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June 30, 2012

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Re: Annual Report for RLF Grant #2010-0014.

The Critical Role of Islands for Waterbird Breeding and Foraging Habitat in Managed Ponds of the South Bay Salt Pond Restoration Project
and
Impacts of Disturbance on Breeding Waterbirds in Pond SF2

USGS, in cooperation with SFBBO, has initiated a research project to monitor the response of waterbirds to management actions and to evaluate the optimal configuration of salt ponds, island morphometry, and water depth that maximize waterbird foraging, roosting, and nesting success. In addition, at the request of the SBSP Restoration Project Team, this project includes a supplement to investigate the impacts of potential disturbance features at SF2 (such as access trails, viewing platforms, internal pond berms, exterior levees, and highways) on nest survival, clutch size, and nest settling patterns of breeding waterbirds. Two USGS offices will be working on this project: USGS Davis Field Station and USGS San Francisco Bay Estuary Field Station.

Below we document activities from March 31, 2012 to June 30, 2012, by task, and summarize the project's current results. This is the sixth quarterly report and the first annual report for the project.

Task 1 – Assess how the specific structure (morphometry and vegetation) of islands influence nest site selection, nest densities, and reproductive success of Avocets and Terns.

USGS-Davis has completed the first year of waterbird nest monitoring and associated parameters to investigate island use and nest site selection, and we are currently in the middle of the second and final year of waterbird nest monitoring.

In 2011, we found and monitored 1,425 nests, including 543 Avocets, 66 Black-necked Stilts, and 816 Forster's Terns. **Figure 1.1** shows the location of all 12,503 nests monitored by USGS from 2005 to 2011. To date in 2012, we have monitored an additional 735 nests. **Figure 1.2** shows the relative abundance of nests at six important nesting wetlands from 2005 to 2011. Overall, nest survival in 2011 was 41% for Avocets, 50% for Black-necked Stilts, and 53% for Forster's Terns, representing a decline of nest survival from the prior two years for Avocets and Terns (**Figure 1.3**). At the sites we monitored, the average annual nesting period in 2011 was shorter for Stilts (31 days) than Terns (37 days) or Avocets (62 days) (**Figure 1.4**).

We determined the precise location of most of the nests monitored in 2011 using an RTK (Real-time Kinetics) GPS; this is also planned for nests monitored in 2012. In addition, we collected fine resolution topographic data on 29 nesting islands using the RTK GPS. Nest location data will be overlaid on the island topographic data to determine preferred nesting locations. Here we highlight an example of the usefulness of these data using SF2 island number 30 (**Figure 1.5**).

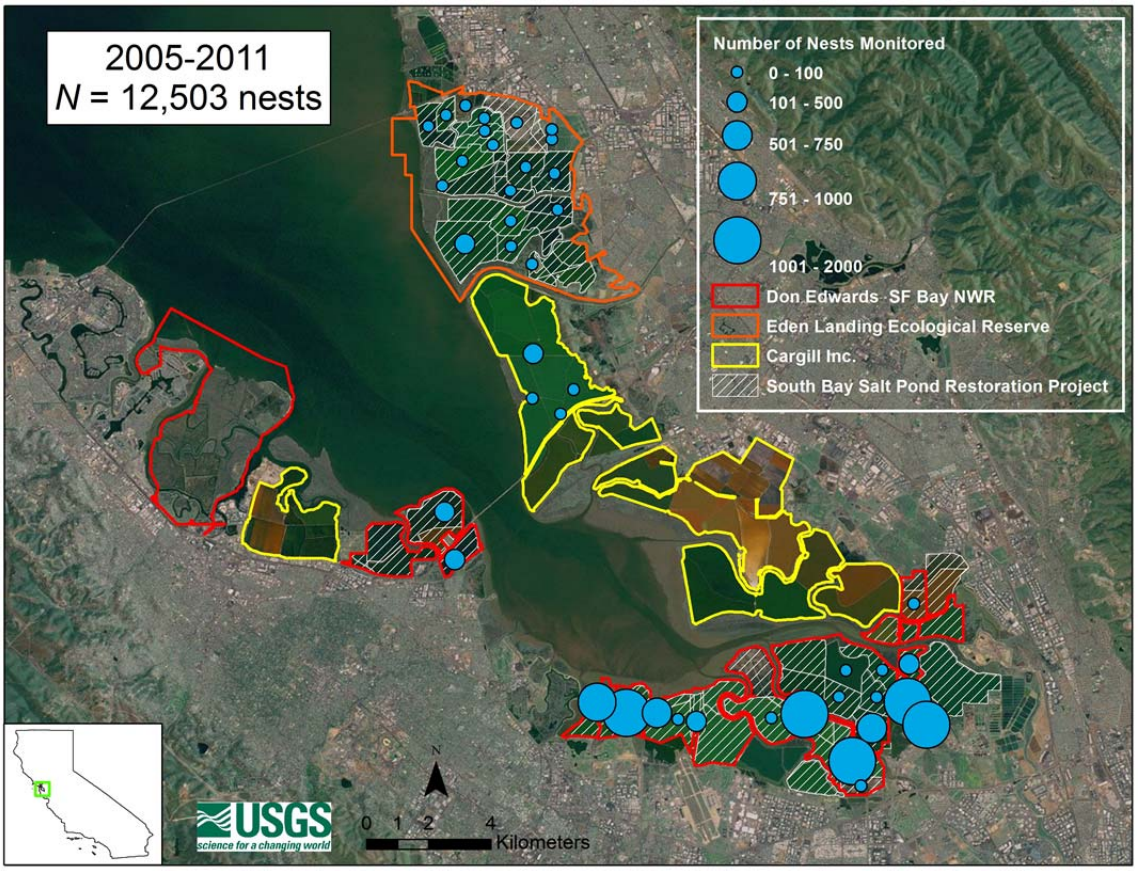


Figure 1.1. Distribution and abundance of nearly 13,000 waterbird nests monitored by USGS (J. Ackerman, Davis Field Station) during 2005 to 2011 in salt ponds and managed wetlands planned for restoration within the South Bay Salt Pond Restoration Project (white hatching), Don Edwards San Francisco Bay National Wildlife Refuge (red), and Eden Landing Ecological Reserve (orange) in the San Francisco Bay, California.

