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Evaluation of Caspian Tern (*Hydroprogne caspia*) and Snowy Plover (*Charadrius alexandrinus nivosus*) Nesting on Modified Islands at the Don Edwards San Francisco Bay National Wildlife Refuge, California—2015 Annual Report

Open-File Report 2016–1049

U.S. Department of the Interior
U.S. Geological Survey

Cover: Photograph showing Caspian terns (*Hydroprogne caspia*) nesting among decoys on an enhanced island in Pond SF2 of the Don Edwards San Francisco Bay National Wildlife Refuge, California. Photograph by Crystal Shore, U.S. Geological Survey, April 30, 2015.

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Conversion Factors

Multiply	By	To obtain
	Length	
inch (in.)	2.54	centimeter (cm)
foot (ft)	0.3048	meter (m)
meter (m)	3.281	foot (ft)
kilometer (km)	0.6214	mile (mi)
meter (m)	1.094	yard (yd)
	Area	
square meter (m^2)	0.0002471	acre
square meter (m^2)	10.76	square foot (ft^2)

Abbreviations

BiOp	Biological Opinion
DENWR	Don Edwards San Francisco Bay National Wildlife Refuge
RPAs	Reasonable and Prudent Alternatives
USACE	U.S. Army Corps of Engineers
USDA-APHIS	U.S. Department of Agriculture Animal and Plant Health Inspection Service
USGS	U.S. Geological Survey

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By C. Alex Hartman[1], Joshua T. Ackerman[1], Mark P. Herzog[1], Cheryl Strong[2], David Trachtenbarg[3], Kimberley A. Sawyer[1], and Crystal A. Shore[1]

Executive Summary

In order to address the 2008/10 NOAA Fisheries Biological Opinion for operation of the Federal Columbia River Power System, the U.S. Army Corps of Engineers (USACE) and the Bureau of Reclamation (Reclamation) have developed and begun implementation of Caspian tern (*Hydroprogne caspia*) management plans. This implementation includes relocating nesting Caspian terns out of the Columbia River estuary and the mid-Columbia River region to reduce predation on salmonids listed under the Endangered Species Act. USACE and Reclamation developed Caspian tern nesting habitat at the U.S. Fish and Wildlife Service Don Edwards San Francisco Bay National Wildlife Refuge (DENWR), California prior to the 2015 nesting season. Further, to reduce or eliminate potential conflicts between nesting Caspian terns and threatened western snowy plovers (*Charadrius alexandrinus nivosus),* nesting habitat for snowy plovers also was developed. Seven recently constructed islands within two managed ponds (Ponds A16 and SF2) of DENWR were modified to provide habitat attractive to nesting Caspian terns (5 islands), and snowy plovers (2 islands). These seven islands were a subset of 46 islands recently constructed in Ponds A16 and SF2 to provide waterbird nesting habitat as part of the South Bay Salt Pond (SBSP) Restoration Project.

We used social attraction methods (decoys and electronic call systems) to attract Caspian terns and snowy plovers to these seven modified islands, and conducted surveys between March and September 2015 to evaluate nest numbers, nest density, and productivity. Results from the 2015 nesting season indicate that island modifications and social attraction measures were successful in establishing Caspian tern breeding colonies at Ponds A16 and SF2 of DENWR. Caspian terns nested on three of the five islands modified for Caspian terns (1 island in Pond A16 and 2 islands in Pond SF2). Caspian terns initiated at least 224 nests, fledged at least 174 chicks, and exhibited a breeding success rate of 0.78 fledged chicks/breeding pair. These results are promising considering it was the first year of the study

[1] U.S. Geological Survey.
[2] U.S. Fish and Wildlife Service.
[3] U.S. Army Corps of Engineers.

and there was no prior history of Caspian terns nesting at Ponds A16 and SF2. In contrast, snowy plovers did not attempt to nest on any island in Ponds A16 and SF2. These results demonstrate the potential of social attraction measures to help establish tern nesting colonies in San Francisco Bay. Social attraction measures similar to those used in this study, but targeting other species such as Forster's terns and American avocets, may help to establish waterbird breeding colonies at wetlands enhanced as part of the SBSP Restoration Project.

Introduction

The U.S. Army Corps of Engineers (USACE), Walla Walla and Portland Districts, and the Bureau of Reclamation (Reclamation) (Action Agencies) are in the process of addressing the 2008/10 NOAA Fisheries Biological Opinion (BiOp) for operation of the Federal Columbia River Power System that includes Reasonable and Prudent Alternatives (RPAs) 45, 47, 66, and 68. As part of implementing these RPAs, the Action Agencies have developed, and are in the process of implementing, pertinent parts of Caspian tern (*Hydroprogne caspia*) management plans. This implementation includes relocating nesting Caspian terns out of the Columbia River estuary and the mid-Columbia River region to reduce predation on salmonids listed under the Endangered Species Act. As part of implementing these management plans, the Action Agencies developed Caspian tern and western snowy plover (*Charadrius alexandrinus nivosus*) habitat at the U.S. Fish and Wildlife Service Don Edwards San Francisco Bay National Wildlife Refuge (DENWR) prior to the 2015 nesting season. Previous studies indicated that salmonids make up a small proportion of the diet of Caspian terns nesting in South San Francisco Bay, and that most smolts consumed by Caspian terns were hatchery-raised and non-listed (Evans and others, 2011; Collis and others, 2012), suggesting that development of Caspian tern nesting colonies in south San Francisco Bay is unlikely to negatively affect endangered salmonids. Nesting habitat for the threatened snowy plover was developed to reduce or eliminate potential conflicts between nesting terns and plovers.

Seven existing islands within two managed ponds of DENWR were modified to provide habitat attractive to nesting Caspian terns and western snowy plovers (fig. 1). At Pond A16, two islands (Islands 11 and 12) were modified for nesting Caspian terns and one island (Island 3) was modified for nesting snowy plovers (fig. 2). At Pond SF2, three islands (Islands 12, 17, and 21) were modified for nesting Caspian terns and one island (Island 10) was modified for nesting snowy plovers (fig. 3). Islands modified for nesting snowy plovers were selected based on locations of snowy plover observations during previous breeding seasons and islands modified for nesting Caspian terns were selected so that they were centrally located within the ponds but away from snowy plover islands. Islands modified for Caspian terns were groomed to a slope of 4 to 1 or less, were covered in 3/8-in. crushed rock 18 in. deep, and 3-in. rock was placed around the island perimeter. Islands modified for snowy plovers were covered with 1/4-in. crushed rock (Island 10 at Pond SF2) or 3/4-in. crushed rock (Island 3 at Pond A16) 5 in. deep, and a 6-ft buffer was left around the edge of the island for plover foraging habitat. Construction was completed in February 2015 prior to the 2015 Caspian tern and western snowy plover nesting seasons.

In coordination with USACE, Reclamation, and DENWR, the U.S. Geological Survey (USGS) implemented social attraction measures to attract Caspian terns and snowy plovers to these recently modified islands. Social attraction is known to be an effective wildlife-management technique whereby adult birds are lured to potential nesting sites to assist in the establishment of successful breeding colonies (Arnold and others, 2011; Jones and Kress, 2012). Colonial waterbirds, such as terns, are excellent candidate species for social attraction efforts because they are readily attracted to decoys of adult birds as well as sound recordings of adult vocalizations (Kress, 1983; Roby and others, 2002).

Further, the presence of conspecifics may influence selection of nest sites by snowy plovers (Patrick and Colwell, 2014), and the use of decoys and vocalizations may encourage nesting (California State Parks and Redwood National Park, 2014). During the 2015 nesting season, USGS conducted the first of 3 years of post-construction social attraction and monitoring efforts at DENWR.

The objectives were to:

1. Deploy and maintain social attraction measures (decoys and call systems) for Caspian terms and snowy plovers on seven islands within Ponds A16 and SF2;
2. Monitor and evaluate nesting by Caspian terns and snowy plovers on the seven modified islands as well as surrounding islands of Ponds A16 and SF2;
3. Evaluate factors limiting breeding success of Caspian terns and snowy plovers at Ponds A16 and SF2;
4. Implement gull dissuasion efforts in coordination with DENWR and U.S. Department of Agriculture Animal and Plant Health Inspection Service (USDA-APHIS)-Wildlife Services to limit potential negative effects of gulls on nesting Caspian terns and snowy plovers.
5. Provide information, based on field observations, to DENWR, USACE, and USDA-APHIS on additional predator management options for limiting potential negative effects of other terrestrial and avian species on nesting Caspian terns and snowy plovers.

Methods

Social Attraction Measures for Caspian Terns and Snowy Plovers

We deployed social attraction measures (decoys and call systems) on seven islands (three islands in Pond A16, four islands in Pond SF2) between March 2 and 6, 2015. Five islands (Islands 11 and 12 in Pond A16; Islands 12, 17, and 21 in Pond SF2) received 50–128 Caspian tern decoys arranged in the interior of each island, and spaced 1–1.5 m apart (table 1, figs. 4–6), which is the nest spacing commonly observed in Caspian tern colonies (Cuthbert and Wires, 1999). The remaining two islands (Island 3 in Pond A16; Island 10 in Pond SF2) each received six snowy plover decoys, arranged in male-female pairs at three locations on the island (fig. 7). We installed a call system (Murremaid Music Boxes, South Bristol, Maine) on each of the seven modified islands and broadcast either Caspian tern colony calls or snowy plover calls continuously through two omni-directional outdoor speakers. Each call system was powered by two 6V Optima® AGM batteries and charged by a 135 W Kyocera© solar panel, enabling it to broadcast continuously without intervention. Call box and solar panels were deployed on the south side of each island, about 20 m from the decoy spread. Speakers were deployed on opposite ends of the decoy spread and connected to the call box by speaker wire loosely buried in the gravel. We used a 20-minute recording of a winter flock of snowy plovers obtained from Little River State Beach in Humboldt County, California, supplied by Amber Transou of California State Parks, and a 42-minute recording of a breeding Caspian tern colony obtained from Rice Island (lower Columbia River estuary) by Kathy Turco of Alaska's Spirit Speaks. The Caspian tern recording is the same one used in social attraction efforts at the other USACE constructed sites in southeastern Oregon and northeastern California as part of implementing the Columbia River estuary Caspian tern management plan. Decoys, and call systems broadcasting on a constant loop, remained on the islands until they were retrieved in late September.

