South Bay Salt Pond Restoration Project
Restoring the Wild Heart of the South Bay

Restoration Funding Application Cover Sheet

APPLICANT INFORMATION

Name of Organization(s) Requesting Funding: **US Geological Survey and San Francisco Bay Bird Observatory**

Mailing Address: **USGS UC-Davis Field Station, University of California Tercero Trailer E, 1 Shields Ave. Davis CA 95616**

Federal Employee Identification Number: **53-0196958**

Principal Investigator: **Dr. Josh Ackerman**

Title: **Research Wildlife Biologist** Institution: **US Geological Survey**

Telephone: **530-752-0485** Email address: **jackerman@usgs.gov**

Grant Administrator: **Cindy Lu, Agreements Management Specialist**

Telephone: **(916) 278-9480** Email address: **Clu@usgs.gov**

PROJECT INFORMATION

RFP Study Topic # **3**

Project Title: **The Critical Role of Islands for Waterbird Breeding and Foraging in Managed Ponds of the South Bay Salt Pond Restoration Project**

Funding Request per year **$116,528 and $130,272** Number of years: **2**

Confirmed in-kind or matching contributions: **$ 180,006**

Source of in-kind or matching contributions: **USGS, SFBBO, and USFWS**

Purpose and Objectives: **The objectives of this proposal are to evaluate the benefit of islands to nesting and foraging waterbirds in the South Bay salt ponds, and identify the features of islands that are most beneficial for providing nesting and foraging habitat.**

Proposed starting date: **Apr. 2009 or 2010** Estimated completion date: **Apr. 2011 or 2012**

Signature : _____ Date: 12/4/08
Principal Investigator

Signature : _____ Date: 12/4/08
Grant Administrator

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

Josh Ackerman and Collin Eagles-Smith
USGS, Davis Field Station, University of California, Davis, CA 95616

John Takekawa and Nicole Athearn
USGS, San Francisco Bay Estuary Field Station, 505 Azuar Drive, Vallejo, CA 94592

Jill Bluso-Demers
San Francisco Bay Bird Observatory, 524 Valley Way, Milpitas, CA 95035

ABSTRACT:
The South Bay Salt Pond (SBSP) Restoration Project plans to restore 50-90% of the salt ponds to tidal marsh to reverse the loss (>80%) of tidal marsh within the San Francisco Bay Estuary. While the restored tidal marsh habitats will benefit many animals, a goal of the SBSP Restoration Project is to maintain current migratory and breeding populations of birds that utilize the salt pond habitats. Thus, the SBSP Restoration Project is implementing plans to reconfigure and enhance existing salt ponds (beginning with Ponds A16 and SF2) by increasing foraging opportunities and the number of nesting islands. Supporting similar numbers of foraging and breeding waterbirds with fewer salt ponds will require a comprehensive understanding of waterbird habitat needs, especially in regards to island creation. We propose to monitor the response of waterbirds to the management actions at A16 and SF2, as well as conduct detailed studies throughout the entire SBSP Restoration Project area at three spatial scales to determine the optimal configuration of salt ponds, island morphometry (shape, size, topography), vegetation, and water depth adjacent to islands to maximize waterbird foraging opportunities and nesting success. The outcome of this study will provide scientific support for adaptive management actions to maintain waterbird populations as future phases of the SBSP Restoration Project are implemented.

BACKGROUND AND JUSTIFICATION:
San Francisco Bay is the largest estuary on the west coast of North America, but it has lost nearly 80% of its tidal marshes and 40% of its tidal flats over the past two centuries due to urban development, agriculture, and salt production (Goals Project 1999). In particular, about 14,000 ha (35,000 acres) of artificial salt evaporation ponds were constructed within the former baylands (Goals Project 1999). Recently, more than 10,000 ha (25,000 acres) of salt ponds have been transferred to government ownership, the majority of which are now a part of the USFWS Don Edwards San Francisco Bay National Wildlife Refuge (hereafter DESFBNWR). The South Bay Salt Pond (SBSP) Restoration Project is beginning to implement a large-scale plan to convert 50% to 90% of these salt ponds into tidal and managed marsh habitats within the next 50 years (Goals Project 1999, Steere and Schaefer 2001, Siegel and Bachand 2002, Life Science 2003).

The San Francisco Bay is a site of hemispheric importance to shorebirds and annually supports over one million waterbirds (Page et al. 1999, Stenzel et al. 2002), and shorebird abundances during peak spring migration have exceeded 200,000 shorebirds in a single salt pond (Stenzel

and Page 1988). While the restoration of former salt ponds to tidal marsh will increase habitat for many animals, including the endangered California Clapper Rail (*Rallus longirostris obsoletus*) and Salt Marsh Harvest Mouse (*Reithrodontomys raviventris raviventris*), it also will reduce the overall pond habitats available for migratory and breeding waterbirds. A goal of the SBSP Restoration Project is to maintain current migratory and breeding populations of waterbirds. Under Phase 1 restoration actions, the SBSP Restoration Project plans to reconfigure and enhance two existing salt ponds (Ponds A16 and SF2) by designing islands to increase roosting and foraging opportunities and provide waterbird nesting habitat (Trulio et al. 2007).

Salt ponds provide critical habitat for both wintering and breeding waterbirds. For example, radio-marked Forster's Terns (*Sterna forsteri;* hereafter Terns) strongly selected salt ponds, especially low salinity salt ponds, as foraging habitat during both the pre-breeding (Ackerman et al. 2008) and breeding seasons (Bluso-Demers et al., submitted; Ackerman et al., submitted). Similarly, Western Sandpipers (*Calidris mauri*) selected salt ponds and avoided tidal marsh habitats during the winter (Warnock and Takekawa 1995, Warnock et al. 2002). American Avocets (*Recurvirostra americana*; hereafter Avocets) and Black-necked Stilts (*Himantopus mexicanus*) used salt pond habitats more than any other habitat in the estuary (Ackerman et al. 2007a, Hickey et al. 2007). Dry areas of salt ponds also provide foraging and nesting habitat for the endangered Western Snowy Plover (*Charadrius alexandrinus nivosus*; Robinson et al. 2007).

Not only do ponds provide preferred foraging habitat, but islands and levees are used extensively by roosting waterbirds (Goals Project 1999, Takekawa et al. 2000, Colwell et al. 2003, Conklin and Colwell 2007). Western Sandpipers selected salt pond levees as roosting sites, especially during high tides, throughout the winter (Warnock and Takekawa 1995). Additionally, salt pond islands and levees play a critical role for fledging chicks. For instance, postfledging Terns were located closer to salt pond levees than would be predicted by chance, indicating that they foraged near levees and used levees as roosting sites as they departed their natal colony (Ackerman et al., submitted).

In addition to providing roosting and foraging habitats, salt ponds support nesting habitat for locally breeding waterbirds, especially Terns and Avocets. Approximately 30% of the breeding population of Forster's Terns on the Pacific coast nests within the San Francisco Bay (McNicholl et al. 2001, Strong et al. 2004), and the islands within salt ponds currently provide nesting habitat for 80% of those Terns (Strong et al. 2004). Thus, the project area currently accounts for about one quarter of the nesting habitat on the Pacific coast. Similarly, the estuary is the largest breeding area for Avocets along the Pacific coast (Stenzel et al. 2002, Rintoul et al. 2003), and 38% of breeding Avocets in the South Bay nest on islands within salt ponds (Ackerman et al. 2006).

As the largest tidal wetland restoration project on the West Coast of the United States proceeds, there are several key uncertainties about how to enhance and manage existing salt ponds to maximize waterbird foraging and nesting opportunities as salt pond habitats are reduced. Pond islands and levees are expected to continue to support high densities of roosting birds, and the experimental addition of pond islands is expected to enhance this effect (Trulio et al. 2007). The proposed project will provide an important model for implementation of the SBSP Restoration Project. In this proposal, we address these key uncertainties to provide robust scientific data to

help direct future management actions to maximize waterbird habitat in the remaining salt ponds.

STUDY OBJECTIVES:
Whereas our broad objectives are to quantify the benefits that islands within salt ponds will provide to waterbirds, our more specific objectives are as follows:

1. Assess how the specific structure (morphometry, vegetation, proximity to neighboring islands and levees) of islands influence nest site selection, nest densities, nest success, and hatching success of Avocets and Terns.
2. Evaluate how island morphometry and surrounding water depths influence the diversity and abundance of foraging and roosting waterbirds compared to random open water sites.
3. Using salt pond complex-wide surveys, determine whether waterbird diversity and abundance at a broader scale are higher (a) near islands, levees, or open water habitats and (b) in ponds with islands versus ponds without islands.

The integrated outcome of these objectives will be a more quantitative understanding of the benefits of salt pond islands to waterbirds at three distinct spatial scales. At the smallest spatial scale (*individual scale*), we will determine how islands characteristics influence waterbird reproduction. At the intermediate scale (*island scale*), we will assess the value of salt pond islands as foraging and loafing habitat. Finally, at the largest spatial scale (*pond scale*), we will evaluate the influence of island presence and number on waterbird abundance and diversity. Ultimately, these data can be used to guide the SBSP Restoration Project in management of ponds to maximize the benefits to nesting, roosting, and foraging waterbirds at multiple spatial scales.