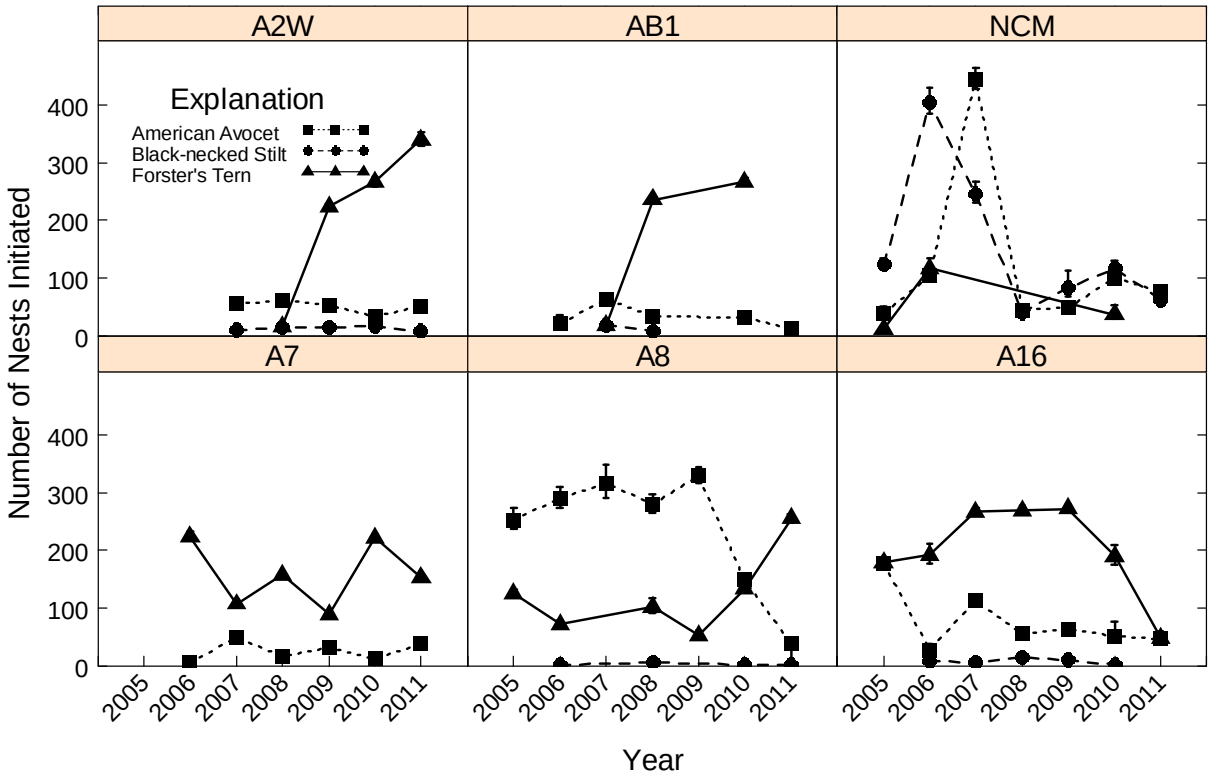


Figure 1.2. Estimated numbers and 95 percent confidence interval of American Avocet, Black-necked Stilt, and Forster's Tern nests initiated at important nesting wetlands in South San Francisco Bay, California from 2005 to 2011. Numbers of nests have been corrected to account for nests that initiated and failed (and thus not observed) between nest checks; this method should be used rather than counting only the number of observed nests.

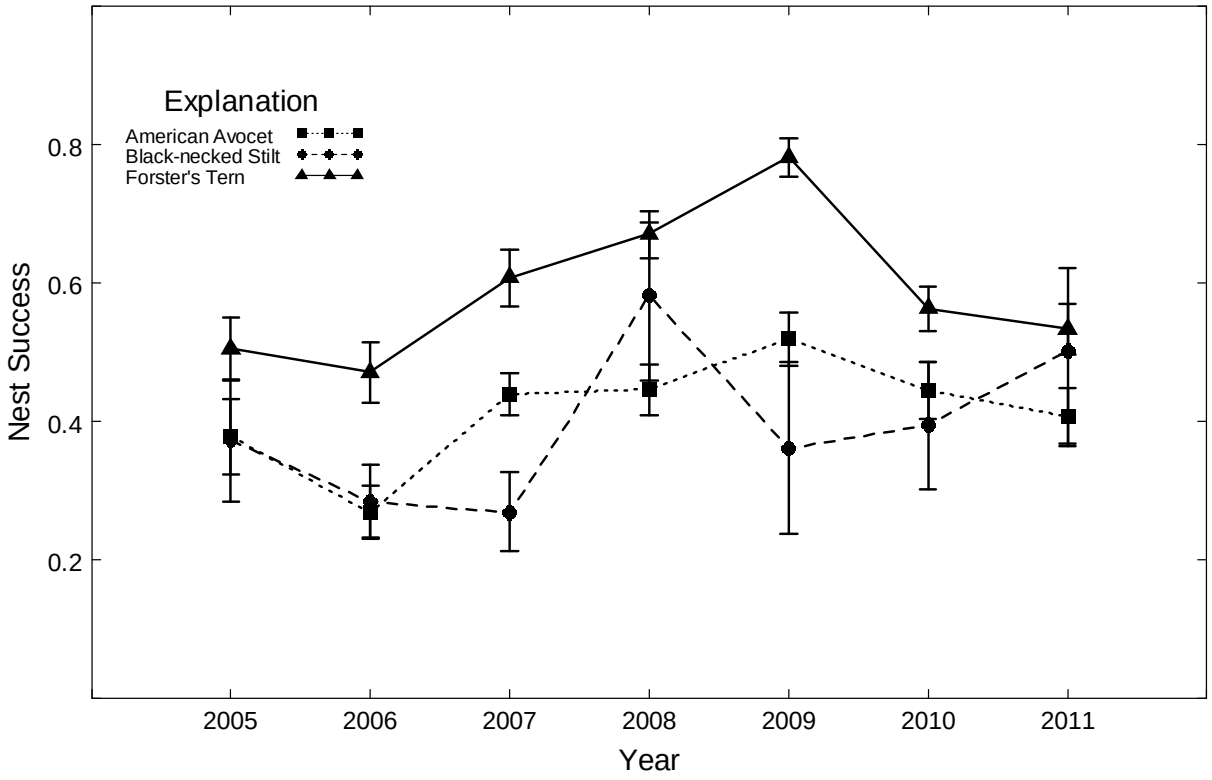


Figure 1.3. Annual nest success and 95 percent confidence interval for Forster's Tern (left panel), American Avocet (middle panel), and Black-necked Stilt (right panel) in South San Francisco Bay, California from 2005 to 2011.