Gull Dissuasion Efforts

We visited Ponds A16 and SF2 at least 2–3 times a week for surveys and, if necessary, to haze gulls from islands (both modified islands and other islands nearby). The California gull (*Larus californicus*) population in San Francisco Bay has increased from fewer than 200 breeding gulls in 1982 to more than 47,000 breeding gulls in 2015 (Strong and others, 2004; Washburn and Butler, 2016). They occur in large numbers around the project area, and have been identified as dominant predators of waterbird eggs and chicks (Herring and others, 2011; Ackerman, Herzog, Hartman, and Herring, 2014; Ackerman, Herzog, Hartman, and Takekawa, 2014). Thus, gull dissuasion was considered an important component for successful nesting of Caspian terns and snowy plovers. Gulls were highly abundant at Pond A16, and we hazed gulls 3 times or more per week from March through May and into June. Gulls were less abundant at Pond SF2 and hazing was more limited. Hazing measures included green lasers, water guns, and most often boating to islands and making noise to flush gulls from the islands.

Evaluation of Nesting by Caspian Terns and Snowy Plovers

We conducted 62 survey bouts at Pond A16 and 62 survey bouts at Pond SF2 in 2015. Survey bouts were conducted 5 days per week at each pond from March 9 to April 3, 3 days per week from April 6 to May 1, and twice weekly from May 4 to September 18. Both ponds were surveyed on the same day, one in the early morning and the other in the afternoon, and the time of day was alternated at each pond during consecutive survey bouts. Each survey bout was separated into three separate surveys, which were conducted using a 20–60× spotting scope.

First, a pond survey was conducted where we traversed around each pond (A16 or SF2) by truck and stopped at set vantage points to record the number and location (grid cell, figs. 2 and 3) of all tern, shorebird, and gull species known to nest in South San Francisco Bay, as well as potential nest predators (for example common raven [*Corvus corax*], raptors, gulls). This survey was completed within 60 minutes so as to limit double-counting of individuals and avoid biasing abundance estimates at each pond.

Second, immediately following the pond survey, we conducted an additional 60-minute behavioral survey from a single vantage point, where we scanned the pond about every 10 minutes and documented the location and behaviors of all Caspian terns and snowy plovers. This survey was designed to provide breeding chronology information such as initiation of courtship, nest-building, and incubation, and to document factors negatively influencing nesting birds such as predation or disturbance.

Third, immediately following the behavioral survey, we conducted island surveys where we recorded the number of adults, the number of incubating adults, the number of nests with chicks, the number of chicks, and the number of fledglings of Caspian terns and snowy plovers observed on each island. In total, each survey bout consisted of about 150–180 minutes of observation. During each survey bout, we attempted to record color-band combinations of any color-banded Caspian tern observed. This allowed identification of the origin of banded Caspian terns and potentially indicate the movement of terns from the Columbia River estuary to modified islands of the DENWR.

Estimating Colony Size and Productivity of Caspian Terns

We estimated the number of breeding pairs of Caspian terns from direct counts of the number of active nests (sum of nests being incubated and nests with chicks) observed during our island surveys. Peak colony sizes were obtained from the high count of active nests observed over the course of the season. However, the nest abundance of Caspian terns at Ponds A16 and SF2 exhibited a bimodal distribution with two distinct peaks in nest initiation and incubation, one occurring in early June and another occurring in July. We presumed that this second pulse of nests was from late-arriving Caspian terns and not renesting attempts by pairs whose first nest failed. Three observations support this presumption. First, the number of adult terns increased throughout the breeding season, indicating that new adults joined the colony during the second nesting pulse. Second, we observed no widespread colony failures that would indicate the second nesting pulse was due to renesting birds. Finally, chicks from the first nesting pulse were being cared for by adults at the time that nests from the second pulse were being initiated and incubated. As a result, we added the peak number of nests from the two nesting pulses to estimate the total colony size of Caspian terns.

When nesting is not highly synchronous, as was the case for Caspian terns in Ponds A16 and SF2, peak colony counts may underestimate the total number of nests initiated and total colony size because nests initiated after the peak (or nests only active between two peaks) would not be included. To account for this, we constructed presumed nesting chronologies to estimate the number of newly initiated nests during each survey date as follows. For each survey date and each island, we calculated the total number of new incubating birds (N_{new}) using equation 1:

$$N_{new} = N_t - N_{t-1}, \quad (1)$$

where

N_t is the total number of incubating birds on the current survey date; and

$N_{t\text{-}1}$ was the total number of incubating birds on the previous survey date.

We then assumed that any new nest at time *t* was initiated on the midpoint date between *t* and *t-1*. Next, we assumed a 27-day egg-laying and incubation interval for each nest, which is a commonly reported interval for Caspian terns (Cuthbert and Wires, 1999). Thus, we assumed a new nest observed at time *t* would be incubated until 28 days after its assumed initiation date. Using this approach, we could determine if new nests had been initiated for each survey date, even if the total number of incubating birds observed decreased from the previous survey date. This allowed us to estimate the cumulative number of nests initiated, and correspondingly, the cumulative number of breeding pairs at each colony. Although this approach may allow for inclusion of nests not included using peak counts, it still may underestimate nest numbers as we assume all nests survived for 27 days. For example, a nest that failed 10 days into incubation still would be assumed to be active 15 days into incubation, thereby masking the presence of a newly initiated nest. However, because nest failure appeared to be low, this error likely was small. These methods for estimating number of nests and colony size generally can be less accurate than physically visiting colonies periodically to monitor nests. However, because it was important to limit disturbance of these newly formed colonies to avoid causing nest and (or) colony failures, islands with active colonies were only visited to address predator management needs (gull hazing).

We estimated productivity as the number of Caspian tern fledglings by adding the peak number of fledglings observed during the two nesting pulses. We considered a chick fledged if it was similar in size to adults and had well-developed flight feathers, and (or) if it was observed flying. We could not use chronologies to refine our estimate of the number of fledglings produced like we did with our analysis of the number of breeding pairs, as unlike incubation that ends after 27 days, fledglings continue to be visible for an indeterminate duration. We estimated breeding success as the number of fledglings per breeding pair by dividing the number of fledged Caspian tern chicks produced by the number of breeding pairs estimated by summing the two peak nest numbers.

Estimating Apparent Nest Density of Caspian Terns

We calculated two measures of apparent nest density. First, we calculated nest density at each colony as a function of the total island area for that colony. Island areas were determined using real-time kinematics (RTK; Leica GNSS RTK Rover, Leica Geosystems, Atlanta, Georgia, USA). Between August 24 and 27, we traced the gravel perimeter of each island with the RTK unit while collecting latitude, longitude, and elevation data at 1-second intervals. These data were imported into ArcGIS™ 10.2 (Environmental Research Systems Institute, Redlands, California) and converted to polygon shapefiles for determination of island area. We then divided the total number of nests at each colony by the corresponding island area. Second, we calculated nest density at each colony as a function of only the area of the island used by the colony. For this second measure, we used aerial photographs of the colonies to map locations of terns on each island. We determined the area of each island used by Caspian terns from digitized aerial colony photographs taken on May 27 and provided by Real Time Research. From these photographs, we identified Caspian terns and Caspian tern decoys and created a minimum convex polygon shapefile around each colony and calculated area using ArcGIS™ 10.2. We then divided the total number of nests at each colony by the area used by Caspian terns. Both of these estimates are of apparent nest densities, not accounting for influences of nest depredation or nest abandonment (Mayfield, 1961), as in the interest of limiting disturbance, we did not access the islands during the nesting season. Therefore, these estimates likely are biased somewhat low.

Results and Discussion

Abundance of Caspian Terns and Other Avian Species in Ponds A16 and SF2

At Pond A16, California gulls were the most abundant species (69 percent of surveyed birds observed), followed by black-necked stilt (*Himantopus mexicanus*; 11 percent), Caspian terns (6 percent), and Forster's terns (*Sterna forsteri*; 5 percent). At Pond SF2, American avocets (*Recurvirostra americana*) were the most abundant species (45 percent of surveyed birds observed), followed by Caspian terns (31 percent), California gulls (10 percent), Forster's terns (8 percent), and ring-billed gulls (*Larus delawarensis*; 5 percent) (table 2). Weekly high counts of the most abundant surveyed species at Ponds A16 and SF2 are shown in figure 8.

We observed an average of 49 and 101 Caspian terns during 62 pond surveys at Ponds A16 and SF2, respectively. High counts of Caspian terns occurred on July 13 (n=117) and July 20 (n=244) at Ponds A16 and SF2, respectively. Caspian terns were observed at least once on 19 islands in Pond A16, including all 3 modified islands, and 14 islands in Pond SF2, including all 4 modified islands (table 3). At Ponds A16 and SF2, Caspian terns were overwhelmingly drawn to those islands with Caspian tern social attraction measures, and in particular, islands with greater than 100 decoys. During the 62 behavioral surveys conducted between March 9 and September 18, 87 and 92 percent of Caspian tern observations in Ponds A16 and SF2, respectively, occurred on islands with social attraction measures for Caspian terns (fig. 9).

Breeding Chronology of Caspian Terns

Caspian terns were first observed on March 20 at Pond SF2 and on March 25 at Pond A16. Courtship behaviors (for example fish feeding, displays, copulation) began soon after Caspian terns arrived at the ponds, and were first observed on March 25 at Pond A16 and on April 1 at Pond SF2. Caspian terns began nesting at Pond SF2 about 10 days earlier than at Pond A16, with the first incubating birds observed on April 20 and May 1 at Ponds SF2 and A16, respectively. Caspian terns were observed incubating eggs over a 14-week period at Pond A16 and over a 20-week period at Pond SF2 (fig. 10). The first chicks were observed at Pond SF2 on May 15 and at Pond A16 on May 22. The 2015 nesting season was longer than has been observed for Caspian terns in San Francisco Bay. Roby and others (2009) reported that by early August 2009, three Caspian tern colonies in San Francisco Bay had completed nesting and were abandoned. In contrast, pre-fledged chicks continued to be observed as late as August 31 at Ponds A16 and SF2 in 2015.