STUDY AREA:
The primary intensive study area will be within the DESFBNWR (Figure 1). Whereas the waterbird surveys at the largest spatial scale will be conducted throughout the South Bay salt ponds, our more intensive breeding and foraging studies will be focused on three types of ponds. First, we will study two salt ponds that are currently being, or are planned to be, enhanced to increase nesting and foraging value (Ponds A16 and SF2). Second, in conjunction with staff of the DESFBNWR, we will lower water levels in a deep-water pond with appropriate bathymetric relief, such as Pond A12, to create nesting islands (Figure 2). In contrast to the physical construction of islands occurring in Ponds A16 and SF2, creating islands by lowering water levels is an inexpensive and rapid way of creating waterbird nesting habitat in less than a month's time, and minimizes disturbance to nesting birds. Together with DESFBNWR staff, we used this approach of drawing down water levels in A12 in a pilot study during the 2008 nesting season, and we successfully created more than a dozen islands of varying size and shape. In response to this management action, we documented more than 400 waterbird nests in A12, a site that had no prior nesting attempts because of previous water inundation (Figure 2). This habitat manipulation will compliment our focused studies in Ponds A16 and SF2 by increasing our sample size of waterbird response to enhanced pond habitats. Third, we will conduct breeding and foraging surveys around an additional 3 reference islands (in addition to islands in A16, SF2, and A12) that presently exist in salt ponds to determine the island characteristics that are associated with the highest nest densities, nest success, roosting densities, and nearby foraging densities. These studies will be conducted at existing islands within ponds such as A1,

AB1, AB2, A2W, A17, R1, and N4. This approach will increase the sample size of available islands to study those island characteristics that benefit waterbirds.

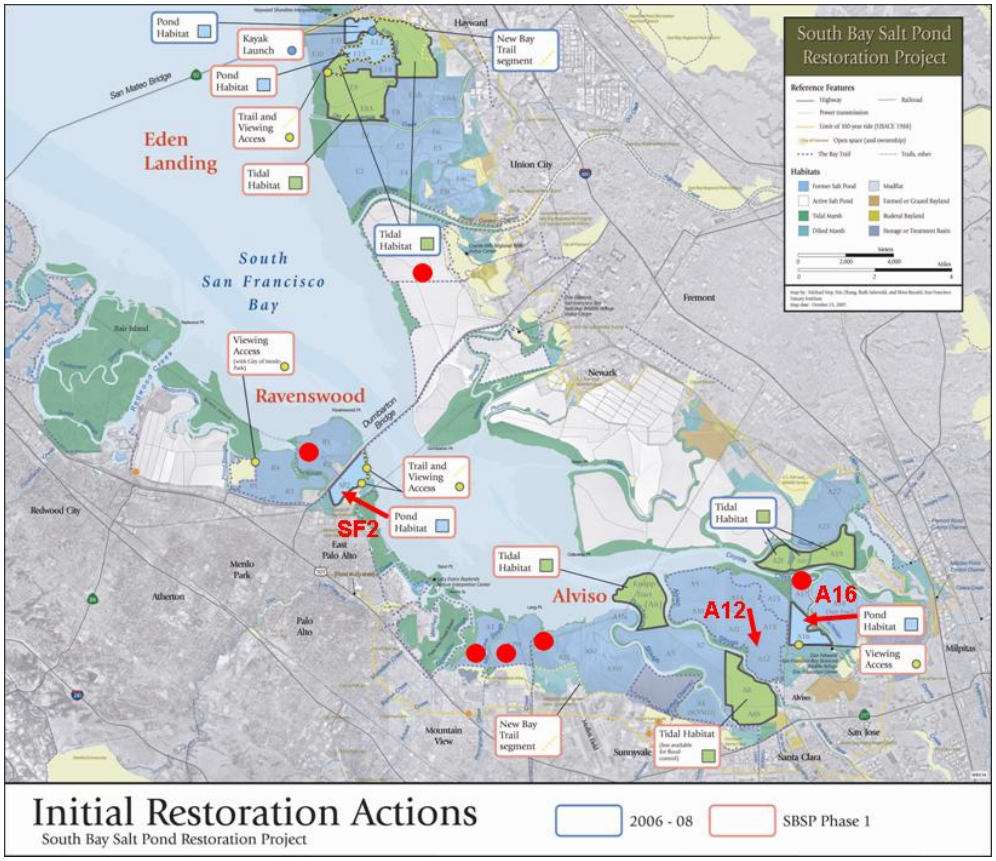

Figure 1. Phase 1 map of the South Bay Salt Pond Restoration Project (http://www.southbayrestoration.org/). Red arrows denote salt ponds that will be enhanced for nesting and foraging value to waterbirds (A16, SF2, and A12) and red dots indicate potential islands to be surveyed to determine island characteristics that are most beneficial to nesting, roosting, and foraging birds.

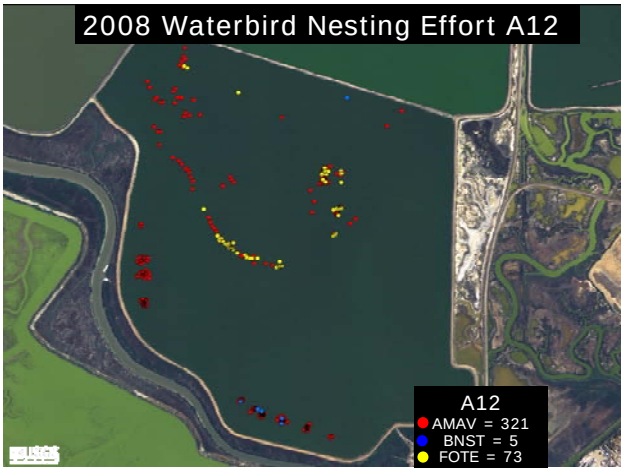

Figure 2. Distribution of Avocet (red), Stilt (blue), and Forster's Tern (yellow) nests in Pond A12 following water level draw-down to expose submerged islands during the 2008 nesting season.

APPROACH:
We propose to evaluate and quantify the benefits of salt pond islands to waterbirds by examining waterbird use of islands at three distinct spatial scales. First, at the smallest spatial scale (*individual scale*), we will examine nesting densities, nest site selection, and nest success of waterbirds breeding on salt pond islands. Second, we will assess the value of salt pond islands (*island scale*) as foraging and loafing habitat by conducting intensive waterbird surveys focused on islands. Within each survey we will conduct behavioral observations of waterbirds using islands in comparison to waterbirds using random salt pond habitats that are not centered around an island. Finally, at the largest spatial scale (*pond scale*), we will evaluate whether waterbird densities are more concentrated (a) in close proximity to salt pond islands and levees compared to open-water sites and (b) in salt ponds where islands are present, as opposed to island-free ponds. We will document waterbird foraging and loafing distributions and abundance throughout the South Bay Salt Pond Complex in relation to salt pond islands and levees by conducting monthly waterbird surveys in the Alviso, Newark, Ravenswood, and Moffett salt pond complexes (the field surveys at the largest scale are currently funded and data will be provided as a cost share). Our research approach is focused on the main factors that can be readily manipulated during restoration or through water management, including: 1) island morphometry (size, shape, perimeter to area ratio, and slope), 2) island vegetation (type, density, and height), and 3) substrate slope adjacent to islands (shallow or deep next to islands).

Small Scale: Individual
Island Morphometry-Island morphometry will be determined through several measurements. Island perimeter, area, and elevation will be measured by recording point coordinates along the land-water boundary of each island, as well as perpendicular transects across each island via real-time kinetics (RTK) GPS (1 cm accuracy) with each point being separated by 0.5 m. The data will be transferred to a geographic information system (GIS; ArcGIS, ESRI, Redlands CA), and linear perimeter (m), maximum length (m), maximum width (m), and area (m^2) will be calculated using standard tools within ArcGIS. An elevation model will be generated using ArcGIS Spatial Analyst (ESRI, Redlands CA), and this will be used to generate slope and aspect calculations. Additionally, we will record the perimeter of each island by mapping the island's edge using the RTK GPS to ground truth our GIS models. Pond water level readings (recorded during each site visit) will be adjusted to NGVD29 and used with the island elevation model to estimate pond perimeter and area, as these parameters will change with changing water levels across seasons.

Nest Monitoring-To determine whether pond management actions will improve waterbird reproduction, we will evaluate nest density, nest success, and hatching success on each island and within each pond (A16, SF2, A12, and 3 reference ponds). Nest monitoring methodology has been extensively developed in cooperation with the DESFBNWR staff over the past five breeding seasons and causes minimal disruption to nesting birds as indicated by low nest abandonment rates. As an added measure to reduce disturbance, waterbird colonies will not be entered until their nesting activities have been underway for two weeks (determined using spotting scopes). Nests will be marked and monitored weekly and new nests will be located at each visit. All nests will be marked with a uniquely numbered anodized aluminum tag (Ben Meadows Company, Janesville, WI) placed at the nest and a colored pin flag placed 2 m from

the nest. We will record Universal Transverse Mercator (UTM) coordinates for each nest site with a Global Positioning Satellite Device (GPS). During nest visits, the stage of embryo development will be estimated by floating (Hays and LeCroy 1971, Alberico 1995), and clutch size and nest fate (hatched, failed, or depredated) will be determined. We will calculate nest success and estimate nest density for each pond and species using Mayfield (1961, 1975) techniques. We will compare nest densities and nest success to our existing nesting database (2005-2008; Ackerman et al. 2007b) to assess how wetland restoration has altered nesting distribution, densities, and success in the same and nearby ponds. Additionally, we will test whether nest densities, nest success, and hatching success is related to island morphology (perimeter to area ratios, topography).