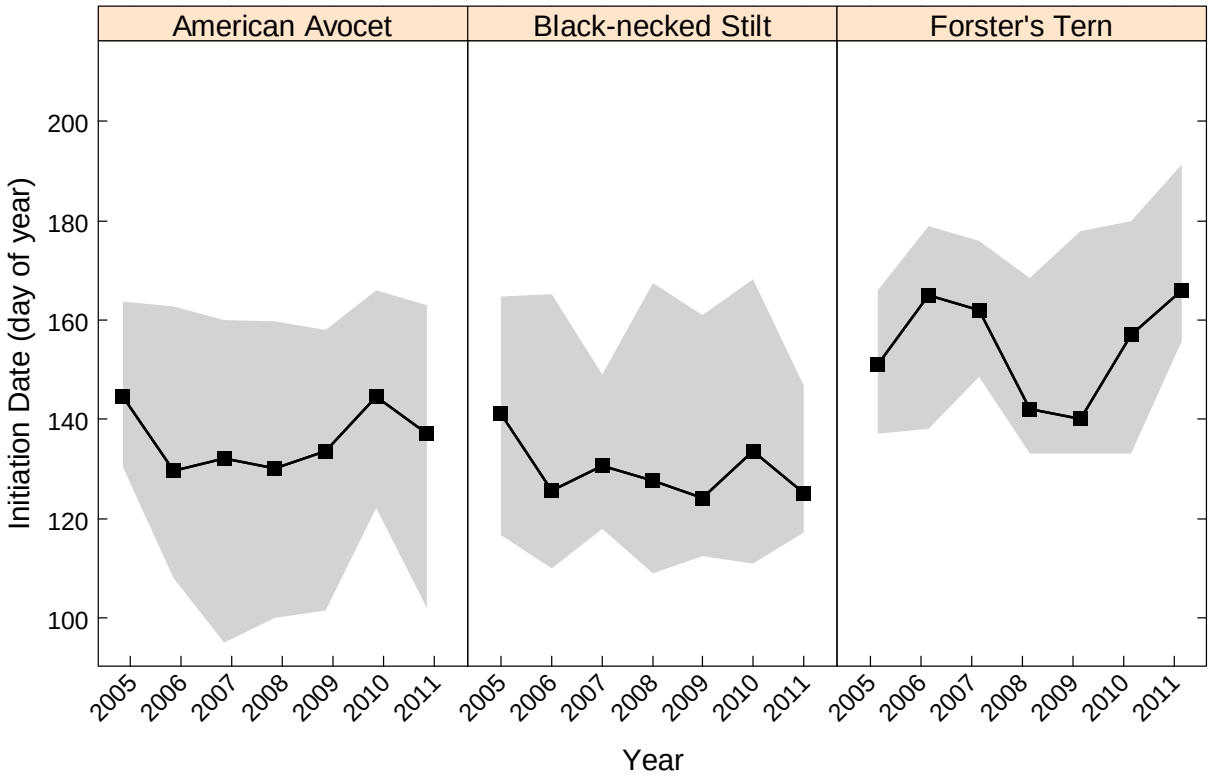


Figure 1.4. Nesting period for American Avocet (left panel), Black-necked Stilt (middle panel), and Forster's Tern (right panel) in South San Francisco Bay, California from 2005 to 2011. Median nest initiation date and the nesting period (defined as the central span where 80 percent of all initiation dates occurred) are displayed in black and gray shading, respectively.

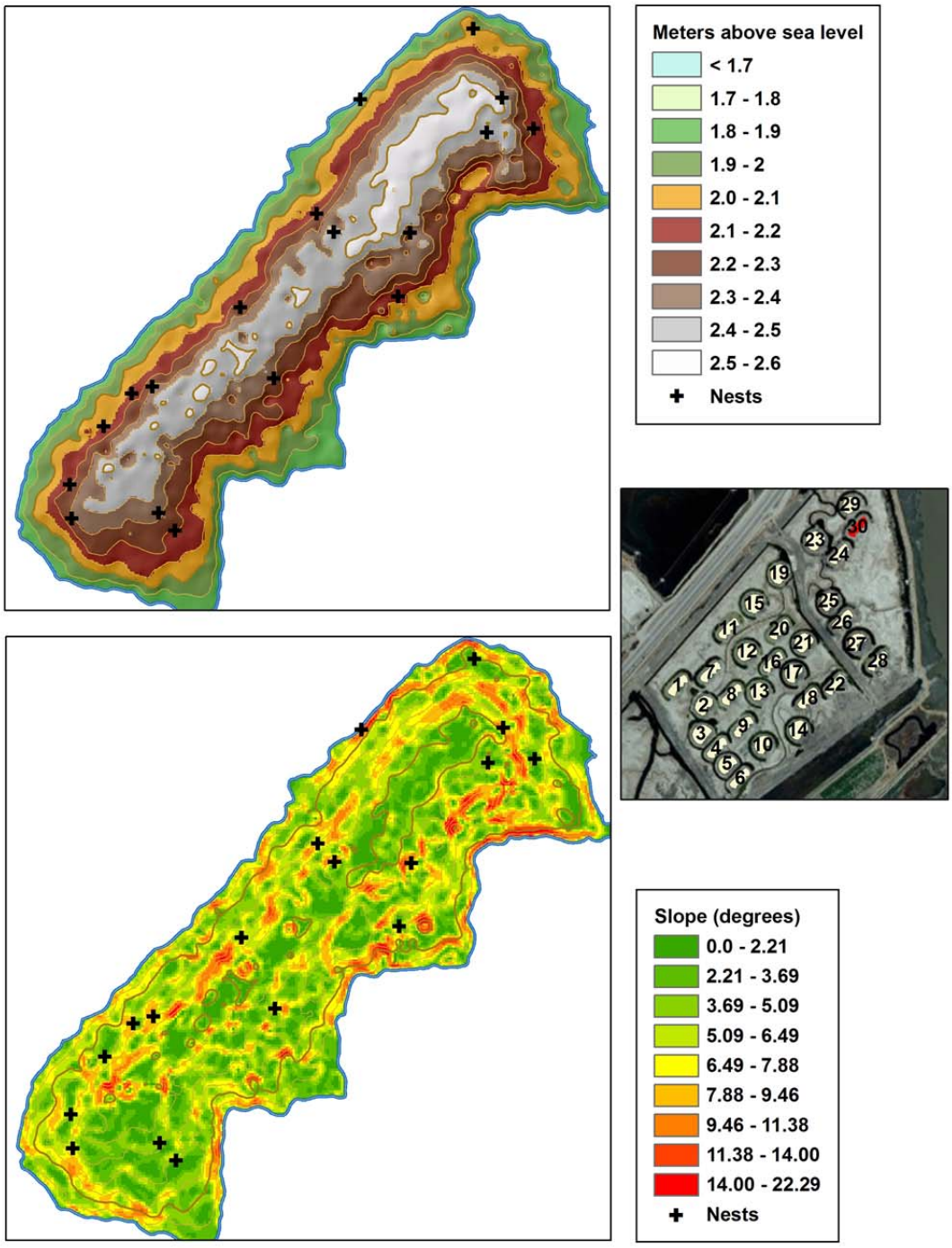


Figure 1.5. Island 30 is the linear version of the newly created islands in SF2 by the South Bay Salt Pond Restoration Project in San Francisco Bay, California. Island 30 is highlighted in red in the inset map of Pond SF2. The top panel shows nest locations (+) overlaid on the topographic elevation relief of the island. The bottom panel shows nest locations (+) in relation to the slope of the island's elevation. Additional metrics will be used to assess selection of nesting locations and characteristics of islands that are preferred by nesting birds.

Task 2 – Evaluate factors influencing the variation in numbers of waterbirds roosting and foraging near the newly created islands in Pond SF2.

