Beginning in the late 1980's, American crows (*Corvus brachyrhynchos*) learned how to find tern nests (Massey and Fancher 1989) and have become the main threat facing the terns. The tern enclosure itself has been through several changes prior to the 3.3-hectare facility that is currently in place. This document is an attempt to record lessons learned and methods developed by Project Biologists to ensure the long-term protection of this colony. However, threats will continue to change and this report should be viewed as a work in progress and revised annually by the Project Biologist.

Predation.

Project Biologists and predation control specialists have used a variety of predator control techniques at the tern colony. Between 1977 and 1990, dogs, cats, and American kestrel were identified as the main predators. Initially a fence was installed to deal with problems presented by pets and recreation, and it was apparently successful as the colony grew into one of the largest in the State by the mid-1980. Other predators mentioned include peregrine falcon, great horned owl, common raven, and loggerhead shrike.

Recently, American crows have been the most commonly reported predator (Comrack pers. comm.). The first mention of American crow in the literature and CDFG annual reports is in 1983; they are mentioned again in 1986, and there was heavy late season predation in 1989. By 1992, all eggs of the first 39 nests were reported predated by crows. In her report, Caffery (1994)

comments, “Crows have historically been the major predators at Venice Beach.” In 1994, Ms. Caffery put out crow heads to attempt to deter the crows, and this tactic appeared to be successful initially (Caffery 1995). Since 1990, American crows have been the terns’ main predator (L. Comrack pers. comm.). Crows destroyed all eggs laid in 2002, 2004, 2005, and 2009 prior to hatching and were the main predators on eggs even in the successful years of 2006, 2007 and 2008. Since 2005, predator management has been mostly successful and played a key role in the successes mentioned above. However, in the past, it was often deployed once egg predation was already a problem, and came too late to influence the outcome.

In 2006, a modified approach was attempted. The volunteer monitor program was expanded and an emphasis was placed on predator observation and reporting. Additionally, predator control personnel used egg-baited traps in the colony. We concluded that early placement of traps and removal of crows prior to least tern nesting is essential to control crow predation at the site. However, these recommendations were not followed in 2008, when, similar to 2005, traps were not set until May 15 (and even then only four were used, with six more added on June 21). Four crows were trapped in late May and June. The colony suffered 100% predation prior to June 16, but very little egg predation afterwards. However, trapping may not be sufficient to guarantee success, particularly in years where foraging resources are scarce and fewer adult terns attend at the colony. This has been documented at other seabird colonies as well (Hatch and Hatch 1990).

Vegetation.

The site is dominated by beach primrose (*Cammisonia cheiranthifolia*), silver beachweed (*Ambrosia chamissonis*), sea rocket (*Cakile maritime*), and sand verbena (*Abronia maritima*). These are found within both the dune habitat and vegetated flats (Figure 1). All of these species have begun to colonize newly enclosed dry beach habitat (Figure 1). In the newly enclosed areas, the habitat was mostly previously groomed dry beach with unvegetated sand. In 2007, sea rocket emerged in large numbers, dominating the other plant species. This may be a problem because this species is non-native and invasive. The project team observed pre-fledge least tern chicks hiding within it, but preliminary studies indicate that adult least terns prefer placing their nests in areas with vegetation heights of less than 10 cm (Ryan and Vigallon 2009); this is smaller than most sea rocket plants grow. In both 2007 and 2008, aggressive action was taken to remove as much sea rocket as possible during both the pre- and post-nesting season periods. In 2008, beach heliotrope (*Heliotropium curassavicum*) was also found near the west fence in newly enclosed dry beach habitat and saltgrass (*Distichlis spicata*) was found in the southeast corner in newly exposed vegetated flat habitat.