Nest Site Selection and Vegetation Measurements-To address whether managers should promote vegetation on nesting islands, we will examine the extent to which waterbirds select vegetated nesting sites versus unvegetated sites. To do so, we will measure the vegetation parameters within a 1m radius of each nest during the first visit, and compare these data to a random site considered available to the bird. For each real nest, we will randomly pick a potential nesting site by selecting an azimuth (direction) and distance from the real nest. Azimuths will be selected by randomly choosing a value from 1-360 degrees on a compass. Distances will be selected by randomly choosing a distance, with the minimum potential value of 1 m and a maximum potential value of 50 m or, for smaller islands, equivalent to the length of the particular island. If the randomly selected location is off the island in an unsuitable nesting site (e.g., water), then we will repeat the random selection process until a suitable potential nesting site is located. At both the real and random nest site, we will then measure the vegetation's visual obstruction height and the percentage of each plant type within 1 m of the nest. The vegetation's visual obstruction height is a reliable index of a site's vegetation biomass, and will be calculated using the methods of Robel et al. (1970). We will use a chi-square test (2×2 cells) to determine whether real nests are more likely to be vegetated than available nest sites. We will use logistic regression to assess whether the nest's fate (successful or unsuccessful) was dependent on the vegetation height around the nest, when correcting for potential influences of other factors, such as island morphometry.

Intermediate Scale: Islands

Water Depth Around Islands-The depth of water surrounding an island is likely an important factor in determining the island's value for adjacent shorebird foraging, and for predator exclusion. Therefore, we will extend the elevation transects ≥50 m beyond the water line at the time of surveying to map submerged island features that determine the foraging depths of water surrounding the islands. We will also measure the slope of the substrate (water depth) at 1 m linear intervals from the edge of the island, maintaining a perpendicular transect relative to the island for 100 m, or until shoreline is reached in the four cardinal directions. Together, these approaches will allow us to determine depth isoclines around each island. Island elevation models will be combined with existing bathymetric and habitat data using GIS to obtain several island parameters, including perimeter, area, mean elevation, slope, aspect, mean pond depth, distance to publicly-accessed or closed levee, distance to Bay, and distance to adjacent habitats such as mudflats, marsh, and urban areas. These data will be extracted from GIS and will be analyzed in conjunction with bird use data.

Detailed Waterbird Foraging and Roosting Surveys-We will evaluate the influence of islands on waterbird densities and behavior in comparison to randomly selected, open water locations within the same pond (potential "island" sites) during bi-monthly waterbird surveys conducted during two 3-month periods each year in the summer and winter. Using binoculars and spotting scopes, we will conduct counts of birds on islands and those surrounding islands out to 100 m. For each bird, we will estimate its distance from the island and its behavior (e.g., roosting, foraging, preening, nesting), and later bin (group) data based on the bird's distance from the island using, for example, 20 m radius intervals. To increase accuracy with distance estimation, we will place semi-permanent markers (PVC poles) in the substrate at 20 m intervals from the island shoreline. For each island, we will randomly select an open-water location within the same pond to act as a control and we will count birds similarly to island counts. We will mark the open-water control location with a single marker and in 4 directions around the marker at 20 m radius up to 100 m. We will determine the density of birds (by taxonomic grouping) within each bin to account for the differences in areas associated with islands of varying sizes. After our initial survey at each island and control site, we will conduct more detailed behavioral scan sampling on up to 20 individual birds (3 min each) to fully evaluate the value of island habitat (e.g., roosting, feeding, preening, or nesting; Martin and Bateson 1986). We will use repeated measures analysis of covariance (ANCOVA) to test whether waterbird densities differ among the specified bins, with pond, treatment, and year as categorical factors, and bin distance, water depth, slope, and salinity as covariates.

Large Scale: Ponds

Incorporating Islands and Levees into Regional Bird Surveys-Under this objective, we will digitize existing islands and non-roaded levees, incorporate them into a GIS system coverage, and apply their use in monitoring surveys. At the largest spatial scale, we will use existing monitoring surveys to assess the distribution of waterbirds in salt ponds relative to islands, levees, and open water habitats. This methodology was developed over the past 8 years (Takekawa et al. 2006) in cooperation with the DESFBNWR staff to assess overall waterbird use in the region. Specifically, we superimposed a 250 m x 250 m (6.25 ha) UTM grid upon the sampled ponds to provide a framework for integrated sampling (Takekawa et al. 2006). Observers conducted total counts of species with binoculars and spotting scopes from vantage points on pond levees, and locations of waterbirds were placed within the grid cells of each pond to examine the spatial distribution of birds.

With development of an island and levee coverage in this study, we will be able to record when birds are on specific levees or islands and include their behavior to indicate whether birds were foraging or roosting. Surveys will be conducted during the day within 3 h of the highest high tide, when the largest number of waterbirds will likely to be in the salt ponds. Identified waterbirds will be separated into guilds to examine differences among foraging groups. These foraging guilds include: 1) dabbling ducks – feed in the upper water column, e.g., northern shoveler (*Anas clypeata*); 2) diving ducks – feed in deeper water on benthic invertebrates, e.g., ruddy duck (*Oxyura jamaicensis*); 3) fish-eating birds – fish consumers, e.g., Forster's tern (*Sterna forsteri*); 4) herons – herons and egrets, e.g., great egret (*Ardea alba*); 5) small shorebirds – forage in the top layer (< 3 cm) of sediments, e.g., western sandpiper (*Calidris mauri*); 6) medium shorebirds – reach deeper into the substratum than small shorebirds, e.g., marbled godwit (*Limosa fedoa*); and 7) gulls, e.g., California gull (*Larus californicus*). We will

use ANCOVA to compare waterbird density in grids on and surrounding islands with those in the open water, and those on or near levees, with calendar date as a covariate. Additionally, we will use ANCOVA to compare waterbird density in ponds with islands to those ponds without islands, with calendar date as a covariate. These data will generate a much better understanding of the benefit of islands to waterbirds, whereas the more detailed island studies at the smaller spatial scale will inform managers about those island characteristics that will improve their value to nesting, roosting, and foraging.

DATA ARCHIVING:
Data handling and storage will follow Federal Geographic Data Committee (FGDC) metadata standards. All data will be compiled, QA/QC checked, and archived on a data server with mirrored drives, tape backup, and redundant copies offsite. Field data will be referenced in GIS coverages, data projected in UTM in NAD83 horizontal and NAVD88 vertical datum. Datasets will be made available with permission for use specified in the metadata. The databases will be made accessible through the SBSP Restoration Projects website. Results will be presented spatially to allow managers and policy makers to view seasonal island and pond characterizations and analyses.

WORK SCHEDULE:
Work will commence from final signature of the agreement for a period of two years (spanning parts of 3 calendar years) with an annual report delivered at the end of year one and a final report delivered at the end of year two. Our waterbird foraging studies will be conducted monthly throughout the year at all salt ponds, whereas our more detailed bi-monthly studies of the selected islands will be conducted during three months in summer (May-July) and three months in winter (November-January). Fieldwork for the nesting studies will occur during the breeding season (April-August). Data analyses and report writing will occur during summer and fall of the second year, with a draft report due in December of the final year, and a final report delivered in May of the final year. Below is a timeline for each task.

Timeline by quarter	Year 1				Year 2				Year 3			
	1	2	3	4	1	2	3	4	1	2	3	4
Physical mapping		x	x									
Nesting studies		x	x			x	x					
General foraging studies		x	x	x	x	x	x	x	x			
Detailed foraging studies		x		x		x		x				
GIS mapping								x	x			
Data Entry			x	x			x	x	x			
Data analysis								x	x			
Report writing									x	x		

EXPECTED PRODUCTS:
Annual briefings and presentations will be provided to the Science Program and given at the South Bay Science Symposium. Annual progress reports and a final report will be delivered to

the SBSP Restoration Project's Lead Scientist and Project Team. Additional presentations and scientific papers will be prepared for appropriate outlets. GIS coverages of waterbird distribution will be provided. Expected journal paper topics include: managing salt ponds and creating islands to promote waterbird foraging and nesting, and influence of vegetation and nest site selection on waterbird nesting success.

LITERATURE CITED:

Ackerman, J. T., J. Y. Takekawa, C. Strong, N. Athearn, and A. Rex. 2006. California gull distribution, abundance, and predation on waterbird eggs and chicks in South San Francisco Bay. Final Report, U. S. Geological Survey, Western Ecological Research Center, Davis, CA, 61 pp.

Ackerman, J. T., C. A. Eagles-Smith, G. H. Heinz, S. E. Wainwright-De La Cruz, J. Y. Takekawa, T. L. Adelsbach, A. K. Miles, D. J. Hoffman, S. E. Schwarzbach, T. H. Suchanek, and T. C. Maurer. 2007. Mercury in birds of the San Francisco Bay-Delta: trophic pathways, bioaccumulation and ecotoxicological risk to avian reproduction. 2006 Annual Administrative Report to CALFED, U. S. Geological Survey, Western Ecological Research Center, and U. S. Fish and Wildlife Service, Environmental Contaminants Division, 41 pp.

