

Project Title:

Climate-Driven Geomorphic Alteration of Intertidal Foraging Habitats for Migratory Birds in the San Francisco Bay Estuary

Project Leader:

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Scope & Budget:

Location: San Francisco Bay\Delta
Duration in months: 15
Requested Funding: \$100,000.00
Leveraged Funding: \$205,116.20

Partners:

Primary Project Team (PIs): Dr. Bruce Jaffe, Research Oceanographer, USGS Pacific Coastal Marine Science Center; Dr. John Takekawa, Research Wildlife Biologist, USGS Western Ecological Research Center; Dr. Mick van der Wegen, Research Coastal Engineer, UNESCO-IHE; Dr. Jan Roelvink, Research Coastal Engineer, UNESCO-IHE; Ms. Amy Foxgrover, Oceanographer, USGS Pacific Coastal Marine Science Center; Dr. Susan De La Cruz, Wildlife Biologist, USGS Western Ecological Research Center; Ms. Isa Woo, Wetlands Biologist, USGS Western Ecological Research Center; Collaborative Partners: Dr. Neil Ganju, USGS Woods Hole Coastal Marine Science Center; Ms. Ariel Rowan, California State University San Francisco; Dr. David Schoellhamer, USGS California Water Science Center; CASCaDE II Project (Delta Science Program); South Bay Salt Pond Restoration Program San Francisco; Bay Conservation and Development Commission; State Coastal Conservancy; San Francisco Bay Subtidal Habitats Project; San Francisco Bay Joint Venture

Briefly summarize the goals of the project, what products will result, and how the products support decision-making and conservation delivery for natural resource management within the CA LCC.

This project is a continuation of the 2010 LCC Project to evaluate the effects of global climate change and sea level rise (SLR) on intertidal shoals in the San Francisco Bay (SFB) estuary and the migratory waterbirds that rely on this critically important resource in the Pacific Flyway. This research would build on the USGS CASCaDE II project by quantifying the impacts to waterbirds of climate and SLR induced geomorphic changes in south SFB shoals. Our primary objectives are to: 1) use downscaled global climate change models to translate SLR and climate scenarios into habitat quantity predictions through Delft3D and Dflow-FM (unstructured grid) geomorphic modeling in South SFB; 2) model the response of avian prey (i.e. benthic invertebrates) to intertidal flat geomorphology and area changes; 3) model shorebird and waterfowl response to geomorphic and invertebrate change; 4) integrate predictive changes in habitat quantity and prey abundance to generate spatially-explicit assessments of avian response to changes expected from climate change and SLR. Our products include Digital Elevation Models of south SFB shoals; Delft 3D models of south SFB to link with Delta and north Bay models; assessment of south SFB wave energy, tidal currents, and sediment flux; waterfowl and shorebird carrying capacity models; and assessment of waterbird habitat change under different scenarios of SLR and climate change. Our study answers the management question “how will climate change and SLR affect the intertidal shoal habitats critical for the health of migratory birds in coastal estuaries?” This project would provide the first data addressing this pivotal question, and would inform conservation and restoration of migratory bird habitat, including the on-going South Bay Salt Ponds Restoration Project. The approach to assessing SLR and climate effects on waterbirds developed in this project is transferable to other areas within California and along the Pacific coast. Additionally, our project integrates with efforts to project SLR and sediment dynamics in tidal wetlands, which form a continuum with intertidal mudflats and shallow subtidal habitats. Understanding the dynamic interactions among these habitats will improve our ability to model and manage critical areas for migratory birds.

For continuing 2011 CA LCC projects, describe the accomplishments and outcomes to date, why additional funds are needed, and what this proposal will add to the project.

On 26-27 October 2010, we hosted a workshop in Berkeley, California entitled “Modeling Effects of Sea Level Rise on the Ecology of Shoals and Migratory Birds” that included invited speakers, research scientists, and stakeholder resource

managers. A comprehensive report incorporating first year project deliverables was released to the LCC and interested parties (www.werc.usgs.gov/Productdetails.aspx?ID=4200). Results from the workshop and first year objectives of this LCC Project have shown that modeling sea level rise effects on shoals and vertebrate predators is feasible by adapting current models and would be very valuable in understanding the effects of future sea level rise in San Francisco Bay. Results from the discussions also indicated that modeling sea level rise effects on shoals in the San Francisco Bay is timely with several complementary projects, particularly the newly funded CASCaDE II Project. ROMS modeling grids developed for Suisun Bay as part of CASCaDE were provided by Ganju, and we evaluated existing grids and methods for quantifying key metrics of habitat change in the South Bay. A series of metrics for habitat change may be created by analyzing geomorphic change from these scenarios, however, existing output from hydrodynamic-sediment transport geomorphic models (both ROMS and Delft3D) are too coarse. We will assess shoals habitat metrics at a finer scale, in order to accurately translate to invertebrate prey and resulting foraging bird response. A comprehensive review of shoal habitats and foraging birds was conducted to help guide future directions for modeling. A bibliography of over 300 scientific journal articles were provided and are being incorporated into a scientific review paper. The literature review presents abiotic influences on avian food supply and prey accessibility, bird foraging responses to variability in prey resources, landscape influences on habitat suitability, effects of carrying capacity and ecological cascades, threats to mud flat and shoal ecosystems, the role of restoration and alternative habitats, and priorities for research and management. Current project funds are depleted and additional funds will allow for model development and running initial scenarios. The continuation project will build on knowledge gained during the first year.