USGS-SFBE has completed the second and final season of data collection at SF2 to assess avian use during the wintering and migration seasons. We surveyed the pond weekly from three locations during October 2010 to May 2011 and October 2011 to May 2012. A survey was defined as two counts: the diurnal high and low tide within a 24-hour period. Counts were performed with a Swarovski 60X spotting scope and Eagle Optics Ranger 10 x 40 binoculars. Observers stood 10 to 15 feet above the pond in order to see the water in between the islands. This height was achieved by using the observational platforms that USFWS installed at the pond or a truck-mounted platform. All birds observed within the pond were recorded by species within 50-m grids and by specific constructed islands labeled with numbered signs. We also recorded bird behavior (foraging or roosting) and habitat type (levee, water, pond bottom, or man-made structure). Parameters expected to explain avian use, including water quality, predator presence, water depths, island elevations, and proximity to edges will be assessed as predictors of avian use of the managed pond at SF2.

We found minimal use of islands by large and small shorebirds across units 1 and 2 (**Figure 2.1**) but substantial use of pond bottoms by foraging shorebirds (**Table 2.1**). We coordinated with the USFWS to systematically alter the sequence of water management of pond SF2 in two-week intervals: a. the north water structure open for inflow only keeping the pond bottom exposure to a minimum, and b. the north water structure open for inflow and outflow causing large amounts of pond bottom exposure during high tide. Western sandpiper (as well as other shorebird) abundances increased dramatically when the north water structure allowed inflow and outflow of tidal waters (**Figure 2.2**).

Table 2.1. Mean number of birds at in Units 1, 2, and 4 of SF2 by tide and season from Oct 2010-Dec 2011.

	High Tide			Low Tide		
	Fall	Winter	Spring	Fall	Winter	Spring
Dabbler	362	504	180	333	375	199
Diver	46	266	74	42	264	138
Eared Grebe	1	3	1	1	3	0
Fish Eater	105	9	25	62	9	19
Goose	4	0	2	0	0	1
Gull	51	16	5	27	10	0
Herons	69	32	25	56	23	5
Medium Shorebird	1151	619	174	253	187	43
Small Shorebird	1217	482	4180	279	32	130
Tern	3	2	30	1	4	15
Total	3010	1932	4696	1056	906	551

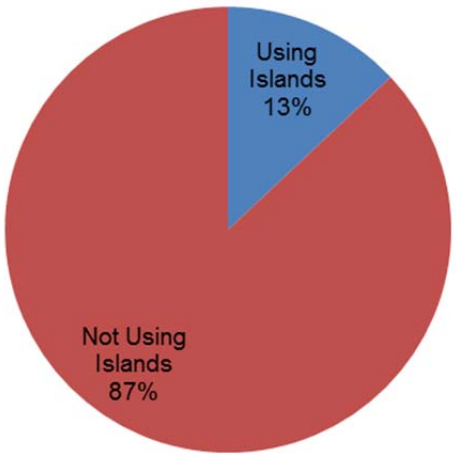


Figure 2.1. Mean shorebird abundance observed on SF2 islands and elsewhere in the pond units 1 and 2 during high tide from 41 counts between October 2010 - December 2011. A total of 97,000 shorebirds were counted.

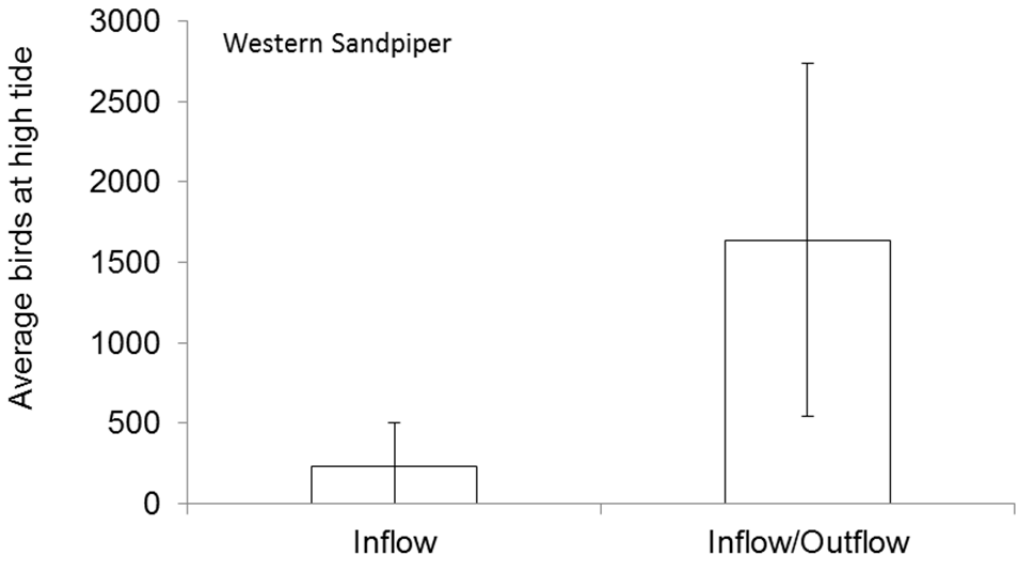


Figure 2.2. Mean number of Western Sandpipers observed on the pond at high tide by two different water management regimes. This is data from October 2011-December 2011. Bars are 95% confidence intervals. There were 5 counts conducted under inflow only and 6 counts under inflow/outflow.

Task 3 – Using salt pond complex-wide surveys, evaluate whether waterbird diversity and abundance at a broader scale are influenced by island habitat and water depth within salt ponds.