Ackerman, J. T., C. A. Eagles-Smith, J. Y. Takekawa, S. A. Demers, T. L. Adelsbach, J. D. Bluso, A. K. Miles, N. Warnock, T. H. Suchanek, and S. E. Schwarzbach. 2007b. Mercury concentrations and space use of pre-breeding American avocets and black-necked stilts in San Francisco Bay. Science of the Total Environment 384:452-466.

Ackerman, J. T., C. A. Eagles-Smith, J. Y. Takekawa, J. D. Bluso, and T. L. Adelsbach. 2008. Mercury concentrations in blood and feathers of pre-breeding Forster's terns in relation to space use of San Francisco Bay habitats. Environmental Toxicology and Chemistry 27:897-908.

Ackerman, JT, JD Bluso, and JY Takekawa. Postfledging Forster's tern movements, habitat selection, and colony attendance in San Francisco Bay. Condor, submitted.

Alberico, J. A. R. 1995. Floating eggs to estimate incubation stage does not affect hatchability. Wildlife Society Bulletin 23:212-216.

Bluso-Demers, JD, JT Ackerman, and JY Takekawa. In review. Habitat selection by Forster's terns at multiple scales in San Francisco Bay: the importance of salt ponds. Auk, submitted.

Colwell, MA, T Danufsky, NW Fox-Fernandez, JE Roth, and JR Conklin. 2003. Variation in shorebird use of diurnal, high-tide roosts: How consistently are roosts used? Waterbirds 26:484-493.

Conklin, JR, and MA Colwell. 2007. Diurnal and nocturnal site fidelity of Dunlin (*Calidris alpina pacifica*) at Humboldt Bay, California. Auk 124:677-689.

Goals Project. 1999. Baylands ecosystem habitat goals. A report of habitat recommendations prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project. USEPA, San Francisco and San Francisco Bay Regional Water Quality Control Board, Oakland, CA, U.S.A.

Hays, H., and M. LeCroy. 1971. Field criteria for determining incubation stage in eggs of the Common Tern. Wilson Bulletin 83:425-429.

Hickey, C., N. Warnock, J. Y. Takekawa, and N. D. Athearn. 2007. Space use by black-necked stilts in the San Francisco Bay estuary. Ardea 95: 275-288.

Life Science Inc. 2003. South Bay Salt Ponds Initial Stewardship Plan, June 2003. Woodland, CA. 251 pp.

Martin, P., and P. Bateson. 1986. Measuring behaviour: an introductory guide. Cambridge Universtiy Press, New York.

Mayfield, H. F. 1961. Nest success calculated from exposure. Wilson Bulletin 73:255-261.

Mayfield, H. F. 1975. Suggestions for calculating nest success. Wilson Bulletin 87:456-466.

McNicholl, M. K., P. E. Lowther, and J. A. Hall. 2001. Forster's tern (*Sterna forsteri*). In A> Poole and F. Gill, eds, The Birds of North America, No. 595, The Academy of Natural Sciences, Philadelphia, PA and The American Ornithologists' Union, Washington, DC.

Page, G. W., L. E. Stenzel, and J. E. Kjelmyr. 1999. Overview of shorebird abundance and distribution in wetlands of the Pacific Coast of the contiguous United States. Condor 101:461-471.

Rintoul, C., N. Warnock, G. W. Page, and J. T. Hanson. 2003. Breeding status and habitat use of black-necked stilts and American avocets in South San Francisco Bay. Western Birds 34:2-14.

Robel R. J., J. N. Briggs, A. D. Dayton, L. C. Hulbert. 1970. Relationships between visual obstruction measurement and weight of grassland vegetation. Journal of Range Management 23:295-297

Robinson C., D. Le Fer, J. Albertson, and C. Strong. 2007. Western snowy plover numbers, nesting success, and avian predator surveys in the San Francisco Bay, 2007. San Francisco Bay Bird Observatory and Don Edwards San Francisco Bay National Wildlife Refuge, 39 pp.

Siegel, S. W., and P. A. M. Bachand. 2002. Feasibility analysis of South Bay salt pond restoration, San Francisco Estuary, California. Wetlands and Water Resources, San Rafael, CA, U.S.A..

Steere, J. T., and N. Schaefer. 2001. Restoring the Estuary: Implementation Strategy of the San Francisco Bay Joint Venture. San Francisco Bay Joint Venture, Oakland, CA, 124 pp.

Stenzel, L. E., C. M. Hickey, J. E. Kjelmyr, and G. W. Page. 2002. Abundance and distribution of shorebirds in the San Francisco Bay area. Western Birds 33:69-98.

Stenzel, L. E., and G. W. Page. 1988. Results of the first comprehensive shorebird census of San Francisco and San Pablo Bays. Wader Study Group Bull. 54:43-48.

Strong, C. M., L. B. Spear, T. P. Ryan, and R. E. Dakin. 2004. Forster's Tern, Caspian Tern, and California Gull colonies in the San Francisco Bay: habitat use, numbers and trends, 1982-2003. Waterbirds 27:411-423.

Takekawa, J. Y., G. Page, J. M. Alexander, and D. Becker. 2000. Shorebirds and waterfowl. Pages 309-316 *in* M. Olufson (ed.). Baylands ecosystem species and community profiles: life histories and environmental requirements of key plants, fish and wildlife. San Francisco Bay Area Wetlands Ecosystem Goals Project. San Francisco Bay Regional Water Quality Control Board, Oakland, CA.

Takekawa, J. Y., A. K. Miles, D. H. Schoellhamer, N. D. Athearn, M. K. Saiki, W. D. Duffy, S. Kleinschmidt, G. G. Shellenbarger, and C. A. Jannusch. 2006. Trophic structure and avian communities across a salinity gradient in evaporation ponds of the San Francisco Bay estuary. Hydrobiologia 567:307–327.

Trulio, L., D. Clark, S. Ritchie, A. Hutzel, and the Science Team. South Bay Salt Pond Restoration Project Public Draft Adaptive Management Plan. Science Team Report for the South Bay Salt Pond Restoration Project, Jan. 31, 2007. Unpubl. Report. 163 pp.

Warnock, N., G. W. Page, T. D. Ruhlen, N. Nur, J. Y. Takekawa, and J. T. Hanson. 2002. Management and conservation of San Francisco Bay salt ponds: effects of pond salinity, area, tide, and season on Pacific Flyway waterbirds. Waterbirds 25: 79-92.

Warnock, S. E., and J. Y. Takekawa. 1995. Habitat preferences of wintering shorebirds in a temporally changing environment: Western Sandpipers in the San Francisco Bay Estuary. Auk 112:920-930.

QUALIFICATIONS:

This proposal is a collaborative effort among the US Geological Survey and San Francisco Bay Bird Observatory. Each of the Principle Investigators has been conducting applied research on waterbirds in the South Bay for more than 5 years. Please see the attached CVs for further details and project participation.

Principal Investigators:

Josh Ackerman. USGS Western Ecological Research Center, Davis Field Station, 1 Shields Avenue, University of California, Davis, CA 95616; tel: 530-752-0485; email: jackerman@usgs.gov.

Nicole Athearn. USGS Western Ecological Research Center, SFBE Field Station, 505 Azuar Drive, Vallejo, CA 94592; tel: 707-562-2002; email: nathearn@usgs.gov.

Jill Bluso-Demers. San Francisco Bay Bird Observatory, 524 Valley Way, Milpitas, CA 95035; tel: 408-946-6548x11; email: jdemers@sfbbo.org.

Collin Eagles-Smith. USGS Western Ecological Research Center, Davis Field Station, 1 Shields Avenue, University of California, Davis, CA 95616; tel: 530-754-8130; email: ceagles-smith@usgs.gov.

John Takekawa. USGS Western Ecological Research Center, SFBE Field Station, 505 Azuar Drive, Vallejo, CA 94592; tel: 707-562-2002; email: john_takekawa@usgs.gov.

Partners and Cooperators:

Joy Albertson, SFBNWR, 9500 Thornton Ave., Newark, CA 94560, tel: 510/792-0222, fax: 510/792-5828, email: Joy_Albertson@fws.gov. **Role:** Refuge oversight and support: will participate in pond management and nesting island development.

Cheryl Strong, SFBNWR, 9500 Thornton Ave., Newark, CA 94560, tel: 510/792-0222, fax: 510/792-5828, email: Cheryl_Strong@fws.gov. **Role:** Participate in water management and nesting island creation.

Eric Mruz, SFBNWR, 9500 Thornton Ave., Newark, CA 94560, tel: 510/792-0222, ext 24, fax: 510/792-5828, email: Eric_Mruz@fws.gov. **Role:** Will collaboratively manage wetland ponds and water flow to promote waterbird nesting habitat.

SYNERGIES WITH OTHER PROJECTS

This study will make use of existing USGS and SFBBO bird monitoring surveys to document use of islands and levees. It will be integrated with the proposal on bird database assessment for carrying capacity estimation (J. Wood, PRBO Conservation Science) to provide the results through an informatics framework. The study will be conducted in conjunction with the proposed invasive gull predation research (J. Ackerman, USGS) to incorporate risks of predation into assessment of island and levee habitat management. We will work closely with any studies that access islands to minimize disturbance.

