Habitat Enhancement, Community Engagement, and Use of Motus to Support Western Snowy Plover and California Least Tern Recovery at Eden Landing Ecological Reserve, Hayward, California

Final Report

Prepared By:

Maddy Schwarz, Snowy Plover and Least Tern Program Director

Josh Scullen, IT Director and Master Bander

Jeremy Reinhard, Lead Biologist

San Francisco Bay Bird Observatory

Ben Pearl, Senior Wildlife Ecologist, H. T. Harvey & Associates

Abra Kaiser, GIS Analyst, H. T. Harvey & Associates

For:

Garrett Allen, Grant Manager

California Department of Fish and Wildlife

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CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

The federally threatened western snowy plover (*Anarhynchus nivosus nivosus*, snowy plover) and the federally endangered California least tern (*Sternula antillarum browni*, least tern) are two small, ground-nesting birds that have been negatively impacted by habitat loss and increased predator populations. The United States Fish and Wildlife Service (USFWS) has written Recovery Plans for each species that outline specific productivity goals and metrics that must be met in order for each species to be delisted (USFWS 1985, USFWS 2007). Snowy plovers and least terns breed in the San Francisco Bay Area (Bay Area) on former salt production ponds, levees, and placed fill material. As Bay Area salt ponds are breached and returned to tidal marsh habitat through the South Bay Salt Pond Restoration Project (SBSPRP) and other restoration projects, snowy plovers and least terns lose vital breeding habitat. Eden Landing Ecological Reserve (ELER) in Hayward, California is a large tract of former industrial salt production ponds owned by the California Department of Fish and Wildlife (CDFW; Figure 1). In the Bay Area, ELER is the only site south of the San Mateo Bridge where least terns breed, and it is also the most productive snowy plover nesting site, with typically over half of the total breeding activity occurring there.

For over 40 years, the San Francisco Bay Bird Observatory [SFBBO; a 501(c)(3) nonprofit] has been conserving bird populations and their habitats through science and outreach. SFBBO began monitoring snowy plovers in 2003 and least terns in 2017. SFBBO's monitoring program aligns with the Recovery Plans written for each species by assessing whether the snowy plovers and least terns in the Bay Area are meeting their recovery goals and metrics. We also use data gathered through our work to inform landowners and land managers of ways they can support snowy plovers and least terns.

In 2024, SFBBO, along with H. T. Harvey and Associates (HTH) and Avocet Research Associates Biologist Carleton Eyster (collectively, project members), were awarded Section 6 grant G2398105 through the USFWS and the CDFW to advance the recovery of snowy plovers and least terns in ELER. HTH are a group of professional ecologists that have delivered exceptional consulting services to public agencies, private entities, and nonprofit organizations since 1970. Carleton Eyster is an independent researcher who has been dedicated to snowy plover conservation for the past 30 years.

The purpose behind this grant was to help landowners address the needs of snowy plovers and least terns as tidal marsh restoration activities continue within the Bay Area and ELER. To accomplish this, project members made use of Motus Wildlife Tracking System (Motus) technology to track snowy plovers' fine-scale movements and habitat use in ELER ponds E14 and E6B. This is the first time that Motus technology has been used on the federally listed snowy plover population and thus represents an important exploratory study. In addition, project members completed multiple other objectives including habitat enhancement, avian predator surveys, management of the South Bay Tern Watch Volunteer Program, and communication with land managers.

This report will focus on the novel Motus study, but will also summarize the work performed in service of the other objectives as well. The following sections will describe the methods and results for each aspect of the project, plus a discussion of the results and recommendations for management and future research.

METHODS

Motus Technology Background

Motus is a radio telemetry system designed to track flying migratory species, including birds, bats, and large insects (Motus 2022). The system relies on a series of remote receivers (Motus towers) that are independently installed and managed, but are connected to Motus' website and receive transmissions from any Motus-compatible tags within range. When a tagged individual moves through an area with adequate Motus tower coverage, its flight path and timeline are recorded by the towers and uploaded to the Motus website. This is the basic Motus model, which is most useful for tracking species that migrate over long distances.

CDFW operates over 30 Motus towers throughout California. One of these towers is installed at ELER between ponds E14 and E6B. The ELER Motus tower includes directional antennas that detect 166 and 434 megahertz transmitter signals and an omnidirectional antenna that detects 434 megahertz transmitter signals.

Cellular Tracking Technologies (CTT), a major supplier of Motus-compatible technology, produces several digital radio products that operate on the 434 megahertz frequency. The products we chose for this study include the CTT Hybridtag with Flex Tab transmitter (tag; 0.65 grams, tab size small, with a nylon coated braided steel antenna); the CTT Sidekick receiver with Handle and both 434 MHz and 2.4 GHz Yagi Antennas (sidekick); and the CTT Node Version 3.0 with CTT SolarPack solar-rechargeable battery pack (node). The node is a small and portable transceiver that can receive Motus-compatible transmitter signals and communicate those data to a nearby Motus tower. Each node records its own GPS location, and multiple nodes arranged in a grid allows multilateration to localize the position of a tagged individual within the grid. CTT recommended nodes be spaced 200 meters apart and within 1.5 kilometers of a Motus tower outfitted with an omnidirectional antenna dedicated to receiving node signals (CTT, personal communication).

Node Grid Deployment and Calibration (Objective 2)

Due to an increase in price of the node hardware between grant writing and project implementation, project members were only able to purchase 56 nodes instead of the originally planned 83 nodes. As such, the coverage area was reduced, so node grids were only installed at ponds E14 and E6B, and no nodes were installed at ponds E13 or E8. Project members chose to focus on these two ponds because they have had the highest rates of snowy plover nesting at ELER in recent years.

Project members and volunteers installed the nodes on March 8, 2025. We installed twenty nodes at Pond E14 (Figure 2) and 36 nodes at Pond E6B (Figure 3). The nodes were installed 200 meters apart in a triangular grid. Where it was not possible to place a node at exactly 200 meters (e.g., if the correct point was in deep water or the middle of a levee), we offset the node to the closest suitable location (typically no more than 10 meters away).

During the initial setup, each node and its associated solar panel was mounted on a five-foot length of metal conduit that we then sheathed over a four-foot length of rebar sunk approximately two feet into the ground. We oriented the conduit so that the solar panel faced south and sank it a few inches into the ground to prevent the conduit from rotating. To deter avian predators from perching on the nodes, we added two six- to eight-inch segments of metal bird spikes to the top of the node and solar panel.

After setup, project members noticed several issues with node performance: nodes farther than 1 kilometer and some nodes between 0.7 kilometer and 1 kilometer from the main Motus tower were not connecting to the tower; and nodes were rotating in heavy winds. Following a conversation with CTT, we raised the nodes higher off the ground by adding another five feet of conduit to each node. We then sank the poles approximately two feet into the ground to prevent rotating, removed the metal bird spikes due to potential signal interference, and set each node's power transmission setting to "high". Additionally, we tested whether directional antennas provided better node connectivity but determined that the omnidirectional antenna performance was superior. After making these changes and switching the nodes back to connecting to the omnidirectional antenna, all 56 nodes connected to the Motus tower.

Once the nodes were deployed and initial connectivity issues corrected, project members calibrated the nodes by walking a tag through the node grid while recording the tag's location with a sidekick. In order to mimic the ground plane effect, where radio signals radiate with increased power due to the tag's placement on an animal's body, we attached a tag to a 40-gram chicken tender (Adrados et al., 2002). We placed the tagged chicken tender on a wooden pole with the tag oriented parallel to and held approximately 4 inches off the ground to replicate the typical movement of a plover.

Separately, we tested detectability for a sample of the tags by attaching a tag to a plastic decoy and setting the decoy on the ground to mimic an incubating plover. With the sidekick, we walked loops away from and around the tag and recorded relative signal strength indicator (RSSI) values for varying distances from the tag.

Over the winter, CDFW raises water levels, permits waterfowl hunting on E6B, and opens E14's northern levee to pedestrian traffic. Due to the increase in human activity and water levels on each pond, project members removed the node grid on September 18, 2025 and stored the nodes for the winter at SFBBO's office.

Snowy Plover Surveys and Nest Monitoring

In order to address snowy plover recovery goals and identify which adult plovers were suitable candidates for a Motus tag, we conducted extensive surveys and nest monitoring. To accomplish this, SFBBO biologists performed weekly observational field surveys at ponds E14 and E6B using spotting scopes and binoculars. During each survey, biologists recorded the number and behavior of all observed plovers, identified the age and sex of each individual by plumage (Page et al. 1991), recorded the combinations of any color-banded birds, and entered all data into Field Maps, a smartphone-based mapping application developed and hosted by Esri (Esri 2025).

We located snowy plover nests by scanning for incubating adults during each survey. If we found an incubating plover, we searched for its nest on foot and entered the nest location into Field Maps. During the first nest visit, we recorded the number of eggs or chicks in the nest and floated eggs that were not in the process of hatching to estimate egg age. Using the estimated egg age, we calculated the nest initiation date and predicted hatch date based on an average egg-laying-to-hatching period of 30 days (calculated from previous data collected in the Bay Area; SFBBO, unpublished data). We confirmed the status of each active nest weekly by observing an incubating adult through a scope during the survey. If we did not observe an incubating adult at a nest, we conducted a follow up nest visit to confirm the nest's status. When there were no longer eggs in the nest, we assigned each nest a fate (hatched, depredated, abandoned, flooded, failed – unknown cause, or unknown) based on evidence seen at the nest (Mabee 1997). We defined a nest as successful if it hatched at least one egg.

Biologists documented additional hatched snowy plover nests based on the presence of broods that did not come from a known active nest (e.g., we observed young chicks but were not currently monitoring any nests close to hatching). We recorded these nests as "found as inactive" and "found at brood stage." In addition, while walking across a pond, surveyors occasionally found empty scrapes that contained eggshell fragments from a hatched nest, or yolk splatters from a depredated nest. As this type of nest evidence degrades over the winter, we assumed the scrape had been active in 2025 and assigned these nests a fate based on the evidence present. We also marked these nests as "found as inactive." We included all "found as inactive" nests in our nest totals, but omitted these nests from our analyses, since including them would positively bias our hatch rate estimates.

Snowy Plover Color Banding and Motus Tagging

Project members responsible for banding (banders) targeted a subset of monitored nests to band adults and chicks. Due to the precocial nature of chicks, banders arrived at the nest before the adult led the chicks away, typically within a 6-8 hour window after the last egg hatched. In order to correctly time banding activities, we visited the nest within four days of the estimated hatch date to confirm the accuracy of the estimated date or update it based on the hatching status of the eggs.

We captured chicks by hand and banded them with a unique four-color combination by placing two bands on each leg (two below the right tibiotarsal joint, one above the left tibiotarsal joint, and one below the left tibiotarsal joint). Each combination consisted of three plastic color bands (Darvic brand, size XCL; Acetal brand, size XCL; or Avian ID brand, size SP3) and one metal USGS band (size 1P). We wrapped each band with colored vinyl tape to increase the band's longevity. The unique color band combination allowed us to identify individuals that survived to fledge. We defined a fledged chick as one that survived to 28 days of age, at which point it was considered capable of flight (Warriner et al. 1986). We documented color-banded snowy plovers when we re-sighted them on subsequent surveys, opportunistically during non-survey activities, and when we received third-party reports of banded snowy plovers. At the end of the season, we calculated apparent fledging success as the percentage of fledged, banded chicks out of the total number of chicks banded.

Project members deployed tags on 20 adults in E14 and E6B in June and July 2025. We trapped adults at the nest using a walk-in trap or snare mats, color-banded them as described above, and weighed them to ensure that the tag and attachment hardware did not exceed 3% of the individual’s body weight (approximately 1.2g or less). We attached tags using a leg-loop harness made from 0.7-millimeter Stretch Magic elastic cord and custom-fit to each individual using a crimping bead to secure the appropriate tension on the cord. Upon deployment, the tag began transmitting a signal every 5 seconds. Tags have a multi-year lifespan, so we will continue receiving data while the tagged plover is within detection range.

Motus Data Analysis

Throughout the season, individual nodes occasionally failed to transmit their recent detection data to the Motus tower. As a result, the detection dataset available through CTT’s website was incomplete. However, each node contained a 16-gigabyte micro Secure Digital (SD) card that stored all of the node’s detection data. After removing the node grid, we downloaded data from each node’s micro SD card. We then collated each tagged individual’s detection data from each node into a single file in ArcGIS Pro. Project members created heat maps for each individual to show the relative intensity of their use of habitat within the node grid. Data were split in the following ways to create heat maps that represented distinct periods of behavior:

- When individuals were banded prior to nests hatching, we split the data into two figures, with one figure showing habitat use before the nest hatched and another showing habitat use from the nest’s hatch date to the chicks’ fledge date. Although SFBBO has observed that some chicks require additional time to become fully independent from their adult, we standardized our approach by limiting our analysis to the accepted 28-day fledge period.
- When individuals were tagged at hatch, we produced one heat map for the pre-fledging period, and a second map showing the individual’s use of habitat during the post-fledging period, which includes all detections until the node grid was taken down on September 18, 2025.
- When individuals were Motus tagged but the nest was depredated before eggs could hatch, we produced one heat map from the date of tagging until the date and time that these nests were confirmed depredated by camera, and a second heat map following the depredation until the last detection in the node grid.
- For five pairs that were both Motus tagged, we split the data by day and night using civil sunrise (5:22am PDT) and civil sunset (8:32pm PDT) on July 4, 2025 in Union City, CA to analyze how a pair split incubation duties and utilized habitat while tending to an active nest.

RESULTS

Snowy Plover Breeding Summary (Objective 3)

Nest Abundance and Success

Project members monitored a total of 89 nests at E14 (Figure 4). Of these nests, 73 hatched (82%), six were depredated (7%), one was abandoned (1%), one was flooded (1%), two failed due to unknown causes (2%), and six had unknown fates (7%). An additional ten nests on E14 were found as inactive and are not included in these metrics (Table 1). Seven of these ten nests were detected at brood stage, and the remaining three were found as empty scrapes with evidence of either recent hatch or recent depredation. However, it is likely that there were more undetected nests in addition to these ten. Because of the high hatch rate on E14 during the height of the breeding season, it became difficult to determine if a given brood was from a known nest or an undetected nest.

Project members monitored a total of 25 nests on E6B (Figure 5). Of these nests, 11 hatched (44%), 12 were depredated (48%), one was abandoned (4%), and one had an unknown fate (4%). One additional nest was detected at the brood stage (Table 1).

Chick Fledging Success

Project members banded a total of 75 snowy plover chicks, including 61 chicks at E14 (30% of chicks hatched) and 14 chicks at E6B (48% of chicks hatched). Of these 75, project members confirmed that 18 have fledged as of December 17, 2025, consisting of 15 from E14 and three from E6B. This results in an apparent fledge rate of 24% across the two ponds, 25% at E14 and 21% at E6B.

Oyster Shell Habitat Use

In the past, SFBBO has demonstrated that snowy plovers preferentially nest in areas that are sparsely covered in oyster shells (see the Habitat Enhancement section below for additional details). However, in the last few years, this preference appears to be getting less distinct, at least on E14.

As of 2025, shelled areas (consisting of the Western Shell Plot, Eastern Shell Plot, and Opportunistic Shell Plots) on E14 account for approximately 52% of the total habitat available, and unshelled areas account for approximately 48% of the total habitat available (Figure 4). On E6B, shelled areas account for approximately 8% of the total habitat available, and unshelled areas account for approximately 92% of the total habitat available (Figure 5). Given these proportions and the number of nests monitored on each pond in 2025, if there was no preference for shells, we would expect to observe approximately 46 nests in the shelled areas and 43 nests in the unshelled areas of E14. We would expect to observe approximately two nests in the shelled areas and approximately 23 nests in the unshelled areas of E6B.

At E14, we observed 55 nests in the shelled areas and 34 nests in the unshelled areas (Figure 4). A chi-squared test reveals that this does not show a significant preference for the shelled areas

($df = 1$, $\chi^2 = 3.42$, $p = 0.064$). However, when we examined each shell plot individually, we found that snowy plovers preferred nesting in the Eastern Shell Plot. Based on the Eastern Shell Plot's area, if there was no preference for shells, we would have expected to observe approximately 22 nests and actually observed 36 nests. A chi-squared test revealed that this apparent preference is significant ($df = 3$, $\chi^2 = 11.15$, $p = 0.01$).

At E6B, we observed 17 nests in the shelled areas and eight nests in the unshelled areas (Figure 5). A chi-squared test revealed that this indicates a strong preference for shelled areas on this pond ($df = 1$, $\chi^2 = 116.73$, $p < 0.00001$).

Table 1: Snowy plover nest fates at E14 and E6B, 2025.

	Hatched		Depredated		Abandoned		Flooded		Failed – Unknown Cause		Unknown		Total Monitored		Found as Inactive		Total	
Pond	**Nests**	**Eggs**	**Nests**	**Eggs**	**Nests**	**Eggs**	**Nests**	**Eggs**	**Nests**	**Eggs**	**Nests**	**Eggs**	**Nests**	**Eggs**	**Nests**	**Chicks**	**Nests**	**Eggs**
E14	73	205	6	14	1	3	1	2	2	4	6	17	89	256	10	18	99	274
E6B	11	29	12	35	1	3	0	0	0	0	1	3	25	73	1	2	26	75
Total	84	234	18	49	2	6	1	2	2	4	7	20	114	329	11	20	125	349

Snowy Plover Movement

Project members tagged a total of 20 adults from 15 nests during the 2025 breeding season (Table 2). At E14, we tagged nine males and seven females from 11 nests (Figure 6), and at E6B, we tagged three males and one female from four nests (Figure 7). Metadata for each tagged individual and a summary of its movements recorded by its tag can be found in Table 2, and Figures 8-27 provide heat maps of these individuals' movements.