Size and Productivity of Caspian Tern Breeding Colonies

Caspian terns nested on Island 11 in Pond A16 and on Islands 17 and 21 in Pond SF2, and did not nest on Island 12 in Pond A16 or Island 12 in Pond SF2 (figs. 11–15). The Caspian tern colony on Island 17 in Pond SF2 consisted of a single breeding pair that initiated a single nest first observed on May 4, and which fledged one chick. In contrast, the nesting colonies on Island 11 in Pond A16 and Island 21 in Pond SF2 consisted of multiple breeding pairs on each island. The abundance of Caspian tern nests at Ponds A16 and SF2 exhibited a bimodal distribution with two distinct nesting peaks (fig. 16). The number of nests being incubated first peaked on May 13 at both ponds, and totaled 27 and 53 at Ponds A16 and SF2, respectively. The second peak in the number of nests being incubated occurred between June 26 and 29 at both ponds, and totaled 33 and 72 at Ponds A16 and SF2, respectively. Preceding the second peak was a large increase in the total number of Caspian tern adults observed on each island, relative to the number of Caspian tern adults observed on each island during the first peak (fig. 16). Moreover, many Caspian tern chicks were observed on the islands before and during the second peak, indicating that many of the nests from the first pulse were successful. Finally, we saw few signs of predator effects on the colonies and no evidence of widespread nest failure, which indicates that the second nesting pulse was not the result of widespread renesting by terns that failed during the first nesting pulse. With these observations, we were confident that the second pulse of nests observed was due to the arrival of late nesters to the colony.

Peak counts of the total number of active nests (which include both nests with eggs and nests with chicks) on Island 11 in Pond A16 occurred on June 5 (29 nests) and July 20 (44 nests). Peak counts for the number of active nests (which include both nests with eggs and nests with chicks) on Island 21 in Pond SF2 occurred on June 1 (66 nests) and June 29 (84 nests). Summing the peak number of active nests during the two nesting peaks resulted in an estimate of 73 Caspian tern breeding pairs on Island 11 in Pond A16 and 150 Caspian tern breeding pairs on Island 21 in Pond SF2, which combined with the 1 breeding pair on Island 17 in Pond SF2 resulted in a total of 224 breeding pairs. Using our second approach for estimating the number of breeding pairs, taking the presumed nest chronologies into account, we estimated a cumulative total of 76 Caspian tern breeding pairs on Island 11 in Pond A16 and 159 Caspian tern breeding pairs on Island 21 in Pond SF2, which combined with the 1 breeding pair on Island 17 in Pond SF2 resulted in a total of 236 breeding pairs.

As with nests, the abundance of Caspian tern chicks and fledglings on Island 11 in Pond A16 and Island 21 in Pond SF2 exhibited a bimodal distribution with two distinct peaks (fig. 16). On Island 11 in Pond A16, the first peak of fledglings occurred on July 13 and totaled 22 individuals, and the second peak of fledglings occurred on August 21 and totaled 32 individuals. On Island 21 in Pond SF2, the first peak of fledglings occurred on July 6 and totaled 75 individuals, and the second peak of fledglings occurred on August 21 and totaled 44 individuals. On Island 11 in Pond A16, the number of nests and the number of fledglings produced was greater during the second peak in nesting. However, on Island 21 in Pond SF2, the number of nests was greater during the second peak in nesting (66 in first peak, 84 in second peak) but fewer fledglings were produced (75 from first peak, 44 from first peak) even though the number of chicks observed was similar between the two nesting pulses (fig. 16). Although this pattern could suggest that chick survival decreased at Pond SF2 late in the season, we suspect that it may be the result of greater asynchrony in fledging of chicks at Pond SF2 late in the season, thereby producing a smaller peak number of fledglings observed.

Summing the number of fledglings from the two peaks resulted in an estimate of 54 and 119 Caspian tern chicks fledged from Island 11 in Pond A16 and Island 21 in Pond SF2, respectively. Combining these numbers, as well as the 1 fledgling from Island 17 in Pond SF2, we estimate that at least 174 Caspian tern chicks fledged from Ponds A16 and SF2 in 2015. Dividing the estimated number of fledglings by the number of breeding pairs (sum of the high counts of number of nests from both nesting pulses) yielded a breeding success (number of fledglings per breeding pair) of 0.74, 1.00, and 0.79 for Island 11 in Pond A16, Island 17 in Pond SF2, and Island 21 in Pond SF2, respectively (table 4). Overall, we estimated that Ponds A16 and SF2 together supported 224–236 breeding pairs of Caspian terns, fledged at least 174 Caspian tern chicks, for a breeding success rate of 0.78 fledglings per breeding pair (table 4).

Nest Density of Caspian Terns

Nest density as a function of the total island gravel area available on each island was 0.09 nests/m^2 on Island 21 in Pond SF2, 0.05 nests/m^2 on Island 11 in Pond A16, and 0.001 nests/m^2 on Island 17 in Pond SF2 (table 4). However, on all three islands, the proportion of total island area used by the colonies was relatively small (figs. 11, 14, 15). The colony on Island 11 in Pond A16 encompassed about 130 m^2 (8 percent) of the 1,603 m^2 of island gravel surface available, and the colony on Island 21 in Pond SF2 encompassed about 236 m^2 (14 percent) of the 1,693 m^2 of island surface available (table 4). Nest densities estimated as a function of only the island area used by Caspian terns was 0.56 and 0.64 nests/m^2 on Island 11 in Pond A16 and Island 21 in Pond SF2, respectively (table 4).

However, nest densities estimated as a function of only the area used by the colony were based on photographs taken during the first pulse of nesting. Although we observed a second, and larger, pulse of nesting in July, no corresponding aerial photographs were taken of the colonies at this time. Thus, nest densities based on the island area used by the colony may have been slightly overestimated if the overall area used by the colony increased during the second nesting pulse.

Sightings of Color-Banded Caspian Terns

The resighting effort of banded Caspian terns was limited because of the distance of observation points on the surrounding levees from the nesting islands (about 200–400 m). On several occasions, we determined that a Caspian tern was banded but were unable to identify the color-band combination. For the 2016 nesting season, observation blinds will be erected on islands or internal levees close to (within 50–180 m of) the modified islands, and observers will observe colonies from these blinds during the nesting season. This likely will improve our ability to identify color-band combinations of banded terns.

We observed five banded Caspian terns over the course of the 2015 surveys (table 5). All five banded Caspian terns were seen at Pond SF2 and no banded Caspian terns were seen at Pond A16. Three of the Caspian terns were banded with engraved bands (field-readable alphanumeric code) and two were banded with color bands only. One banded Caspian tern was seen on two occasions—once on August 21 and again on August 28. The other four banded Caspian terns were seen on a single occasion on April 30 (two birds), August 21 (one bird), and August 28 (one bird).

Two Caspian terns were identified as having been banded on Brooks Island in northern San Francisco Bay (one as a chick in 2005, one as an adult in 2008), one was identified as a bird banded as a chick in 2007 on East Sand Island in the Columbia River estuary, one was identified as having been banded as a chick either in 2006 on East Sand Island or in 2010 on Goose Island on Potholes Reservoir in Washington, and one could not be identified (table 5). The two birds banded on Brooks Island have been observed in recent years on Brooks Island and about 10 km north of Pond SF2 at the Eden Landing Ecological Reserve (fig. 1). The bird banded on East Sand Island was observed in 2013 at Tule Lake, California (Yasuko Suzuki, Oregon State University, written commun., January 9, 2016).

Nesting of Snowy Plovers

At Pond A16, snowy plovers were observed on only four occasions (April 27, May 1, May 22, and July 27) over the course of 62 pond surveys between March 9 and September 18, with a high count of 29 birds recorded on July 27. At Pond SF2, snowy plovers were observed more frequently (14 surveys), with a high count of 23 birds recorded on April 27. On average, 0.6 and 1.7 snowy plovers were observed over the course of 62 pond surveys at Ponds A16 and SF2, respectively. Almost all snowy plovers were observed on mudflats or along the pond levees. At Pond A16, only two snowy plovers were observed on an island (one on Island 5 and one on Island 7 on May 22). At Pond SF2, only three snowy plovers were observed on an island (three on Island 29 on May 8). We did not observe snowy plovers on either of the islands modified for snowy plovers (Island 3 in Pond A16, Island 10 in Pond SF2), although surveyors from the San Francisco Bay Bird Observatory did see a snowy plover pair on one occasion on modified Island 10 in Pond SF2. No snowy plovers nested in Pond A16, and snowy plovers only nested in the salt panne part of Pond SF2 west of the constructed islands.

Gull Dissuasion

Gulls were found roosting on the modified islands less often than on other islands. However, when gulls were observed roosting on modified islands, attempts to haze gulls were often unsuccessful as the gulls would flush from the islands only to return once we left, and often flushing gulls from nearby islands was counter-productive because they would fly over and roost on the modified islands. Based on results of this study, future intensive gull hazing could occur at each pond early in the season to deter nesting or roosting by gulls on islands. However, once Caspian terns begin nesting, limiting hazing only to gulls observed actively disturbing waterbirds that are nesting or attempting to nest may reduce disturbance. Attempting to haze roosting gulls, even those roosting on modified islands, may cause more disturbance to nesting birds than the presence of the gulls themselves.

On June 6, USDA-APHIS-Wildlife Services shot two gulls on modified Island 11 in Pond A16. From that point forward, gulls were rarely observed on any of the modified islands at Pond A16. At Pond SF2, there were fewer gulls than at Pond A16 (fig. 8). This is likely due, in part, to the greater distance of Pond SF2 to the nearest breeding gull colony and to the nearest landfill, which attract large numbers of gulls (J.T. Ackerman, U.S. Geological Survey, unpub. data, 2009). The distance from modified islands in Pond A16 to the nearest gull colony is less than 3 km, whereas the distance from modified islands in Pond SF2 to the nearest gull colony is more than 5 km (fig. 1). In addition, the density of gull breeding colonies is much greater around Pond A16 than around Pond SF2 (fig. 1). Furthermore, the distance from modified islands in Pond A16 to the nearest landfill (Newby Island) is about 2 km, whereas the distance from modified islands in Pond SF2 to the nearest landfill (Tri Cities) is more than 11 km. Finally, gulls likely were attracted to Pond A16 because it lies almost directly between the large A9/A10 gull colony and the Newby Island Landfill (fig. 1). Overall, gull dissuasion was less needed at Pond SF2 than at Pond A16. We never observed gulls prospecting for nest sites, building nests, or engaging in other nesting behaviors at either Ponds A16 or SF2.