BUDGET AND STAFF ALLOCATIONS:
We are requesting funds totaling $246,800 over a two year period to complete all 3 tasks, and we are providing direct matching funds totaling $29,163 with additional in kind contributions totaling more than $25,000 worth of research equipment (RTK GPS unit, computers, boats, motors, spotting scopes). Additionally, we already have funds in the amount of $150,844 secured to complete the complex-wide waterbird surveys, so we are not requesting any money for these surveys. Our request includes funds for <9% time for each project PI. We are requesting approximately $65,000 total per year for technician time (2 technicians @ 50% time and 1 technician @ 15% time) to conduct field work and data entry. Funds for supplies include consumables such as nest markers, monitoring, and office supplies. All salaries include benefits and administrative costs. A detailed budget follows:

South Bay Salt Pond Restoration Project

South Bay Salt Pond Restoration Project
Selected Monitoring and Applied Studies

Project Budget Worksheet*

Timeframe: April 2009-April 2011, or April 2010-April 2012 depending on contract approval

Budget Categories	Total Project Budget			Total Grant Request			Total Proposed From Other Sources *(please specify the source, if known)*
	Year 1	Year 2	Total	Year 1	Year 2	Total	
Labor-Salaries and Benefits (agency: annual %FTE requested)							
Ackerman (USGS: 4%,8%)	$10,774	$19,259	$30,033	$7,183	$15,407	$22,590	*$7,443 USGS Contribution*
Eagles-Smith (USGS: 8%,8%)	$15,100	$16,195	$31,295	$12,080	$12,956	$25,036	*$6,259 USGS Contribution*
Athearn (USGS: 9%,9%)	$18,016	$18,737	$36,753	$15,013	$15,614	$30,627	*$6,125 USGS Contribution*
Takekawa (USGS: 2%,2%)	$9,152	$9,518	$18,670	$4,576	$4,759	$9,335	*$9,335 USGS Contribution*
Bluso-Demers (SFBBO: 2%,2%)	$1,440	$1,440	$2,880	$1,440	$1,440	$2,880	
Technicians (USGS: 50%,50% & 15%,15%)	$51,688	$55,548	$107,236	$51,688	$55,548	$107,236	
Technician (SFBBO: 50%,50%)	$11,520	$11,520	$23,040	$11,520	$11,520	$23,040	
Consultant fees/ Contractual Services							
Travel - Field Vehicles	$6,000	$6,000	$12,000	$6,000	$6,000	$12,000	
Project specific equipment, supplies/materials	$2,165	$2,165	$4,330	$2,165	$2,165	$4,330	*>$25,000 in field equipment by USGS*
Overhead (not to exceed 10%)	$4,863	$4,863	$9,726	$4,863	$4,863	$9,726	
Other: ***Complex-wide salt pond surveys***	$75,422	$75,422	$150,844	$0	$0	$0	*$150,844 for waterbird surveys from US Fish & Wildlife Service*
TOTAL	$206,140	$220,667	$426,807	$116,528	$130,272	$246,800	*$180,006*

POTENTIAL REVIEWERS:
Nils Warnock, Wildlife Health Center, University of California, Davis, CA 95616; tel: 530/752-5797; email: nwarnock@ucdavis.edu
Gary Page, PRBO Conservation Science, 3820 Cypress Drive #11, Petaluma, CA 94954; tel: 707/781-2555; email: gpage@prbo.org
Cheryl Strong, San Francisco Bay National Wildlife Refuge Complex, 9500 Thornton Avenue, Newark, CA 94560; cell: 510-557-1271; email: Cheryl_Strong@fws.gov
Dan Anderson, University of California, Davis, 1 Shields Avenue, Davis, CA 95616; tel: 530/752-2108; dwanderson@ucdavis.edu

NECESSARY PERMITS:
Birds will be monitored and handled and areas accessed under existing California Department of

Fish and Game Scientific Collection Permits (SC000009, SC004741, SC007199, SC004857), Federal U.S. Fish and Wildlife Service Permits (MB173904, MB102896), U.S. Geological Survey Bird Banding Laboratory Permits (23564, 22911), Eden Landing Ecological Reserve Access Permit (Letter of Permission from John Krause dated August 1, 2008), and Don Edwards San Francisco Bay National Wildlife Refuge Special Use Permit (11640-2008-003 [will be updated each year of the project]).

ANIMAL CARE AND USE:
All research will be conducted under approved study plans and guidelines of the U.S. Geological Survey, Western Ecological Research Center, Animal Care and Use Committee. This study proposes limited handling and disturbance of birds and is mainly observational in nature. Weekly nest monitoring activities have been extensively developed in cooperation with the Don Edwards SFBNWR staff over the past 5 breeding seasons and causes minimal disruption to nesting birds as indicated by low nest abandonment rates.

JOSHUA T. ACKERMAN

U.S. Geological Survey, Biological Resources Discipline, Western Ecological Research Center, Davis Field Station, University of California, Davis, CA, 530/752-0485, jackerman@usgs.gov

EDUCATION

Ph.D. Ecology. University of California, Davis (2002).
B.S. (High Honors) Wildlife, Fish, and Conservation Biology. University of California, Davis (1997).

RELEVANT EXPERIENCE TO THIS PROJECT

As a Principal Investigator with the USGS Western Ecological Research Center, I lead several research projects investigating waterbird ecology, avian reproduction, and mercury bioaccumulation in the San Francisco Bay Estuary. I have been conducting research on waterbirds in the South San Francisco Bay for five years and have led studies investigating (1) nesting ecology of avocets, stilts, and Forster's terns, (2) movements, habitat selection, and diet of avocets, stilts, and Forster's terns, (3) movements and diet of California gulls, and (4) mercury bioaccumulation and ecotoxicological effects of mercury on avian reproduction. Important to this proposal, I lead the largest avian nest monitoring dataset on waterbirds in the South Bay salt ponds which will provide a detailed 5-year dataset on nesting distributions, densities, and nest success at several colonies within the project area. Through this research, we also have developed the necessary methodology to monitor the reproductive success of waterbirds breeding on salt pond islands with minimal disturbance.

EXPECTED CONTRIBUTIONS TO THIS PROJECT

I will lead the research project, including coordinating data collection for the nesting studies and focal island surveys, and summarize, analyze, and report project results.

PROFESSIONAL EXPERIENCE

Research Wildlife Biologist, USGS, BRD, WERC, UC Davis Field Station (2/04-present)
Post-doctoral Researcher, John Muir Institute of the Environment, UC Davis (8/02-2/04)
Doctoral Research, Dept. of Wildlife, Fish, and Conservation Biology, UC Davis (9/97-7/02)
Waterfowl Research Associate, California Waterfowl Association, Sacramento (10/99-4/00)

PUBLICATIONS:

I have authored 33 peer-reviewed journal papers (19 lead), 13 popular articles (9 lead), 16 technical reports, and 138 scientific presentations. Below is a selected list of publications.

Ackerman, JT, and CA Eagles-Smith. Integrating toxicity risk in bird eggs and chicks: using chick down feathers to estimate mercury concentrations in eggs. Environmental Science and Technology, submitted.

Ackerman, JT, JD Bluso, and JY Takekawa. Postfledging Forster's tern movements, habitat selection, and colony attendance in San Francisco Bay. Condor, submitted.

Eagles-Smith, CA, **JT Ackerman**, J Yee, and TL Adelsbach. 2008. Mercury demethylation in livers of four waterbird species: evidence for dose-response thresholds with liver total mercury. Environmental Toxicology and Chemistry, in press.

Stebbins, KR, JD Klimstra, CA Eagles-Smith, **JT Ackerman**, and GH Heinz. 2008. A non-lethal micro-sampling technique to monitor the effects of mercury on wild bird eggs. Environmental Toxicology and Chemistry, in press.

Iverson, SA, JY Takekawa, S Schwarzbach, CJ Cardona, N Warnock, MA Bishop, GA Schirato, S Paroulek, **JT Ackerman**, H Ip, and WM Boyce. 2008. Low prevalence of avian influenza virus in shorebirds on the Pacific Coast of North America. Waterbirds, in press.

Demers, SA, MA Colwell, JY Takekawa, and **JT Ackerman**. 2008. Breeding stage influences space use of American avocets in San Francisco Bay, California. Waterbirds, in press.

Demers-Bluso, JD, MA Colwell, JY Takekawa, and **JT Ackerman**. 2008. Space use by Forster's terns breeding in South San Francisco Bay. Waterbirds 31:357-364.

Ackerman, JT, CA Eagles-Smith, JY Takekawa, and SA Iverson. 2008. Survival of postfledging Forster's terns in relation to mercury exposure in San Francisco Bay. Ecotoxicology 17:789-801.

Ackerman, JT, CA Eagles-Smith, JY Takekawa, JD Bluso, and TL Adelsbach. 2008. Mercury concentrations in blood and feathers of pre-breeding Forster's terns in relation to space use of San Francisco Bay habitats. Environmental Toxicology and Chemistry 27:897-908.