The number of detections for each bird varied greatly. Female ak:yb had the lowest number of detections at 2,322. Male Ng:ko had the highest number of detections at 1,422,025. The average number of detections for an individual was 176,744.

Project members observed some general trends in the movement data, which include:

1. Male and female incubation shifts were complicated. It is generally accepted that females incubate during most of the day and males incubate most of the night (Warriner et al. 1986). While these general trends held true, we observed that both adults spent a large amount of time near the nest, regardless of the time of day. This proximity may have allowed them to interrupt their partner and incubate for short bursts (sometimes up to several hours), even when it was not "their shift."
2. After a nest hatched, males tended to lead their chicks to an area near water to forage. On E14, this included along the borrow ditch or along a large channel that cuts through the northeast corner of the pond. Often, this area was the same as where the male spent time foraging before the nest hatched.
3. Both males and females were often detected by the node nearest their nest site after their chicks hatched.
4. During post-breeding dispersal, snowy plovers that were detected by additional Motus towers in the Bay Area appeared to fly back and forth between ELER and other locations. Even if they were detected at another location for an extended period of time, they would still make short trips back to ELER
5. During post-breeding dispersal, all snowy plovers detected by other Motus towers were picked up within 50 miles of ELER, except for nn:pk, who was detected by Motus towers in the Channel Islands on November 1, 2025

Table 2: Summary of Motus Tagged Snowy Plovers

<table>
<tr><th>Band Combo</th><th>Sex</th><th>Nest</th><th>Date Tagged</th><th>Date Nest Hatched</th><th>Chicks Banded</th><th>Chicks Fledged</th><th>Last Detection</th><th>Number of Detections</th></tr>
<tr><td>Ng:ry</td><td>M</td><td>E14-44</td><td>6/23/25</td><td>6/23/25</td><td>Yes</td><td>Yes</td><td>8/4/25</td><td>11,658</td></tr>
<tr><td colspan="9">Summary: Ng:ry was tagged the same day his chicks hatched, so there is no data for him during the pre-hatch period. During the pre-fledge period, Ng:ry was detected with very high density near nodes 36, 24, and 38 in the northeast corner of E14 northeast of the nest location; moderate density near the nest at node 17; and sparse to low density at three areas on the west side of E6B where foraging habitat is present (Figure 8). During the post-fledge period, he continued to be detected with high to very high density in the northeast corner of E14. Ng:ry was observed by SFBBO biologists with at least one chick on eight occasions near node 36, including four times on the levee between E14 and E8XN. At least one of the chicks, Ka:wk, was confirmed as fledged on 7/30 on this levee. In addition to E14, there were numerous areas of low to sparse detections of Ng:ry in E6B in the western and central portions of the pond.

This bird has also been detected by Motus stations outside of ELER. Ng:ry pinged the Coyote Creek Field Station (CCFS) tower in Milpitas on 11/23 and 11/25, then was picked up by the Don Edwards San Francisco Bay National Wildlife Refuge (the Refuge) tower in Newark on 12/2 and 12/10. Throughout this period, he was also recorded by the ELER tower multiple times.</td></tr>
<tr><td>Ng:ko</td><td>M</td><td>E14-45</td><td>6/26/25</td><td>6/26/25</td><td>Partial</td><td>Yes</td><td>9/18/25</td><td>1,422,025</td></tr>
<tr><td colspan="9">Summary: Ng:ko was tagged the same day that his nest hatched, so there is no data for him during the pre-hatch period. During the pre-fledge period, Ng:ko was detected with high to very high density near nodes 24, 38, and 37 in the northeast corner of the pond where high quality foraging habitat is present, and low to moderate density west of these areas (Figure 9). During the post-fledge period, Ng:ko continued to be observed in the northeast corner of E14 near nodes 24, 38, and 37 with a high density of detections. He was observed with fledged chick Ko:yb in this area on 7/30. There were also sparse detections of Ng:ko in the western end of E14 and in the southern portion of E6B. He was observed at E4C on 9/9 and E3C on 9/16.</td></tr>
<tr><td>Ng:pg</td><td>M</td><td>E14-63</td><td>6/29/25</td><td>6/28/25</td><td>Yes</td><td>Yes</td><td>9/1/25</td><td>125,729</td></tr>
<tr><td colspan="9">Summary: Ng:pg was tagged the day after his nest hatched, so there is no data for him during the pre-hatch period. During the pre-fledge period, Ng:pg was detected primarily at the eastern end of E14 with moderate to high detection density near node 36 where high quality foraging habitat is available. This is approximately 10 - 200 meters north of his nest location (Figure 10). He was also occasionally detected in the northern portion of E6B. Ng:pg was observed eleven times by SFBBO during the pre-fledge period in the southeast corner of E14, including</td></tr>
</table>

Band Combo	Sex	Nest	Date Tagged	Date Nest Hatched	Chicks Banded	Chicks Fledged	Last Detection	Number of Detections
seven times on the levee between E14 and E8XN. He successfully fledged two chicks (Gk:ar and Rk:wb). During the post-fledge period, he continued to be detected with high density in the eastern portion of E14 near node 36, but was also detected in E6B in the northern, central, and southeast sections of the pond with sparse to low frequency.								
Rk:wo	F	E14-41	6/20/25	6/30/25	Yes	No	9/18/25	17,016
Summary: During the pre-hatch period, Rk:wo had a high density of detections at or near the nest location in the southwest corner of the eastern shell plot (Figure 11). She was detected with sparse to low density along the borrow ditch in the northeast corner of the pond near nodes 14 and 35, presumably to roost or forage when not incubating, and with low density in the central portion of the pond. During the post-hatch-to-fledge period, she was observed with moderate to high density in the same area near nodes 14 and 35. There was a sparse number of detections near nodes 37 and 38, and at the nest site. Direct observations of this bird showed that she stayed with the chick while the male renested with a different female. During banding, two out of three chicks from this nest unexpectedly died. This may be what led to the male abandoning the remaining chick. The remaining chick, Rk:bk, has not been confirmed as fledged. Rk:wo has also been detected outside of ELER, briefly pinging the China Camp Kiosk Motus tower near San Rafael on 10/2. However, she was back in ELER by 10/5, and her tag has not pinged any towers since then.								
Ka:kk	M	E14-52	6/24/25	6/30/25	No	Unknown	9/18/25	257,257
Summary: During the pre-hatch period, Ka:kk was detected with high density at the nest near node 32 and sparse to low density in the areas adjacent to the nest (Figure 12). During the post-hatch-to-fledge period, Ka:kk was observed in the same areas with a similar level of detection density. Node 32 is along the northern borrow ditch and provides moderate quality foraging habitat. He was observed with chicks through 7/24, and detected in E13 on 8/2 using a sidekick, but not seen through a scope or binoculars. Because we did not band his brood, we cannot determine whether he successfully fledged any chicks. At night during the pre-hatch period, when he was expected to be incubating, Ka:kk was detected exclusively near the nest and node 32 with very high density (Figure 13). During the day, he was observed with very high density near the nest and node 32; moderate density to the southeast of the nest at node 56; and sparse to low density in the rest of the western and central portions of E14.								

Band Combo	Sex	Nest	Date Tagged	Date Nest Hatched	Chicks Banded	Chicks Fledged	Last Detection	Number of Detections
Ka:kk has also been detected outside of ELER. He was picked up by the Napa-Sonoma Marshes Wildlife Area (NSMWA) Motus tower on 10/3, and spent the majority of his time there from 10/3 to 11/21, making brief trips back to ELER or the Refuge (on 10/11 and 11/8). Since 11/21, his tag has briefly pinged at both ELER and NSMWA.								
ak:yb	F	E14-52	6/27/25	6/30/25	No	Unknown	9/18/25	2,322
Summary: During the pre-hatch period, ak:yb was detected with very high density at the nest location near node 32 in E14, and sparse to low density in the central portion of E14 near the nest (Figure 12). During the post-hatch-to-fledge period, she was detected with very high density at the nest site and sparse to low density in the central portions of the pond east of the nest. On 7/13, she was observed by SFBBO with her brood on the levee between E14 and E13 displaying aggression towards a nearby unbanded brood. However, by 7/18 she appeared to have abandoned the brood, as the male, Ka:kk, was observed with the chicks by SFBBO, but ak:yb was not. Her low number of detections overall indicate that her transmitter may not have been functioning properly. Because we did not band her brood, we cannot determine whether she successfully fledged any chicks. During the day before the nest hatched, when she was expected to be incubating, ak:yb was detected with very high density near the nest at node 32, and sparse to low density east and southeast of the nest near nodes 6 and 56 (Figure 13). At night during the pre-hatch period, when she was expected to foraging or roosting, she was detected with very high density near the nest at node 32; moderate density in the center of the pond near nodes 6, 34, and 56; and sparse to low density southwest of the nest at node 16 and in the eastern side of the pond at nodes 11 and 17.								
Ko:yw	M	E6B-14	6/28/25	6/30/25	No	Unknown	8/15/25	21,564
Summary: During the pre-hatch period, Ko:yw was detected with very high density near the nest at nodes 46 and 50; high density to the southwest of the nest; moderate density to the west, southeast, and along the northern borrow ditch; and sparse to low density in the center and southwest corner of E6B and east side of E14 (Figure 14). During the post-hatch to fledge period, he was detected with high to very high density in the central portion of E6B near nodes 2, 4, 7, 22, and 45 where high quality foraging habitat is present; moderate density in the eastern end of E6B, where high quality foraging habitat is also present; and low to sparse density in most of the rest of the pond except along the northern and southern margins. SFBBO observed Ko:yw twice after hatch, including once on 7/5, when he was confirmed with the female and one young chick in the interior of the pond; on 7/10, he was observed alarm calling near the levee before flying back towards the interior of the pond. Because we did not band his brood, we cannot determine whether he successfully fledged any chicks.								
Gk:pw	F	E14-65	6/25/25	7/1/25	Yes	Yes	7/19/25	2,490

Band Combo	Sex	Nest	Date Tagged	Date Nest Hatched	Chicks Banded	Chicks Fledged	Last Detection	Number of Detections
Summary: During the pre-hatch period, Gk:pw was detected with high to very high density near the nest at nodes 11, 34, and 56, with sparse detections in the western portion of E14 (Figure 15). During the post-hatch period, she was detected with high to very high density in the same location as male nn:pk and brood in the northern central portion of E14 where moderate quality foraging habitat is present. SFBBO observed Gk:pw with the male and brood in this area on 7/5, but she was not observed by SFBBO again. Her chick, Ng:bk, has been confirmed as fledged. There are no detections for Gk:pw after 7/19/25, but another snowy plover biologist observed her in Point Reyes on 7/29 and 11/24. Her low number of detections overall indicate that her transmitter may not have been functioning properly. During the day before the nest hatched, when she was expected to be incubating, Gk:pw was detected with very high density northwest of the nest at nodes 6 and 32; moderate density near the nest at node 34 and northeast of the nest at node 10; and sparse to low density east of the nest at node 11 and at the west end of E14 near node 21 (Figure 16). At night before the nest hatched, when she was expected to foraging or roosting, she was detected with very high density near the nest at node 34; high density west of the nest at node 56; moderate density east of the nest at node 11; and low density in the west side of the pond near nodes 16 and 32. These detections provide further evidence that her transmitter may not have been functioning properly, due to both the low number of detections and the fact that she did not appear to spend a significant amount of time incubating during the daytime.								
nn:pk	M	E14-65	6/26/25	7/1/25	Yes	Yes	9/18/25	226,550
Summary: During the pre-hatch period, nn:pk was detected with moderate to high density near the nest location in the central area of E14, but was also detected with low density throughout the western and northeastern areas of the pond (Figure 15). The density of detections throughout E14 during this time indicate that he may have spent the majority of his time on this pond before the nest hatched. During the post-hatch-to-fledge period, he was detected with high to very high density along the northern central portion of E14 near nodes 6 and 32. However, SFBBO observed him on 7/23 and 7/24 outside of the node grid with two chicks on E13. One of these chicks, Ng:bk, was observed by SFBBO as fledged in the E13 saltworks on 8/4, indicating that the brood may have finished fledging in E13. At night before the nest hatched, when he was expected to be incubating, nn:pk was detected with very high density northeast of the nest near nodes 10 and 14 along the borrow ditch where moderate quality foraging habitat is present; moderate to high density near the nest at node 34 and in the northeast corner of E14 near nodes 24, 35, 37, and 38; and sparse to low density west and northwest of the nest near nodes 6, 56, and 32 and in the southeast corner of E14 (Figure 16). During the day, when he was expected to be foraging and roosting, he was observed with very high density west of the nest near node 56; moderate density near the nest and north of the nest near nodes 6, 10, and 34; and sparse to low density in the western side of E14 near nodes 16 and 32, east of the nest near nodes 11 and 14, and the northeast corner of the pond near nodes 24, 37, and 38.								

Band Combo	Sex	Nest	Date Tagged	Date Nest Hatched	Chicks Banded	Chicks Fledged	Last Detection	Number of Detections
This bird has also been detected outside of ELER. On 8/12, nn:pk pinged the Refuge tower once, then returned to ELER until 10/25. There is a gap in detections from 10/25 to 10/31; he was then detected in the Channel Islands, first by the East Anacapa Island tower on 10/31 and 11/1, then the Fletcher Peak - Catalina Island tower and Boulders - San Clemente Island tower on 11/1. There are no records for this bird after 11/1.								
Rk:ab	F	E14-61	6/28/25	7/11/25	Partial	Unknown	7/18/25	51,960
Summary: During the pre-hatch period, Rk:ab was observed with very high density at the nest location on the western side of E14, and low density near two nodes to the west of the nest site (Figure 17). During the post-hatch to fledge period, she was observed with low density at the nest site and very high density along the borrow ditch near node 32 north of the nest site where moderate quality foraging habitat is present. SFBBO did not observe her during surveys post-hatch. During the day before the nest hatched, when she was expected to be incubating, Rk:ab was detected with very high density near the nest and node 56; moderate density northwest of the nest near node 32; and low density west of the nest near node 16 (Figure 18). During the night, when she was expected to be foraging or roosting, she was detected with very high density near the nest at node 56; high density northwest of the nest near node 32; and sparse to low density west and east of the nest near nodes 16, 21, and 34.								
Gk:kr	M	E14-61	6/28/25	7/11/25	Partial	Unknown	9/18/25	104,827
Summary: During the pre-hatch period, Gk:kr was observed with very high density near the nest site in the western portion of E14, with two areas of sparse to low density detection in the western area of the pond, including near node 32 along the northern borrow ditch where moderate quality foraging habitat is present (Figure 17). During the post-hatch-to-fledge period, he was observed with low density at the nest site and very high density along the borrow ditch north of the nest site near node 32. Gk:kr was observed by SFBBO on 7/24 with one unbanded chick in the E13 saltworks north of node 32. During this observation, he flew off a distance to forage and left the chick alone, but eventually returned to brood. There were no detections of Gk:kr from 7/30 to 8/4 or from 8/6 to 8/20. SFBBO observed Gk:kr further north at the Oliver Brothers North pond in Hayward Regional Shoreline on 7/3, 7/10, and 7/17. It is possible he was at this location again during these gaps in his detections. At night before the nest hatched, when he was expected to be incubating, Gk:kr was detected with very high density near the nest and node 56, and low density west and northwest of the nest at nodes 16 and 32 (Figure 18). During the day, he was observed with very high density near the nest and node 56; high density northwest of the nest near node 32; moderate density west of the nest near node 16; and sparse to low density in the east side E14 near nodes 14 and 17.								

<table>
<tr><th>Band Combo</th><th>Sex</th><th>Nest</th><th>Date Tagged</th><th>Date Nest Hatched</th><th>Chicks Banded</th><th>Chicks Fledged</th><th>Last Detection</th><th>Number of Detections</th></tr>
<tr><td>Gk:yo</td><td>F</td><td>E14-69</td><td>6/29/25</td><td>7/11/25</td><td>Yes</td><td>Unknown</td><td>8/23/25</td><td>76,898</td></tr>
<tr><td colspan="9">Summary: During the pre-hatch period, Gk:yo was detected with moderate to very high density in the northeast corner of the pond near nodes 36, 17, 38, and 24 where high quality foraging habitat is present; moderate density near the nest and node 31; and sparse to low density in the rest of the eastern and southern portions of E14 (Figure 19). During the post-hatch-to-fledge period, she was observed with very high density in the southeast side of E14 along the remnant borrow ditch where foraging habitat is sometimes present (and where mate, male vo:bk, was also observed). She was observed with moderate to high density in the eastern portion of the pond, and along the northern borrow ditch where high quality foraging habitat is present, and low to sparse density in the central and western portions of E14. She was not observed by SFBBO with the brood after the nest hatched.