Figure 1: Habitat Types at the Venice Beach Tern Enclosure

Figure 2: Habitat Types at the Venice Beach Tern Enclosure with Buffer Zone

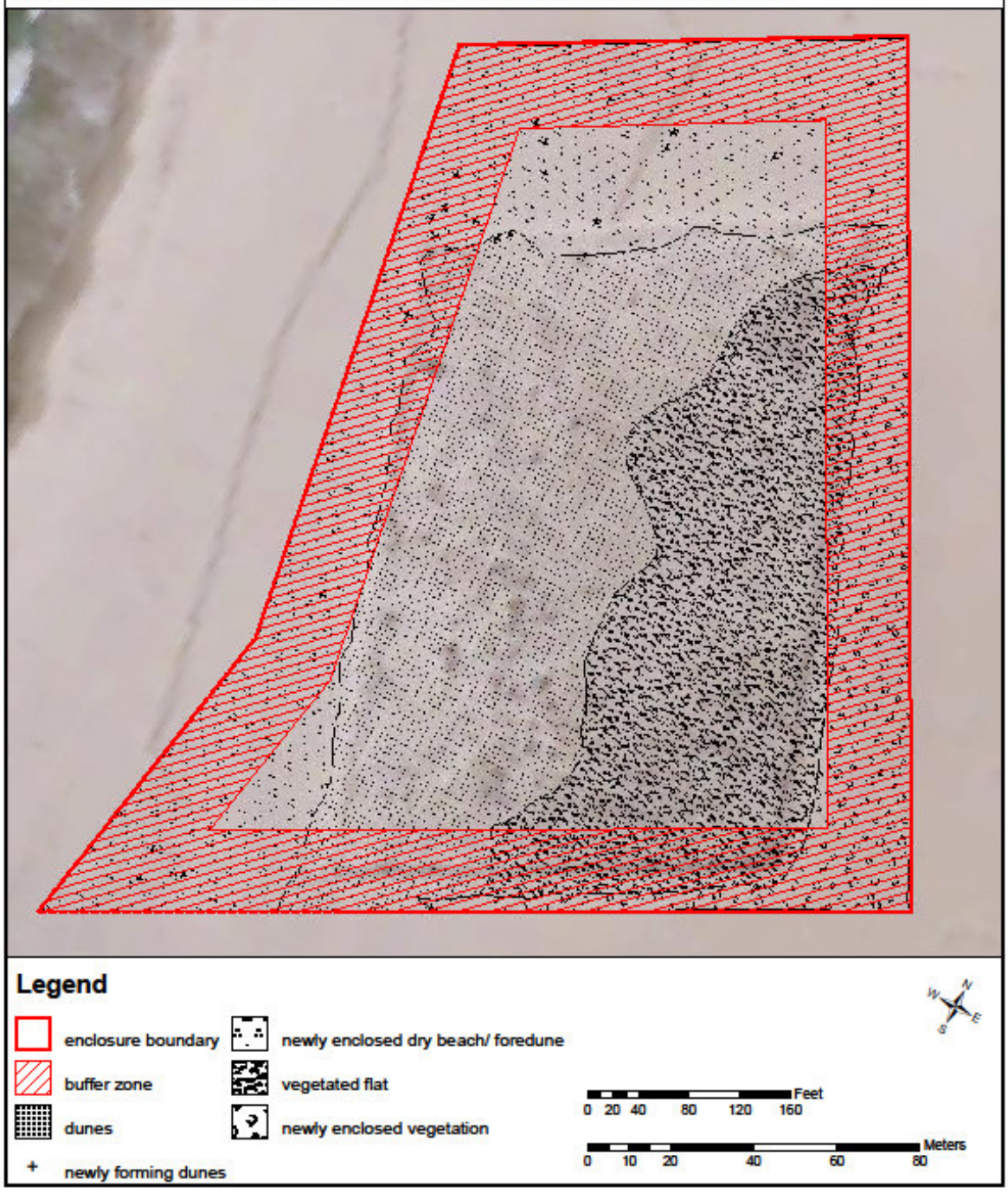
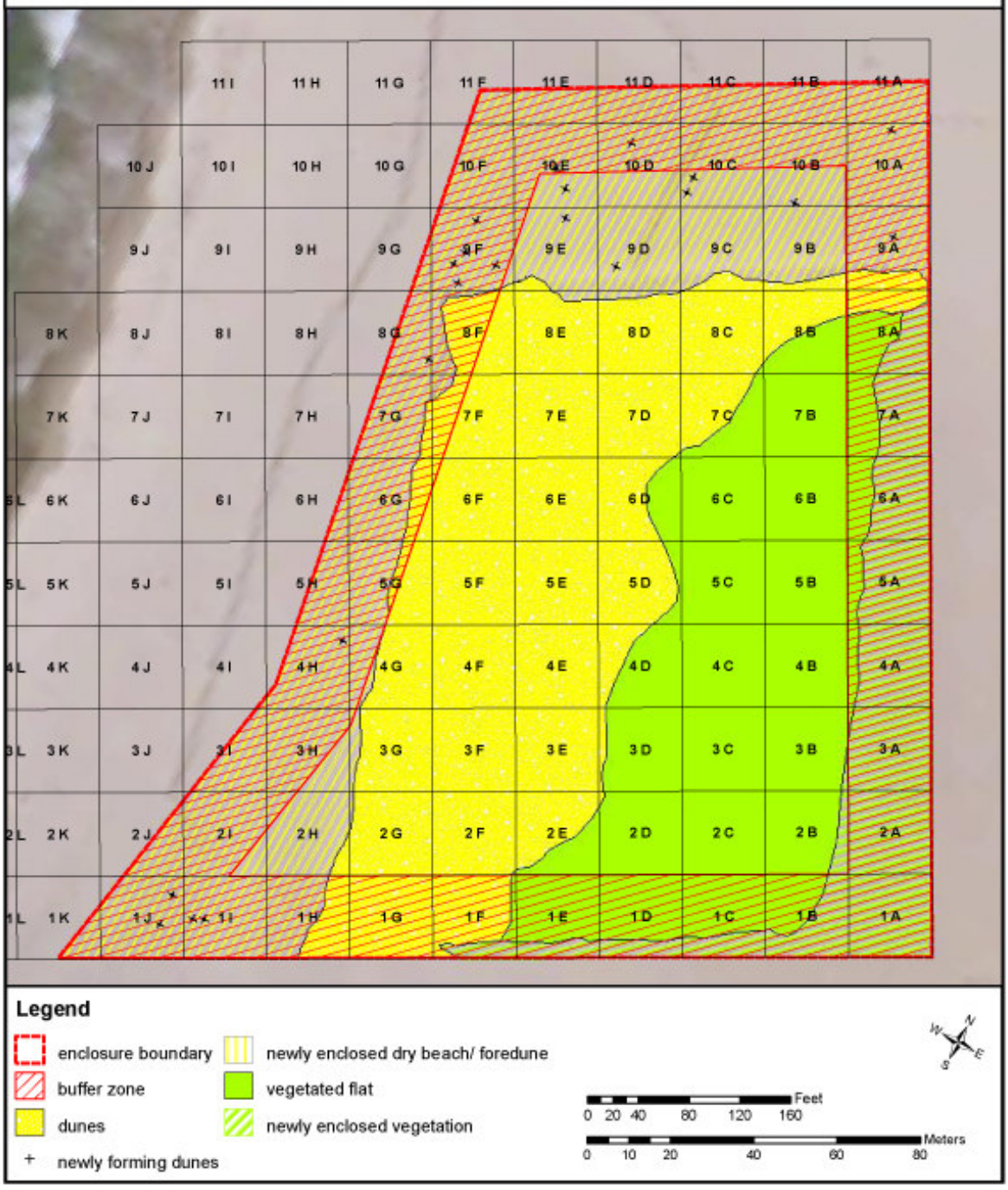


Figure 3: Habitat Types at the Venice Beach Tern Enclosure with Buffer Zone and Study Grid



Sand Dunes.