Ackerman, JT, JY Takekawa, CA Eagles-Smith, and SA Iverson. 2008. Mercury contamination and effects on survival of American avocet and black-necked stilt chicks in San Francisco Bay. Ecotoxicology 17:103-116.

Ackerman, JT, JY Takekawa, JD Bluso, JL Yee, and CA Eagles-Smith. 2008. Gender identification of Caspian terns using external morphology and discriminant function analysis. Wilson Journal of Field Ornithology 120:378-383.

Eagles-Smith, CA, **JT Ackerman**, TL Adelsbach, JY Takekawa, AK Miles, and RA Keister. 2008. Mercury correlations among six tissues for four waterbird species breeding in San Francisco Bay. Environmental Toxicology and Chemistry 27:2136-2153.

Ackerman, JT, CA Eagles-Smith, JY Takekawa, SA Demers, TL Adelsbach, JD Bluso, AK Miles, N Warnock, TH Suchanek, and SE Schwarzbach. 2007. Mercury concentrations and space use of pre-breeding American avocets and black-necked stilts in San Francisco Bay. Science of the Total Environment 384:452-466.

Mason, JW, GJ McChesney, WR McIver, HR Carter, JY Takekawa, RT Golightly, **JT Ackerman**, DL Orthmeyer, WM Perry, JL Yee, MO Pierson, and MD McCrary. 2007. At-sea distribution and abundance of seabirds off southern California: a 20-year comparison. Studies in Avian Biology 33:1-101.

Ackerman, JT, JY Takekawa, DL Orthmeyer, JP Fleskes, JL Yee, and KL Kruse. 2006. Spatial use by wintering greater white-fronted geese relative to a decade of habitat change in California's Central Valley. Journal of Wildlife Management 70:965-976.

Ackerman, JT, JM Eadie, and TG Moore. 2006. Does life history predict risk-taking behavior of wintering dabbling ducks? Condor 108:530-546.

Ackerman, JT, JM Eadie, ML Szymanski, JH Caswell, MP Vrtiska, AH Raedeke, JM Checkett, AD Afton, TG Moore, FD Caswell, RA Walters, DD Humburg, and JL Yee. 2006. Effectiveness of spinning-wing decoys varies among dabbling duck species and locations. Journal of Wildlife Management 70:799-804.

Bluso, JD, **JT Ackerman**, JY Takekawa, and JL Yee. 2006. Using morphological measurements to sex Forster's terns. Waterbirds, 29:511-516.

Blackmer, AL, RA Mauck, **JT Ackerman**, CE Huntington, GA Nevitt, and JB Williams. 2005. Exploring individual quality: basal metabolic rate and reproductive performance in Leach's storm-petrels. Behavioral Ecology 16: 906-913.

Ackerman, JT, AL Blackmer, and JM Eadie. 2004. Is predation on waterfowl nests density dependent? Tests at three spatial scales. Oikos 107:128-140.

Ackerman, JT, JY Takekawa, KL Kruse, DL Orthmeyer, JL Yee, CR Ely, DH Ward, KS Bollinger, and DM Mulcahy. 2004. Using radiotelemetry to monitor cardiac response of free-living tule greater white-fronted geese to human disturbance. Wilson Bulletin 116:146-151.

Ackerman, JT, J Adams, JY Takekawa, HR Carter, DL Whitworth, SH Newman, RT Golightly, and DL Orthmeyer. 2004. Effects of radio transmitters on the reproductive performance of Cassin's auklets. Wildlife Society Bulletin 32:1229–1241.

Blackmer, AL, **JT Ackerman**, and GA Nevitt. 2004. Effects of investigator disturbance on hatching success and nest-site fidelity in a long-lived seabird, Leach's storm-petrel. Biological Conservation 116:141-148.

Ackerman, JT, JM Eadie, GS Yarris, DL Loughman, and MR McLandress. 2003. Cues for investment: nest desertion in response to partial clutch depredation in dabbling ducks. Animal Behavior 66:871-883.

Ackerman, JT, JM Eadie, DL Loughman, GS Yarris, and MR McLandress. 2003. The influence of partial clutch depredation on duckling production. Journal of Wildlife Management 67:576-587.

Ackerman, JT, and JM Eadie. 2003. Current versus future reproduction: an experimental test of parental investment decisions using nest desertion by mallards. Behavioral Ecology & Sociobiology 54:264-273.

Ackerman, JT. 2002. Of mice and mallards: positive indirect effects of coexisting prey on waterfowl nest success. Oikos 99:469-480.

Ackerman, JT, MC Kondratieff, SA Matern, and JJ Cech, Jr. 2000. Tidal influence on spatial dynamics of leopard sharks in Tomales Bay, California. Environmental Biology of Fishes 58:33-43.

COLLIN A. EAGLES-SMITH

US Geological Survey, Western Ecological Research Center, Davis Field Station
One Shields Ave, University of California, Davis, CA 95616, ceagles-smith@usgs.gov, 530-754-8130

EDUCATION

Ph.D. Ecology. University of California, Davis (2006)
B.S. (Magna Cum Laude) Env. Resource Sciences. University of California, Davis (2000)

RELEVANT EXPERIENCE AND RESEARCH INTERESTS

For the past 5 years I have been conducting research on waterbird reproductive and foraging ecology in the San Francisco Estuary, focusing specifically on Forster's terns, American avocets, and black-necked stilts within the South San Francisco Bay. I was the lead USFWS scientist on a large project assessing mercury bioaccumulation and risk in waterbirds and currently co-lead several projects on waterbird reproduction, foraging ecology and ecotoxicological effects of mercury to wildlife. I have also studied foraging ecology of Bald Eagles on the Catalina Islands and reproductive ecology of Western Grebes and Osprey in California Lakes.

EXPECTED CONTRIBUTIONS TO THIS PROJECT

I will coordinate and supervise the collection for the nesting studies and focal island surveys, and collaborate on summary, analysis, and reporting of project results.

PROFESSIONAL EXPERIENCE

Wildlife Biologist, USGS, WERC, UC Davis Field Station (8/07-present).
Senior Biologist, US Fish and Wildlife Service, Sacramento (2/07-8/07).
Staff Biologist, US Fish and Wildlife Service, Sacramento (2/03-2/07).
Doctoral Research, Dept. of Wildlife, Fish and Cons. Biology, UC Davis (9/00-11/06).
Staff Research Assistant, Dept. of Wildlife, Fish and Cons. Biology, UC Davis (2/98-9/00).

PUBLICATIONS:

21 peer-reviewed journal publications (4 lead), 6 popular articles (4 lead), 8 technical reports, and 63 scientific presentations. Below is a selected list of publications.

Eagles-Smith, CA, JT Ackerman, J Yee, and TL Adelsbach. 2009 Mercury demethylation in livers of four waterbird species: evidence for dose-response thresholds with liver total mercury. Environmental Toxicology and Chemistry, in press.

Stebbins, KR, JD Klimstra, **CA Eagles-Smith**, JT Ackerman, GH Heinz. 2009. Micro-sampling eggs to monitor the effects of methylmercury on wild birds. Environmental Toxicology and Chemistry. In press.

Anderson, DW, TH Suchanek, **CA Eagles-Smith**, T Cahill. 2008. Mercury residues in ospreys and grebes in a mine-dominated ecosystem: Clear Lake, California. Ecological Applications. In press.

Eagles-Smith, CA, TH Suchanek, AE Colwell, NL Anderson, PB Moyle. 2008. Changes in fish diets and food web mercury bioaccumulation induced by an invasive planktivorous fish. Ecological Applications, in press.

Eagles-Smith, CA, TH Suchanek, AE Colwell, NL Anderson. 2008. Mercury trophic transfer in a eutrophic lake: the importance of habitat-specific foraging. Ecological Applications, in press.

Eagles-Smith, CA, JT Ackerman, TL Adelsbach, JY Takekawa, AK Miles, RA Keister. 2008. Mercury correlations among six tissues for four waterbird species breeding in San Francisco Bay, California, USA. Environmental Toxicology and Chemistry 27:2136-2153.

Ackerman, JT, **CA Eagles-Smith**, JY Takekawa, SA Iverson. 2008. Survival of postfledging Forster's terns in relation to mercury exposure in San Francisco Bay. Ecotoxicology. 17: 789-801.

Ackerman, JT, **CA Eagles-Smith,** JY Takekawa, JD Bluso, TL Adelsbach. 2008. Mercury concentrations in blood and feathers of pre-breeding Forster's terns in relation to space use of San Francisco Bay habitats. Environmental Toxicology and Chemistry 27:897-908

Ackerman, JT, JY Takekawa, JD Bluso, JY Yee, **CA Eagles-Smith**. 2008. Gender identification of Caspian Terns using external morphology and discriminant function analysis. The Wilson Journal of Ornithology. 120:378-383.

Ackerman, JT, JY Takekawa, **CA Eagles-Smith**, SA Iverson. 2007. Mercury contamination and effects on survival of American avocet and black-necked stilt chicks in San Francisco Bay. Ecotoxicology 17:103-116.

Ackerman, JT, **CA Eagles-Smith**, JY Takekawa, SA Demers, TL Adelsbach, JD Bluso, AK Miles, N Warnock, TH Suchanek, and SE Schwarzbach. 2007. Mercury concentrations and space use of pre-breeding American avocets and black-necked stilts in San Francisco Bay. Science of the Total Environment 384: 452-466.