During the day before the nest hatched, when she was expected to be incubating, Gk:yo was detected with high to very high density in the northeast corner of the pond near nodes 17, 24, and 38 where high quality foraging habitat is present; moderate density near the nest at node 31 and in the northeast corner of the E14 near nodes 36 and 37; and sparse to low density throughout the rest of the east side of E14 (Figure 20). At night, when she was expected to be foraging or roosting, she was detected with high to very high density in the northeast corner of the pond near nodes 24 and 38; moderate density in the east side of the pond near nodes 17 and 36; and sparse to low density throughout the rest of the east side of E14 and the northwest, north, and east sides of E6B.</td></tr>
<tr><td>Gk:og</td><td>M</td><td>E14-72</td><td>7/2/25</td><td>7/15/25</td><td>Partial</td><td>Unknown</td><td>368, 375</td><td>368,375</td></tr>
<tr><td colspan="9">Summary: During the pre-hatch period, Gk:og was observed with very high density near the nest site at node 34, and sparse density in the northeast corner of the pond and at one location in the southwest corner of E6B (Figure 21). During the post-hatch to fledge period, he was observed with very high density near the nest site, moderate density northeast of the nest at node 10, and sparse to low density along the northern borrow ditch in the northeast corner of E14, eastern side of E6B, and southwest corner of E6B. SFBBO observed Gk:og with female Ka:wr and three young chicks on 7/18, however none of them have been observed since, so it is unknown whether any of his chicks fledged.

At night before the nest hatched, when he was expected to be incubating, Gk:og was detected exclusively near the nest and node 34 with very high density (Figure 22). During the day, he was observed with very high density near the nest and node 34; moderate density to the northeast of the nest at node 10, in the northeast corner of E14 near nodes 24 and 38, and in the southwest and southeast corners of E6B near nodes 55 and 18, all of which provide high quality foraging habitat; and sparse to low density directly west of the nest, and in the east side of the pond where high quality foraging habitat is present.</td></tr>
<tr><td>ng:ka</td><td>F</td><td>E14-57</td><td>7/2/25</td><td>7/15/25</td><td>Yes</td><td>Unknown</td><td>9/17/25</td><td>533,978</td></tr>
</table>

<table>
<tr><th>Band Combo</th><th>Sex</th><th>Nest</th><th>Date Tagged</th><th>Date Nest Hatched</th><th>Chicks Banded</th><th>Chicks Fledged</th><th>Last Detection</th><th>Number of Detections</th></tr>
<tr><td colspan="9">Summary: During the pre-hatch period, ng:ka was observed with high density at the nest site, moderate density directly northeast of the nest to the corner of E14 and southwest corner of E6B, where high quality foraging habitat is present in both areas; and sparse density throughout the east side of E14 (Figure 23). During the post-hatch-to-fledge period, she was not observed at the nest location, but was observed with moderate to very high density at the northeast corner of E14 near nodes 37 and 38 where high quality foraging habitat is present, and sparse density in the southeast corner of E6B. SFBBO observed ng:ka twice during the post-hatch-to-fledge period, including on 7/23 and 7/24. Both times she was located near node 37 and with chick Gk:yw. Both the unbanded male and other two chicks from the brood were nowhere to be found. No chicks from this nest are known to have fledged.</td></tr>
<tr><td>vo:bk</td><td>M</td><td>E14-69</td><td>7/3/25</td><td>7/11/25</td><td>Yes</td><td>Unknown</td><td>8/10/25</td><td>4,974</td></tr>
<tr><td colspan="9">Summary: During the pre-hatch period, vo:bk was detected with moderate to very high density at the nest site; low density in two areas in the central and western parts of E14; and sparsely throughout much of the eastern portion of the pond (Figure 19). He was also observed in E6B, with sparse detections in both the southwest and eastern portions of the pond. During the post-hatch-to-fledge period, he was observed with very high density in the southeast side of E14 along the remnant borrow ditch where foraging habitat is sometimes present, moderate density northeast of this area, and sparse to low density throughout all of the east side and a portion of central E14. SFBBO observed vo:bk once after hatch on 7/20 near node 23 on the east side of E14 with one chick (Gk:gw). No chicks from this nest are known to have fledged.

During the night before the nest hatched, when he was expected to be incubating, vo:bk was detected with very high density near the nest and nodes 11 and 31; moderate density west of the nest near node 34; and sparse to low density in the central area of the pond near nodes 32 and 56, and in the eastern side of the pond near nodes 17, 35, and 52 (Figure 20). During the day, when he was expected to be foraging or roosting, he was observed with very high density near the nest and node 31; moderate density north of the nest near nodes 11 and 14, and in the central area of E14 near node 32, which both provide moderate quality foraging habitat; and sparse to low density throughout much of the east side of E14 and the southwest and east sides of E6B, which would also provide some foraging habitat.</td></tr>
<tr><td>Ka:wr</td><td>F</td><td>E14-72</td><td>7/7/25</td><td>7/15/25</td><td>Partial</td><td>Unknown</td><td>4,555</td><td>4,555</td></tr>
<tr><td colspan="9">Summary: During the pre-hatch period, Ka:wr was observed with very high density near the nest site at node 34, low density at nodes surrounding the nest in E14, and in the southern end of E6B where high quality foraging habitat is present; and sparse density in the northeast corner of E14 (Figure 21). During the post-hatch to fledge period, she was observed with very high density at the nest site; high density in the southeast corner of E6B near node 18 where high quality foraging habitat is present; moderate density at nodes surrounding the nest, including 10, 11, 56, and 32, most of which provide moderate quality foraging habitat; and sparse to low density in the northeast corner of E14 and southern end of E6B where high quality foraging habitat is present. SFBBO observed Ka:wr with male Gk:og and three young chicks on 7/18,</td></tr>
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<tr><td colspan="9">however none of them have been observed since.

During the day before the nest hatched, when she was expected to be incubating, Ka:wr was detected with very high density near the nest and node 36; high density to the northeast of the nest near node 10, where some moderate quality foraging habitat is present; and sparse to low density throughout the central and northern areas of E14 (Figure 22). During the night, when she was expected to be foraging or roosting, she was detected with very high density near the nest and node 34; moderate density directly east and west of the nest, and in the southern portion of E6B where high quality foraging habitat is present; and sparse to low density in the northeastern corner of E14, southwest corner of E6B near nodes 55, 3, and 5, and northwest corner of E6B where good quality foraging habitat is present.

This bird has also been detected outside of ELER. Ka:wr flew from ELER to the Refuge on 10/3, and persisted there until 10/9, when she flew to Bolinas, pinging the Wolfback Ridge tower near Sausalito, the Richardson Bay Audubon Center tower northwest of Tiburon, and the Martin Griffin Preserve tower near Bolinas on the way. She has not pinged any towers since 10/9, but was observed by a biologist in Point Reyes on 11/24.</td></tr>
<tr><td>Ka:yo</td><td>M</td><td>E6B-20</td><td>7/9/25</td><td>7/8/25</td><td>Yes</td><td>No</td><td>9/18/25</td><td>12,965</td></tr>
<tr><td colspan="9">Summary: Ka:yo was tagged the day after his nest hatched, so he does not have any data for the pre-hatch period. During the pre-fledge period, Ka:yo was detected with very high density near nodes 8 and 30 in the northeast corner of E6B where high quality foraging habitat is present; high density west of these areas and along the southeast corner of the pond; moderate density in the center of the pond and along the northern borrow ditch; and low to sparse density in other areas of the center and southeast corners of the pond (Figure 24). During the post-fledge period, he was detected with very high density near nodes 8 and 30 in the northeast corner of E6B; high density west of these areas; moderate density further west and in the southeast corner of the pond; and low to sparse density in the southeast corner and center of the pond. SFBBO observed Ka:yo once after hatch on 7/10. His chicks were not observed at that time, and he did not display any behavior that would indicate that he was guarding chicks; it is likely that the brood was depredated within two days of hatch.</td></tr>
<tr><td>Ko:rw</td><td>M</td><td>E14-89</td><td>7/11/25</td><td>7/24/25</td><td>Yes</td><td>Unknown</td><td>9/18/25</td><td>276,047</td></tr>
<tr><td colspan="9">Summary: During the pre-hatch period, Ko:rw was detected with very high density at node 56 near the nest in the west side of E14; moderate density west and northwest of the nest at nodes 16 and 32, of which node 32 is near moderate quality foraging habitat; and sparsely in the east side of E14 where high quality foraging habitat is present (Figure 25). During the post-hatch-to-fledge period, he was observed with very high density northwest of the nest near node 32 where moderate quality foraging habitat is present along the borrow ditch; moderate density at nodes 16 and 56 near the nest; and low density in the northwest corner of the pond at node 27 where moderate quality foraging habitat is present adjacent to a public trail. SFBBO did not observe Ko:rw after hatch.</td></tr>
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<tr><td>Gk:ok</td><td>F</td><td>E6B-22</td><td>7/14/25</td><td>Depredated 7/15/25</td><td>N/A</td><td>N/A</td><td>9/18/25</td><td>7,286</td></tr>
<tr><td colspan="9">Summary: During the pre-depredation period, Gk:ok was detected with very high density at one location near the nest in the northeast corner of E6B, and low to moderate density in the rest of the northeastern corner of the pond (Figure 26). During the post-depredation period, she was observed with very high density near node 55 in the southwest corner of E6B where high quality foraging habitat is present; moderate density at adjacent nodes 3 and 15 and 26; and sparse to low density in the southeast corner and north-central area of E6B, and one area in the eastern end of E14. SFBBO observed Gk:ok once after the nest was depredated; she was acting suspicious and possibly attempted to re-nest in E6B on 7/19.</td></tr>
<tr><td>Ng:ap</td><td>M</td><td>E6B-21</td><td>7/17/25</td><td>Depredated 7/20/25</td><td>N/A</td><td>N/A</td><td>9/13/25</td><td>6,409</td></tr>
<tr><td colspan="9">Summary: During the pre-depredation period, Ng:ap was detected with very high density east of the nest near node 54; high density southeast of the nest, northeast of the nest, and in the northwest corner of E6B; moderate to low density throughout most of the rest of E6B; and sparse density in the east side and central area of E14 (Figure 27). During the post-depredation period, he was observed with moderate to very high density in the southwest corner of E6B where high quality foraging habitat is available, as well as in the northwestern corner of E6B near node 26; and with sparse to low density in the southeast and eastern side of the pond. SFBBO observed Ng:ap once after the nest depredation on 7/21 near the nest.</td></tr>
</table>

OTHER OBJECTIVES

Habitat Enhancement (Objective 1)

Another objective of this project was to enhance ten hectares of snowy plover and least tern habitat in ELER. Project members accomplished this through a variety of methods including spreading oyster shells, stomping in the mud to create depressions, and reconnecting historical channels to increase water flow.

- **Oyster shells**: SFBBO conducted a study from 2009-2012 which confirmed that snowy plovers preferentially nest on pond bottoms that have been sparsely covered with oyster shells (Donehower et al. 2013). The apparent reason for this preference is that the shells increase the visual complexity of the pond and provide camouflage for plovers at all life stages. Since then, SFBBO has added large areas of oyster shells to E14 in a successful effort to increase nesting at this pond. Least terns also appear to be attracted to the shell enhancement, as the majority of tern nests monitored at ELER are located in shelled areas.
- **Mudstomps**: Snowy plovers nest in scrapes, or small, shallow depressions that breeding pairs create by scraping at the ground with their feet. However, if the landscape already presents a suitably shaped depression, such as a footprint created by researchers while walking on a pond, the pair may use that as the base of their scrape. In the early 2000's, project member Carleton Eyster began to hold public "mudstomp" events where volunteers would walk across plover habitat before the breeding season began and leave behind lots of footprints, which pairs would then lay eggs in. These events have the added benefit of bringing volunteers into plover conservation and allowing them to interact with plover habitat up close. SFBBO also regularly uses this technique at their habitat enhancement events.
- **Water flow:** The salt ponds in ELER were created from tidal marsh that consisted of a network of interconnected slough channels. Once the ponds were diked and drained, some ponds were internally graded to subdivide them or change the elevation to improve water circulation for salt production. Many of these subdivisions have since degraded, but strips of higher elevation fill prevent some remnant slough channels from connecting to each other. The invertebrates that snowy plovers forage on mostly occur in shallow water, or on the surface of saturated mud, meaning the best foraging habitat is located in wet areas. However, most breeding ponds are very dry, making it hard for chicks to find foraging habitat. In these situations, broods are often forced to the edges of a pond along the borrow ditch and levees, which can increase negative outcomes for broods by increasing interbrood aggression, which past monitoring by SFBBO has found to cause chick mortality (Pearl et al. 2016). It also may allow predators to more efficiently target foraging plovers, especially broods, and reduce plovers' ability to detect approaching predators due to a constrained viewshed. In addition, broods foraging along the pond margins are more likely to end up on top of levees where they face threats from vehicles. Digging out the strips of fill that prevent channels from connecting is an effective way to

create wetter foraging areas, enhance habitat for broods across wide swathes of a pond, and decrease the negative interactions described above.

As was previously described in the Interim Report for this project, SFBBO held a habitat enhancement event on March 9, 2024 during which 31 volunteers spread approximately 3,300 pounds of shells over 2.4 hectares. On March 8 and March 11, 2025, project members and seven volunteers participated in a joint mudstomp and node installation event. While we distributed nodes evenly across E14 and E6B, we covered approximately 5.2 hectares of soft pond substrate with footprints (Table 4).

Project members determined that creating more foraging habitat on E14 was a high priority following the 2025 breeding season, when record numbers of broods at the site were forced into close proximity along the edges of the pond and onto levees due to limited foraging habitat. On October 11, 2025, project members and three volunteers dug a channel through approximately 45 cubic feet of fill on E14 (Table 4). This strip of fill prevented a spur of remnant slough channel in the northeast corner of the pond from connecting to the rest of the channel in the interior of the pond. Once water from the northern borrow ditch flows across the east side of the pond to the southern borrow ditch, this reconnected channel will create approximately one hectare of additional foraging habitat in E14. It will also enhance the overall quality of breeding habitat in the entire eastern half of the pond, an area of approximately 12.2 hectares. By creating more foraging habitat in the most productive area of the pond, the density of broods foraging at any one foraging area will be reduced, which may in turn reduce the ability of predators to hunt chicks. In addition, broods would have easier access to foraging habitat and would not need to travel long distances across the pond, which may also reduce chick mortality when they are recently hatched and most vulnerable.

Least Tern Breeding Summary (Objective 4)

California least terns have bred at ELER since 2017. In 2025, SFBBO biologists conducted least tern surveys in order to document vital colony metrics relevant to the Recovery Plan, including the number of adults, fledglings, and chicks observed, as well as locating and monitoring nests. Staff also estimated the number of fledglings produced by the colony. Staff surveyed by driving slowly on adjacent levees and observing the colony through spotting scopes and binoculars. Least tern nests were identified by scanning for incubating adults and observing mate provisioning behavior. SFBBO staff entered the colony once per week to locate and check nests, float eggs, mark nests with numbered chick shelters, and record new nest locations with Field Maps. Nests were monitored weekly until the fate of the nest could be determined. On each nest visit, the nest status was documented. When there were no longer eggs in the nest, a fate was assigned based on observed evidence, including hatched, probable hatch, failed, or unknown.

Least terns were first observed at ELER on April 22, 2025. From April 22 to May 20, SFBBO biologists conducted weekly least tern surveys at ponds E12, E13, E14, and E6B concurrently with snowy plover surveys. Dedicated least tern surveys began on May 27 and survey frequency increased to twice-weekly. These surveys continued through September 9. A maximum high count of 26 least terns was observed on July 15, 2025.

SFBBO biologists monitored 18 least tern nests, including 14 nests on E14 (Figure 4), three nests on E6B (Figure 5), and one nest on E12. Of these 18 nests, seven were confirmed as hatched (39% hatch rate), five were classified as probable hatches (67% hatch rate), five nests failed, and the fate of one nest could not be determined. This results in a hatch rate of 39% when only considering confirmed hatched nests. However, the hatch rate increased to 67% when probable hatches were included. SFBBO estimates that ELER produced between 20 and 21 fledglings in 2025.

The above metrics represent a successful year for least terns at ELER. Although breeding effort was modest compared to previous years, with 18 nests representing the third fewest confirmed nests in this colony, hatching success was much higher compared to previous years. From 2017 to 2024, SFBBO monitored 471 least tern nests, only 63 of which were confirmed to hatch. An additional 29 nests were classified as probable hatches. That means that over this time period, the least tern colony's average confirmed hatch rate was only 13%; if probable hatches are included, the hatch rate improves to 20%. In light of this, a 39% confirmed hatch rate and a 67% probable hatch rate is notable. This also mirrors the high apparent hatch rate observed for snowy plovers at ELER this year.

Even more notable is how many least tern chicks fledged in 2025. It is difficult to estimate fledge counts at ELER because the area receives many foraging and roosting fledges that originate from the Hayward Shoreline colony approximately 2.5 kilometers north. However, SFBBO is confident that our reported fledges came from ELER because we observed chicks at every age class throughout the season. From 2018 to 2024, SFBBO estimates that ELER has only produced between 20 and 30 fledges, meaning that in just one year, the colony produced nearly as many fledges as it has for the past seven. SFBBO does not know what led to the colony being so much more successful this year, but a preliminary report from the Hayward Shoreline colony suggests that they also had an extremely productive year (D. Riensche, pers. comm.). Therefore, this success may be part of a larger trend for least terns in 2025.

The least tern Recovery Plan states that in order for the species to be delisted, there must be 20 secure colonies that are each capable of supporting 20 breeding pairs with a 5-year reproductive mean of 1.0 chick fledged per pair (USFWS 1985). Given the historical statistics listed above, the least tern colony at ELER has never qualified as a secure colony. This year is the closest it has come with 18 pairs and more than 1.0 chick fledged per pair. However, this level of success would need to be maintained for another four years for the colony to be considered secure.