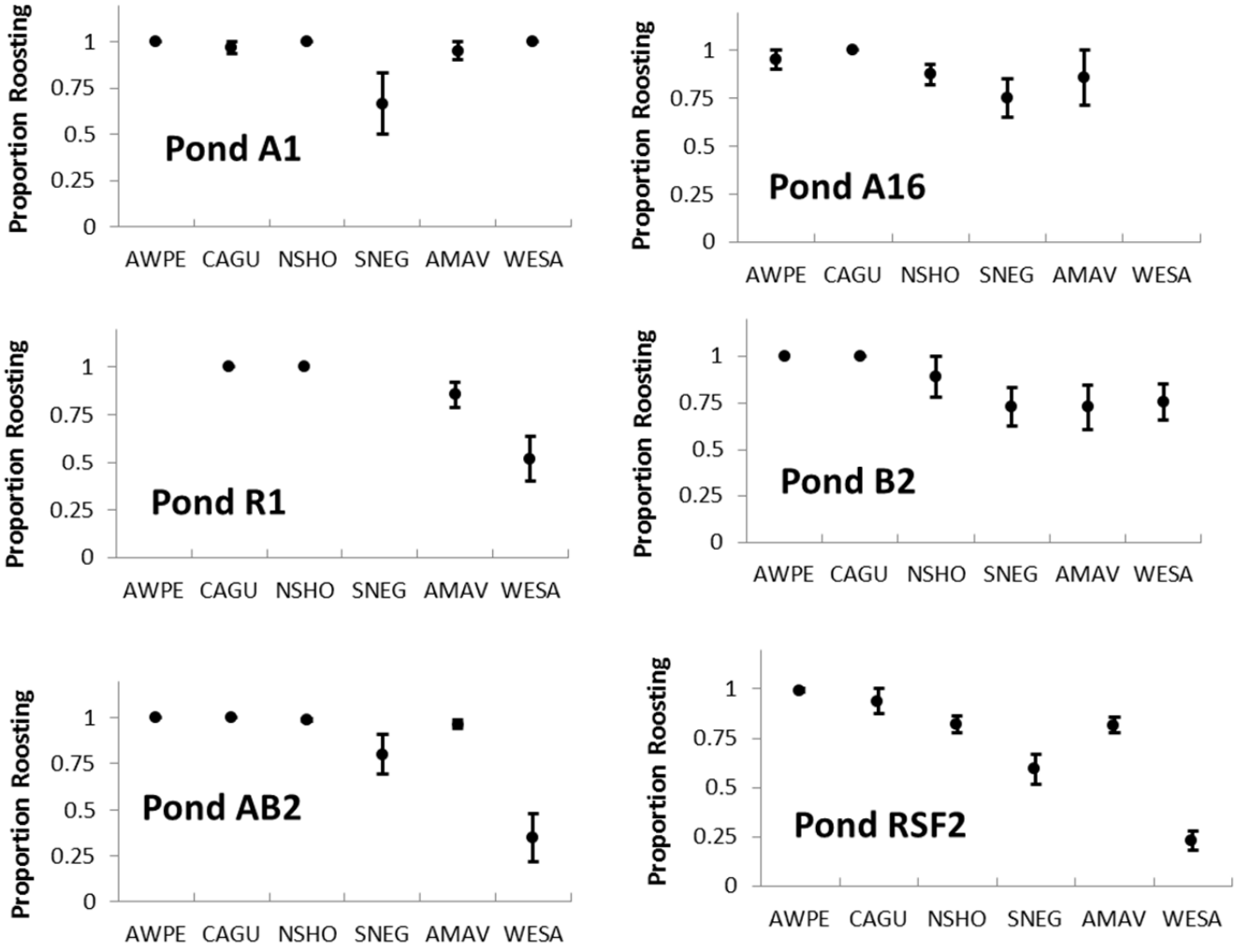
USGS-SFBE has completed its final two years of sampling to evaluate waterbird use of Islands during winter and migration seasons across South Bay Salt Pond Restoration Project ponds. We recorded foraging and roosting behavior by species on over 90 constructed Islands within 25 ponds including 30 Islands at SF2 from October 2010 – May 2011 and October 2011 – February 2012 (**Table 3.1**). We evaluated the behavior of six species in six ponds during the non-breeding season, and found that the majority of birds use islands to roost rather than forage, particularly American-white Pelican, Northern Shoveler, and California Gull (**Figure 3.1**). Snowy Egret, American Avocet, and Western Sandpiper had slightly lower proportions of roosting birds (higher proportions of foraging birds) and more variation in behavior across ponds. Future work will include evaluating avian use of islands in relation to island characteristics.

In addition to island-scale surveys, we continued monthly salt pond surveys in 54 ponds within five pond complexes encompassing restoration ponds (Alviso, Eden Landing, and Ravenswood complexes). During the surveys, we recorded the number of birds, species and behaviors. We also recorded the birds' locations within the ponds, using a 250m X 250m grid system. We conducted an initial assessment of the proportion of birds that use islands in relation to whole-pond abundances during Winter 2011-2012. We found that waterbird use of islands during the non-breeding season was relatively minimal, with bird use of islands serving less than 10% of overall Winter abundances in the majority of ponds for the most abundant guilds: Dabbling ducks, Piscivorous birds, Gulls, Medium Shorebirds and Small Shorebirds (**Figures 3.2- 3.6**). However, Islands did support a relatively high proportion of certain guilds in particular ponds, such as >50% of Piscivorous birds in pond A16, Gulls in Pond A1, Medium Shorebirds in Ponds E10, SF2 Unit 1, and A2W, and Small Shorebirds in Ponds E2 and A1, most of which otherwise maintained relatively low abundances (**Figures 3.2-3.6**).

Table 3.1. Total detections of most common species roosting or foraging on over 90 islands including pond SF2 sampled across 3 complexes during the non-breeding seasons (October – May) of 2010 – 2011. Note that data proofing for recently collected data is not complete and thus data are subject to change.

Species	Guild	Alviso	Eden Landing	Ravenswood	Total
Northern Shoveler	Dabbler	6693	153	593	7439
Western Sandpiper	Small shorebird	568	1870	4553	6991
American Avocet	Medium shorebird	3693	88	465	4246
Willet	Medium shorebird	682	2003	776	3461
California Gull	Gull	2825	34	193	3052
American White Pelican	Piscivore	2057	33	240	2330
Northern Pintail	Dabbler	929	47	1039	2015
Dunlin	Small shorebird	282	702	1010	1994
Black-bellied Plover	Medium shorebird	197	1183	287	1667
Double-crested Cormorant	Piscivore	867	164	464	1495
Marbled Godwit	Medium shorebird	808	162	258	1228
Least Sandpiper	Small shorebird	353	332	478	1163
Dowitcher spp.	Small shorebird	827	42	189	1058
Ring-billed Gull	Gull	700	7	155	862
Forster's Tern	Tern	757	26	37	820
Herring Gull	Gull	571	8	6	585
American Coot	Dabbler	363	19	41	423
Black-necked Stilt	Medium shorebird	335	1	3	339
American Green-winged Teal	Dabbler	145	4	178	327
Snowy Egret	Herons and Egrets	101	42	176	319
Western Gull	Gull	276	19	11	306
American Wigeon	Dabbler	66	5	161	232
Mallard	Dabbler	125	15	12	152
Brown Pelican	Piscivore	50	8	11	69
Gadwall	Dabbler	51	0	14	65
Canada Goose	Goose	61	1	0	62
Great Egret	Herons and Egrets	15	8	31	54
Elegant Tern	Tern	53	0	0	53

Figure 3.1. Proportion of birds roosting (± SE) versus total observed foraging or roosting on islands for 6 species in 6 ponds. (AWPE – American-white Pelican, CAGU – California Gull, NSHO – Northern Shoveler, SNEG – Snowy Egret, AMAV – American Avocet, WESA – Western Sandpiper). A low proportion roosting indicates a higher proportion foraging.