Suchanek, TH, **CA Eagles-Smith**, DG Slotton, EJ Harner, D Adam, AE Colwell, NL Anderson, D Woodward. 2008. Mine-derived mercury: effects on lower trophic species in Clear Lake, California. Ecological Applications. In press

Suchanek, TH, **CA Eagles-Smith**, EJ Harner. 2008. Is Clear Lake methylmercury decoupled from bulk mercury loading? Implications for lake management and TMDL implementation. Ecological Applications. In press

Suchanek, TH, **CA Eagles-Smith**, DG Slotton, EJ Harner, AE Colwell, NL Anderson, L Mullen, J Flanders, D Adam, K McElroy. 2008. Spatio-temporal trends of mercury in fish from a mine-dominated ecosystem at Clear Lake, California: individual, species, and population trends. Ecological Applications. In press.

Suchanek, TH, **CA Eagles-Smith**, EJ Harner, D Adam. 2008. Mercury in abiotic compartments of Clear Lake, California: human health and ecotoxicological implications. Ecological Applications. In press

Richerson, P, TH Suchanek, R Zierenberg, D Osleger, A Heyvaert, D Slotton, **CA Eagles-Smith**, C Vaugh. 2008. Anthropogenic stressors and changes in the Clear Lake ecosystem as recorded in sediment cores. Ecological Applications. In press.

McEachern, M, **CA Eagles-Smith**, CM Efferson, DH Van Vuren. 2006 Evidence for local specialization in a generalist mammalian herbivore, *Neotoma fuscipes.* Oikos 113: 440-448

Suchanek, TH, PJ Richerson, DC Nelson, **CA Eagles-Smith**, DW Anderson, JJ Cech, Jr., G Schladow, R Zierenberg, JF Mount, SC McHatton, DG Slotton, LB Webber, AL Bern, and BJ Swisher. 2003. Evaluating and managing a multiply-stressed ecosystem at Clear Lake, California: A holistic ecosystem approach. In: Managing For Healthy Ecosystems, Case Studies; CRC/Lewis Press, Boca Raton, FL, USA.

JOHN Y. TAKEKAWA

U.S. Geological Survey, Western Ecological Research Center, San Francisco Bay Estuary Field Station, 505 Azuar Drive, Vallejo, CA 94592, 707/562-2000, john_takekawa@usgs.gov

EDUCATION

Ph.D., 1987 Animal Ecology, Iowa State University, Ames
M.S., 1982 Fish and Wildlife Resources, University of Idaho, Moscow
B.S., 1979 Forestry and Wildlife Science, University of Washington, Seattle

RELEVANT EXPERIENCE TO THIS PROJECT

I established the San Francisco Bay Estuary Field Station of the USGS Western Ecological Research Center in 1995 to conduct research on waterbirds and their habitats in an ecosystem of international significance for migratory birds. My station has led several projects to examine the movements and habitat use of migratory species within the estuary. Our station has led a large part of the ongoing bird monitoring and adaptive study support for the South Bay Salt Pond Restoration Project, as well as for the Napa and Sonoma Marshes Restoration Project. I am a co-investigator on the recent studies of gull movements in the South Bay that were determined with radio telemetry.

EXPECTED CONTRIBUTIONS TO THIS PROJECT

I will participate in the research project as a co-investigator, focused on integrating this project with ongoing adaptive management, and participating in analyzing and reporting project results in publications.

PROFESSIONAL EXPERIENCE

May 2008-present: Research Biologist (GS-15), San Francisco Bay Estuary Field Station, Western Ecological Research Center, USGS, in Vallejo, CA; Oct 2004-Apr 2008: Research Biologist (GS-14), USGS WERC, Vallejo, CA; Oct 1997-Sep 2004: Research Biologist (GS-13), USGS WERC, Vallejo, CA; Aug 1995 - Sep 1997: Research Biologist, SFBE Station Chief, National Biological Service, California Science Center, Vallejo, CA; Jan 1995 - Aug 1995: Wildlife Biologist (Research), National Biological Service, California Pacific Science Center, Dixon, CA; Oct 1993 - Dec 1994: Wildlife Biologist (Research), National Biological Survey, California Pacific Science Center, Dixon, CA; Oct 1986 - Oct 1993: Wildlife Biologist (Research), USFWS, Northern Prairie Wildlife Research Center, Pacific States Ecology Field Station, Dixon, CA; Aug 1982 - Sep 1986: Wildlife Biologist, FWS, NPWRC, Upper Mississippi River Field Station, LaCrosse, WI; Aug 1983 - Jun 1986: Research & Teaching Assistant, Iowa State University, Department of Animal Ecology, Ames, IA; Jun 1979 - May 1982: Graduate Research Assistant, University of Idaho, Department of Fisheries and Wildlife, Moscow, ID.

PUBLICATIONS *ten selected publications*

Takekawa, J. Y., A. K. Miles, D. H. Schoellhamer, D. C. Tsao-Melcer, S. Fregien, and N. D. Athearn. *In press.* Dietary flexibility in three representative waterbirds across salinity and depth gradients in salt ponds of San Francisco Bay. Hydrobiologia.

Foxgrover, A. C., P. Dartnell, B. E. Jaffe, J. Y. Takekawa, and N. D. Athearn. 2007. High-resolution bathymetry and topography of south San Francisco Bay, California: U. S. Geological Survey Scientific Investigations Map 2987, 1 sheet. [http://pubs.usgs.gov/sim/2007/2987].

Takekawa, J. Y., A. K. Miles, D. H. Schoellhamer, N. D. Athearn, C. Jannusch, M. K. Saiki, W. D. Duffy, and S. Kleinschmidt. 2006. Trophic structure and avian communities across a salinity gradient in evaporation ponds of the San Francisco Bay estuary. Hydrobiologia 567: 307-327.

JOHN Y. TAKEKAWA

U.S. Geological Survey, Western Ecological Research Center, San Francisco Bay Estuary Field Station, 505 Azuar Drive, Vallejo, CA 94592, 707/562-2000, john_takekawa@usgs.gov

Poulton, V.K., J. R. Lovvorn, and J. Y. Takekawa. 2004. Spatial and overwintering changes in clam populations of San Pablo Bay, a semiarid estuary with highly variable freshwater inflow. Estuarine, Coastal, and Shelf Science, 59: 459-473

Warnock, S. E., and J. Y. Takekawa. 1995. Habitat preferences of wintering shorebirds in a temporally changing environment: western sandpipers in the San Francisco Bay estuary. Auk 112:920-930.

Williams, T.D., N. Warnock, J. Y. Takekawa, and M. A. Bishop. 2007. Flyway scale variation in plasma triglyceride levels as an index of refueling rate in spring migrating western sandpipers (Calidris mauri). Auk 124: 886-897.

Bishop, M.A., N. Warnock, and J. Y. Takekawa. 2004. Differential spring migration by male and female Western Sandpipers at interior and coastal stopover sites. Ardea 92(2): 185-196.

Warnock, N., J. Y. Takekawa, and M. A. Bishop. 2004. Migration and stopover strategies of individual Dunlin along the Pacific coast of North America. Can. J. Zool. 82: 1687-1697.

Poulton, V. K., J. R. Lovvorn, and J. Y. Takekawa. 2002. Clam density and scaup feeding behavior in San Pablo Bay, California. Condor 104: 518-527.

Frederick, R. B., W. R. Clark, and J. Y. Takekawa. 1992. Application of a computer simulation model to migrating white-fronted geese in the Klamath Basin. Pages 696-706 *in* D. R. McCollough and R. H. Barrett (eds.). Wildlife 2001: populations. Elsevier, NY.

NICOLE D. ATHEARN

U.S. Geological Survey, Biological Resources Discipline, Western Ecological Research Center, San Francisco Bay Estuary Field Station, Vallejo, CA, 707/562-2002, nathearn@usgs.gov

EDUCATION

Ph.D. Ecology. University of California, Davis (2011)

M.S. Wildlife Ecology; Certificate, Geographic Information Systems. Oklahoma State University, Stillwater (2002)

B.S. Wildlife, Fisheries, and Conservation Biology. University of California, Davis (1996).

RELEVANT EXPERIENCE TO THIS PROJECT

I have led the USGS salt pond ecology program at the USGS San Francisco Bay Estuary Field Station since 2002. I am particularly interested in the integration of science and management, and the focus of my current work is to develop models and tools that can be used for the management of salt ponds as bird habitat. I earned a certificate in Geographic Information Systems in 2002 and am experienced with conducting the GIS-based analyses needed for this study. Additionally, I am familiar with South Bay waterbirds and habitats as I have led the collection of monthly bird data and water quality data at all South Bay Salt Pond Restoration Project (SBSPRP) ponds since 2002.

EXPECTED CONTRIBUTIONS TO THIS PROJECT

I will lead field surveys of island location and elevation and will process the data to derive elevation models of islands. I will generate the GIS-based spatial data required for analysis of island use relative to island morphometrics, identify specific islands for surveys, and assist in leading surveys of foraging bird use at focal islands.

