San Diego Audubon Society Research Study

Testing an ecosystem-based approach to managing vegetation at California Least Tern (LETE) nesting sites in Mission Bay Park

Goals:

1) Increase LETE nesting activity and productivity at selected nesting sites in Mission Bay Park;
2) Manage LETE nesting sites in a manner that improves their ecosystem value to multiple native plant and animal species.

Primary research question: Will restoring coastal dune habitat at LETE nesting sites in Mission Bay Park result in increased nesting activity and productivity of LETEs?

Secondary research questions:

1) Which alternative vegetation management options are most effective in establishing coastal dune habitat and minimizing the presence of non-native and invasive plant species?
2) How do alternative management options compare to status quo vegetation treatment options in providing appropriate vegetation cover for LETE nesting (e.g. vegetation cover and vegetation height)?

Study sites: Four sites will be included in this study, including Mariners Point (MP), North Fiesta Island (NFI), Stony Point (SP), and FAA Island (FAA). All are located within Mission Bay Park.

History of vegetation management of study sites: In partnership with the City of San Diego and wildlife agencies, San Diego Audubon Society (SDAS) has managed vegetation at the MP LETE nesting site for more than twenty years. Due to the presence of sensitive MSCP-covered plant species at this site (e.g. *Lotus nuttallianus*), vegetation management protocols have been limited to hand weeding and periodic spot spraying with herbicide. These protocols have allowed coastal dune habitat to persist at the site. Vegetation management at NFI and SP has been conducted by the City of San Diego. Protocols include mechanical scraping, broadcast herbicide spraying, and occasional application of pre-emergent treatments. These protocols have encouraged the spread of non-native and invasive plant species. At FAA, vegetation management activities, including spraying and hand weeding, have been conducted by various entities periodically over the past several years. Because the site is on a small island within Mission Bay, mechanical scraping has not been possible and the vegetation has not been kept to acceptable levels (e.g. approximately 20% cover) on a consistent basis for the past five years. LETE nesting activity and productivity is significantly higher at MP. Therefore, we wish to test a hypothesis that encouraging the development of coastal dune habitat at other nesting sites will result in increased LETE nesting activity and productivity.

Methodology:

Secondary Research Questions

Which alternative vegetation management options are most effective in establishing coastal dune habitat and minimizing the presence of non-native and invasive plant species?

To address this secondary research question, four treatment options have been selected for testing:

1) No management (other than outlined above to attain optimal percent vegetation cover)
2) Amend substrate with sand (5 inch depth)
3) Amend substrate with sand (5 inch depth) and coastal dune seed species*
4) Amend substrate with sand (5 inch depth) and plant coastal dune species*

*See Appendix B for draft species lists for seeds and plants. [TBD]

Treatments will be tested by establishing grids comprised of four cells at each study site. 40x40m grids will be established at NFI and 20x20m grids will be established at SP, MP, and FAA. Four replicates of each treatment will be tested at each site (see Figure 1). Replicate grids will be placed in areas where terns have historically nested (based on data from previous years) and will be spaced within each site to capture variability in soil and vegetation across each site.

A combination of point intercept transects and quadrats will be used to collect data in each cell. Data will be collected on percent cover, ground characteristics, species composition, and vertical structure. See Appendix A: Monitoring for details on monitoring protocols.

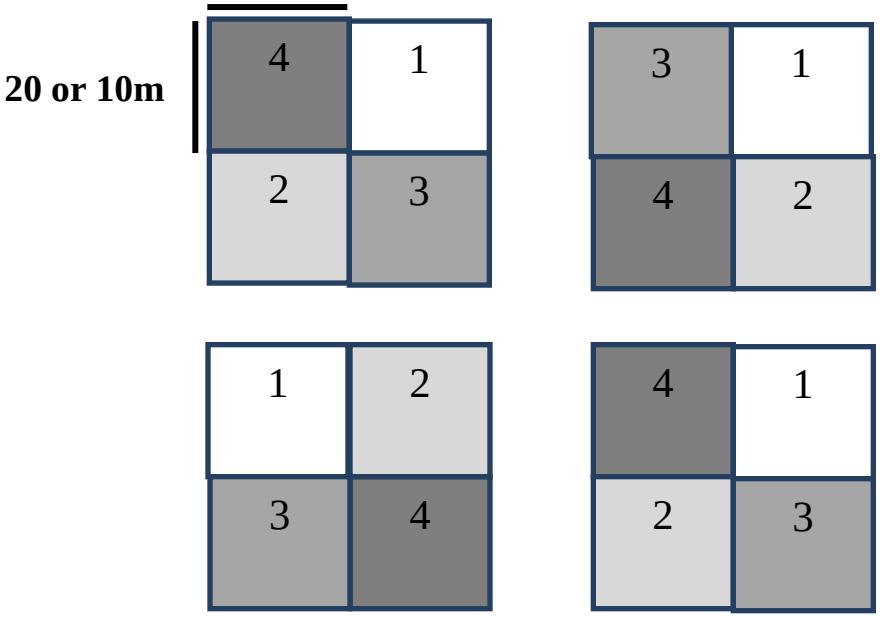


Figure 1. Grid layout

To attain optimal vegetation cover to attract LETE nesting, all treatment options will also include hand weeding and/or spot spraying with herbicide to attain approximately 20% vegetation cover and contain no plants over 10cm high by the start of each nesting season (April 15). Performance of each treatment in meeting management goals will be timed to capture variation in each treatment prior to hand weeding and/or spot spraying for each upcoming nesting season (see Appendix A: Monitoring).