Tern Watch Volunteer Program (Objective 6)

Since 2018, SFBBO has enlisted volunteers to assist with monitoring the least tern colony at ELER as part of our Tern Watch program. Recruitment for the 2025 Tern Watch began in late March. Throughout April, staff interviewed prospective volunteers, then hosted an online training session and two field training sessions. During the online session, volunteers were introduced to least tern biology, the history of the ELER colony, and their volunteer duties. During the field trainings, volunteers familiarized themselves with scopes and tripods, navigated through ELER, and identified least terns in the field. Once all trainings were completed, volunteers began signing up for survey shifts.

Volunteers used similar techniques to staff surveys, but were only permitted to survey from a select number of points due to access restrictions. Because of high snowy plover breeding activity at ELER, staff directed volunteers to three different vantage points from which the least tern colony could be seen, but that would not disturb nesting snowy plovers. Volunteers were instructed to survey from each point for a minimum of 30 minutes and record their data in an online form.

The 2024 Tern Watch consisted of 14 volunteers who monitored the least tern colony for a combined 98 hours (Table 4). The 2025 Tern Watch consisted of 11 volunteers who monitored the least tern colony for a combined total of 63 hours (Table 4). Staff used this supplemental data to help assemble the timelines of nests and confirm whether certain nests were still active on certain days. The Tern Watch volunteers were a particularly crucial aspect of the monitoring program in 2025 for their role in alerting SFBBO staff to the continued presence of a red fox family denning near the least tern colony. One volunteer who had been coming to ELER early in the morning to bird and take photographs before the least tern season started, informed staff during a field training session that he had seen the fox family repeatedly over the last several weeks. At this point, SFBBO staff had not yet observed the foxes, so we passed this valuable information on to USDA immediately. The volunteer's photographic record of the foxes plus subsequent observations from volunteers and staff prompted USDA to conduct a special operation to remove the foxes, despite not having dedicated funding for ELER in 2025.

Predator Impacts on Snowy Plovers and Least Terns (Objective 5)

In order to assess predator impacts on snowy plovers and least terns in ELER, SFBBO conducted avian predator surveys in conjunction with snowy plover surveys. We defined avian predators as any species that could potentially prey on snowy plover nests, chicks, or adults, which includes most raptors, gulls, corvids, herons, and egrets. Non-avian predators and their sign were recorded opportunistically, but these surveys were not designed to detect these species, particularly since many mammals are nocturnal. Throughout each snowy plover survey, observers would simultaneously scan for avian predators. We recorded the number, species, habitat type, and time when each predator was observed and entered the predator's approximate location into Field Maps. In addition, observers documented any predator nests in the area and their fates when possible. We calculated the average number of predators observed per survey at each pond during the season (Table 3).

The most numerous predators at E14 were unidentified gulls (*Larus* sp.; 5.18/survey, 6 observations) followed by northern harriers (*Circus hudsonius*; 1.54/survey, 40 observations). Despite their high average per survey, unidentified gulls were observed infrequently at E14, and most of these gulls were recorded during a single incident of a large flock flying south over the pond. Northern harriers were consistently observed during predator surveys, and were primarily seen hunting over vegetated areas along the levees.

At E6B, the most numerous predators were California gulls (*Larus californicus*; 33.89/survey, 15 observations), followed by unidentified gulls (14.79/survey, 3 observations). Gulls at E6B were primarily observed during July through September, when large flocks were seen roosting on the dry areas of the pond and feeding in the water. Snowy egrets (*Egretta thula*) and great egrets (*Ardea alba*) were also commonly observed hunting in the inundated areas of E6B.

In order to confirm which species were responsible for select depredation events, we placed camera traps on eight different nests, six at E14 and two at E6B. These cameras captured two depredations by common ravens (*Corvus corax*), both at E6B. All nests with cameras at E14 hatched. These results are consistent with the overall depredation trends at E14 and E6B in 2025. Out of 89 monitored nests at E14, only six were depredated (7%). Conversely, at E6B, 12 out of 25 monitored nests were depredated (48%). Project members are unsure what caused such a strong disparity in nest fates between these two sites. There was not a strong difference in common raven abundance between either site. According to previous camera trap data gathered predominantly at E14, common ravens are the most common confirmed snowy plover nest predator. Out of 94 snowy plover nest depredations caught on camera between 2009 and 2025, common ravens accounted for 65 of those depredations, or 69% (SFBBO, unpublished data). Therefore, it is unsurprising that common ravens were responsible for the two confirmed depredations on E6B, but it is unknown why they were not depredating snowy plover nests at the same rate on E14. Furthermore, the confirmed hatch rate for least terns at 39% is the second highest SFBBO has ever recorded, indicating that least terns at ELER also benefitted from unusually low predator activity this year.

Another unusual aspect to the low predation rate at E14 was the prolonged presence of a red fox family directly adjacent to the pond. USDA was not programmatically removing predators from ELER in 2025, so the foxes' eventual removal was a special operation that did not occur for several months after the initial observations. During that time, volunteers and staff repeatedly saw the female and kits on the levees around E14. In 2018, SFBBO's camera traps recorded a red fox depredating ten snowy plover nests at E14, and although researchers were not permitted to place camera traps on least tern nests at that time, they assumed that the red fox was responsible for depredating many of the tern nests on E14 that year as well (Pearl et al, 2018). Given this history, it is surprising that this group of foxes did not appear to be a significant threat to snowy plovers and least terns at E14 in 2025. Through conversations with USDA, project members learned that there was an increase in reports of mange in foxes and coyotes this year (USDA, pers. comm.). Perhaps this accounts for the foxes' disinterest in snowy plover and least tern nests, although the animals appeared healthy whenever observed.

Table 3: Average number of predators observed per survey at E14 and E6B, 2025.

Common Name	Scientific Name	E14 (28)[1]	E6B (28)
American crow	*Corvus brachyrhynchos*	0.00	0.39
Bonaparte's gull	*Chroicocephalus philadelphia*	0.00	0.04
California gull	*Larus californicus*	0.18	33.89
Cooper's hawk	*Astur cooperii*	0.04	0.00
Common raven	*Corvus corax*	0.82	0.71
Coyote	*Canis latrans*	0.11	0.25
Great blue heron	*Ardea herodias*	0.07	0.14
Great egret	*Ardea alba*	0.50	2.68
Unidentified gull	*Larus* spp.	5.18	14.79
Merlin	*Falco columbarius*	0.04	0.04
Northern harrier	*Circus hudsonius*	1.54	0.39
Peregrine falcon	*Falco peregrinus*	0.07	0.11
Red fox	*Vulpes vulpes*	0.04	0.00
Red-tailed hawk	*Buteo jamaicensis*	0.00	0.04
Snowy egret	*Egretta thula*	0.11	4.04
Sharp-shinned hawk	*Accipiter striatus*	0.00	0.04
White-tailed kite	*Elanus leucurus*	0.11	0.00

[1] Designates the number of surveys performed.

Landowner and Land Manager Communication (Objective 7)

Throughout the breeding season, project members communicated weekly with CDFW about where least tern and snowy plover nests and broods were located. This allowed CDFW to appropriately manage water levels in ponds across ELER, avoid levees where broods were present, and monitor the level of breeding activity from week to week. USDA could not perform regular control at ELER this year, so project members only reported high priority predators like the red foxes on E14.

DISCUSSION

Node Grid Performance and Feasibility

Motus is a powerful technology that has many applications in wildlife ecology and management. Project members first became interested in using tracking technology on snowy plovers in 2019 after learning about a snowy plover GPS-tagging project while attending a workshop in Ceuta, Mexico. However, to the project members' knowledge, no one had used a node grid for plover research at this time. CDFW had already installed a Motus tower at ELER in 2021 and was very interested in the node technology when project members approached them with a study design. Both CDFW and the project members understood that this was an exploratory project that would generate valuable information about how Motus technology and the node grid performed in a snowy plover research context. Now, after having completed the study, project members can speak to the successes and challenges of the technology and share lessons learned with potential future researchers.

The first key takeaway is that a node grid is very labor intensive to maintain. Following installation, project members had to visit each node individually multiple times to change settings and troubleshoot issues, which took a lot of time considering our grid covered approximately 450 acres and some nodes were only accessible by kayak. Therefore, we recommend taking node accessibility and grid size into account when choosing a project location.

Second, project members learned that Motus-compatible tags do not perform optimally when placed on species that spend a lot of their time on the ground, and as a result, the node grid performance was suboptimal. When a radio signal hits the ground, a large percentage of it is absorbed by the earth and the remaining signal that successfully bounces back into the air is greatly reduced in strength (Rueda-Uribe et al. 2024). Since plovers spend so much time on the ground, their tags' signal strength was greatly diminished. Although CTT recommended spacing our nodes 200 meters apart, based on the average signal strength of each ping received from our deployed tags, we would have needed to space our nodes closer to 50 meters apart for successful multilateration. As such, instead of being able to report exact locations for each bird, project members could only report where a snowy plover was within a roughly 80-meter radius around a node. The diminished tag detection distance also created significant "dead zones" within any given triangle of nodes, where a tagged plover may have been roosting or nesting but was not detected because it was too far away from each node. This makes it much harder to draw conclusions about what an individual was doing at any given time.

Conversely, we noticed that tags appeared to transmit better when the bird was near water, likely because signals reflect better off of water than earth. Future research should take these limitations into consideration and design projects so that they either do not require precise location data, are in very wet areas, or are in small enough areas that setting nodes 50 meters apart is not cost prohibitive.

Third, we learned that not every tag or node functioned perfectly. The number of pings received from each tag ranged from 2,322 to 1,422,025. While much of this variation can be explained by individuals spending prolonged periods of time in dead zones or outside of the node grid, looking at the raw data, it appears as though some tags were having trouble transmitting regularly, even when a bird appeared to be in full range of a node. We do not know the exact reason for this, but suspect that differences in a tag's ability to stay charged may have contributed to the issue. We chose a small Flex Tab style for the tags in order to minimize overall weight, but that may have allowed snowy plover's back feathers to more easily cover the tag's solar panel. In addition, eight node batteries stopped holding a charge overnight by the end of the season (five within the first five months of deployment), and two node micro SD cards had to be replaced within the first month of deployment.

Overall, however, the project members feel that this was a valuable study and the data generated from the node grid could not have been collected any other way. Future node and tag deployments adjusted for these limitations will yield improved results.

Snowy Plover Breeding Success

This was a highly productive year for snowy plovers at ELER due to the large number of nests and unprecedented hatch rate at E14. Based on SFBBO's past monitoring efforts, the average hatch rate for a pond with more than 50 nests is only 47%, making the 82% hatch rate at E14 this year an extreme outlier. It is unclear what may have led to this elevated hatch rate considering the predator concerns discussed above. Whatever the cause may be, it seems unlikely that snowy plovers will experience such high hatching success at this pond in the future, as past monitoring by SFBBO has found that predators key in on areas of high nesting density.

Compared to the 82% hatch rate at E14, the pond's 25% fledge rate is much more modest, even slightly below average. Across the South Bay, SFBBO has recorded a slightly depressed fledge rate for 2025. Based on previous years, the average South Bay fledge rate is 31%; this year the current apparent fledge rate is 28%. Although the final rate may increase slightly as band sightings from various researchers and birders are reported over the winter, SFBBO still expects this to be a lower than average year for fledging.

Although the exact cause of this lower fledge rate is unknown, project members noticed that chicks seemed to be fledging very slowly in 2025. The expected fledge date for a snowy plover chick is 28 days post-hatch (Warriner et al 1986), but project members observed four broods in ELER that were still associating with an adult male and not attempting to fly after the 28-day mark, including one 37-day old "chick" still attempting to brood. With so many more broods on

E14 than normal, it is possible that chicks experienced increased competition for food resources, or increased aggression from neighboring adults due to closer brood proximities. In the past, SFBBO has observed that chicks appear to fledge more slowly when foraging habitat is extremely limited, including in 2021 when three chicks in an area that was completely dry were not fledged until 35 days post-hatch (Pearl et al. 2022). Something similar may have happened this year at ELER.

Snowy Plover Movement

This study confirmed some snowy plover behavior and habitat use that SFBBO had previously observed through monitoring. Motus detections showed that during the pre-hatch period, when snowy plover adults were not incubating or near the nest, they spent a large amount of time in the areas closest to water within E14, which provide the highest quality foraging habitat. This was primarily at the eastern end of the pond but also included various locations along the northern borrow ditch. This is consistent with our field observations of snowy plover adults being concentrated in these areas. During the post-hatch-to-fledge period, we found that adults led broods to these same areas, and most often led them to the closest suitable foraging areas. The data also confirmed that adults breeding in E14 occasionally foraged in E6B, even during the post-hatch-to-fledge period when adults were attending to broods. This phenomenon has been previously observed by SFBBO at ELER and elsewhere in the South Bay, when chicks were observed foraging alone for a time before a male eventually returned to the area to watch over them.

This study also allowed project members to track snowy plovers within the node grid at night, which uncovered interesting observations. We found that the timing of male and female incubation shifts was variable from day to day, and often occurred at unexpected times based on the literature. For example, at nest E14-72, we observed male Gk:og begin his incubation shift at times ranging from 2:06 p.m. to 6:14 p.m, well before sunset.

Management Recommendations

This study indicated that foraging habitat is very important for both adults and broods. Adults spent a large amount of time in areas that provide high quality foraging habitat, including outside of the pond where their nest was located on a semi-regular basis. Once nests hatched, adults typically led broods to the nearest foraging area along the margins of the pond where water was present. Some adults did take their broods considerable distances, such as Ng:ko that led his brood over 500 meters to the northeastern corner of the pond, despite the northern borrow ditch being located approximately 70 meters north of the nest (Figure 5). Due to the unprecedented number of nests that hatched at E14 in 2025, this led to a large number of broods competing for limited foraging habitat, and may have resulted in interbrood aggression that impacted chick survival, as has been previously observed by SFBBO in this pond (Pearl et al. 2016). In addition, because broods were concentrated in certain areas, predators were likely able to more easily depredate chicks. As such, providing more foraging habitat throughout E14 should be considered a priority to reduce interbrood aggression and reduce the ability of predators to focus their hunting in concentrated foraging areas. This can be accomplished by reconnecting remnant slough channels that are present in the pond to the borrow ditch, as we did during the habitat enhancement event in October. In order to be successful, efforts to reconnect these sloughs must consider the elevation of the borrow ditches, remnant slough channels, and suitable nesting habitat so that foraging habitat can be provided throughout the year without risk of flooding out active nests.

Project members also strongly recommend that additional Motus towers be installed in Santa Clara and San Mateo County and in northern Alameda County. Marin County contains reasonable Motus tower coverage, but the large dead zones along the Peninsula and in the East Bay make it hard to track snowy plover dispersal to areas where they are known to occur. The project members suggest that if CDFW were to sponsor additional towers, installing towers at Albany Mudflats Ecological Reserve (ER), Bair Island ER, Redwood Shores ER, and San Bruno Mountain ER would most effectively reduce the dead zones within the Bay Area. This expanded coverage may also allow researchers to track how often snowy plovers are flying from one side of the Bay to the other.

In addition to expanding Motus efforts, there are many other management actions landowners can take to support snowy plovers and least terns in the Bay. SFBBO is committed to continuing to expand the shelled areas on multiple ponds, but especially on E6B. In 2023, the least tern colony expanded onto the shell plots on this pond. Hopefully, increasing the amount of shells will also increase the amount of least tern nesting and allow them to form a larger colony they can defend more easily. We also recommend increasing funding for predator control across the Bay Area, but especially within ELER. USDA's current funding at this location is insecure, which results in coverage gaps, like what occurred in 2025. Although predation pressure appeared low this season, project members feel it is important to at minimum have the ability to remove specific problem individuals, like the foxes at E14. Lastly, invasive plant species are encroaching onto the ponds in ELER and degrading nesting habitat. Hand pulling is not feasible at scale and inundating ponds for the winter in an attempt to smother vegetation, removes winter foraging habitat and potentially allows plants to grow back more easily in the spring. Finding new methods of vegetation management that can be deployed at the pond scale would help ensure that ELER continues to provide high quality breeding habitat.

Future Research

This project provided interesting insights into snowy plover breeding behavior at ELER and was a useful exploration into Motus technology and how it can be used in snowy plover research. Given the limitations we discovered, we now know how to better design future projects that maximize the technology's potential. These projects would fall into two broad categories: projects that do not require knowing the exact location of a tagged individual, and projects that involve shrinking the node grid so exact location can be calculated.

Research questions that do not require exact location data would simplify data interpretation and allow the nodes to continue being used in their current configuration with only minor modifications. One project that fits into this category could be investigating how long it takes a female to re-nest after her current nest is no longer active. The project associated with this grant occurred too late in the season for us to observe any females re-nesting. However, by beginning to tag earlier in the season, project members could track a female's activity throughout the breeding period and investigate how many nests she initiates, if the time between initiations changes based on whether the previous nest succeeded or failed, and how likely she is to stay with her chicks after they hatch. This would be possible to observe from the Motus data even if the exact location of each nest is never discovered. During this project, we observed that incubating birds displayed a density of detections around a single node that was not replicated by foraging birds or adults with broods. Learning this would allow researchers to make better estimates of the number of breeding adults in the Bay Area, estimate an adult's breeding efforts throughout the season, and illuminate plover behavior following a nest failure.

Research questions that involve shrinking the node grid size would ideally eliminate the presence of dead zones between nodes and allow for multilateration of exact locations. One project that fits into this category could be examining how close males stick to their chicks. Project members observed at least one male leaving his chicks for significant periods of time and foraging on a different pond. CTT makes tags that are small enough they can be attached to a freshly hatched chick without exceeding 3% of the chick's body weight. These tags would naturally fall off as the chick molted into its flight feathers, but while it was still a chick, project members would be able to track its exact location and compare it to their siblings' and father's locations. This would allow researchers to investigate whether there were differences in young versus experienced male's chick-rearing behaviors, understand how closely chicks associate with each other at different age classes, and identify the exact moments of any depredations.