California least terns have been known to nest in dune vegetation historically near the current colony site (Lamb 1922) and currently at colonies in Baja California (E. Palacios, pers. comm.). They have also been known to nest between dunes at North Beach, Camp Pendleton, California (Swickard 1972). In the absence of sand manipulation, small sand dunes have formed within the enclosure (Figure 1). It appears that these dunes occurred here naturally at least into the 1920's based on a report by Lamb (1922). This area has been protected from beach grooming and raking since the late 1970's, and in the subsequent 30+ years, a dune system formed in the former enclosed area. Prior to 2006, the largest dunes built up along the west fence, where the prevailing westerly winds built up sand on the old fence. After the expansion of the fence in 2006, this area continues to serve as the foredune (see definition below) area, with small coppice mounds (see definition below) forming to the newly enclosed dry beach area to the west (Figure 1). Behind these first foredunes, low sand dunes extend 40-60 m to an area of vegetated flat that continues to the extent of the former fenceline (Figure 1).

We suggest that these dunes are important for the nesting terns as they have the highest nest density of any of the grids in the enclosure. In addition, sand dunes are known to be a resilient natural barrier to the destructive forces of wind and waves. They are the least expensive and most efficient defense against storm-surge flooding and beach erosion, both absorbing the impact of storm surge and high waves and preventing or delaying intrusion of waters into inland areas. Dunes hold sand that replaces eroded beaches after storms and buffer windblown sand and salt spray (TGLO 2005). These dunes may be increasingly important both to the terns and to local homeowners in the face of potential sea level and tidal range rises predicted to occur as effects of global warming.

Habitat Definitions

Dry Beach is the relatively flat, sandy habitat between the wet sand and beach slope and the foredunes (see below). This area has little vegetation, although areas that are not overwashed will begin to grow dune-affiliated plants. These may then form coppice mounds.

Coppice mounds are the initial stages of dune growth. They are formed as sand accumulates on the downwind side of plants and other obstructions on or immediately adjacent to the beach. Coppice mounds may become vegetated and eventually increase in height, becoming foredunes (TGLO 2005).

Foredunes (also called fore-island dunes or primary frontal dunes) are the first clearly distinguishable, vegetated dune formations landward of the water. They are also the first to dissipate storm-generated wave and current energy. Although foredunes may be large and continuous, they typically are separate rounded knolls (TGLO 2005).

Vegetated Flat forms in the leeward side of the dune and consists of a relatively flat, more heavily vegetated area. Soils may build up in these areas, leading to a greater diversity of vegetation.

Several methods may be used to increase the height and stability of existing dunes, repair damaged dunes, encourage sand accumulation closer to the beach, or establish dunes where a low sand supply has inhibited dune formation or where dunes have been destroyed. Where fresh sand deposits around obstructions such as grass clumps show conditions conducive to natural dune formation, plantings of native vegetation or structural barriers can be used to start and accelerate sand accumulation (TGLO 2005).

Fence.

A new 6-ft chain-link fence, coated with sand-colored rubber, was erected in March 2006. It expanded the enclosed area from 1.7 to 3.3 ha. Overall, the site was expanded outward, mostly to the north and a triangle-shaped area in the southwest corner. The newly enclosed areas were previously subject to regular beach grooming and flattening by heavy equipment. In 2007 and 2008, vegetation continued to grow in these areas and coppice mounds have formed (Ryan and Vigallon 2008). Data taken from 2006 to 2008 indicates that fewer terns select nest sites less than 20 m from the fence on the north, south and west sides, and less than 40 m on the east side (Ryan and Vigallon 2009). Those that do nest in these areas are subject to higher rates of egg depredation by American crows, and thus lower productivity. This may be in part due to the crow's ability to use the fence as cover for their approach to the colony, and as a perch from which to hunt. However, without this fence, mammalian predators and human disturbance would likely destroy the colony.

Global Warming & Sea Level Change.

The enclosure is located between the ocean and the boardwalk and apartments of the City of Marina del Rey. Winter storms combined with high tide events in 2007 and 2008 caused some overwash into the southwest corner of the enclosure from the Pacific Ocean. Therefore, the low point of the enclosure sits within the zone of impact from a combined high tide and storm surge. Current models forecast increases in both sea level and high tide level. In the near-term, these are likely to be a few inches, but some models predict increases as high as 3 ft. In the near future, the dunes will help protect both the enclosure and the adjacent houses from wave action caused by storm events that are likely to wash into the enclosure with increased frequency. The dunes will also help prevent coastal erosion, which may be a greater threat to the enclosure if wave action erodes the sand from beneath the fence, rendering it useless. Although the speed and size of these changes are subject to on-going analysis, we suggest that the presence of dunes is beneficial to maintaining this colony and will become increasingly important as maximum tides and sea level increase.

Potential for community outreach and academic collaboration.

Though the specified purpose of the enclosure is to provide protected breeding season habitat for California least terns, the site also serves as habitat for a wide range of plants, invertebrates, and bird species on a year-round basis. It is important to note that little dune habitat remains in Los Angeles County, making the colony enclosure a unique opportunity for potential collaboration with the academic community during the pre- and post-breeding seasons. Such collaboration could bring not only greater understanding of the requirements for restoring dune habitat and the

wildlife dependent upon it within the enclosure, but could also provide additional sources of funding to maintain the colony. In addition, the enclosure's location on a public beach offers excellent community outreach and wildlife viewing opportunities on a year-round basis at no cost to beach-goers, and thus is accessible to a broad spectrum of the public. The implementation of outreach events and interpretive signage could help garner public support for conservation efforts and broaden the potential funding resources for the enclosure's maintenance as well.