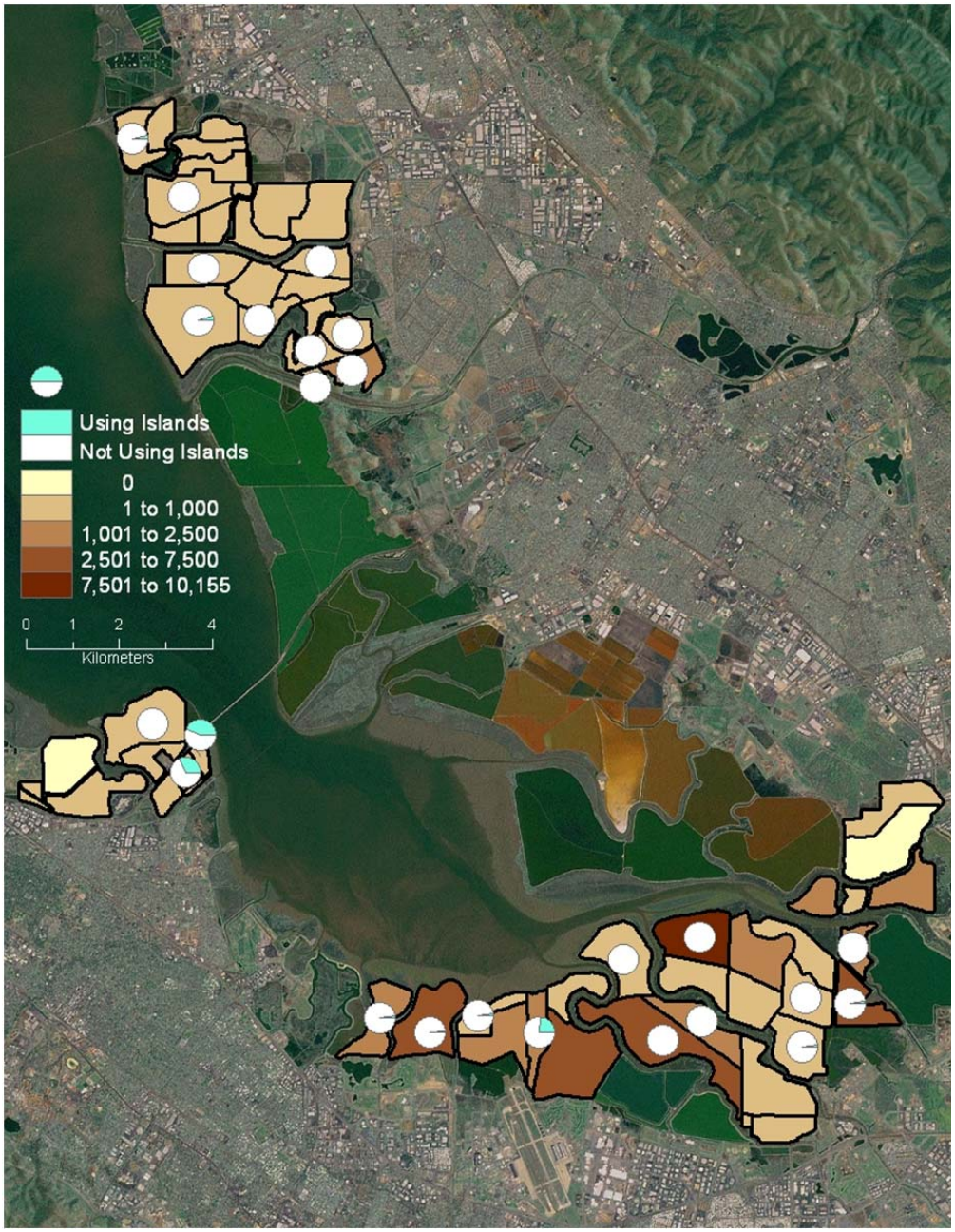


Figure 3.2. Relative abundance of Dabbling Ducks in Winter (December-February) during 2010-2012 across all ponds in Eden Landing, Alviso, and Ravenswood Complexes with pie charts representing the proportion of birds detected upon islands in relation to the pond total (pies only pertain to ponds that contain constructed Islands).

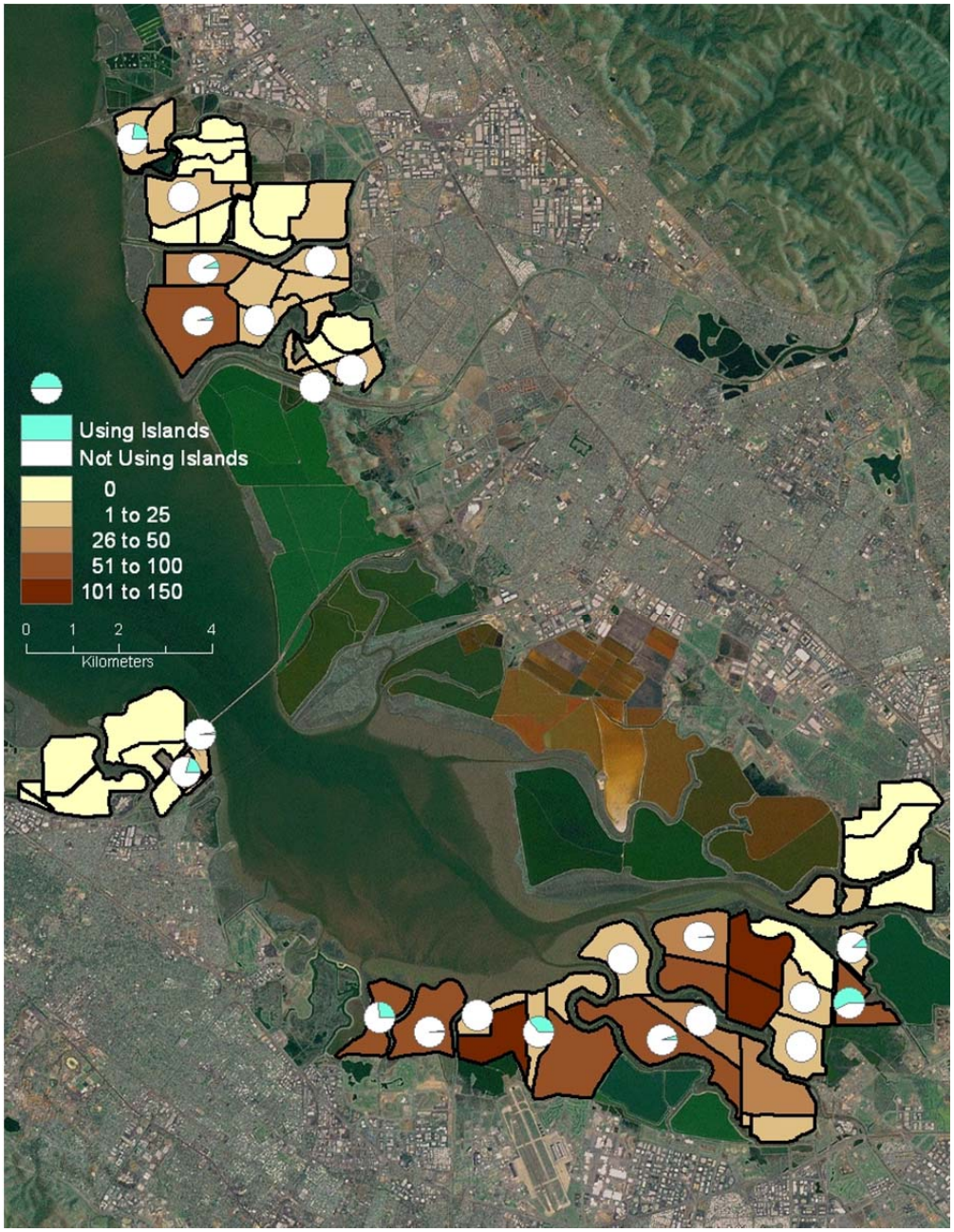


Figure 3.3. Relative abundance of Piscivorous birds in Winter (December-February) during 2010-2012 across all ponds in Eden Landing, Alviso, and Ravenswood Complexes with pie charts representing the proportion of birds detected upon islands in relation to the pond total (pies only pertain to ponds that contain constructed Islands; except for ponds R1, E4C and E5C that contained zero birds).