In addition to further Motus research, there are many other questions regarding snowy plovers and least terns that deserve investigation. More thorough predator surveys that generated estimates of their population sizes would allow researchers to model the predator-prey dynamics acting on snowy plover and least tern populations more accurately. Another important topic is determining how snowy plover nesting density has changed over time as their habitat in the Bay Area has shrunk and whether there are any associated effects relating to nest success.

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Figure 1: Vicinity Map

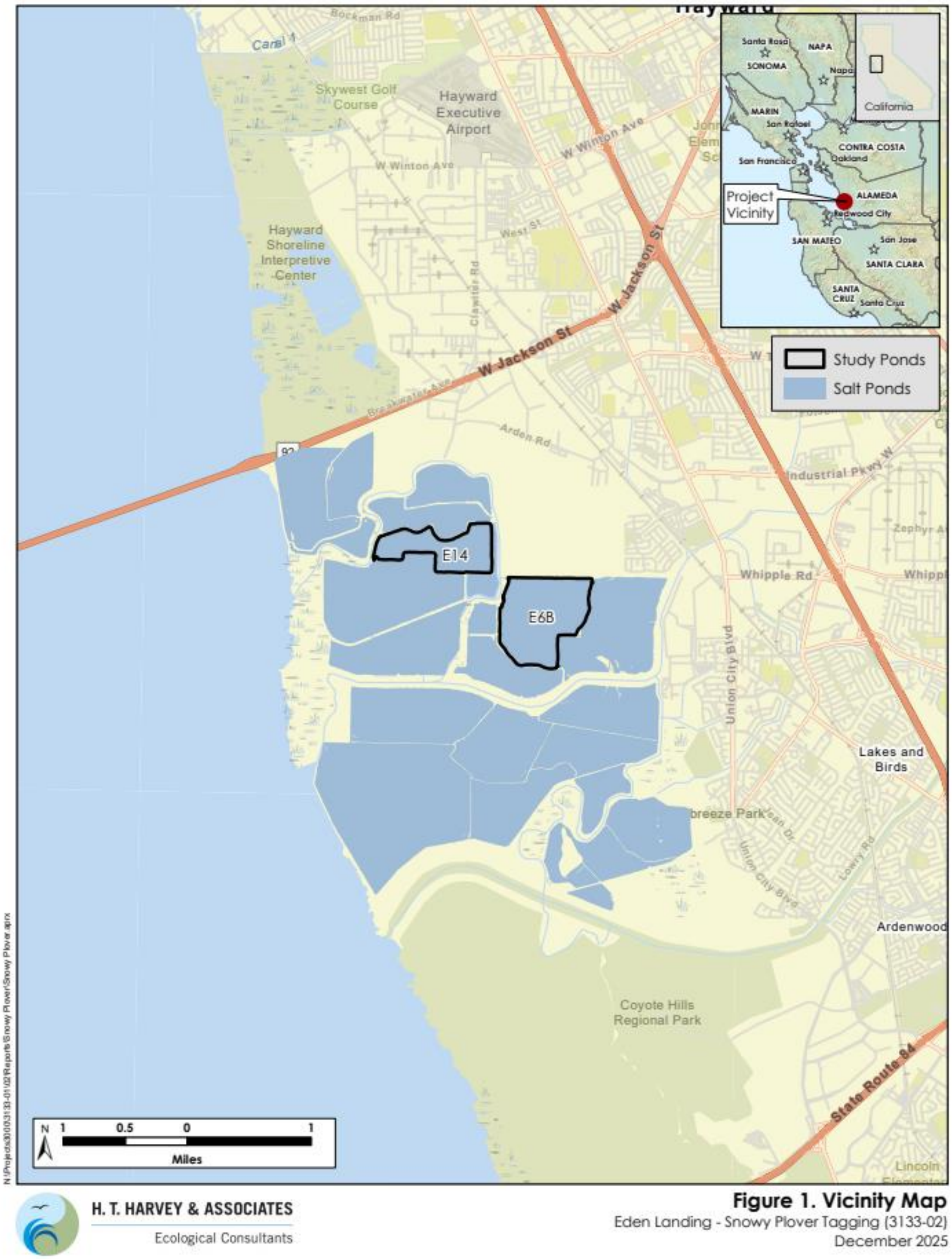

Figure 2: Node Locations on Pond E14

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Figure 2. Node Locations at Pond E14
Eden Landing - Snowy Plover Tagging (3133-02)
December 2025

Figure 3: Node Locations on Pond E6B

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Figure 3. Node Locations at Pond E6B
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December 2025

Figure 4: Pond E14 Oyster Shell Plots and Snowy Plover and Least Tern Nest Locations

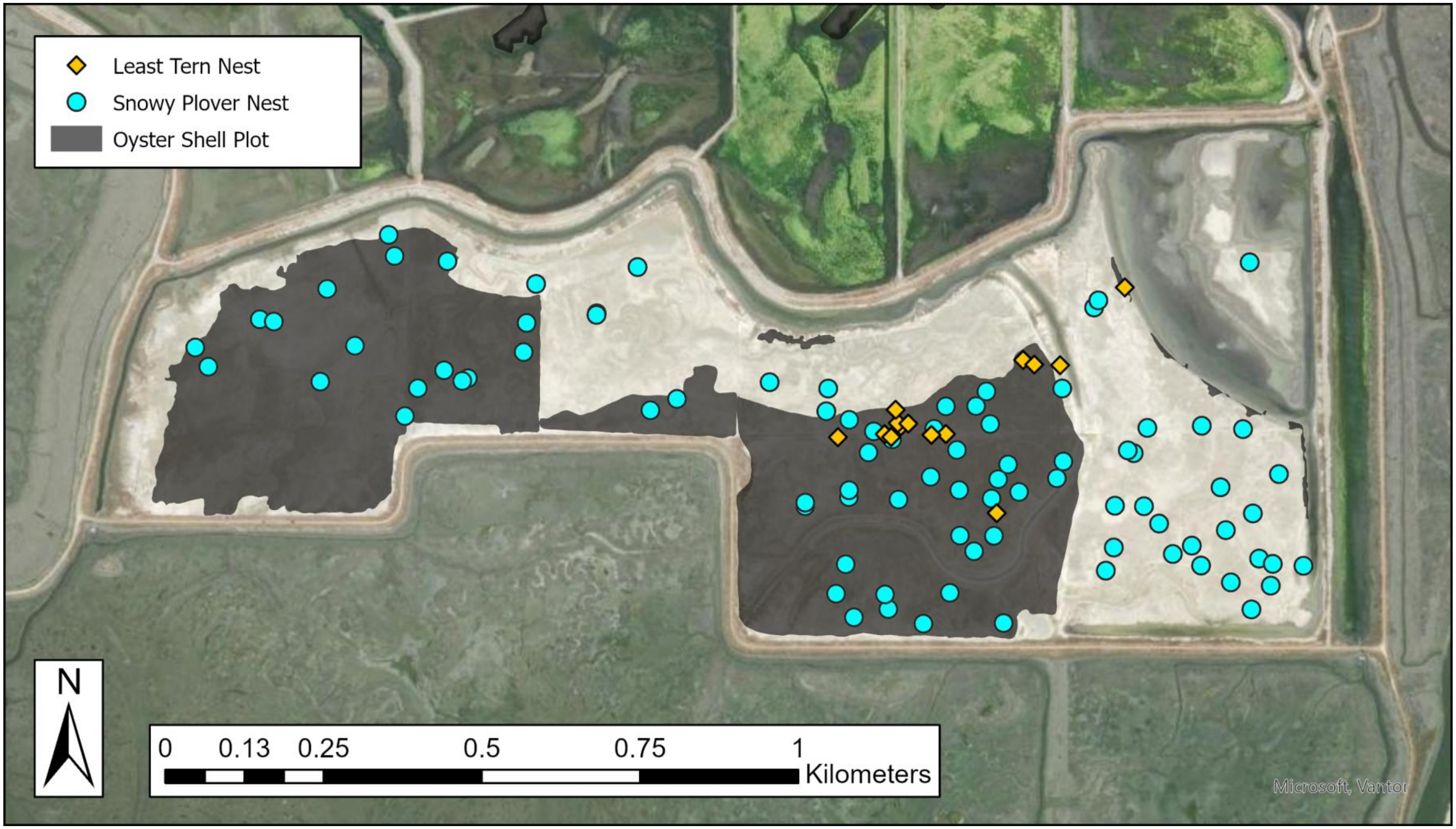

Figure 5: Pond E6B Oyster Shell Plots and Snowy Plover and Least Tern Nest Locations