Briefly describe how the project team (main PIs) provides the range of experience, expertise, and organizational capacity needed to accomplish the project.

This project will be led by a multi-disciplinary team of investigators. The lead investigator (B. Jaffe) has conducted research on sedimentation and shallow water habitats in the SFB estuary for the past 17 years. He is currently working in SFB on intertidal geomorphic evolution and mercury remobilization from Alviso Slough scour (2 yrs, 10% time, \$190K), Corte Madera wetland response to sea level rise (2 yrs., 10% time, \$221K), and CASCaDE (3 yrs, 15% time, \$201K). J. Takekawa has conducted research on wetlands and waterbirds on the Pacific coast for the past 25 years. He is currently working on shoals ecology augmentation (2 yrs, 10% time, \$219K), the SFB PES Program (2 yrs, 10% time, \$135K), and the USGS National Climate Change and Wildlife Science Center Program (3 yrs, 15% time, \$254k). The research team includes hydrologic, sediment-transport and geomorphological modelers D. Roelvink and M. van der Wegen (UNESCO-IHE). Van der Wegen is the lead modeler for the CASCaDE project. Avian and invertebrate experts include I. Woo, a wetland biologist with 10 years of experience in SFB and S. De La Cruz, a benthivore specialist with over 15 years of experience conducting research in SFB.

Identify which National LCC Performance Measure(s), if any, your project addresses.

A risk and vulnerability assessment
Inventory and monitoring protocols
A population and habitat assessment
A management evaluation action

California Landscape Conservation Cooperative 2012 Proposal Budgets

Budget Categories	CA LCC Request	Partner(s) Contribution(s) (monetary)	Partner(s) Contribution(s) (non-monetary value/in-kind)	Total
Salaries	\$ 73,623.50	\$ -	\$ 181,116.20	\$ 254,739.70
Supplies	\$ 651.00	\$ -	\$ 1,500.00	\$ 2,151.00
Overhead	\$ 24,225.50	\$ -	\$ -	\$ 24,225.50
Equipment	\$ -	\$ -	\$ 16,000.00	\$ 16,000.00
Other (specify)	\$ 1,500.00	\$ -	\$ 6,500.00	\$ 8,000.00
Total	\$ 100,000.00	\$ -	\$ 205,116.20	\$ 305,116.20

Other:

Project requests \$1500 for travel to partner meetings and research sites. In-kind contribution of \$6,500 for 'other' includes \$2500 from the SFB Priority Ecosystem Science Program and \$4000 from the USGS CASCaDE II Project (Delta Science Program). Total project contributed in-kind funds are from CASCaDE II Project (Delta Science Program, \$75K in-hand), SFB Priority Ecosystem Science Program (\$134K in-hand), SCC Living Shorelines (\$160K in-hand), Coastal Systems Program - USGS Pacific Coastal and Marine Science Center (\$30K in-hand).

California Landscape Conservation Cooperative 2012 Proposal Budgets

Digital Elevation Model of South SF Bay Intertidal Habitats

Budget Categories	CA LCC Request	Partner(s) Contribution(s) (monetary)	Partner(s) Contribution(s) (non-monetary value/in-kind)	Total
Salaries	\$ 4,840.50	\$ -	\$ 8,000.00	\$ 12,685.00
Supplies	\$ -	\$ -	\$ -	\$ -
Overhead ^a	\$ 1,863.59	\$ -	\$ -	\$ 1,911.48
Equipment	\$ -	\$ -	\$ 2,000.00	\$ 2,000.00
Other (specify)	\$ -	\$ -	\$ -	\$ -

Total	\$ 6,704.09	\$ -	\$ 10,000.00	\$ 16,704.09
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a = Indirect cost calculated at DOI client 38.501% for FY12

Other:

In-kind partner contributions of \$10,000 toward salary and equipment costs are available through SFB Coastal Systems of the Pacific Coastal and Marine Science Center (in-hand).