Factors Influencing Overall Success of Caspian Tern Colonies

Potential egg or chick predators observed at Ponds A16 and SF2 included California gulls, ring-billed gulls, western gulls (*Larus occidentalis*), Bonaparte's gulls (*Chroicocephalus philadelphia*), and common ravens (table 2). Of these, California gulls were by far the most numerous, and are well documented predators of waterbird eggs and chicks in South San Francisco Bay (Herring and others, 2011; Ackerman, Herzog, Hartman, and Herring, 2014; Ackerman, Herzog, Hartman, and Takekawa, 2014). California gulls were particularly abundant at Pond A16 (fig. 8), likely because of the proximity of Pond A16 to the large Pond A9/A10 California gull colony and to the Newby Landfill (J.T. Ackerman, U.S. Geological Survey, unpub. data, 2006, 2009; Ackerman and others, 2013). Gulls in Pond A16 typically were observed roosting on islands and the surrounding pond levees. However, despite their large numbers, there was little evidence that California gulls had a negative influence on nesting Caspian terns. Prior to nesting, California gulls were observed on a few occasions chasing Caspian terns to steal fish and, on one occasion, a California gull was observed removing a Caspian tern eggshell from Island 11 in Pond A16. However, gulls were never observed harassing nesting terns at Pond A16. At Pond SF2, there were fewer gulls, and gulls were largely absent from the pond between mid-April and mid-July (fig. 8). Gulls rarely roosted on SF2 islands modified for Caspian terns, and were never observed harassing terns.

Although the number of Caspian terns observed at Pond A16 was about one-half the number observed at Pond SF2, the proportion of those terns that ultimately bred was similar between the two ponds. It is possible that the large number of gulls at Pond A16 compared to Pond SF2 dissuaded additional Caspian terns from visiting Pond A16 and ultimately nesting. However, the difference in overall Caspian tern numbers also could have been due to the locations of the two ponds and the likelihood that they would be visited by Caspian terns. Nevertheless, the large number of gulls at Pond A16 warrants continued monitoring to evaluate potential negative effects of gulls on Caspian terns.

Early in the season at Pond A16, common ravens were observed on a few occasions lifting or tipping over Caspian tern decoys. However, once the Caspian terns began nesting, ravens rarely were seen on the modified islands and were never observed harassing nesting terns.

In late September, at the time decoys and call systems were removed, we observed several dead Caspian terns at each of the three Caspian tern nesting islands, which can be typical among colonial waterbird nesting colonies. This included 2 fledglings and 26 pre-fledged chicks on Island 11 in Pond A16; 3 fledglings on Island 17 in Pond SF2; and 1 adult, 5 fledglings, and 21 pre-fledged chicks on Island 21 in Pond SF2. Causes of mortality for these individuals were unknown, but there were no obvious signs of trauma, suggesting that these individuals died because of abandonment, starvation, exposure and (or) other natural causes.

Conclusions and Management Implications

Results from the 2015 nesting season indicate that island modifications and social attraction measures for Caspian terns (*Hydroprogne caspia*) were successful in establishing Caspian tern breeding colonies at Ponds A16 and SF2 of the Don Edwards San Francisco Bay National Wildlife Refuge (DENWR), South San Francisco Bay, California. The U.S. Geological Survey (USGS) has been monitoring breeding waterbirds on DENWR for the past 10 years, and 2015 was the first year Caspian terns were documented nesting at either Ponds A16 or SF2. Overall, we estimated that at least 224 Caspian tern breeding pairs nested at Ponds A16 and SF2, and at least 174 chicks were fledged, for a breeding success rate (fledglings per breeding pair) of 0.78. This represents relatively good productivity, as it was greater than the long-term averages on East Sand Island (about 0.62) and Crescent Island (0.53) in the Columbia River estuary system (Roby and others, 2013), and greater than the average among several sites in South San Francisco Bay (Collis and others, 2012). Nest density (nests per square meter of colony area) in Ponds A16 and SF2 averaged 0.61, which was less than densities observed at San Francisco Bay sites of Brooks Island (0.9) and Eden Landing (1.0), but slightly higher than densities observed at Steven's Creek (0.5; Roby and others, 2009). The relatively low nest densities observed, the low proportion of island habitat used by the colonies on Island 11 in Pond A16 and Island 21 in Pond SF2, and the fact that three of the five islands modified for Caspian terns were largely unused (two islands had no nests, one island had only one nest), suggests that there is considerable opportunity to expand Caspian tern colonies at each pond.

At least one, and possibly two Caspian terns observed in Pond SF2 were banded at East Sand Island, suggesting that modified islands on DENWR are supporting birds that originated from the Columbia River basin. With greater resighting effort scheduled to take place in 2016, additional Caspian terns from the Columbia River basin potentially will be recorded using modified islands at DENWR.

We found little evidence that the large population of California gulls in South San Francisco Bay had a negative effect on nesting Caspian terns. However, as the islands in Pond SF2 and especially Pond A16 are relatively new, continued monitoring, as well as hazing, may be necessary to ensure that this attractive nesting habitat is not overtaken by nesting gulls. Moreover, removal of two gulls by the U.S. Department of Agriculture Animal and Plant Health Inspection Service at Pond A16 proved highly effective at limiting gull presence on modified islands. Continuing the monitoring of gull activity at both ponds would help evaluate if further removals are warranted.

The two islands that successfully attracted Caspian tern nesting colonies had more Caspian tern decoys deployed (104 and 158 decoys) than the three islands with one or zero nests (50, 51, and 58 decoys on each island). Another 300 Caspian tern decoys are scheduled to be delivered to USGS prior to the 2016 breeding season, and these additional decoys will enable the deployment of 100–150 decoys on each of the five islands modified for Caspian terns at Ponds A16 and SF2 in 2016 and 2017. Although snowy plovers did not nest on the two islands modified for them, they also did not nest, nor were they observed, on any of the five islands modified for Caspian terns. Furthermore, Caspian terns were observed on the two islands modified for snowy plovers on only three occasions between March 9 and September 18. Thus, there were no signs of conflict between Caspian terns and snowy plovers associated with island modifications in Ponds A16 and SF2.

Successful establishment of Caspian tern colonies in Ponds A16 and SF2 during 2015 demonstrate the potential of social attraction measures to help establish waterbird nesting colonies in San Francisco Bay. To offset the loss of managed pond habitat from tidal marsh restoration, the South Bay Salt Pond Restoration Project has constructed 46 new islands (16 in Pond A16, 30 in Pond SF2) over the past 5 years to provide nesting and roosting habitat for waterbirds (7 of these islands were further modified for nesting Caspian terns and snowy plovers in 2015 and are the focus of the current study). However, these other recently constructed islands thus far have been used relatively little by nesting waterbirds and have not been used by nesting Forster's terns (*Sterna forsteri*), one of the most abundant colonial-breeding waterbird in South San Francisco Bay. Like Caspian terns, Forster's terns and American avocets (*Recurvirostra americana*) nest colonially, and select nest sites based on the presence of nearby Forster's tern nests. Moreover, Forster's tern breeding colonies have been successfully established in other locations using social attraction measures (Ward and others, 2012). Thus, social attraction measures similar to those used in this study, but targeting Forster's terns and American avocets, may help to establish breeding colonies of these species at targeted wetlands enhanced for the South Bay Salt Pond Restoration Project.

Acknowledgments

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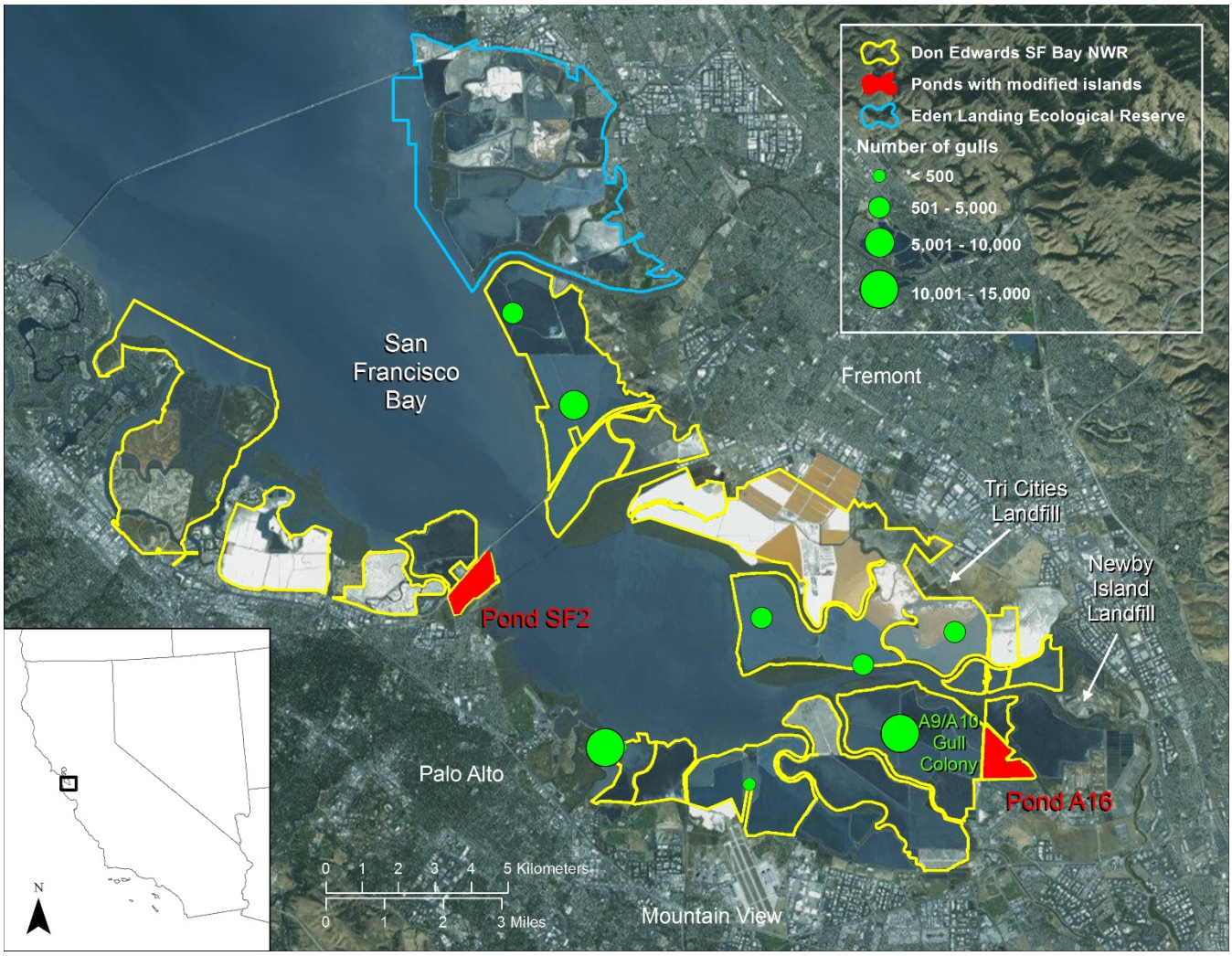

Figure 1. Locations of Ponds A16 and SF2 containing islands modified for Caspian terns and snowy plovers, Don Edwards San Francisco Bay National Wildlife Refuge, California. Size of the green circles represents the number of breeding gulls in 2015 (Washburn and Butler, 2016).