How do alternative management options compare to status quo vegetation management options in providing appropriate vegetation characteristics for LETE nesting (e.g. percent vegetation cover and vegetation height)?

To address this secondary research question, control transects will be established at NFI and SP study sites to measure vegetation response to status quo management protocols (mechanical scraping, broadcast spraying, and occasional application of pre-emergent treatments). These responses will be compared to vegetation responses for the alternative management options outlined above. See Appendix A: Monitoring for details on specific monitoring targets and protocols.

Primary Research Question

Will restoring coastal dune habitat at LETE nesting sites in Mission Bay Park result in increased nesting activity and productivity of LETEs?

To address our primary research question, we will compare nesting data collected by the LETE biologist within our treatment areas to control areas. Nesting data to be analyzed includes nests, eggs, and chicks produced.

Schedule: [This needs work, including specific time frames when treatments and monitoring will occur.]

- Spring pre-breeding monitoring of vegetation
- Remove vegetation to 20% cover
- Breeding season monitoring of nesting
- Fall post-breeding monitoring of vegetation
- Conduct treatments in experimental blocks
- Spring pre-breeding monitoring of vegetation
- Remove vegetation to 20% cover

Data Analysis: [This needs work, including specifically what statistical analysis will be done.]
An ANOVA will be used to compare the four experimental treatments in the experimental blocks.

Appendix A: Monitoring

Monitoring will focus on three primary targets: percent cover, species composition (i.e., presence/richness), and vertical structure (i.e., vegetation height).

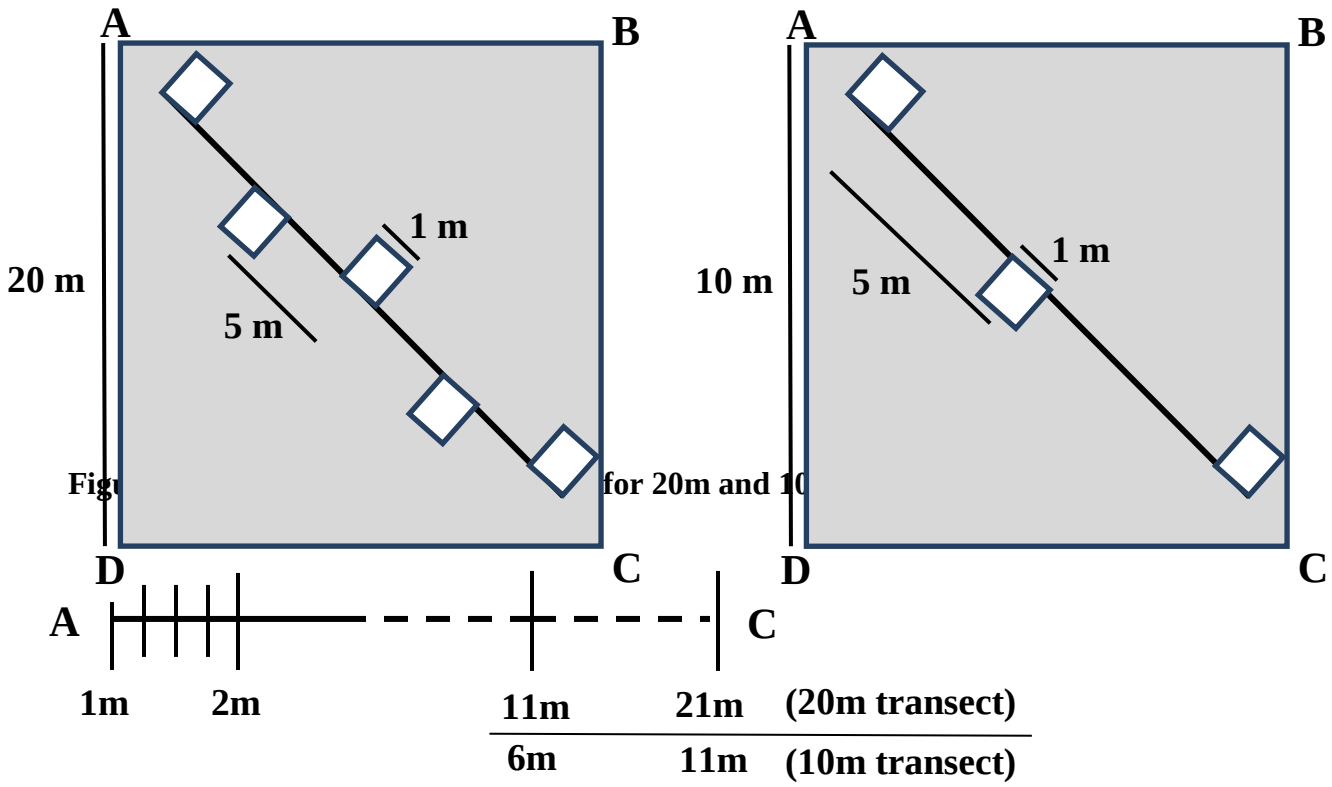
Percent cover and species composition: A combination of point intercept transects and quadrats will adequately measure % vegetation cover and species composition/richness. A complete census of plant species in each plot is not necessary using these methods and will avoid excess disturbance to these sites. If certain plants are obviously being missed, they will be noted opportunistically.