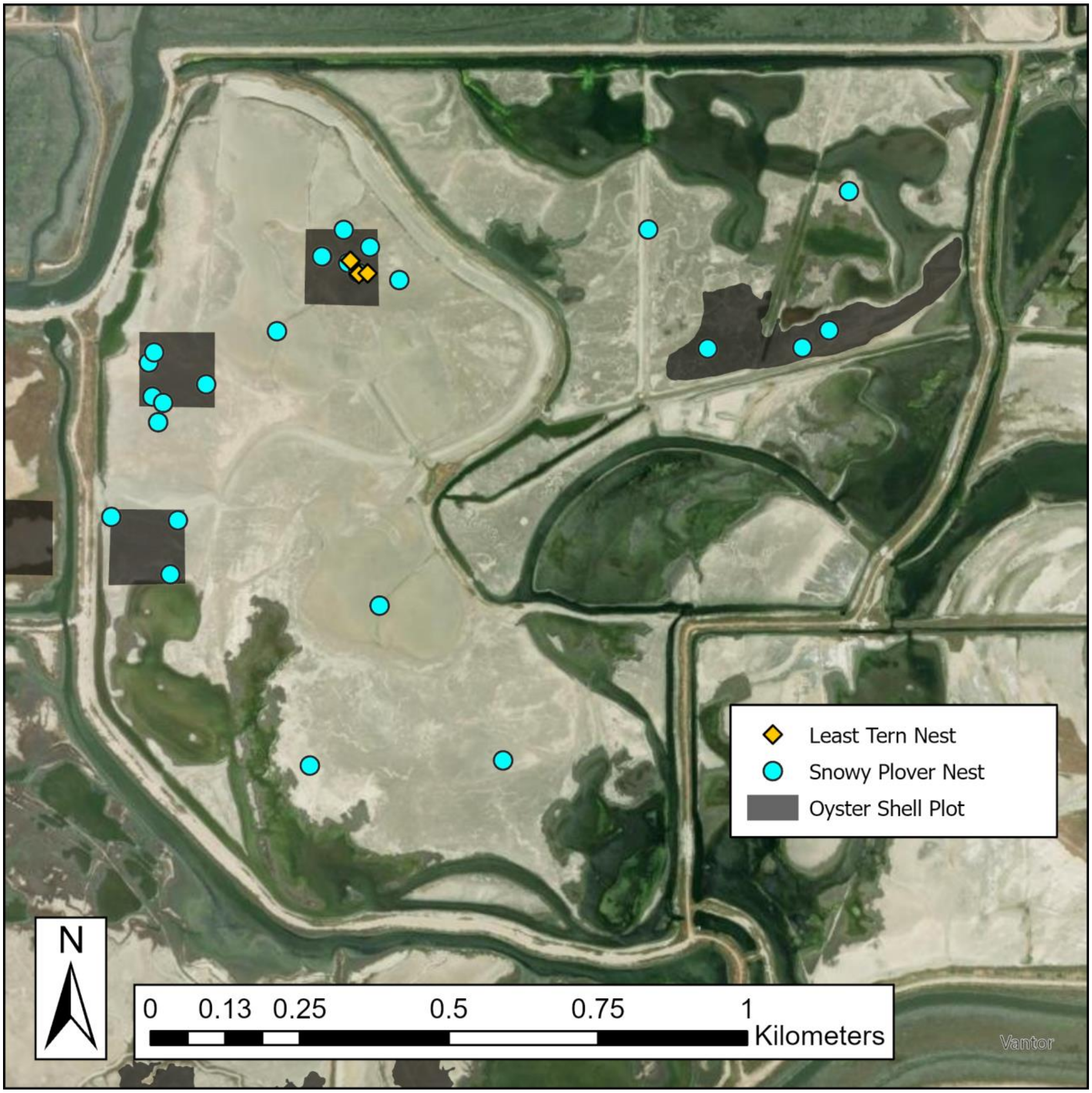

Figure 6: Nest Locations of Motus-Tagged Adults on Pond E14

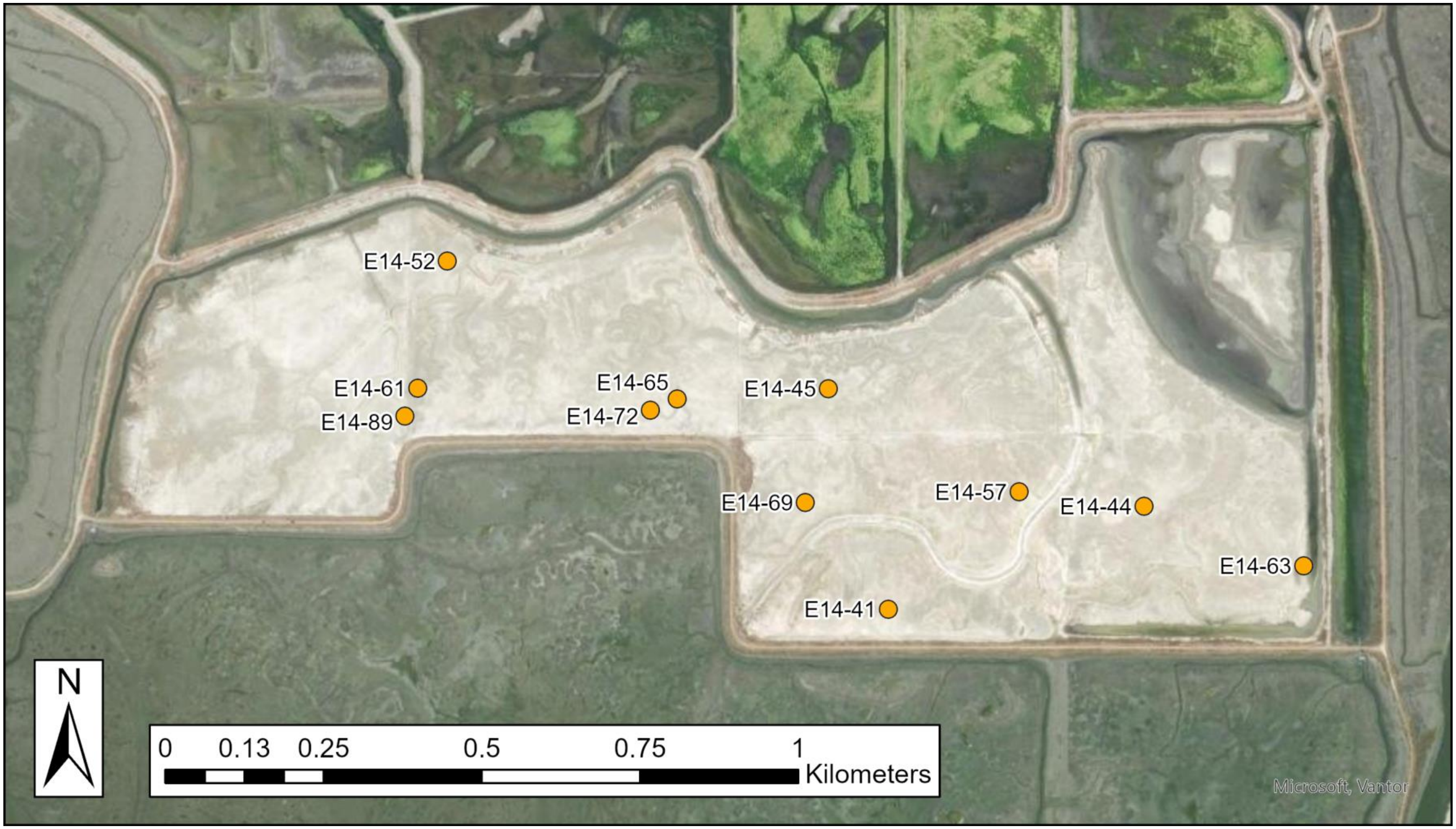

Figure 7: Nest Locations of Motus-Tagged Adults on Pond E6B

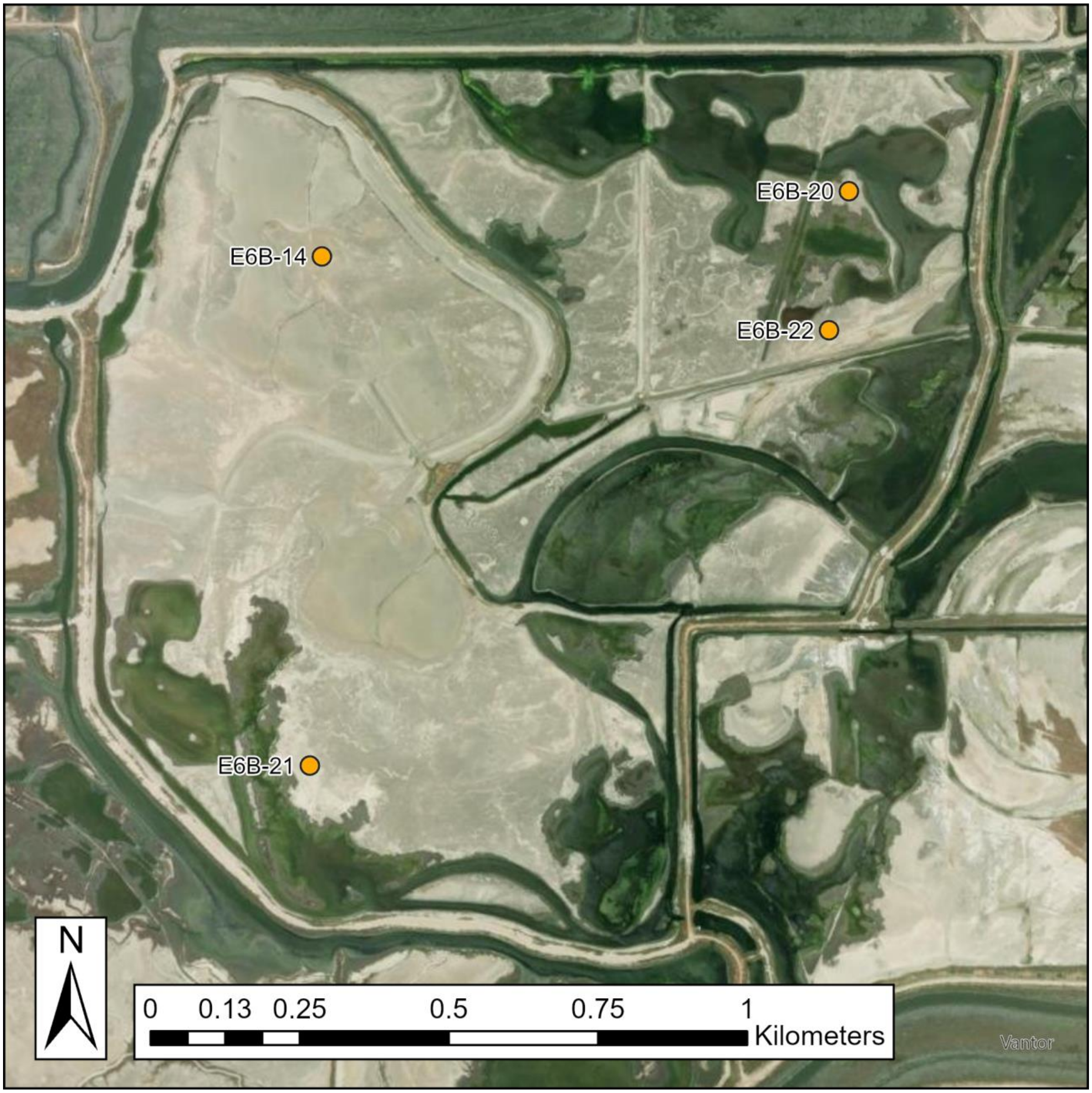

Figure 8: Male Ng:ry Detections During Pre- and Post-Fledge Periods

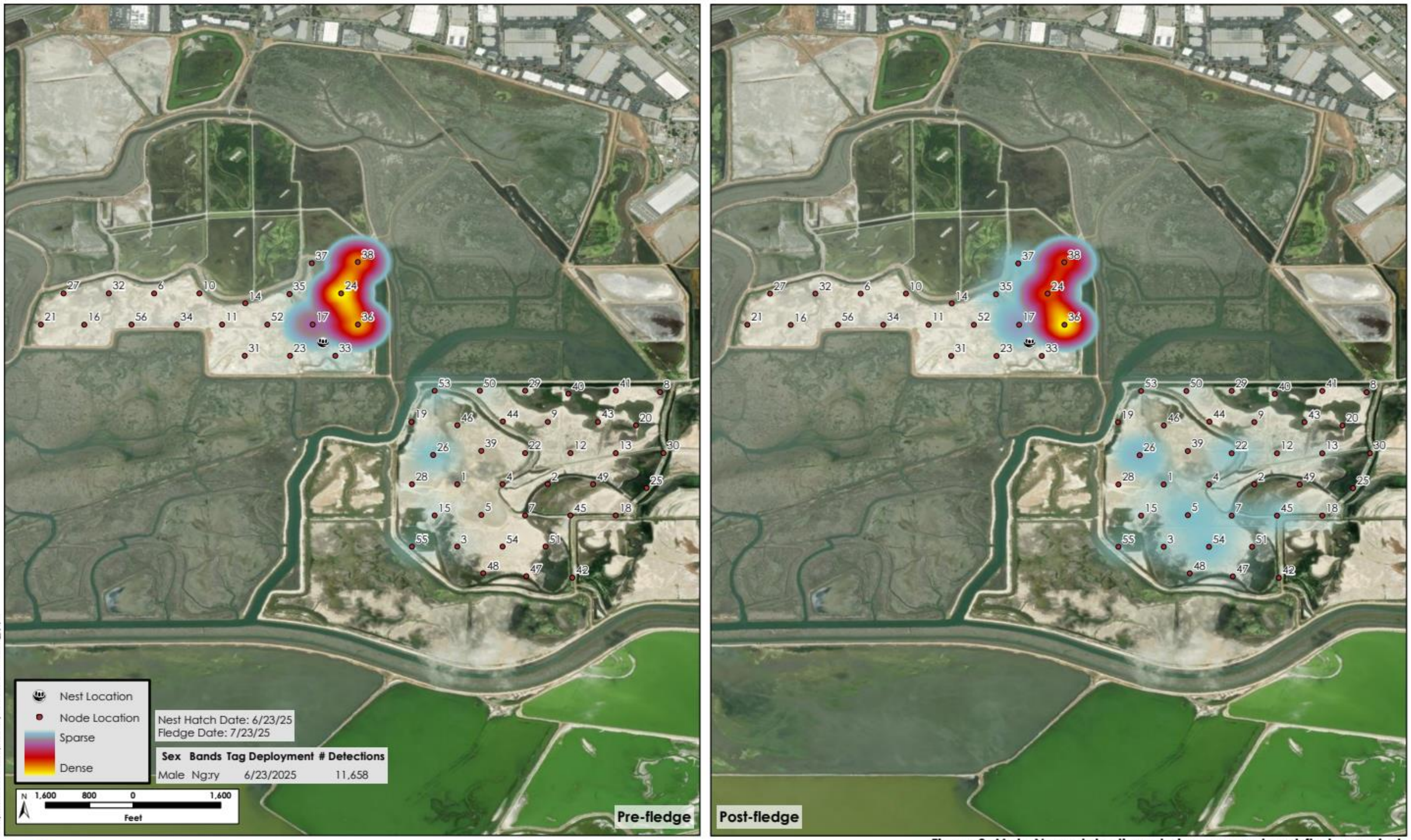

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Figure 8. Male Ng:ry detections during pre- and post-fledge periods
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December 2025

Figure 9: Male Ng:ko Detections During the Pre- and Post-Fledge Periods

Figure 9. Male Ng:ko detections during the pre -and post-fledge periods
Eden Landing - Snowy Plover Tagging (3133-02)
December 2025

Figure 10: Male Ng:pg Detections During the Pre- and Post-Fledge Periods

Figure 11: Female Rk:wo Detections During the Pre-Hatch and Post-Hatch-to-Fledge Periods

Figure 12: Male Ka:kk and Female ak:yb Detections During the Pre-Hatch and Post-Hatch-To-Fledge Periods

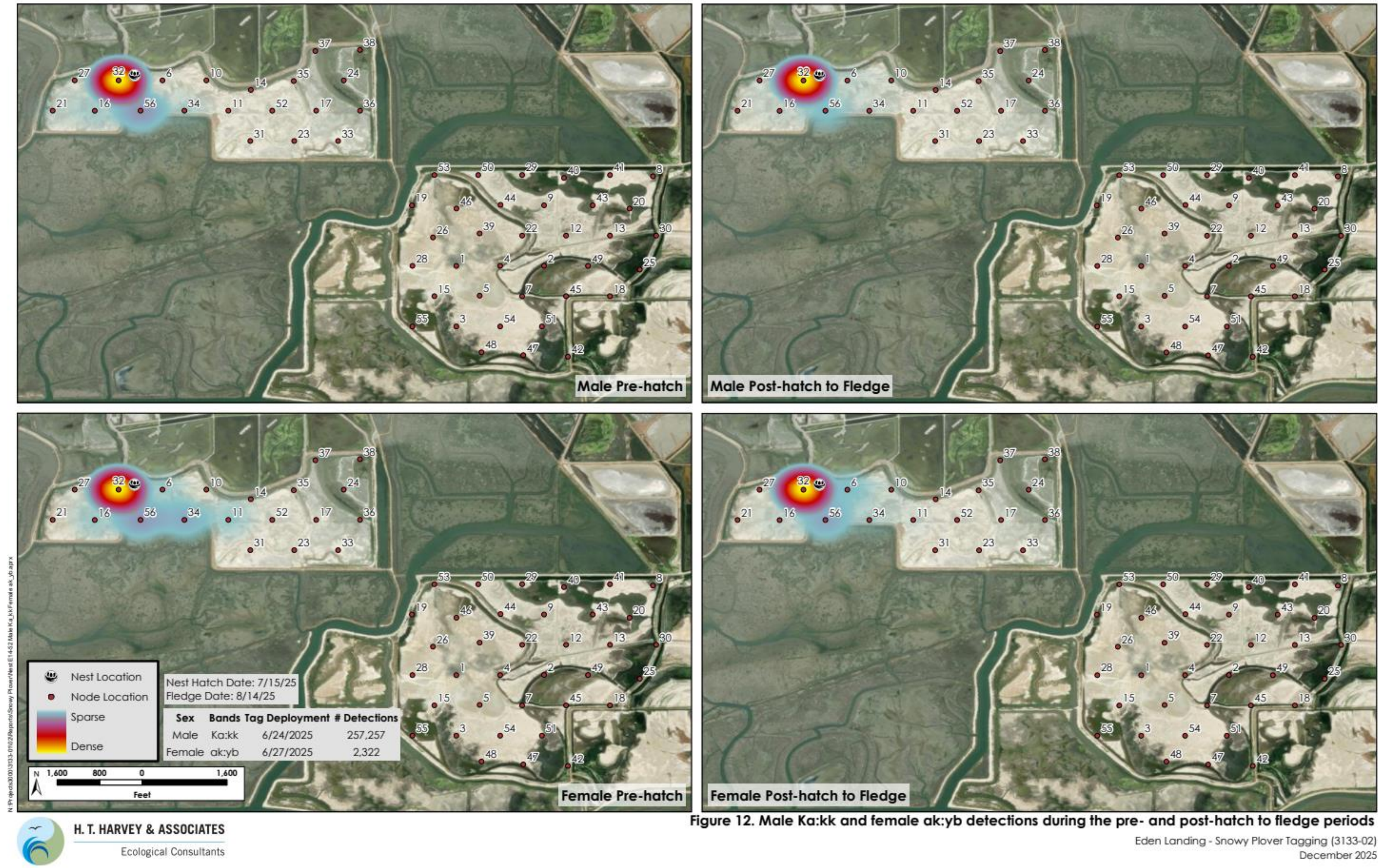

Figure 13: Male Ka:kk and Female ak:yb Detections Prior to Hatch During Civil Sunset to Sunrise and Civil Sunrise to Sunset

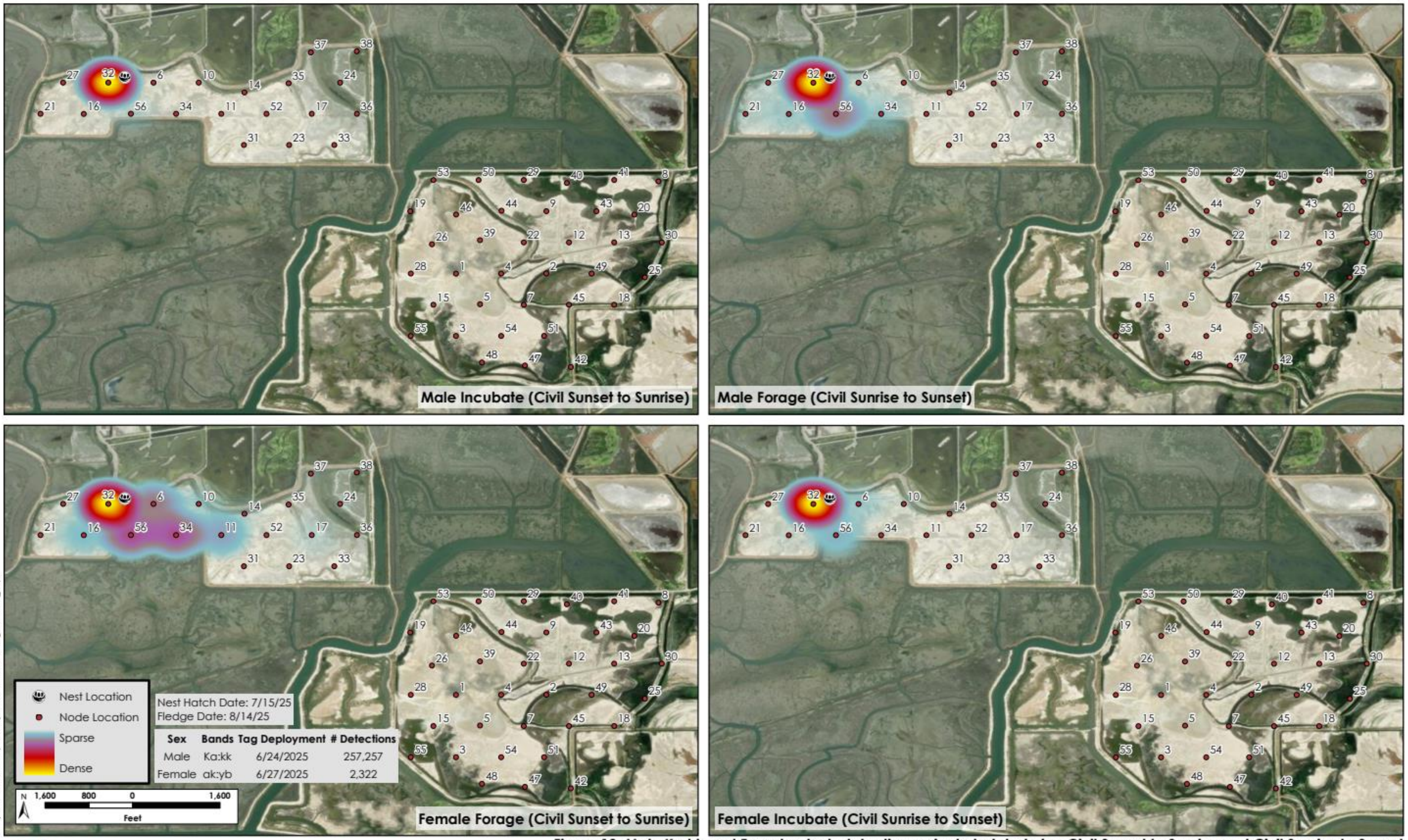

Figure 13. Male Ka:kk and Female ak:yb detections prior to hatch during Civil Sunset to Sunrise and Civil Sunrise to Sunset

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Eden Landing - Snowy Plover Tagging (3133-02)
December 2025

Figure 14: Male Ko:yw Detections During the Pre-Hatch and Post-Hatch-to-Fledge Periods

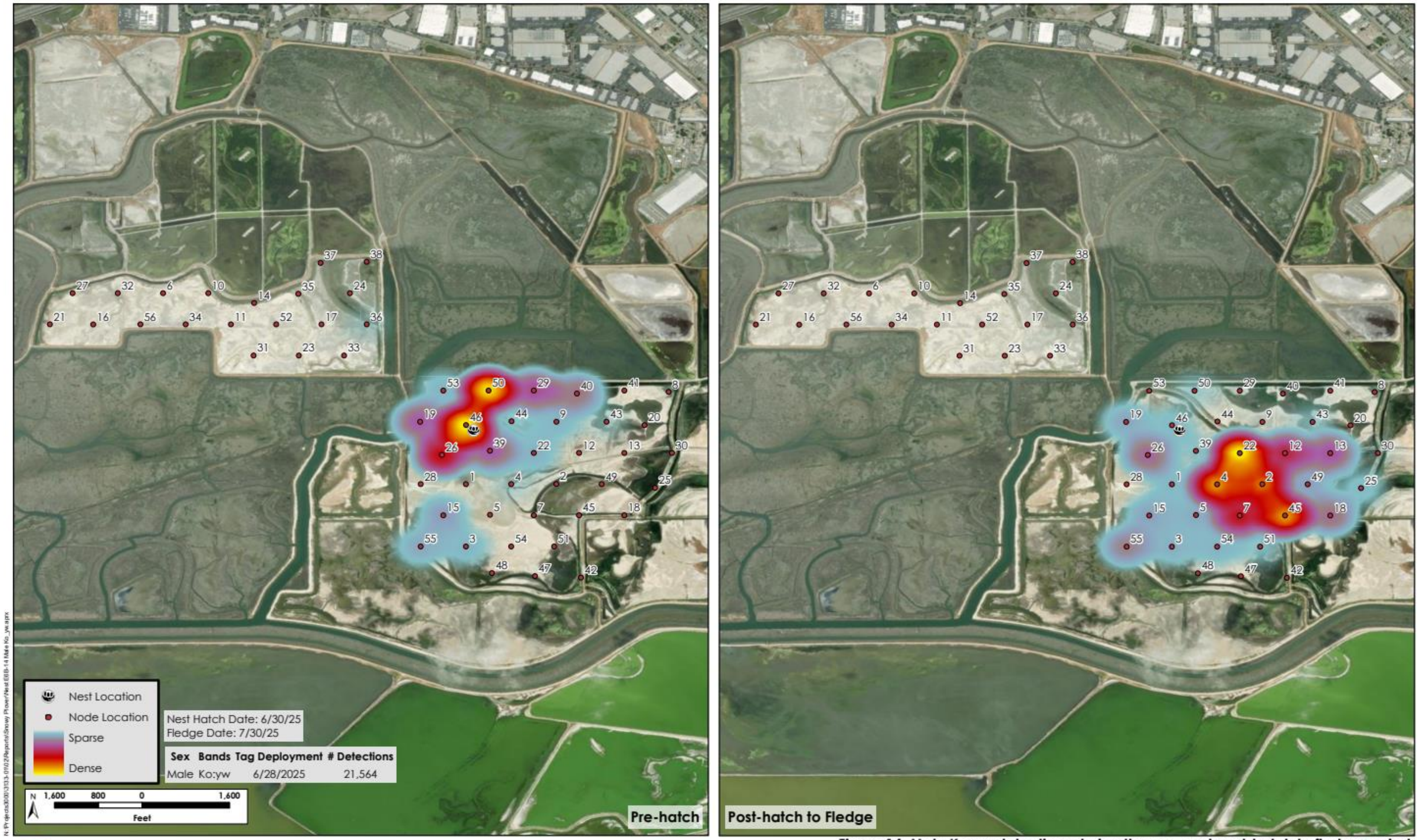

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Figure 14. Male Ko:yw detections during the pre- and post-hatch to fledge periods
Eden Landing - Snowy Plover Tagging (3133-02)
December 2025