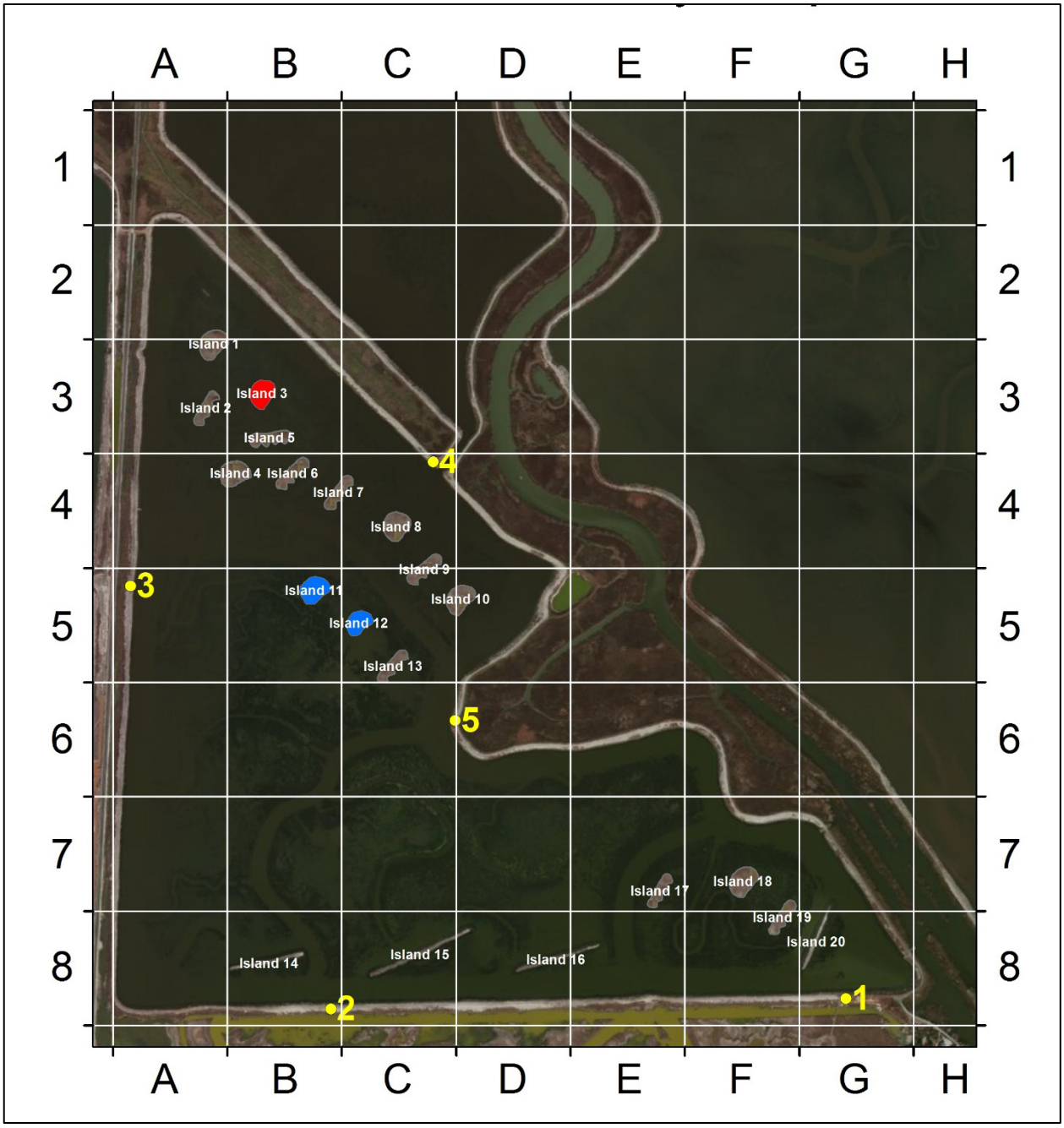

Figure 2. Locations of islands modified for nesting Caspian terns (Islands 11 and 12) and nesting snowy plovers (Island 3) in Pond A16, Don Edwards San Francisco Bay National Wildlife Refuge, California. Numbered yellow dots designate vantage points used to count birds in the pond during pond surveys.

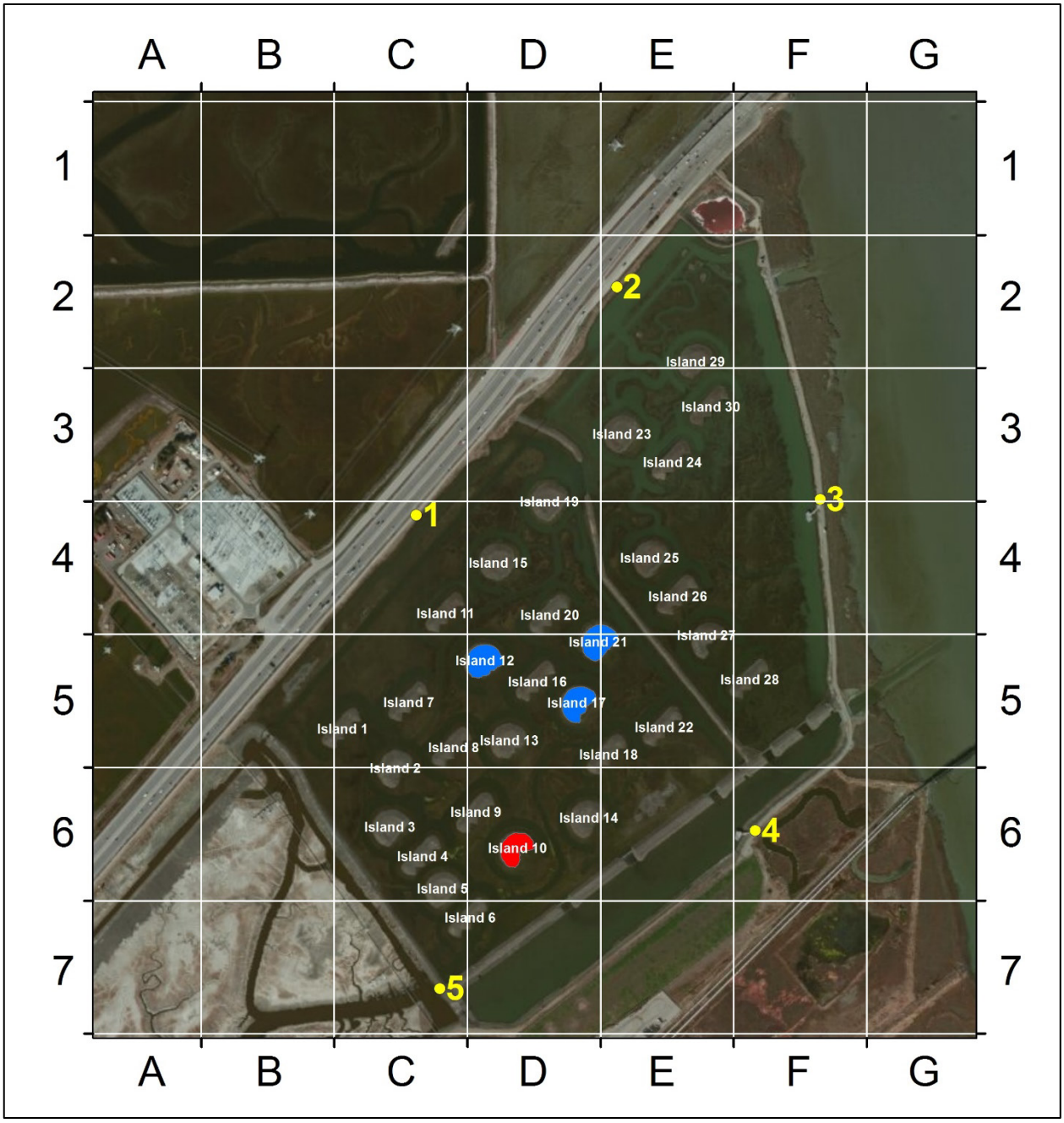

Figure 3. Locations of islands modified for nesting Caspian terns (Islands 12, 17, and 21) and nesting snowy plovers (Island 10) in Pond SF2, Don Edwards San Francisco Bay National Wildlife Refuge, California. Numbered yellow dots designate vantage points used to count birds in the pond during pond surveys.

Figure 4. Arrangement of social attraction measures for Caspian terns (decoys and call system) on modified Island 11 (top left) and Island 12 (top right) in Pond A16, Don Edwards San Francisco Bay National Wildlife Refuge, California. Bottom photograph shows Island 12 in foreground (with solar panel) and Island 11 in background (with many Caspian terns and decoys). Top left and top right photographs by Kimberley Sawyer, USGS, March 17, 2015. Bottom photograph by Crystal Shore, USGS, April 27, 2015.

Figure 5. Arrangement of social attraction measures for Caspian terns (decoys and call system) on modified Island 12 (top) and Island 17 (bottom) in Pond SF2, Don Edwards San Francisco Bay National Wildlife Refuge, California. Top photograph by Alex Hartman, USGS, March 3, 2015. Bottom photograph by Kimberley Sawyer, USGS, March 17, 2015.

Figure 6. Arrangement of social attraction measures for Caspian terns (decoys and call system) on modified Island 21 in Pond SF2, Don Edwards San Francisco Bay National Wildlife Refuge, California. Photographs by Crystal Shore, USGS, April 30, 2015.

Figure 7. Arrangement of social attraction measures for snowy plovers (decoys and call system) on modified Island 10 in Pond SF2, Don Edwards San Francisco Bay National Wildlife Refuge, California. Photograph by Alex Hartman, USGS, March 2, 2015.