METHODS

This document is based on both Project Biologist experience and data analysis provided by a study of nest placement and success measured among habitat characteristics conducted between 2006 and 2009. For a complete discussion on methods used during this study, please see Ryan et al. (2010). Habitat characteristics studied include vegetation cover and height, dune height, and distance from the fence of nest sites. Our findings indicated that predation by American Crow exerts an "edge effect," with the heaviest predation on individuals away from the center of the colony and closest to the fence. We found that nests were less likely to succeed if they were placed within 20 m of the enclosure fence, in grids with fewer than 5 other nests (<125 nests/ha), more than 5 m from their nearest neighbor and more than 70 m from the center of the colony. Additionally, tern nests were more likely to be predated in areas with less than 5% vegetation cover, and terns prefer to nest, and are most successful, in areas with 20-40% vegetation cover. We found that the best vegetation management technique was to reduce vegetation to less than 30% cover, but even this was not as successful as areas that are naturally between 5-30% vegetation cover. The terns also prefer to nest, and are most successful in, areas with dunes, although our findings indicate that predation increases with the number of dunes in an area. Based on these findings we recommend:

1. Manage the American Crow and other nest predators with a goal of decreasing the strong edge effect and colony failures. We must continue aggressive management to discourage incursions into the colony and use volunteer observers to inform staff of predation rates.

2. Nesting should be discouraged within 20 meters of the fence.

3. Control vegetation, with a goal of maintaining 20-40% cover in nesting areas within the colony. Vegetation manipulation will likely have the most impact if used to maintain open areas in the vegetated flat (Figure 2) and increase cover in the newly exposed areas (Figure 2). We should accomplish this by first removing non-native sea rocket, then selectively removing native vegetation.

4. Maintain some areas of the vegetated flat as dense vegetation as we have noted that chicks hide in this area once they leave the nest, but before fledging.

5. Maintain dune habitat where it exists and encourage growth in the newly exposed areas (Figure 2). However, this requires further study as there may be an upper limit to the height of dunes that the terns will accept. We should use caution when clearing vegetation so that we do not destabilize dunes.

We have also used Project Biologist recommendations included in published annual reports from the colony. This report has also benefitted from discussions with Charles T. Collins, Lyann Comrack, Kathy Keane, W.L. Ross, and Michael D. Taylor.

PART I: HABITAT MANAGEMENT PLAN

The goal of the Habitat Management Plan is to manage the vegetation and dunes, and to encourage the terns to nest in areas that optimize hatching rates and minimize predation rates. Our results (Ryan et al. 2010) indicate that the least terns prefer, and are more productive in, areas of the enclosure with the following characteristics:

1. Areas with higher nest density (>125 nests/ha) or more than five nests per grid, where nests are less than 5 m from their neighbor and within 70 m of the colony center.
2. Areas greater than 20 m from the nearest fence.
3. Areas with 20-40% vegetation cover and vegetation height of 1-10 cm.
4. Areas with multiple (>11) dunes 1.5 to 2.0 m in height.

They have tended to do poorly at the boundaries of the colony within the newly enclosed area that mostly consists of non-vegetated, flat, bare sand and best within the moderately vegetated dune habitat.

Based on these findings, we make the following recommendations for the preliminary Habitat Management Plan. We divide the existing enclosure into four zones: the dunes, vegetated flat, newly enclosed dry beach/vegetated flat, and the fenceline (Figure 1).

1. **Dunes.** This zone typically has the highest density of nesting terns. We recommend preserving the existing dune habitat as the primary nesting area and recommend the following for the grids shown in yellow in Figure 3.
    a. The vegetation management in this zone has an annual goal of clearance to 20-40% vegetation cover. Grids that meet this goal will require no vegetation management other than non-native plant removal. Grids above this goal should be subject to vegetation removal prior to the nesting season.
        i. Vegetation removal from existing dunes should be minimized to the extent possible in order to preserve the dunes.
        ii. Vegetation removal that must occur to meet goals should be achieved by:
            1. Hand-clearing non-native sea rocket and other invasive plant species.
            2. Removing vegetation from low areas between dunes.
            3. Selective clearing of some vegetation from dunes if necessary; when it is, vegetation may be removed from the leeward side, and should be thinned on dune tops and the windward side so that enough vegetation remains to stabilize the dune.
    b. The following dune conservation practices should be observed:
        i. In areas where large amounts of sea rocket or other non-native plants are removed from the windward side and tops of dunes and coppice mounds, it should be replaced by transplanted native vegetation.

ii. Native vegetation should not be taken from coppice mounds or other dunes.

2. **Vegetated Flat.** This zone typically consists of flat areas and small coppice mounds (Figure 1). It has a lower nest density than the dunes, but still supported 11% of nests in 2008. If left alone, it can become heavily vegetated (>60%). Areas that have been cleared typically demonstrated a higher nest density than uncleared areas with greater than 30% cover (Ryan et al 2010). However, heavily vegetated uncleared areas appear to provide significant protection for tern chicks after they have left the nest but before they are able to fly. We recommend the following for the grids shown in green on Figure 3:
    a. One-third of this zone should be designated as a vegetated area and only be cleared of non-native plant species; this will include grids 2B, 2C, 2D, 5B, and 5C.
    b. The other two-thirds should be partially cleared of vegetation (treated areas) to encourage tern nesting, with one half of the total area being cleared each year, so that these grids are maintained between 20-40% vegetated. Grids cleared in odd numbered years will be 3B, 3C, and 3D, 6B and 6C. Grids cleared in even number years will be 4B, 4C, and 4D, 7B and 7C.
    c. Non-native vegetation taken from the treated areas should be disposed of in garbage bags and removed from the site.
    d. Native vegetation removed from the treated areas should be transplanted into both the dunes to compensate for non-native plant removal from dunes or into the newly enclosed and buffer areas to help generate new vegetated areas and dunes.
    e. Damaged native vegetation should be stacked in the newly enclosed dry beach/foredune to encourage new dune formation.