Figure 15: Male nn:pk and Female Gk:pw Detections During the Pre-Hatch and Post-Hatch-to-Fledge Periods

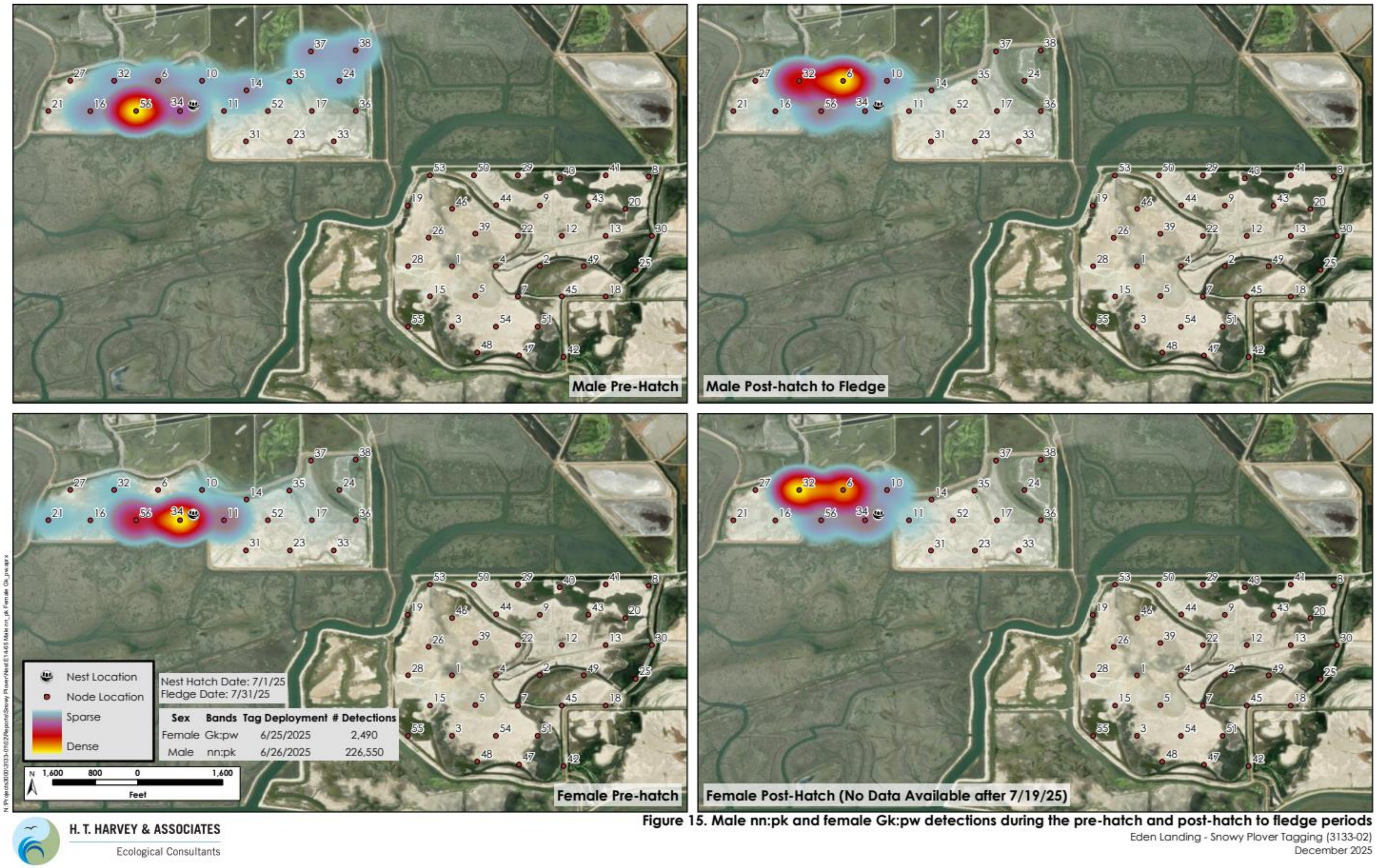

Figure 16: Male nn:pk and Female Gk:pw Detections Prior to Hatch During Civil Sunset to Sunrise and Civil Sunrise to Sunset

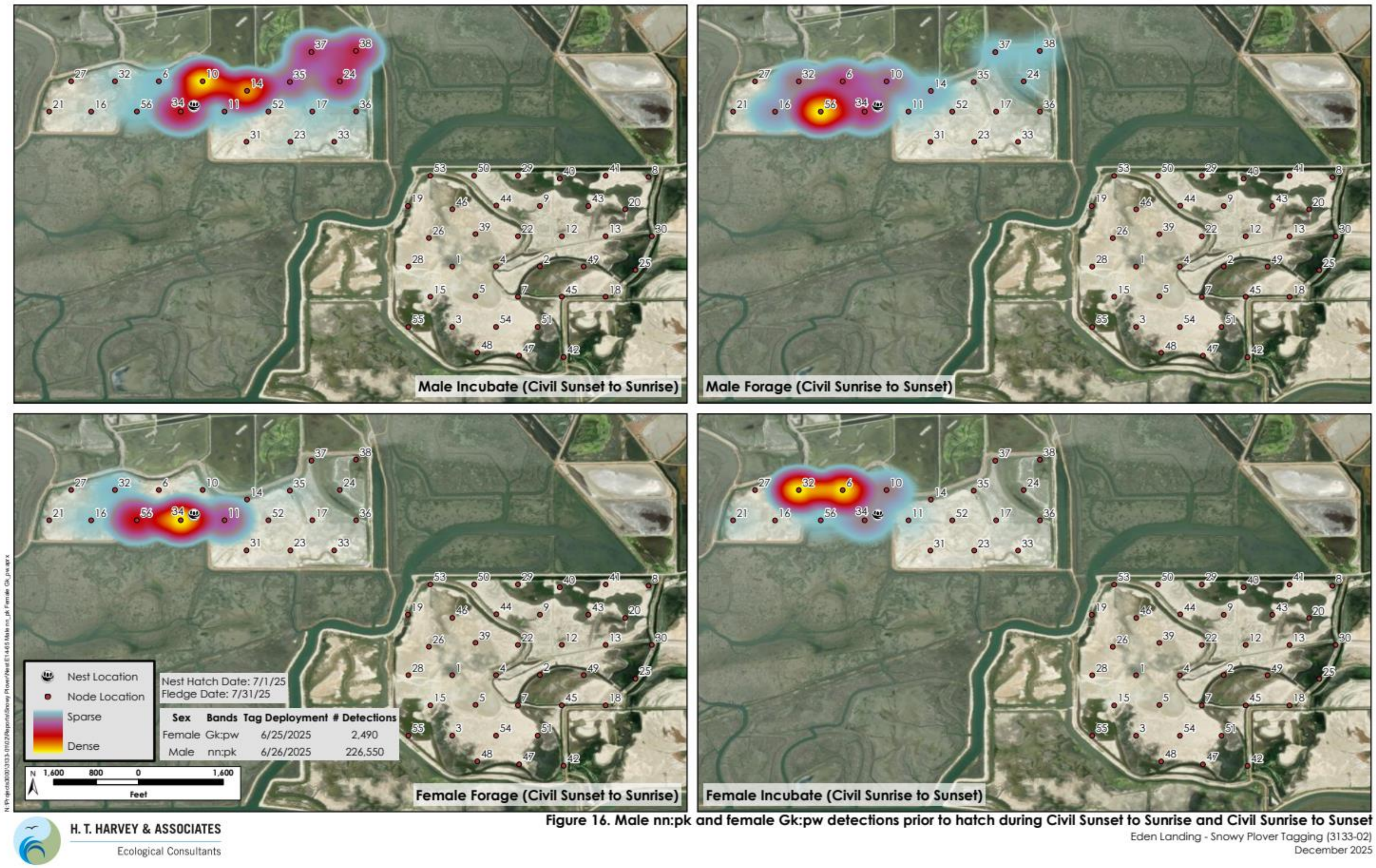

Figure 17: Male Gk:kr and Female Rk:ab Detections During the Pre-Hatch and Post-Hatch-to-Fledge Periods

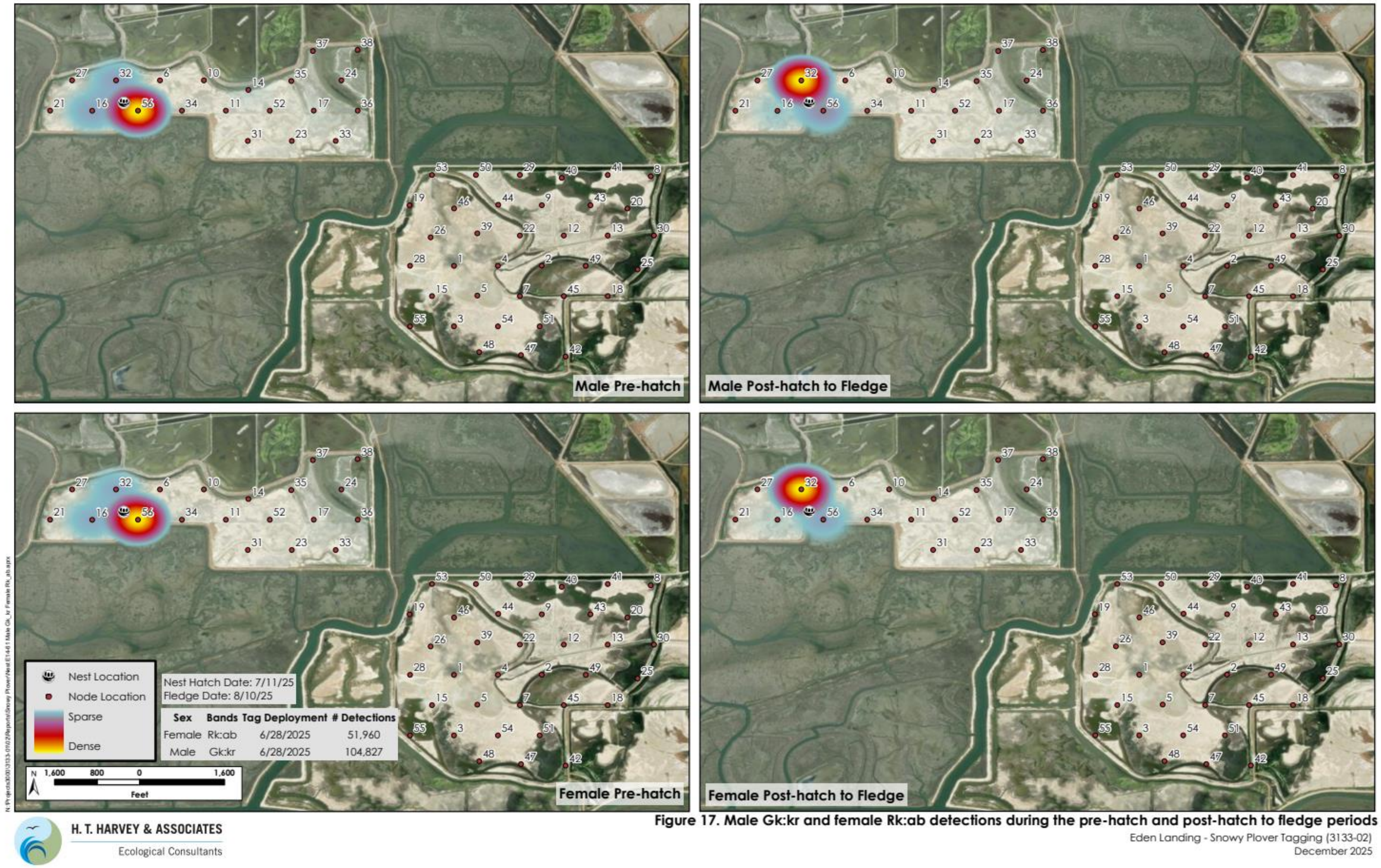

Figure 17. Male Gk:kr and female Rk:ab detections during the pre-hatch and post-hatch to fledge periods
Eden Landing - Snowy Plover Tagging (3133-02)
December 2025

Figure 18: Male Gk:kr and Female Rg:ab Detections Prior to Hatch During Civil Sunset to Sunrise and Civil Sunrise to Sunset

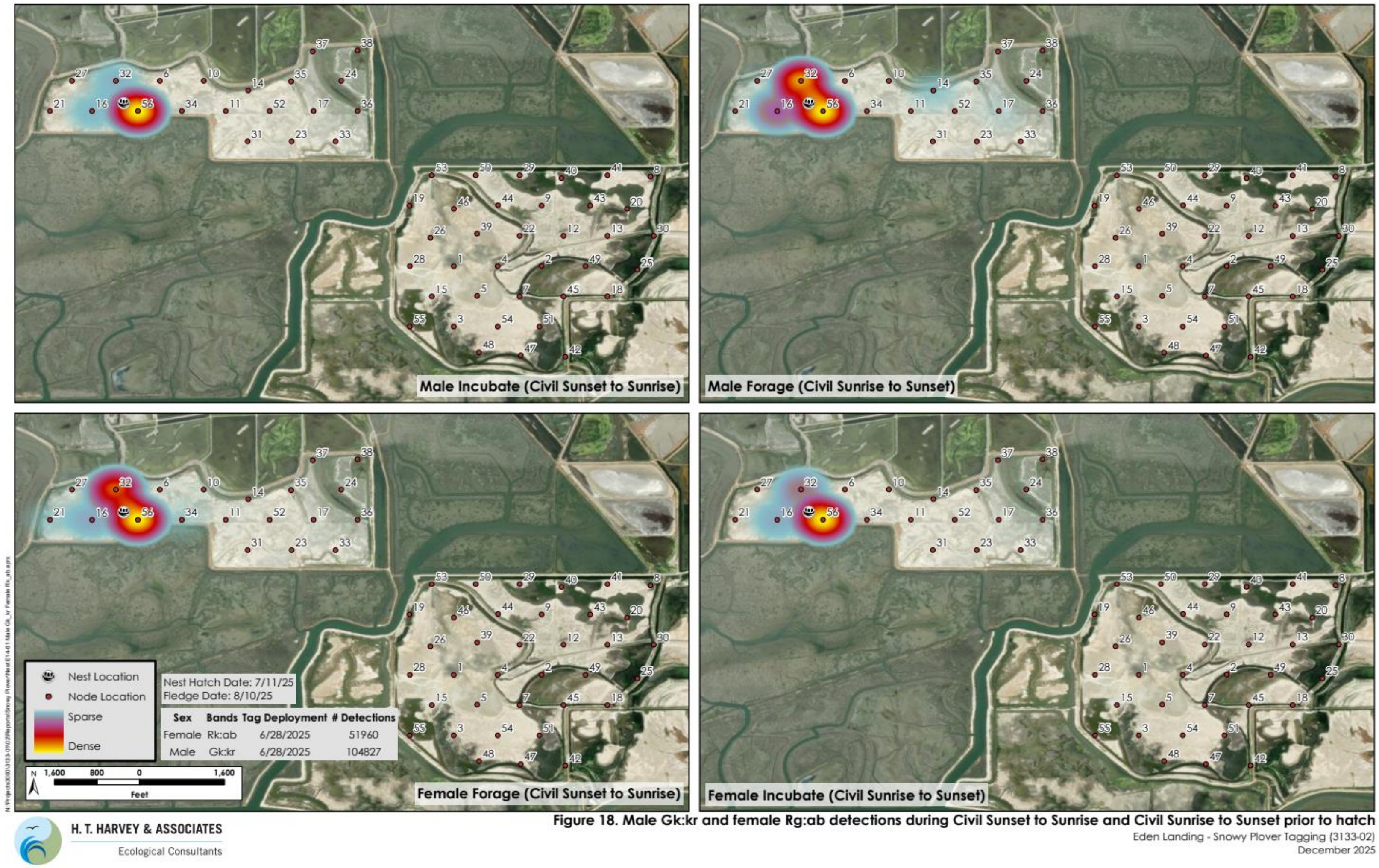

Figure 19: Male vo:bk and Female Gk:yo Detections During the Pre-Hatch and Post-Hatch-to-Fledge Periods