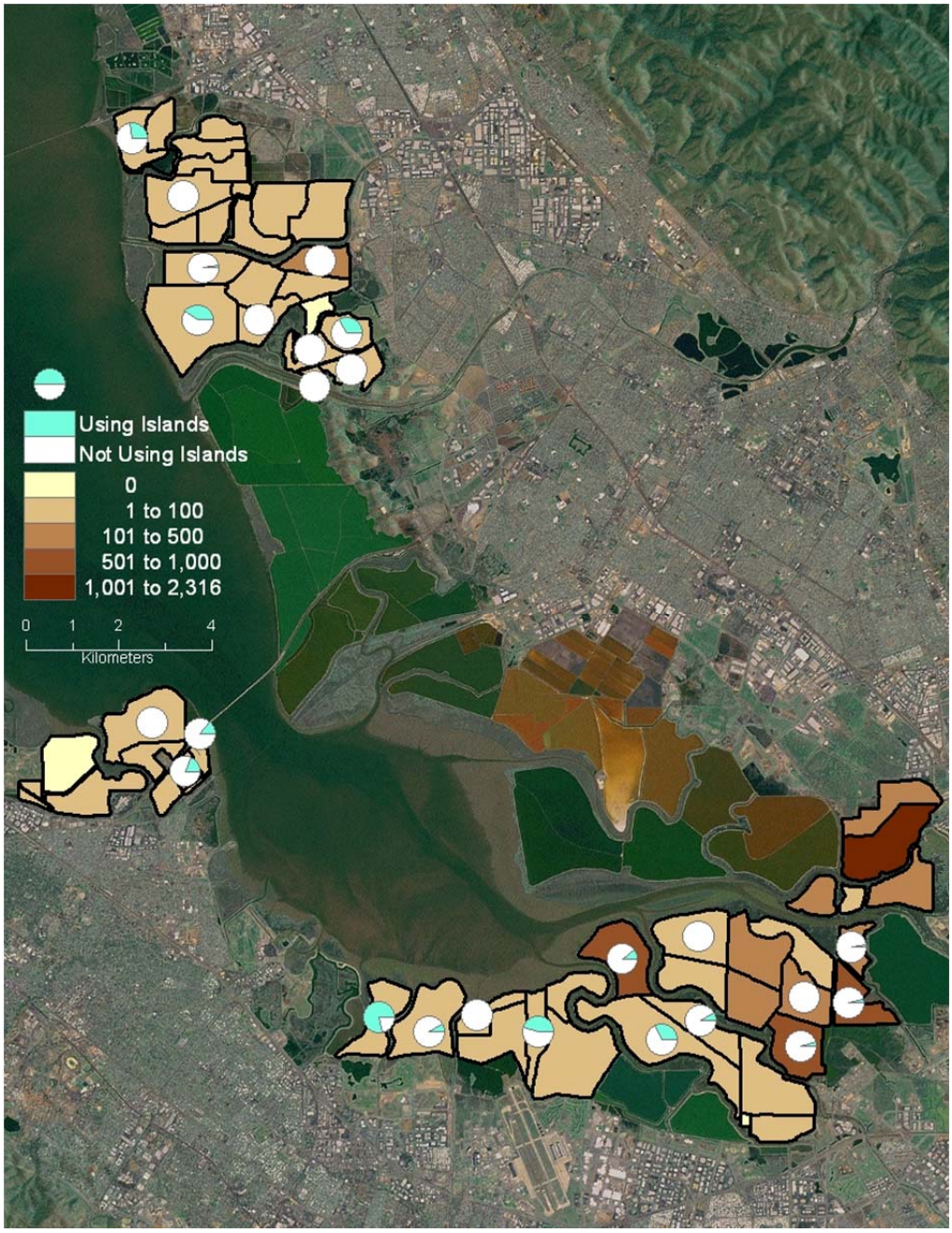


Figure 3.4. Relative abundance of Gulls in Winter (December-February) during 2010-2012 across all ponds in Eden Landing, Alviso, and Ravenswood Complexes with pie charts representing the proportion of birds detected upon islands in relation to the pond total (pies only pertain to ponds that contain constructed Islands).