3. **Newly Enclosed Dry Beach/Foredune/Vegetated Flat.** Much of this zone is within the Fenceline/Buffer Zone (Figure 1). However, there are substantial areas fitting this description on the northern side of the enclosure (Figure 1). Most are still mainly non-vegetated, although dune formation is in the early stages (Figure 1). We predict that these areas will form dunes and become one of the more productive regions of the colony.
    a. We recommend the following in grids 9B, 9C, 9D, 9E, 2H and portions of grids 10B, 10C, 10D, 10E and 3H:
        i. Encourage additional vegetation growth and dune formation in these areas.
        ii. Remove only non-native plants from these areas.
        iii. Pile dead/damaged native plant material removed from the cleared grids to create dunes and transplant native plants that are still in good condition into these areas.
        iv. When dunes and vegetation become established, use recommendations provided in Dunes (see above).

4. **Fenceline/Buffer Zone**. We recommend encouraging additional vegetation growth and dune formation in the areas within 20 m of fence that were freshly exposed in 2006 (buffer zone) (Figures 2 & 3).
    a. We recommend that in grids areas within the buffer zone (Figure 1):

i. Only non-native plants should be removed annually from these border areas.
ii. These areas should be planted with native plants removed from treated grids.
iii. These areas should be targeted for planting other sensitive dune plants.
iv. These areas be allowed to grow to >40% cover to provide a border that will discourage nesting and provide cover for fledgling terns.

In addition to these recommendations, we suggest to local agencies and biologists that this enclosure creates a unique opportunity for dune restoration in coastal Los Angeles County. We suggest that there is an opportunity to plant other sensitive native plant species that are consistent with the management goals for terns. These species should be low growing and not prone to covering large areas of ground. Agreements should allow removal and trampling of these plant species during normal enclosure maintenance as described above and during the nesting season surveys.

PART II: ANNUAL RESPONSIBILITIES OF THE PROJECT TEAM

Volunteer Organization

The volunteer program began in 2005 as an informal effort by Mr. Ryan, members of the Santa Monica Bay Audubon Chapter, and community residents. Since 2007, it has been managed by Los Angeles Audubon through Section 6 Grant funds provided by the San Diego Office of the CDFG.

Recruitment.

A calendar for Volunteer Monitors should be prepared each year consisting of days of the week and time-periods when the colony should be monitored. Currently, the time-periods are dawn to 9 am, 9 am to noon, noon to 3 pm, and 3 pm to sunset. The previous year's volunteers should be contacted first so that they can reserve days and times that they would like to monitor. They should also be asked if they would like additional help during their survey and if they are planning any extended vacations. Each year an effort should be made to enlist new Volunteer Monitors. We recommend starting these efforts early in February by a) placing free ads in local community newsletters and craigslist, and posting fliers in downtown Venice Beach and Playa del Rey; b) visiting Santa Monica Bay, Los Angeles and South Bay Audubon Chapter meetings; c) contacting other local environmental volunteer programs. Volunteers should also be organized to assist with pre-season vegetation management and general maintenance that takes place in March. After April 15, Volunteer Monitor teams should be visiting the colony four times per day (ideally 28 teams of 1-2 volunteers, 28 – 56 people). Minimally, we should have volunteers visiting the colony each day (7 – 14 people). **Annual effort: approximately 20 hours.**

Training.

A volunteer training course should take place each year during February or March. All new volunteers must attend, or may be trained later by a Project Biologist or experienced volunteer. Volunteers from previous years should be encouraged to attend to be updated on any changes in

data collection, methods, or forms. The training should cover a) biology of the least tern, b) laws and regulations, c) study methods, d) personal safety, and e) reporting requirements. In the past, these have been scheduled to coincide with vegetation management days, but this has been unsuccessful. A separate training should be conducted on a weekday evening or weekend day, or both. **Annual effort: approximately 20 hours.**

Coordination.

Continual coordination is necessary between volunteers, Project Biologists, predator control personnel, and agency staff. A Volunteer Coordinator needs to organize the training course and schedule the volunteers prior to April 1. Beginning April 15, the volunteers will begin to monitor the least tern colony. On a daily basis, the Volunteer Coordinator must a) collect and review daily reports for signs of predator problems, b) enter data into an MS Excel Spreadsheet, c) communicate problems to the Project Biologists, and d) be available to answer questions from the volunteers. On a weekly basis, the Coordinator must a) prepare and review a weekly summary of the spreadsheet and submit it to the Project Biologists and assist with reports to the agencies. Monthly, the Volunteer Coordinator helps prepare a report to the volunteers. At the end of the year, the Coordinator must summarize the volunteers' activities for the annual report. This takes approximately 10 hours per week.