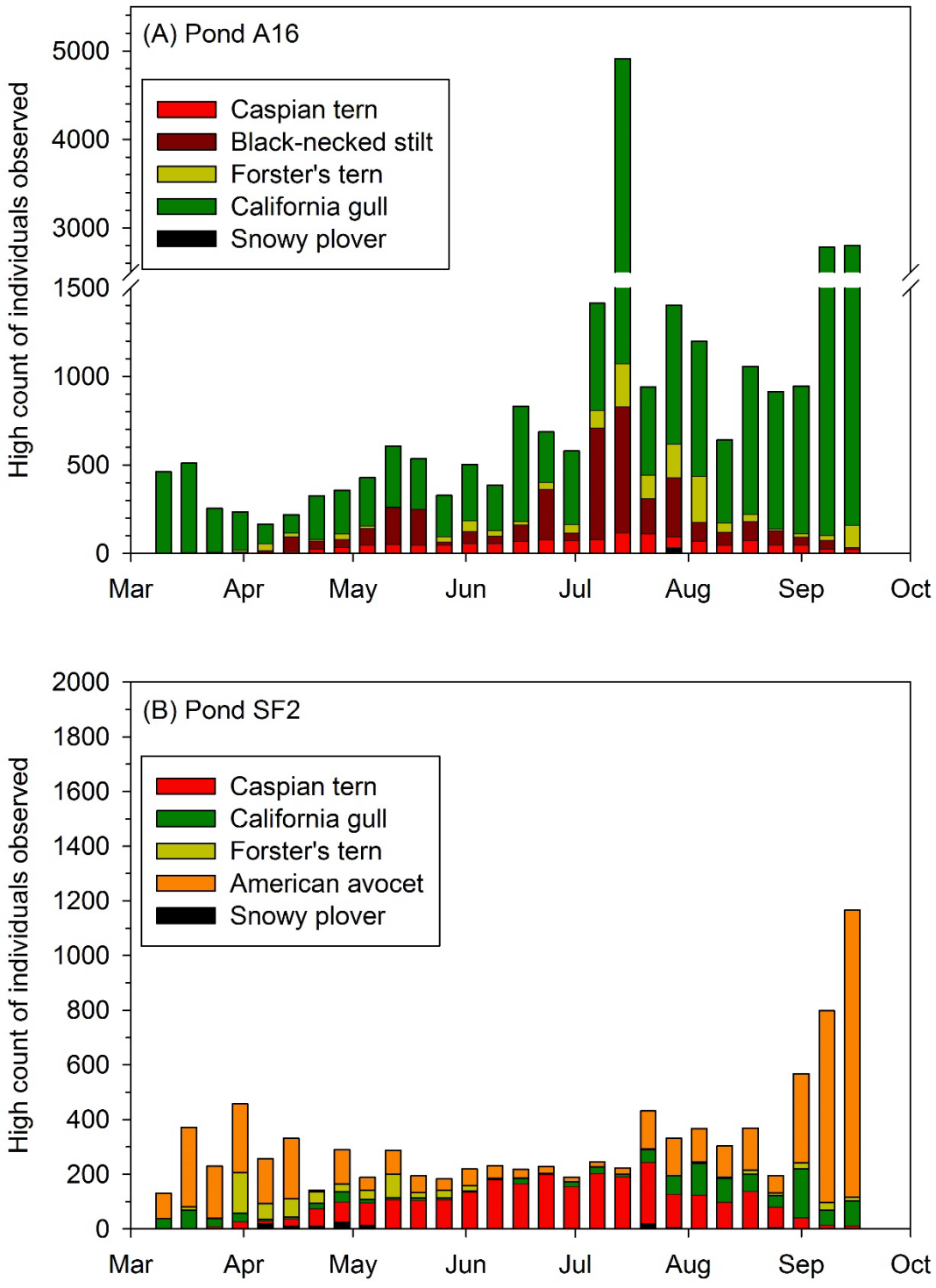

Figure 8. Weekly high counts of individuals of the most abundant surveyed waterbird species (and snowy plovers) observed during pond surveys at (A) Pond A16 and (B) Pond SF2, Don Edwards San Francisco Bay National Wildlife Refuge, California, March 9–September 18, 2015.

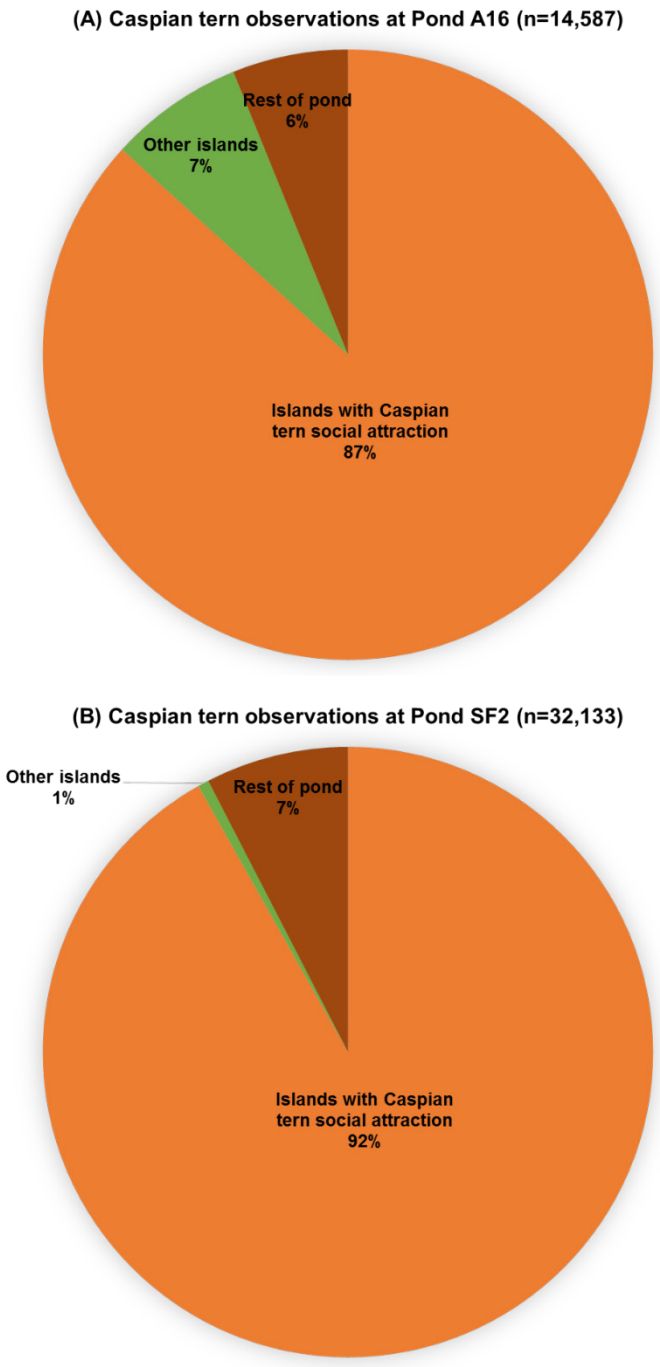

Figure 9. Percentage of Caspian tern observations by location during sixty-two 60-minute behavior surveys conducted at (A) Pond A16, and (B) Pond SF2, Don Edwards San Francisco Bay National Wildlife Refuge, California, March 9–September 18, 2015. Sample size includes multiple observations of the same individuals over each 60-minute behavioral survey.

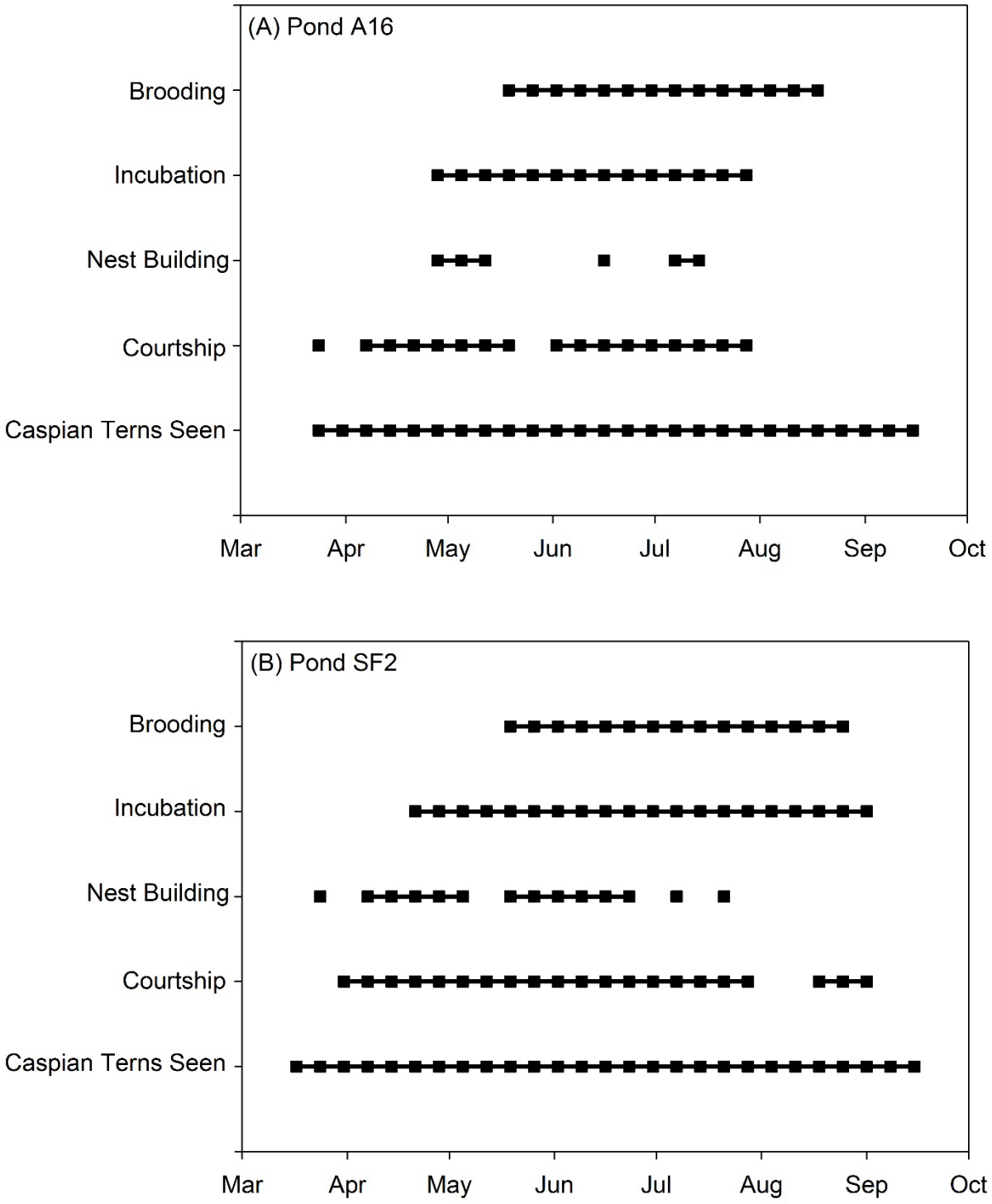

Figure 10. Breeding chronology of Caspian terns based on observed behaviors at (A) Pond A16, and (B) Pond SF2, Don Edwards San Francisco Bay National Wildlife Refuge, California, 2015. Surveys were conducted between March 9 and September 18.