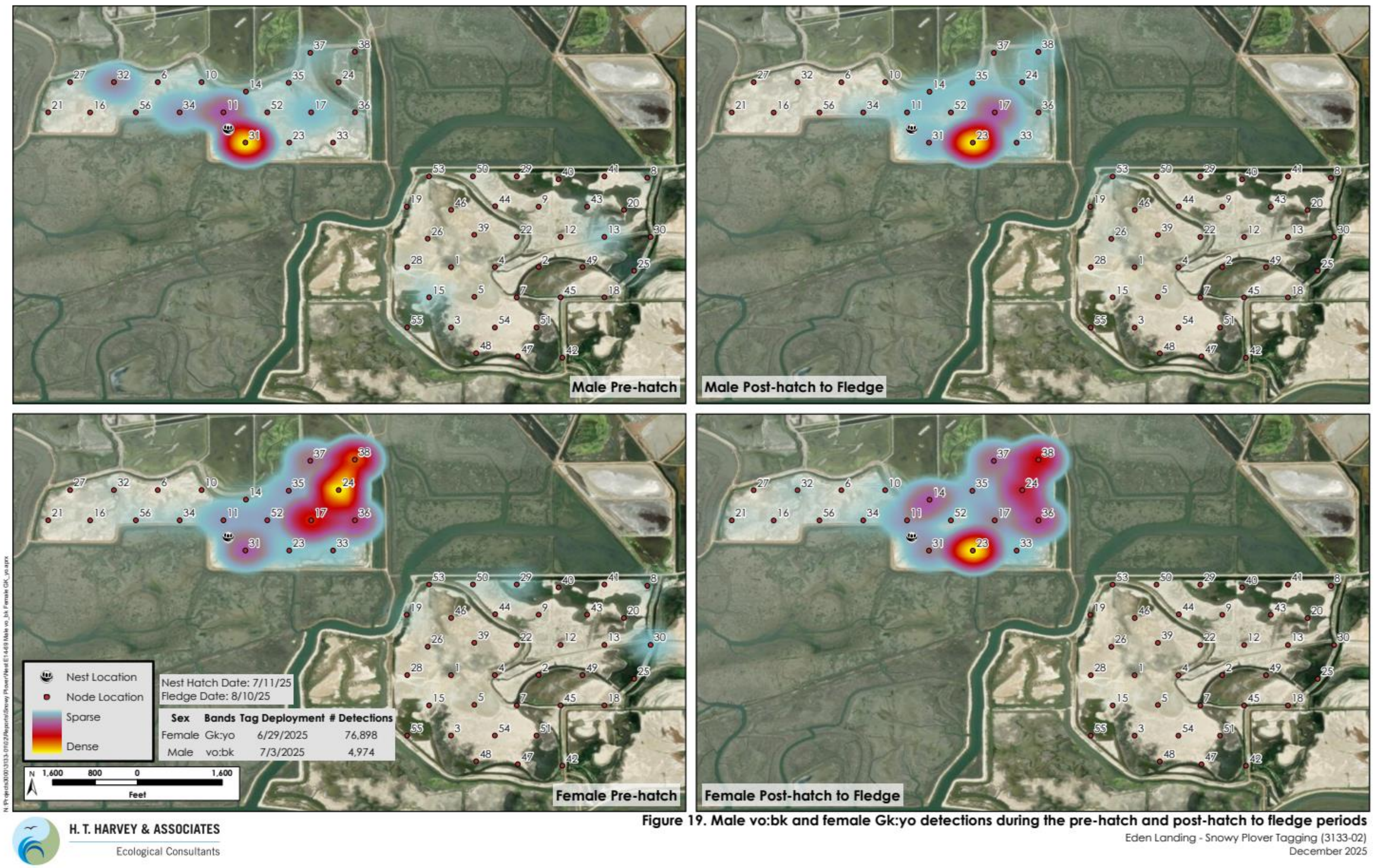

Figure 19. Male vo:bk and female Gk:yo detections during the pre-hatch and post-hatch to fledge periods
Eden Landing - Snowy Plover Tagging (3133-02)
December 2025

Figure 20: Male vo:bk and Female Gk:yo Detections Prior to Hatch During Civil Sunset to Sunrise and Civil Sunrise to Sunset

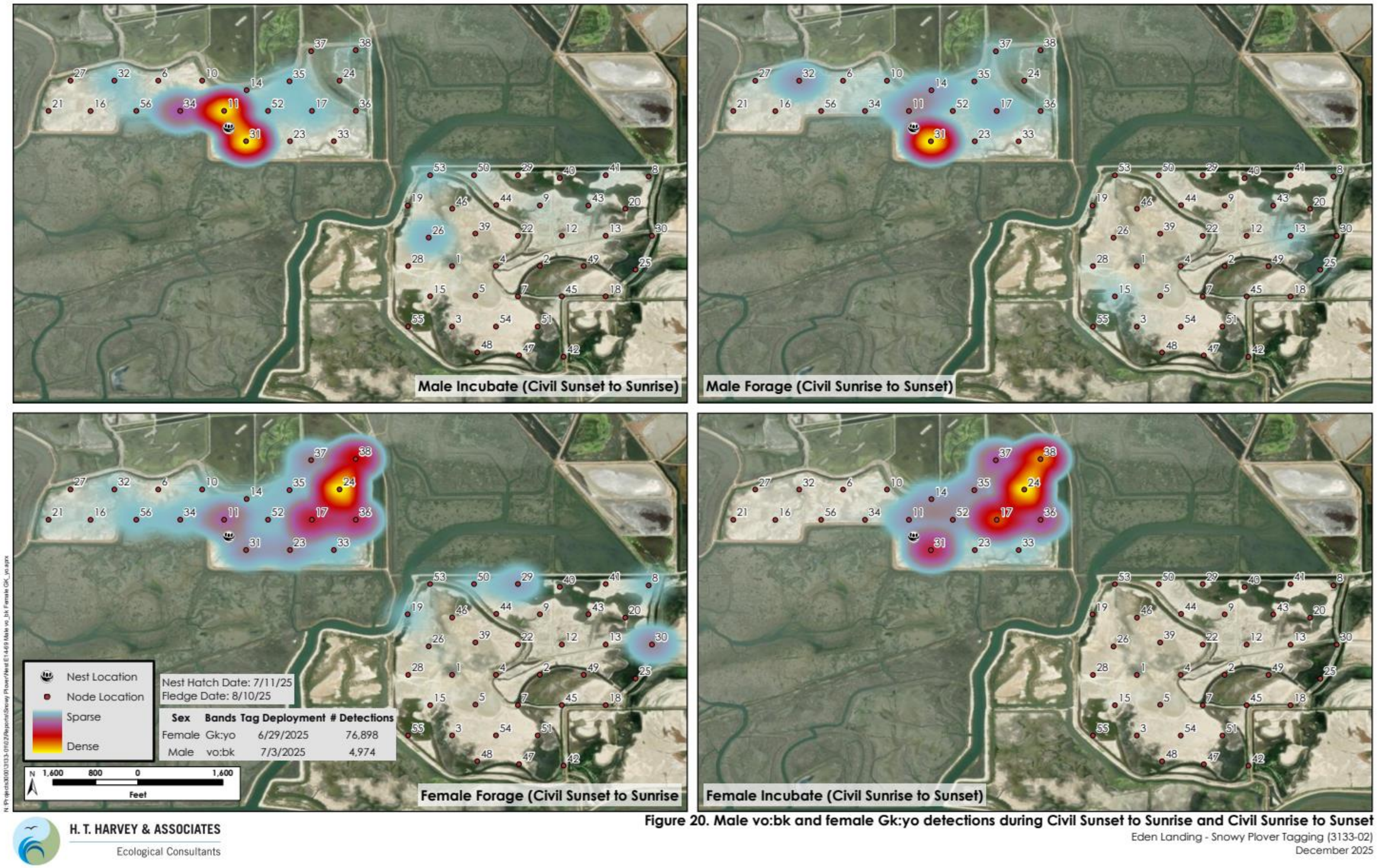

Figure 20. Male vo:bk and female Gk:yo detections during Civil Sunset to Sunrise and Civil Sunrise to Sunset
Eden Landing - Snowy Plover Tagging (3133-02)
December 2025

Figure 21: Male Gk:og and Female Ka:wr Detections During the Pre-Hatch and Post-Hatch-to-Fledge Periods

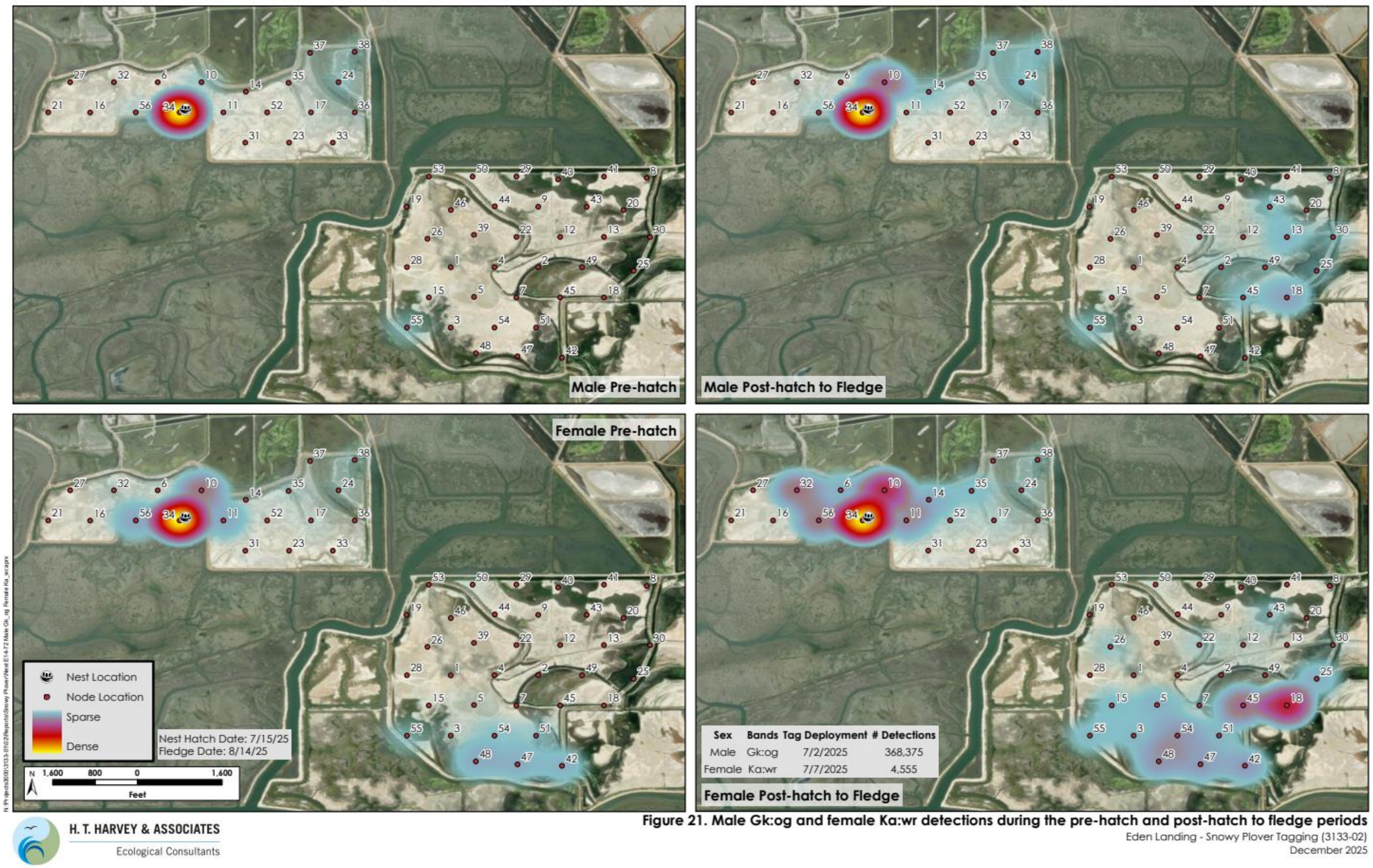

Figure 22: Male Gk:og and Female Ka:wr Detections Prior to Hatch During Civil Sunset to Sunrise and Civil Sunrise to Sunset

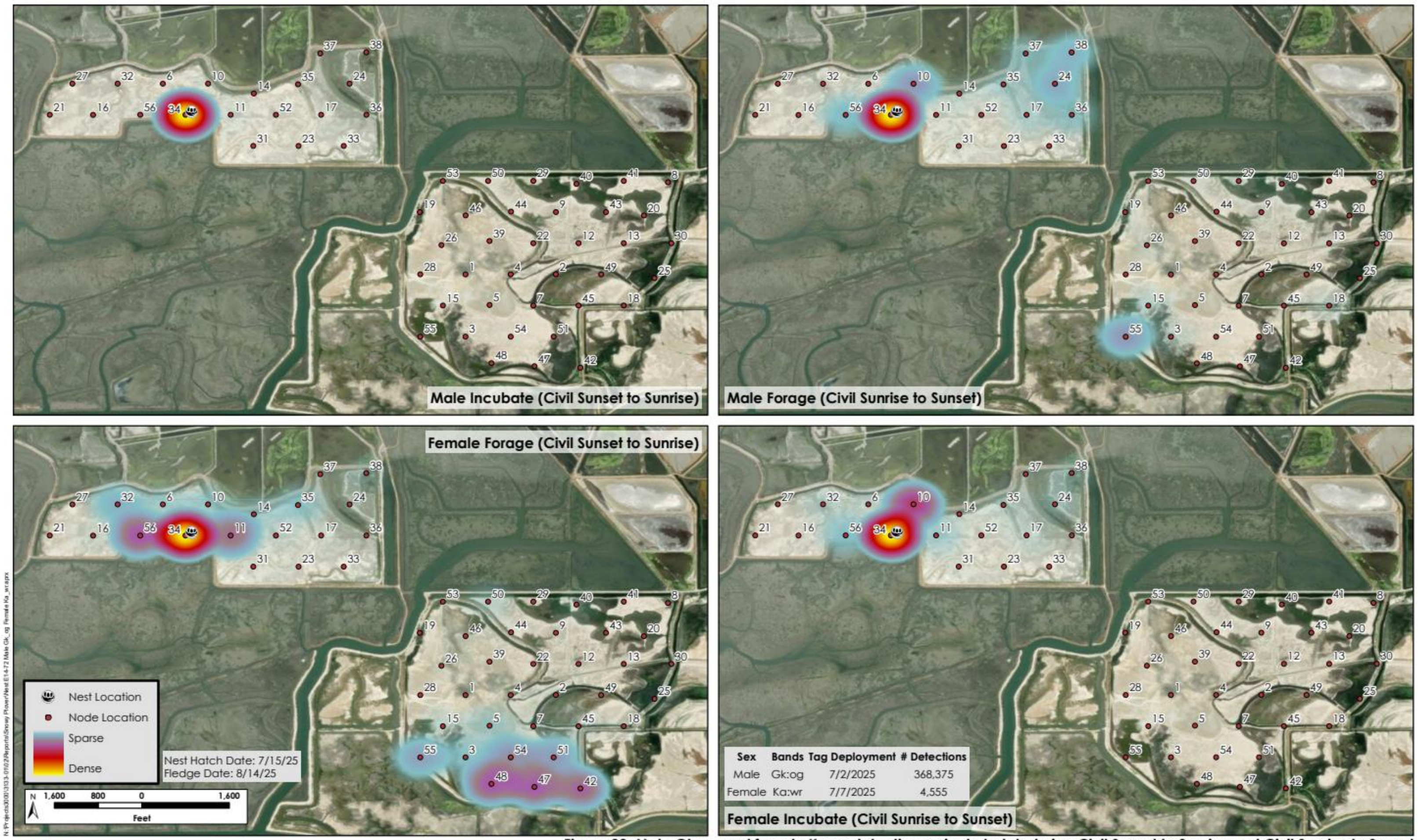

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Figure 22. Male Gk:og and female Ka:wr detections prior to hatch during Civil Sunset to Sunrise and Civil Sunrise to Sunset

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December 2025

Figure 23: Female ng:ka Detections During the Pre Hatch and Post-Hatch-to-Fledge Periods

Figure 23. Female ng:ka detections during the pre-hatch and post-hatch to fledge periods
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December 2025

Figure 24: Male Ka:yo Detections During the Pre-Fledge and Post-Fledge Periods

Figure 25: Male Ko:rw Detections During the Pre-Hatch and Post-Hatch-to-Fledge Periods

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Figure 25. Male Ko:rw detections during the pre-hatch and post-hatch to fledge periods
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December 2025

Figure 26: Female Gk:ok Detections During the Pre- and Post-Depredation Periods

Figure 26. Female Gk:ok detections during the pre- and post-depredation periods
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December 2025

Figure 27: Male Ng:ap Detections During the Pre- and Post-Depredation Periods

Table 4: Summary of Match Amounts

Program	Number of People	Hours per Person	Match Rate	Total
Habitat Enhancement	41	4	$25.00	$4,100
Least Tern Watch	25	7	$25.00	$4,375
Snowy Plover Intern	1	366	$23.00	$8,418
HT Harvey, Senior Ecologist	1	32.5	$226.00	$7,358
Snowy Plover and Least Tern Breeding Surveys	3	234	$45.00	$31,590
Transportation	2,474 (miles)		$0.655	$1,620
Total	***45***	N/A	N/A	***$57,461***