PROFESSIONAL EXPERIENCE

Wildlife Biologist, USGS, BRD, WERC, San Francisco Bay Estuary Field Station (7/02-present)

PUBLICATIONS:

I have authored 8 peer-reviewed journal papers, 10 technical reports, and 32 scientific presentations. Below is a selected list of relevant publications.

Ackerman, JT, JY Takekawa, C Strong, **N Athearn**, and A Rex. 2006. California Gull distribution, abundance, and predation on waterbird eggs and chicks in South San Francisco Bay. Final Report, U. S. Geological Survey, Western Ecological Research Center, Davis and Vallejo, CA 61 pp.

Athearn, ND, and JY Takekawa. 2006. Avian Data Summaries and Analyses from Short-term Data Needs, 2003-2005. Unpubl. Rep., U. S. Geological Survey, Vallejo, CA. 183 pp.

Athearn, ND, JY Takekawa, and JM Shinn. Avian response to early tidal salt marsh restoration at former commercial salt evaporation ponds in San Francisco Bay, California, USA. *In* Oren, A., Naftz, D.L., and Wurtsbaugh, W.A. (eds.). 2009. Saline lakes around the world: unique systems with unique values. The S.J. and Jessie E. Quinney Natural Resources Research Library, published in conjunction with the Utah State University College of Natural Resources, in press.

Athearn, ND, JY Takekawa, B Jaffe, BJ Hattenbach, and AC Foxgrover. 2009. Mapping bathymetry of tidal wetland restoration sites in San Francisco Bay: comparing accuracy of aerial LiDAR with a singlebeam echosounder. Journal of Coastal Research, in press.

Foxgrover, AC, P Dartnell, BE Jaffe, JY Takekawa, and **ND Athearn**. 2007, High-resolution bathymetry and topography of south San Francisco Bay, California: U.S. Geological Survey Scientific Investigations Map 2987, 1 sheet. [http://pubs.usgs.gov/sim/2007/2987].

Hickey, C, N Warnock, J Takekawa, and **N Athearn**. 2007. Space use of black-necked stilts in the San Francisco Bay Estuary. Ardea 95: 275-288.

Miles, AK, JY Takekawa, DH Schoellhamer, SE Spring, **ND Athearn**, GG Shellenbarger, and DC Tsao. 2004. San Francisco Bay Estuary Salt Ponds Progress Report 2001 – 2003, Priority Ecosystem Science Program, USGS/USFWS (CNO) Science Support Program. Unpubl. Prog. Rep., U. S. Geological Survey, Davis and Vallejo, CA. 67pp.

Shellenbarger, GG, **ND Athearn**, JY Takekawa, and AB Boehm. 2008. Fecal indicator bacteria and Salmonella in ponds managed as bird habitat, San Francisco Bay, California, USA. Water Research 42: 2921-2930.

Shellenbarger, GG, DH Schoellhamer, TL Morgan, JY Takekawa, **ND Athearn**, and KD Henderson. 2008. Dissolved oxygen in Guadalupe Slough and Pond A3W, South San Francisco Bay, California, August and September 2007: U.S. Geological Survey Open-File Report 2008–1097, 26 pp.

Takekawa, JY, DH Schoellhamer, AK Miles, GG Shellenbarger, **ND Athearn**, SE Spring, MK Saiki, and CA Jannusch. 2004. Initial biophysical changes after breaching a salt pond levee: final report on the Napa-Sonoma Wildlife Area Pond 3 breach. Unpubl. Progr. Rep., U. S. Geological Survey, Vallejo, CA. 42pp.

Takekawa, JY, AK Miles, **ND Athearn**, SE Spring, MK Saiki, F Mejia, I Woo, and KS Goodenough. 2005. Habitat Restoration Monitoring for the Napa-Sonoma Marsh Restoration Project, Progress Report 2005. Unpubl. Prog. Rep., U. S. Geological Survey, Vallejo, CA. 78pp.

Takekawa, JY, AK Miles, DH Schoellhamer, B Jaffe, **ND Athearn**, SE Spring, GG Shellenbarger, MK Saiki, F Mejia, and MA Lionberger. 2005. South Bay Salt Ponds Restoration Project Short-term Data Needs, 2003-2005. Unpubl. Final Rep., U. S. Geological Survey, Vallejo, CA. 270 pp.

Takekawa, JY, **ND Athearn**, BJ Hattenbach, and AK Schultz. 2006. Bird Monitoring for the South Bay Salt Pond Restoration Project. Unpubl. Final Prog. Rep., U. S. Geological Survey, Vallejo, CA. 74pp.

Takekawa, JY, **ND Athearn**, AK Miles, SE Spring, MK Saiki, F Mejia, I Woo, AK Schultz, and B Hattenbach. 2006. Habitat Restoration Monitoring for the Napa-Sonoma Marshes Restoration Project. Unpubl. Final Prog. Rep., U. S. Geological Survey, Vallejo, CA. 114pp.

Takekawa, JY, AK Miles, DH Schoellhamer, **ND Athearn**, MK Saiki, WD Duffy, S Kleinschmidt, GG Shellenbarger, and CA Jannusch. 2006. Trophic structure and avian communities across a salinity gradient in evaporation ponds of the San Francisco Bay estuary. Hydrobiologia 567: 307-327.

Takekawa, JY, DT Melcer, **ND Athearn**, AK Miles, and DH Schoellhamer. 2009. Dietary Flexibility of Waterbirds across Salinity and Depth Gradients in Salt Ponds of San Francisco Bay. Hydrobiologia, in press.

Takekawa, J, I Woo, ND Athearn, S Demers, R Gardiner, W Perry, N Ganju, G Shellenbarger, and D Schoellhamer. Measuring sediment accretion in early tidal marsh restoration. Wetlands Ecology and Management, submitted.

JILL BLUSO DEMERS

San Francisco Bay Bird Observatory, 524 Valley Way, Milpitas, CA, 408/946-6548, jdemers@sfbbo.org

EDUCATION

M.S. Natural Resources: Wildlife. Humboldt State University (2007).
B.A. Biology. Colby College (2002).

RELEVANT EXPERIENCE TO THIS PROJECT

As the Science Programs Director at San Francisco Bay Bird Observatory, I oversee research projects centered on the migratory, wintering, and avian ecology of waterbirds in South Bay salt ponds. I have studied avian ecology in the San Francisco Bay estuary for 6 years and my research has focused on the spatial and reproductive ecology of Forster's Terns, Avocets, Stilts, the effects of landfills on California Gull reproductive and foraging ecology, and other aspects of avian biology related to the South Bay Salt Ponds Restoration.

EXPECTED CONTRIBUTIONS TO THIS PROJECT

I will assist project leads in coordinating nesting studies and data collection, and summarizing, analyzing, and reporting project results.

PROFESSIONAL EXPERIENCE

Science Programs Director, San Francisco Bay Bird Observatory (8/08-present)
Biologist, USGS, BRD, WERC, UC Davis Field Station (7/07-8/08)
Graduate Researcher, Wildlife Department, Humboldt State University (8/04-07/07)
Biological Sciences Technician, USGS, BRD, WERC, San Francisco Estuary Field Station (02/03-08/04)

PUBLICATIONS: *I have authored 5 peer-reviewed journal papers, 1 popular article, 4 technical reports, and 24 scientific presentations. Below is a selected list of publications.*

Bluso-Demers, J.D., J.T. Ackerman, and J.Y. Takekawa. Colony Attendance Patterns by mated Forster's Terns using an automated data-logging receiver system. Ardea, submitted

Ackerman, J. T., **J. D. Bluso-Demers**, and J. Y. Takekawa. Postfledging Forster's tern movements, habitat selection, and colony attendance in San Francisco Bay. Condor, submitted.

Bluso-Demers, J.D., J.T. Ackerman, and J.Y. Takekawa. Habitat selection by Forster's Terns at multiple scales in San Francisco Bay: the importance of salt ponds. Auk, submitted

Bluso-Demers, J.D., M.A. Colwell, J.Y. Takekawa, and J.T. Ackerman. 2008. Space use by Forster's Terns breeding in South San Francisco Bay. Waterbirds 31: 357-364.

Ackerman, J.T., J.T. Takekawa, **J.D. Bluso**, J.L. Yee, and C.A. Eagles-Smith. 2008. Gender determination of Caspian Terns using external morphology and discriminant function analysis. Wilson Journal of Ornithology 120: 378-383

Ackerman, J.T., C.A. Eagles-Smith, J.T. Takekawa, **J.D. Bluso**, T.A. Adelsbach. 2008. Mercury Concentrations in Blood and Feathers of Prebreeding Forster's Terns in Relation to Space Use of San Francisco Bay Habitats. Environmental Toxicology and Chemistry 27: 897-908.

Ackerman, J.T., C.A. Eagles-Smith, J.T. Takekawa, S.D. Demers, T.A. Adelsbach, **J.D. Bluso**, K.A.

Miles, N. Warnock, T.H. Suchanek, S.E. Schwarzbach. 2007. Mercury concentrations and space use of pre-breeding American Avocets and Black-necked Stilts in San Francisco Bay. Science of the Total Environment 384: 452-466.

Bluso, J. D., J.T. Ackerman, J. Y. Takekawa, and J.L. Yee. 2006. Sexing Forster's Terns using morphometric measurements. Waterbirds 29: 511-516.