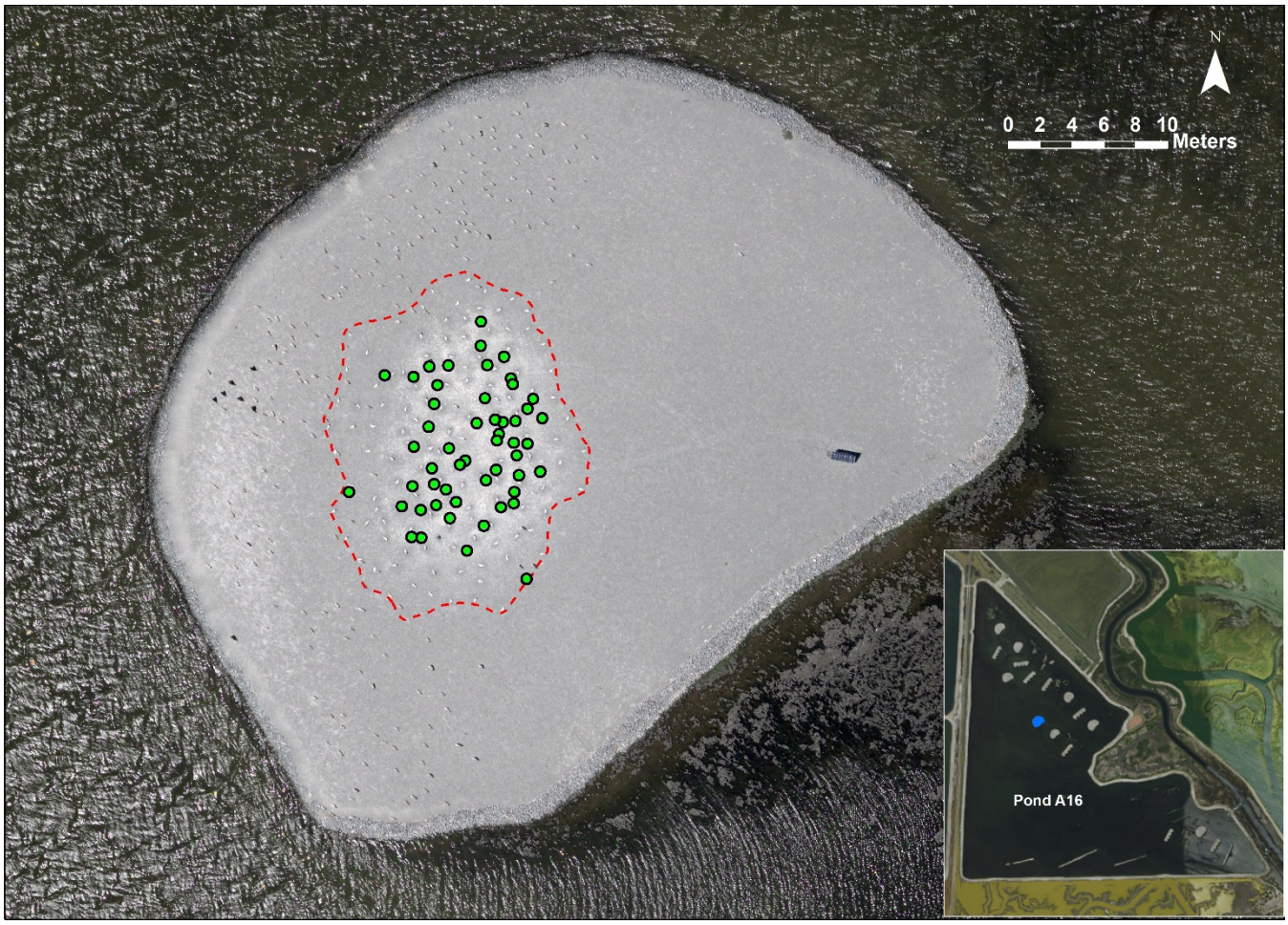

Figure 11. Aerial photograph of Island 11 modified for Caspian terns in Pond A16, Don Edwards San Francisco Bay National Wildlife Refuge, California. Dashed red line denotes the extent of the decoy spread. Green circles denote locations of individual Caspian terns. Roosting gulls and cormorants are seen on the island periphery. Photograph taken during the first peak of nesting and provided by Real Time Research, May 27, 2015.

Figure 12. Aerial photograph of Island 12 modified for Caspian terns in Pond A16, Don Edwards San Francisco Bay National Wildlife Refuge, California. Dashed red line denotes the extent of the decoy spread. No Caspian terns nested in 2015. Photograph taken during the first peak of nesting and provided by Real Time Research, May 27, 2015.

Figure 13. Aerial photograph of Island 12 modified for Caspian terns in Pond SF2, Don Edwards San Francisco Bay National Wildlife Refuge, California. Dashed red line denotes the extent of the decoy spread. No Caspian terns nested in 2015. Photograph taken during the first peak of nesting and provided by Real Time Research, May 27, 2015.

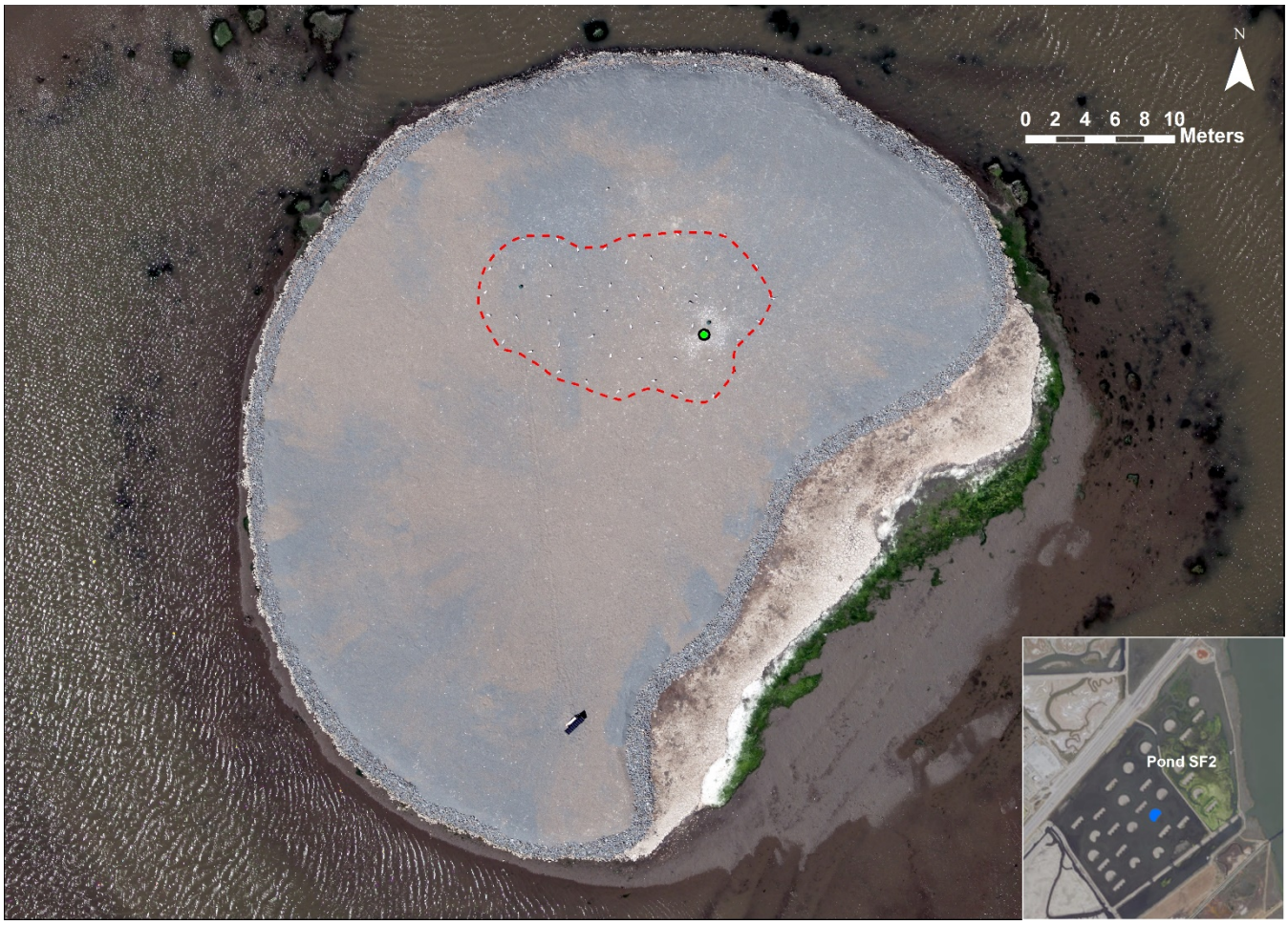

Figure 14. Aerial photograph of Island 17 modified for Caspian terns in Pond SF2, Don Edwards San Francisco Bay National Wildlife Refuge, California. Dashed red line denotes the extent of the decoy spread. Green circle denotes locations of individual Caspian tern. Photograph taken during the first peak of nesting and provided by Real Time Research, May 27, 2015.

Figure 15. Aerial photograph of Island 21 modified for Caspian terns in Pond SF2, Don Edwards San Francisco Bay National Wildlife Refuge, California. Dashed red line denotes the extent of the decoy spread. Green circles denote locations of individual Caspian terns. Photograph taken during the first peak of nesting and provided by Real Time Research, May 27, 2015.