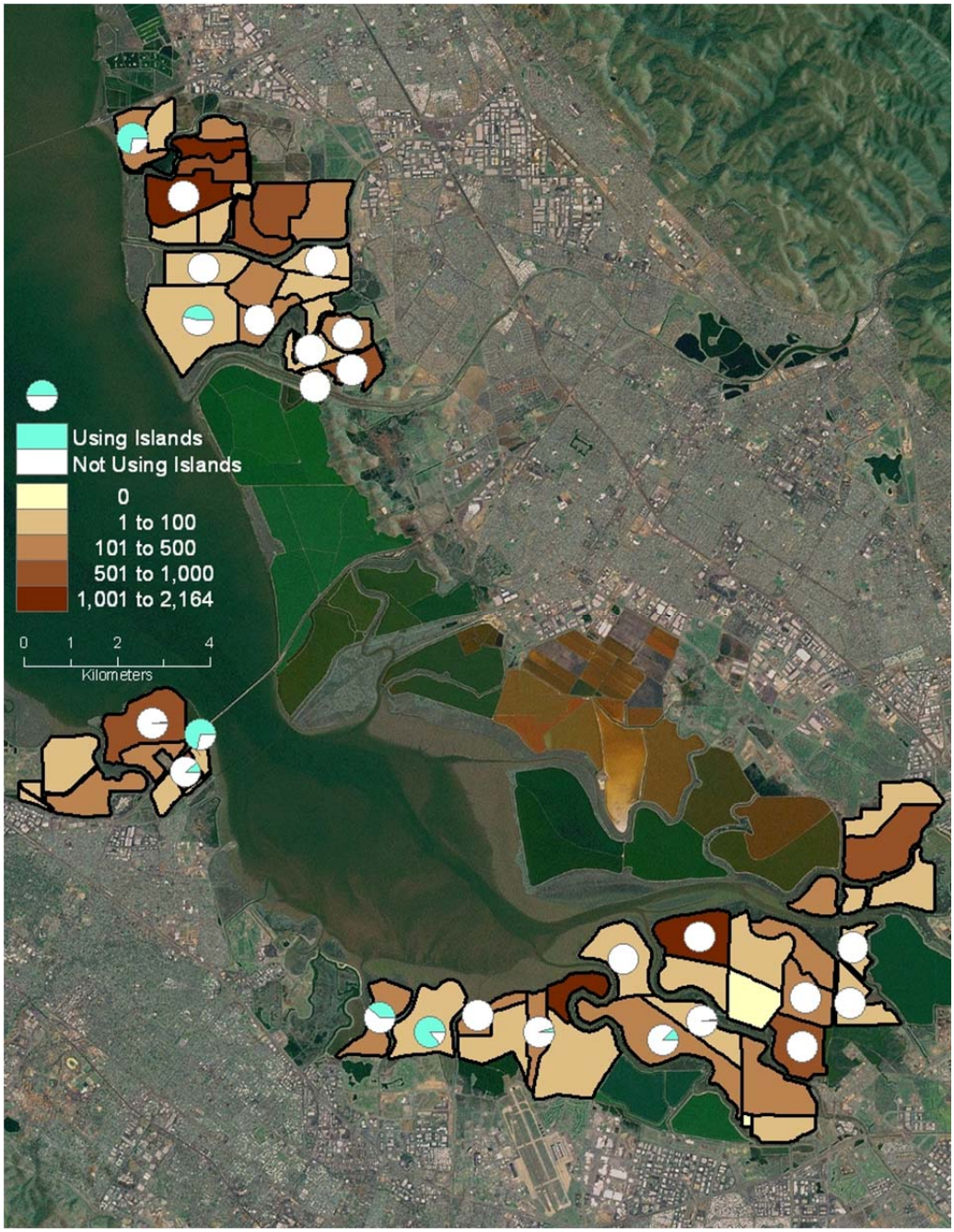


Figure 3.5. Relative abundance of Medium Shorebirds in Winter (December-February) during 2010-2012 across all ponds in Eden Landing, Alviso, and Ravenswood Complexes with pie charts representing the proportion of birds detected upon islands in relation to the pond total (pies only pertain to ponds that contain constructed Islands).

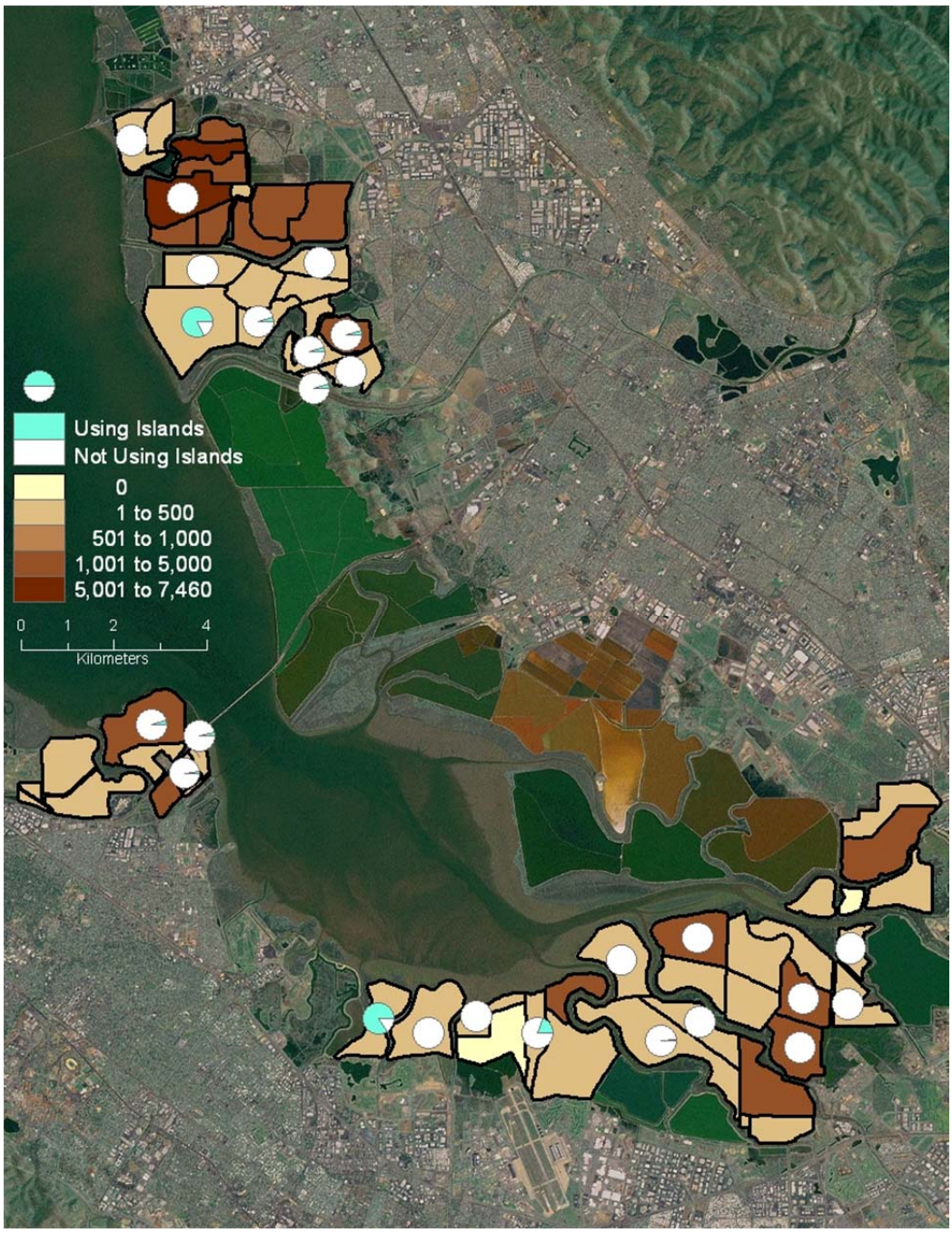


Figure 3.6. Relative abundance of Small Shorebirds in Winter (December-February) during 2010-2012 across all ponds in Eden Landing, Alviso, and Ravenswood Complexes with pie charts representing the proportion of birds detected upon islands in relation to the pond total (pies only pertain to ponds that contain constructed Islands).

Task 4 – Supplemental Proposal: Increase the field effort to monitor nests in SF2 and model the effects of potential disturbance features (viewing platforms, trails, berms, levees, highways, etc.) on nest survival, clutch size and nest settling patterns of breeding waterbirds.

USGS-Davis has completed the first year of waterbird nest monitoring and RTKing nest locations at SF2, and we are currently in the middle of the second and final year of waterbird nest monitoring.

In 2011, we found and monitored 193 nests within Pond SF2, including 187 Avocets and 2 Black-necked Stilts. Of these, 80% of nests were on the newly created nesting islands (n=154), 6% were on internal levees (n=12), and 14% (n=27) were in cell 3's dry panne area. Twenty-eight of the 30 islands in SF2 had at least one nesting attempt. Of those nests on islands, 41% (n=63) were on round islands and 59% (n=91) were on the linear islands.

In 2012 to date, we have currently found and monitored 68 nests in Pond SF2, including 62 Avocets and 6 Black-necked Stilts. However, the nesting attempts seem to have slowed to a stop this year as of June 2012.

We determined the precise location of each nest in SF2 using an RTK GPS in 2011; this is also planned for 2012 nests. This data will be used in future analyses to examine the influence of disturbance features on nesting patterns.

Task 5 – Project management and report writing.
USGS wrote and submitted the June 30, 2012 annual report.