Once nesting begins, the Volunteer Monitors should be visiting the site weekly and reporting their observations in a timely manner. The Project Biologists and Volunteer Coordinator should send each volunteer a weekly update on the status of the colony via e-mail and then send a report at the end of each year. The Volunteer Coordinator's responsibilities include scheduling volunteers, collecting data, screening for and relaying important predator reports, ensuring that volunteers are following protocol and sending in their data, assisting with surveys if needed, organizing the data, and supplying a weekly summary to the Project Biologists. The Project Biologists should assist the Volunteer Monitor, especially with training and providing feedback to the volunteers. **Annual effort: 150 hours.**

Public Outreach

Currently, there is little public information about the Venice Beach tern colony. In 2009, we installed new signs on the fence. We recommend the following:

1. Permanent signage be constructed either on the beach near the colony, or on the walkway adjacent to the colony. We suggest the installation of a chalkboard, where Volunteer Monitors can write the number of birds/eggs/chicks each week, as the public has requested this.
2. The Volunteer Coordinator should schedule public outreach days in June and July. At these events, volunteers and staff may lead tours from outside the fence using spotting scopes.
3. Do more local advertising of the colony clean-up days within the Venice Beach community.
4. An outreach program should be scheduled with the LA County Lifeguard's "Beachology" programs given adjacent to the colony.

Annual effort: approximately 30 hrs.

Predation Control

Predation control will always be a dynamic challenge, especially with intelligent, social corvids. Our first recommendation is to continually experiment with new techniques and monitor closely for new problems. Here we address these activities by predator type.

American Crows. The Project Biologists and Volunteer Monitors should continually monitor levels of predation. Each week, predator activity should be reviewed, including the number of individuals and activity levels measured by fly-overs and landings. Predation rates should also be compared with previous years. If levels are above those for "successful" years, then additional predator control measures should be considered, including the following:

1. Predator control management should begin early in the year, at least by mid-March. This may need to be expanded to a year-round activity to reinforce the lesson that eggs are dangerous to the local crow population.
2. At least ten egg-baited traps should be used until the volunteer monitoring reports indicate that crow activity is in a similar range as was observed in 2006 and 2007 and the terns have at least 100 nests established with less than 30% week-to-week predation.
3. We recommend using "wildlife body traps" baited with quail or dead tern eggs, placed in a depression in the sand, similar to a tern nest.
4. These traps should be operated for as much time as possible prior to nesting by terns. They should be checked daily and eggs should be used each time they are set or every four days.
5. When crows are captured, their stomachs should be removed and preserved to determine what else might be drawing them to the colony, and the carcasses should be placed on the colony.
6. We should continue to place additional crow carcasses on the colony beginning in early April.
7. If volunteer monitoring reports during the nesting season indicate high levels of crow predation and/or activity, then egg-baited traps should continue to be deployed in areas where biologists note heavy predation activity, but out of sight of the public. Any crows killed should be left in place within the colony.
8. If the traps are failing to capture crows and volunteer observations still indicate a high level of activity, other techniques, including noose-traps and predator-baited mist nets, should be used until the terns begin to nest. Once the terns begin nesting, less invasive techniques such as noose traps and baited box-traps may be continued.
9. If none of the aforementioned methods works and the predation problem persists, CDFG predator control staff should confer with agency personnel and local public safety officers and a limited shooting plan should be considered to remove problem birds. We recommend that this be accomplished by baiting crows into the deeper dunes and shooting from a blind with dunes in the background. If this shooting is necessary, the beach should be closed within a distance specified by the public safety officers.

Raptors. Historically, raptors tend to be more of a problem during the fledgling phase. American kestrels in particular have caused heavy chick losses at Venice Beach. The Project Biologists

should immediately report any raptor that appears to be harassing the terns to the CDFG. Volunteers should be notified of its presence and asked to record the time, location of perches, flying direction, and any sign of take within the colony. If a particular individual begins concentrating on the colony, CDFG predator control staff may need to remove it using appropriate techniques. This should be determined in consultation with CDFG staff and predator control staff. It should be noted that Section 3503.5 of the Fish and Game Code specifically protects raptors and any activities conducted must be compliant with this code.

In addition to taking chicks, peregrine falcons also pose a significant threat during early egg laying. They have been known to cause colony abandonment if they concentrate their efforts on a particular colony and it suffers high adult mortality as egg laying is occurring. Project Biologists should record all predated adults and watch for peregrine falcon activity during this period as well as when fledglings are present. CDFG staff should be contacted if an individual begins attending the colony on a regular basis.

Mammalian Predators. The Project Biologists should check for tracks during colony surveys. If tracks are detected, baited havahart traps should be deployed until the tracks are no longer observed or the animal is caught. The traps should be deployed outside of public view, and if possible, between the access point/route of travel and the tern colony.

Other Predators. Numerous other species of birds and wildlife may occasionally prey upon the terns and some have the potential to inflict serious damage. Other species to be watchful of include herons and egrets, gulls, gull-billed terns, northern harriers, and burrowing owls. Either a large-scale (tracks every 5-10 m) nocturnal predation event by what were likely black-crowned night-herons and great egrets or, more likely, great blue herons ended the 2005 nesting season. A western gull was observed killing and eating an adult tern in 2008. Gull-billed terns are significant predators of least terns in San Diego County and were observed adjacent to the Venice Beach Colony in 2006. Individual northern harriers and burrowing owls can concentrate foraging efforts at least tern colonies and cause significant adult and chick mortality. Each of these predators should be watched for by the Project Biologists and Volunteer Monitors and reported if observed. If they become a problem, the Project Biologists should work with the CDFG predator control staff to reduce their impact or remove them from the vicinity, preferably via non-lethal means.

These recommendations will require approximately 90 hours of pre-season trapping, which can be combined with other site preparation activities. In addition, approximately 30 minutes to one hour during the monitoring surveys and visits during non-monitoring days will be necessary to check the status of the traps, or approximately 8 hours per week during the incubation period (approx. 6 weeks). **Annual effort: approximately 210 hours** (**assuming one week of additional crow trapping, one additional event that CDFG would need to respond to and one mammalian predation event).**

Habitat Management

Each year in mid-March, the Project Biologists should inspect the vegetation within the colony and evaluate how it conforms to the Habitat Management Plan (above). The Project Biologists should take measurements of vegetation, including cover and height in each of the vegetation

management grids. They should use the line-intercept methods, using a minimum of two samples per grid. Written descriptions may suffice in areas where vegetation is being allowed to grow without management, or in areas with less than 5% vegetation cover. They should then compare the observations with the goals for each grid and prioritize grids for clearing. Additionally, they should keep a list of plant species observed at the colony and mark any areas with sensitive plant species.