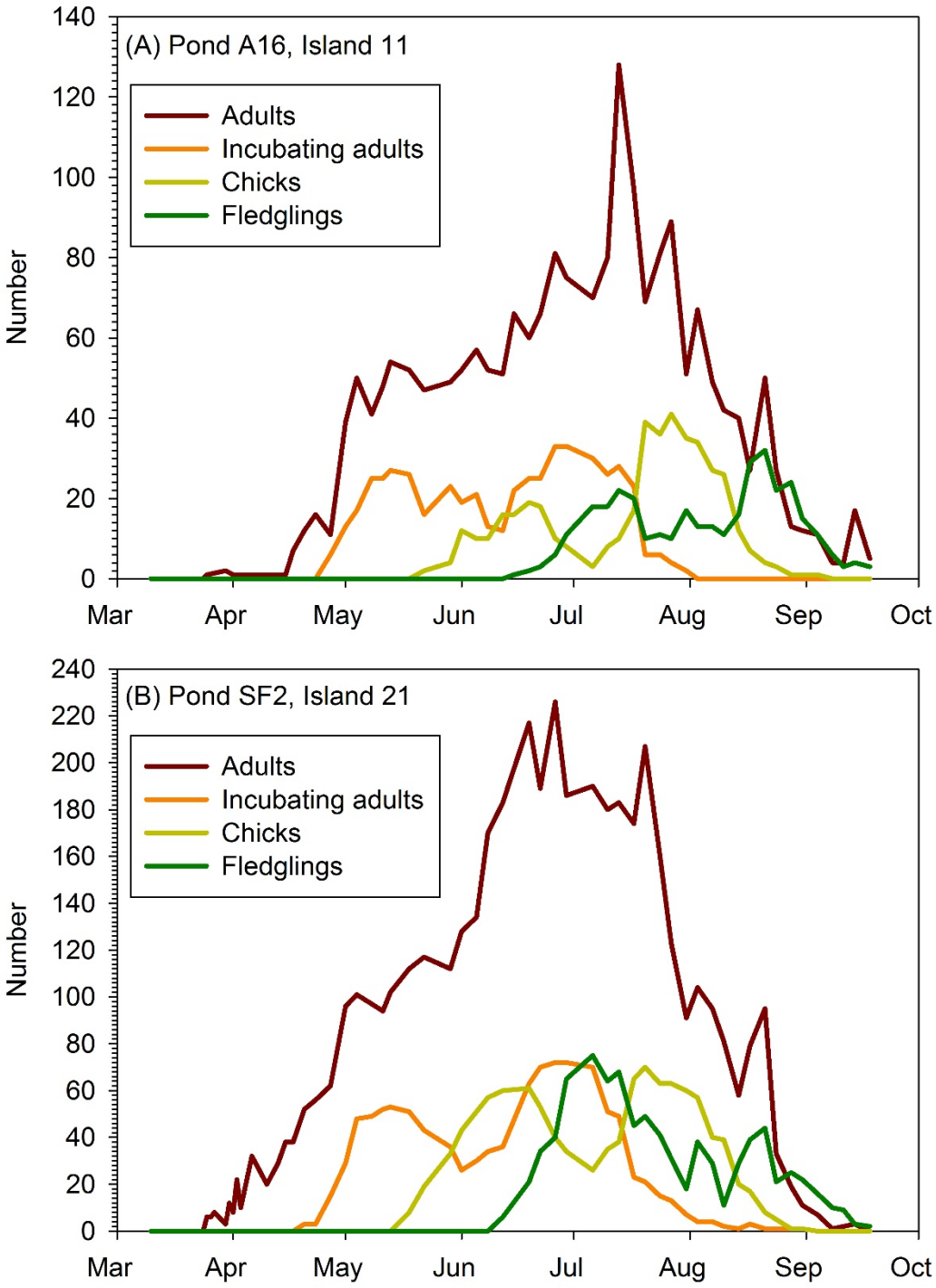

Figure 16. Number of Caspian tern adults, incubating adults, chicks, and fledglings by date at (A) Pond A16, Island 11; and (B) Pond SF2, Island 21, Don Edwards San Francisco Bay National Wildlife Refuge, California, 2015. In addition to these two islands, a single Caspian tern breeding pair nested on Pond SF2, Island 17.

Table 1. Summary of social attraction efforts at three islands in Pond A16 and four islands in Pond SF2, Don Edwards San Francisco Bay National Wildlife Refuge, California, 2015.

Pond	Island No.	Decoy/Call type	Number of decoys	Date of decoy and call system	
				Deployment	Removal
A16	3	Snowy plover	6	March 6	September 23
A16	11	Caspian tern	128	March 4	September 23
A16	12	Caspian tern	58	March 4	September 23
SF2	10	Snowy plover	6	March 2	September 22
SF2	12	Caspian tern	50	March 3	September 22
SF2	17	Caspian tern	51	March 5	September 22
SF2	21	Caspian tern	104	March 3	September 22

Table 2. Cumulative number of individuals counted and percentage of total observations of waterbirds (gulls, terns, and shorebirds) and potential egg and chick predators observed during 62 pond surveys conducted at (A) Pond A16, and (B) Pond SF2, Don Edwards San Francisco Bay National Wildlife Refuge, California, March 9–September 18, 2015.

[Focal species Caspian terns and snowy plover are bolded. <, less than]

Species	Cumulative number of individuals counted	Percentage of total
(A) Pond A16		
California gull	28,827	69
Black-necked stilt	4,804	11
Caspian tern	**2,340**	**6**
Forster's tern	2,174	5
Ring-billed gull	1,642	4
American avocet	1,494	4
Western gull	554	1
Bonaparte's gull	81	<1
Common raven	70	<1
Snowy plover	**37**	**<1**
Elegant tern	10	<1
Turkey vulture	6	<1
Black skimmer	2	<1
Least tern	1	<
Mew gull	1	<1
Osprey	1	<1
(B) Pond SF2		
American avocet	7,441	45
Caspian tern	**5,058**	**31**
California gull	1,555	10
Forster's tern	1,306	8
Ring-billed gull	848	5
Snowy plover	**106**	**1**
Western gull	24	<1
Black-necked stilt	14	<1
Common raven	8	<1
Elegant tern	1	<1

Table 3. Number of pond surveys in which Caspian terns were observed and the total number of Caspian terns counted on each island during 62 pond surveys conducted at (A) Pond A16, and (B) Pond SF2, Don Edwards San Francisco Bay National Wildlife Refuge, California, March 9–September 18, 2015.

[Islands modified for Caspian terns or snowy plovers are bolded]

Island	Number of surveys where Caspian terns observed	Total number of Caspian terns counted during all surveys
(A) Pond A16		
1	5	4
2	4	5
[1]**3**	**1**	**1**
4	18	38
5	1	1
6	6	9
7	7	8
8	12	84
9	8	13
10	1	1
[2,3]**11**	**49**	**1,985**
[2]**12**	**16**	**85**
13	5	6
14	2	2
15	1	1
16	1	1
17	1	1
18	1	18
19	1	4
(B) Pond SF2		
8	1	3
[1]**10**	**2**	**3**
[2]**12**	**10**	**15**
13	1	1
14	3	3
16	2	2
[2,3]**17**	**43**	**178**
18	8	14
20	11	21
[2,3]**21**	**58**	**4,538**
22	8	14
24	2	10
25	2	2
29	1	1

[1]Denotes islands with social attractions for snowy plovers.

[2]Denotes islands with social attractions for Caspian terns.

[3]Denotes islands where Caspian terns nested.

Table 4. Breeding metrics on seven modified islands with social attraction measures for (A) Caspian terns and (B) snowy plovers in Ponds A16 and SF2, Don Edwards San Francisco Bay National Wildlife Refuge, California, 2015.

[Dash (–) denotes that the calculation is not possible. m^2, square meter]

Pond	Island	Number of breeding pairs		Number of chicks fledged[3]	Breeding success (fledglings/ breeding pair)[4]	Island gravel area (m^2)	Colony area (m^2)	Apparent nest density	
		Method 1[1]	Method 2[2]					(nests/islands m^2)[5]	(nests/colony m^2)[6]
(A) Caspian tern									
A16	11	73	76	54	0.74	1,603	130	0.05	0.56
A16	12	0	0	0	–	1,247	–	–	–
SF2	12	0	0	0	–	1,841	–	–	–
SF2	17	1	1	1	1.00	1,518	–	0.001	–
SF2	21	150	159	119	0.79	1,693	236	0.09	0.64
TOTAL		224	236	174	0.78	7,903	366	0.03	0.61
(B) Snowy plover									
A16	3	0	0	0	–	1,318	–	–	–
SF2	10	0	0	0	–	1,420	–	–	–
TOTAL		0	0	0	–	2,738	–	–	–

[1]Calculated by summing the peak number of nests from the two nesting pulses.

[2]Calculated using assumed nest chronologies (see text for details).

[3]Calculated by summing the peak number of fledglings from the two nesting pulses.

[4]Calculated by dividing the number of fledglings by the number of breeding pairs estimated using Method 1.

[5]Calculated by dividing the total number of breeding pairs on the island (Method 1) by the total island area.

[6]Calculated by dividing the total number of breeding pairs on the island (Method 1) by the colony area.

Table 5. Sightings of five color-banded Caspian terns at Pond SF2, Don Edwards San Francisco Bay National Wildlife Refuge, California, 2015.

[Banding information provided by Yasuko Suzuki (Oregon State University, written commun., January 9, 2016). **Terns:** 1, banded as a chick either in 2006 on East Sand Island in the Columbia River estuary or in 2010 on Goose Island in Potholes Reservoir, Washington; 2, banded as a chick in 2005 on Brooks Island in San Francisco Bay, California; 3, banded as an adult in 2008 on Brooks Island in San Francisco Bay, California; 4, identity unknown; 5, banded as a chick in 2007 on East Sand Island in the Columbia River estuary. A question mark (?) denotes a color band or alphanumeric code that could not be determined]

Terns	Date	Time	Weather	Wind	Pond /island	Left leg			Right leg				Comments
						Top	Middle	Bottom	Behavior	Band color	Code color	Alpha numeric code	
1	4/30/2015	1640	Sunny	Moderate	SF2/21	Orange	Light Blue	Metal	Loafing	Yellow	White	??95	–
2	4/30/2015	1520	Sunny	Light	SF2/21	Light Blue	Light Blue	Light Blue	Loafing	Dark Blue	White	–	Left leg bands could be gray or light blue.
3	8/21/2015	1030	Cloudy	Light	SF2	Red	Orange	Metal	Loafing	Yellow	Black	C379	Roosting on mudflat.
4	8/21/2015	1030	Sunny	Light	SF2	Orange	Orange	?	Loafing	Light Blue	White	–	Mudflat.
3	8/28/2015	0921	Cloudy	Light	SF2	Red	Orange	Metal	Loafing	Yellow	Black	C379	Roosting on mudflat, second observation.
5	8/28/2015	0921	Cloudy	Light	SF2	Light Blue	GR	Metal	Loafing	Yellow	Black	C073	Roosting on mudflat.

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