For each plot, a 10 or 20m transect will be established along the AC diagonal of the plot, beginning at 1m and extending to 11 or 21m (Figure 2). Point intercept data will be read every 0.25 m, yielding 80 points for each 20m transect and 40 points for each 10m transect. All species touching the sampling stick will be recorded, and ground surface will be characterized. Ground cover options include:

- Sand/Shell – sand with shell fragments
- Bare Ground – dirt or dirt with sand (little or no shell fragments)
- Litter – 50% or more organic dead material under stick
- Rock – large rock that is not easily nudged

For each transect, five ocular estimates of vegetation cover will be conducted utilizing a $1m^2$ quadrat. For 10m transects, 3 quadrats will be sampled. Relative cover of vegetation will be categorized as either 0, 1-10, 11-25, 26-50, 51-75, or 76-100% cover. Quadrats will be conducted every five meters (i.e., 1m, 6m, 11m, 16m, 21m), beginning on the left and alternating sides for each quadrat (see Figure 2).

Vertical Structure: Vertical structure measures habitat structure in terms of height and homogeneity of vegetation cover, which provides information about habitat suitability for wildlife. Using the same transect as above, height category (0cm, 1-10cm, 11-20cm, 21-30cm) will be recorded every 0.25m using tape marks on the point-intercept stick, yielding 80 or 40 data points for each 20m or 10m transect, respectively.



Figu for 20m and 10

Notes on procedure:

- Rebar poles should be hammered into the corners at A and C so transects can be easily replicated each sampling period.
- A meter tape can be latched around the rebar at A and pulled to the other rebar at C.
- The meter tape should be stretched to be as straight as possible.
- Point-intercepts should start at 1 m and continue every 0.25m to 11m or 21m.
- Conduct point-intercepts followed by quadrats to minimize impact of trampling on intercept data

Point Intercept Procedure:

- **Start at 1m** (the origin), proceeding every 0.25 m to 11 m or 21 m.
- **At each 0.25m point**, drop the stick perpendicular to the meter tape (or the transect axis) as possible.
- **Record** the ground cover
    - S = Sand/Shell – sand with shell fragments
    - B = Bare Ground – dirt or dirt with sand (little or no shell fragments)
    - L = Litter – 50% or more organic dead material under stick
    - R = Rock – large rock that is not easily nudged
- **Record** ONLY the plant species that are touching the stick
    - Make sure to check the side and top to avoid optical illusions.
    - Use 6 letter code: the first three letters of the genus and the first three letters of the species.

    - Standing Dead Material: is dead woody material that is still attached to the ground or living shrub. Only record a dead shrub if the dowel touches a primary or secondary stem—ignore fine feathery material because many shrubs dieback naturally and the dead material isn't a sign of bad health.
- **Unknown species** should be recorded with a unique number or designation, preferably with the same number of characters and a code to mark it as unknown (UK##).
- **Species known to genus—**If you know the genus of a plant but not the species record the first 6 letters of the genus. In the past we used the first 3 of the genus and "sp." However this created several intersecting codes.
- **Handle unknowns** by collecting a sample off the transect, place in a baggie, and label it
    - If an herb is highly abundant collect a whole plant (if you are not sure leave it)
    - Try to get as many of the following structures as possible without excessive damage: Leaves, Flowers, Fruit, Stem
    - Labels should look something like this:

Date: M/D/YR
Team: use initials
Site: E.G. Reserve Name
Plot: The specific plot designation
Unknown #: unique number for this plot

Quadrat Procedure:

Materials:

- A 1 m^2 quadrat can be made out of ½ inch PVC pipe
- Be sure inside dimensions of quadrat measure 1 m.
- You may opt to drill holes in regular intervals (10cm, for example) on the sides of the quadrats and rung string through the holes
    - These strings will delineate sections for estimating cover. This makes estimation easier; however, moving through dense vegetation gets much harder.
- Quadrat data sheet
- Pen/pencil
- Clip board

Procedure:

- **Begin at the origin (1 m), on the left side**
  - Measurements will be taken every 5m on alternating sides.
- **Place the quadrat** between the 1-2 m markers on the meter tape
- **Estimate** the percent vegetation cover using the following categories:
  - 0 (all bare ground – dirt or sand w/ dirt)
  - 1-10%
  - 11-25%
  - 26-50%
  - 51-75%
  - 75-100%
- Move up the transect to the 6 m mark
- Place the quadrat on the right side of the tape and **repeat procedure.**
- Continue to end of transect, alternating sides and spacing sample plots 5m apart.

Appendix B: Seed and Plant List [TBD]