Working with the Volunteer Coordinator, Project Biologists should organize 2 volunteer clean-up days between March 1 and 31. This date range allows vegetation to be cleared close to the nesting season, but keeps volunteers out of the enclosure after April 1 as per USFWS instructions. Volunteers should be contacted in early February (see above). The Project Staff should provide the volunteers with the following:

- Gloves
- Photos of species to be removed and species to be conserved
- Large contractor-size plastic garbage bags (approximately 200)
- Shovels and hoes
- Water (at least 2 1-liter bottles per person)
- Shade (umbrella or tarp)
- Lunch

The Project Staff should prepare the site prior to the volunteers' arrival by clearly marking the grids to be cleared with pin-flagging as well as marking sensitive plant species with "caution" tape. They should also inform LACBH maintenance staff that clean-up is taking place and that the garbage bags will be stacked outside the enclosure. Project Staff should also set up all tables and shade structures and have water and materials ready by the time the volunteers arrive.

Upon the volunteers' arrival, they should be greeted and provided with clear instructions on where to remove vegetation and what type should be removed or clearly instructed on other duties such as picking up garbage or clearing sand from the chick fence. They should also sign in and sign a volunteer clearance form. One Project Staff member or trained Senior Volunteer should be assigned to each grid where people are working to supervise and answer questions.

During the volunteer clean-up day held after the nesting season, an effort should be made to remove all the remaining sea rocket and other non-native plant species from the colony. Dunes should be inspected and any areas where blowouts appear should have stacks of vegetation or other structures added to help maintain and protect existing dunes and create additional dune habitat during the winter months. **Annual effort: approximately 82 hrs.**

Volunteers may also be assigned to assist with General Maintenance as described below.

General Maintenance

Each year prior to March 1, the Project Biologists should a) inspect the condition of the fence and notify CDFG if there is any major damage that requires repair, b) note the amount of sand and any dunes building on the fenceline that could allow people or mammalian predators easy access, c) report any fenceline dunes to CDFG so that they can work with LACBH to remove or

reduce the sand, d) inspect and if needed replace the lock on the east gate if it is damaged by rust, and e) walk through the colony to identify problem areas. Prior to April 1, they should work with CDFG and LACBH to resolve issues involving the fence and sand build-up.

Following the nesting season (after September 15th), a volunteer clean-up day should be scheduled at the colony to assist with removal of a) trash and debris, b) clear non-native vegetation, and c) remove the temporary chick fencing. In addition, volunteers will assist with habitat management (see below). The Project Biologists and Volunteer Coordinator should visit the site prior to the clean-up day to make a list of tasks to be accomplished.

All predator control devices should be removed after the nesting season. All locks should be covered in plastic and lubricated once per month. They will likely need to be replaced annually. The Project Biologists should visit the enclosure monthly through the winter months, especially following heavy storm events, and report any damage to LACBH and CDFG as quickly as possible. **Annual effort: approximately 62 hrs.**

Courtship Monitoring (April 15 to ~May 15)

Courtship monitoring should begin within a week of April 15, based on volunteer reports of the presence of terns. During this period, one Project Biologist should walk the fence perimeter and make one pass on the gridline, checking two grid-widths at a time for signs of predation and nest scrapes by terns. This should be done weekly.

As more birds are present, the Project Biologist should first count the total number of terns present, and then walk each grid, tallying the number of scrapes. They should check each scrape for eggs and look for predated eggshells. This should continue until May 15, or the detection of an egg, or when terns are observed sitting regularly within the colony throughout the day. Project Biologists should note any courtship behaviors they see and fill in a predator monitoring form on each visit. **Annual effort: approximately 24 hrs.**

Incubation Monitoring (~May 15 to ~July 1)

Once a nest is found or there is evidence that the terns may be incubating, two Project Biologists should begin walking all grids in a zigzag pattern to obtain 100% visual coverage of each grid, tallying scrapes within each grid, checking each scrape for eggs, and looking for signs of predated eggs. They should also look for dropped fish and note the species observed. This should be done weekly.

Upon detection of a nest with eggs, Project Biologists should fill in the data form with the date, assign a nest number, note the number of eggs, draw its location on the colony map, and map it with a Trimble GeoXT (or other sub-meter accuracy) GPS Unit. The nest number shall be assigned with a letter indicating the date and a number indicating the order in which the nest was found on that date (ex. A5 would be the fifth nest found on the first day that nests with eggs were detected). Once at least 50 nests are present, all nests should be marked with a tongue depressor (to help avoid alerting predators) with the nest number written in permanent ink and placed 0.5 m north of the nest. The Project Biologist may also choose to float eggs found during the early visits to determine approximate hatch dates.

The Project Biologist shall then work with a GIS Specialist to map each nest on an aerial photograph with the grid overlaid. This map should then be taken into the field on subsequent visits to aid in finding nests.

During subsequent visits, all new nests shall be marked as described above and all existing nests checked for the status of the contents. Upon arrival at an existing nest, the Project Biologist will count the eggs and look for signs of predators. If there are no eggs, they should assess the outcome of the nest. They first should check a 2 m radius around the nest for chicks or eggshells. If eggshells are found, they should be checked for signs of pipping (clean cut circle around the egg) or predation (triangular beak mark, signs the egg was ripped open, blood, or yolk). If no chicks or eggshells are found, the Project Biologist will check the 2 m radius for signs of chick tracks or predator tracks. The monitor shall assign each nest to the category that best fits their observations:

1. **Confirmed Hatch**: chick(s) found in or adjacent to the nest.
2. **Presumed Hatch**: nest had been present for at least 15 days, no sign of predation, recent chick tracks, and pipped eggshell nearby.
3. **Predated**: nest present for less than 15 days with no sign of hatching, predator tracks present within 1 m of nest, predated egg found nearby, no sign of recent chick use.
4. **Did not hatch/Abandoned**: egg present for more than 28 days.
5. **Unknown**: does not fit any category, nest lost, not able to locate the nest.

Once eggs have been present for 15 days, the Project Biologist should install chick fencing in all areas that volunteers were not able to unbury the permanent chick fence to at least 12 inches. At this point, the Project Biologist should begin to survey twice per week in order to maximize the potential for confirming hatching at all nests. This is because chicks tend to run away from the nest after they are 3-4 days old.

These activities should be carried into the fledgling monitoring period (below) as long as nests with eggs are present. **Annual effort: approximately 100 hrs (monitoring + 12 GIS, 16 chick fence).**

Fledgling Monitoring (July 1 to August 15)

In addition to the duties described in the incubation monitoring period (above), the Project Biologist will need to attempt to obtain an estimation of fledgling success. This has been notoriously difficult to obtain.

Method 1: The Project Biologist shall determine the Total Hatched (Confirmed Hatch + Presumed Hatched) using the methods described above. The Project Biologist shall also begin searching for and counting dead chicks, which will then be either collected or buried so that they will not be counted again (Total Found Dead). Any chicks observed predated and removed from the colony by the Project Biologist and the volunteers will be dated, extrapolating by survey effort. Total Hatched minus the Total Found Dead minus the Total Estimated Predated will provide the estimate of Total Fledged.

Methods 2 & 3: On each visit, the Project Biologist will also count all of the chicks observed a) within nests, b) hiding within the colony, c) running (mainly in the northern and southwestern open areas) and d) hiding within and near the chick fence. These will be divided into downy, feathered, and fledged chicks. Using **Method 2**, the Project Biologist will count the number of fledglings present during three predetermined windows and sum those counts. Using **Method 3**, the Project Biologist will count feathered, pre-fledged chicks from surveys 2 weeks apart (using the highest combination of surveys).

Each method has the potential of over/underestimating the total, so the three estimates will be summed and divided by 3 to obtain an average, which is the total estimated fledglings produced from the colony in any given year. The range should be reported as well. This should be corroborated with mark-recapture estimates using banded chicks (see below). **Annual effort: approximately 144 hrs.**

Banding (July 1 to August 15)

During the fledgling period, the Project Biologist should band opportunistically during the colony walk-throughs as long as it does not significantly slow the time it takes to complete the survey. After the walk-through, the Project Biologist can find additional chicks by walking the chick fence and adjacent vegetation, capture them by hand, place them in holding boxes, and then band the chicks using standard banding pliers with USGS 1A bands. Wing chords should be measured using a metal wing rule and the chicks weighed using a Pesola spring balance scale. Chick measurements can be used for providing another estimate of fledgling success. Using wing chord and body weight, one can estimate the approximate age of each chick at banding and the date it was banded. All banded birds should be reported to the USGS Bird Banding Laboratory, as permits require.

All dead chicks found at the colony should then be checked for bands. The Project Biologist will then record the date of encounter and the band number from all banded dead chicks. Using this information, the Project Biologist will divide the total dead by the total banded to generate an estimate of mortality. Then the average age of banding will be subtracted from the oldest estimated chick age, generating an estimate of average number of days on the colony. Next, the Project Biologist will divide the estimate of mortality by the average number of days to generate a daily estimate of mortality. This estimate can then be multiplied by 20, the average number of days until fledging (Thompson et al. 1997) to obtain an overall estimate of mortality/survivorship. The Project Biologist can multiply the estimated total eggs hatched by the survivorship estimate to obtain a third estimate of total fledged.

Additionally, the wing chord and body weights can then be compared to previous years to determine whether growth in a given year was lower, which would indicate a problem with food resources. **Annual effort: approximately 18 hrs (in addition to walk-thru time).**

Funding

The Project Biologists should begin securing funding for the following season as early as possible. They should work with the Carlsbad FWO, the San Diego Office of CDFG, local Audubon Chapters, and look for private sources of funding.

Reports

Each year, several reports must be generated.

1. **CDFG Monitoring Report.** This is an MS Excel spreadsheet provided by CDFG to each colony manager. Project Biologists must complete a mid-season (July) and annual report, which should be submitted to the CDFG by the end of September. **Annual effort: approximately 20 hrs.**

2. **Annual Report.** This report is based on the format used by Project Biologists at the colony and provides summaries of the chronology, productivity, predation, and disturbance that occurred in a given year. This should be completed by the end of September and submitted to CDFG and USFWS. **Annual effort: approximately 40 hrs.**

3. **Nest Placement and Productivity/Site Management Plan.** This report should detail nest placement and productivity in relation to any habitat manipulations that are conducted. Patterns and trends should be analyzed and the Site Management Plan amended and/or modified to result changing conditions at the colony. **Annual effort: approximately 40 hrs**

CONCLUSIONS

In conclusion, it is our goal that this plan will help serve as a guide and plan for all of the individuals involved each year in the successful operation of the Venice Beach least tern colony. We hope it builds further understanding among team members. In addition, that it be used as an aid in planning each season's activities. Further, that it helps to guide those who may follow in their efforts at the colony. As with any field project, new challenges will continue to arise. We strongly suggest that this document be amended and modified each year to address these new challenges and as new technologies aid in improved estimates with less disturbance to the terns.

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