California Landscape Conservation Cooperative 2012 Proposal Budgets

Delft3D/Unstruc Model for South SF Bay Developed, Calibrated and Linked to CASCaDE

Budget Categories	CA LCC Request	Partner(s) Contribution(s) (monetary)	Partner(s) Contribution(s) (non-monetary value/in-kind)	Total
Salaries	\$ 16,150.00	\$ -	\$ 46,000.00	\$ 62,000.00
Supplies	\$ 251.00	\$ -	\$ -	\$ 200.00
Overhead ^a	\$ 6,507.05	\$ -	\$ -	\$ 6,813.60
Equipment	\$ -	\$ -	\$ -	\$ -
Other (specify)	\$ 500.00	\$ -	\$ 4,000.00	\$ 4,500.00
Total	\$ 23,408.05	\$ -	\$ 50,000.00	\$ 73,408.05

a = Indirect cost calculated at DOI client 38.501% for FY12

Other:

Project requests \$500 for travel to partner meetings and research sites. In-kind contribution of \$4,000 from CASCaDE II Project (Delta Science Program). Additional \$46,000 in-kind support toward salaries, supplies, and equipment also will be provided through CASCaDE II Project (Delta Science Program)

California Landscape Conservation Cooperative 2012 Proposal Budgets

Assessment of South SF Bay Wave Energy, Tidal Currents, and Sediment Flux

Budget Categories	CA LCC Request	Partner(s) Contribution(s) (monetary)	Partner(s) Contribution(s) (non-monetary value/in-kind)	Total
Salaries	\$ 13,822.00	\$ -	\$ 18,000.00	\$ 31,662.00
Supplies	\$ 200.00	\$ -	\$ -	\$ 200.00
Overhead ^a	\$ 5,591.12	\$ -	\$ -	\$ 5,859.70
Equipment	\$ -	\$ -	\$ 2,000.00	\$ 2,000.00
Other (specify)	\$ 500.00	\$ -	\$ -	\$ 500.00
Total	\$ 20,113.12	\$ -	\$ 20,000.00	\$ 40,113.12

a = Indirect cost calculated at DOI client 38.501% for FY12

Other:

Project requests \$500 for travel to partner meetings and research sites. In-kind partner contribution of \$20,000 in salary and equipment costs are available through Coastal Systems of the Pacific Coastal and Marine Science Center.

California Landscape Conservation Cooperative 2012 Proposal Budgets

Habitat and Carrying Capacity Models for South SF Bay Shoals

Budget Categories	CA LCC Request	Partner(s) Contribution(s) (monetary)	Partner(s) Contribution(s) (non-monetary value/in-kind)	Total
Salaries	\$ 34,818.00	\$ -	\$ 84,116.20	\$ 118,934.60
Supplies	\$ 200.00	\$ -	\$ 1,500.00	\$ 1,700.00
Overhead ^a	\$ 8,533.89	\$ -	\$ -	\$ 8,533.98
Equipment	\$ -	\$ -	\$ 12,000.00	\$ 12,000.00
Other (specify)	\$ -	\$ -	\$ 2,500.00	\$ 2,500.00

Total	\$ 43,551.89	\$ -	\$ 100,116.20	\$ 143,668.09
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a = Indirect cost calculated at DOI client 24.37% for FY12

Other:

In kind partner contribution of \$100,000 in salary, equipment, and other costs (travel to field sites) are available through SFB Priority Ecosystem Science Program funding (\$134K) and SCC Living Shorelines (\$160K) Funding to the Western Ecological Research Center.

California Landscape Conservation Cooperative 2012 Proposal Budgets

Preliminary Assessment of Habitat Change Due to Scenarios of Sea Level and Climate Change

Budget Categories	CA LCC Request	Partner(s) Contribution(s) (monetary)	Partner(s) Contribution(s) (non-monetary value/in-kind)	Total
Salaries	\$ 3,993.00	\$ -	\$ 25,000.00	\$ 28,793.00
Supplies	\$ -	\$ -	\$ -	\$ -
Overhead ^a	\$ 1,729.85	\$ -	\$ -	\$ 1,751.54
Equipment	\$ -	\$ -	\$ -	\$ -
Other (specify)	\$ 500.00	\$ -	\$ -	\$ 500.00
Total	\$ 6,222.85	\$ -	\$ 25,000.00	\$ 31,222.85

a = Indirect cost calculated at DOI client 38.501% for FY12

Other:

Project requests \$500 for travel to partner meetings. In kind contribution of \$25,000 toward salary costs will be provided through associated for the CASCaDE II Project (Delta Science Program).

Project Description:

The invertebrate-rich intertidal habitats of San Francisco Bay (SFB) make this estuary one of the most important wintering and stopover areas for migratory birds on the Pacific coast (Page et al. 1999, USFWS 2010). Understanding the quality and quantity of this SFB habitat and how it varies with the projected effects of climate change is vital to waterbird management. This project is a continuation of a 2010 CA LCC Project to evaluate the effects of global climate change and sea-level rise on intertidal habitats in the SFB estuary and on the migratory waterbirds that rely on this critically important resource in the Pacific Flyway. This research complements CASCaDE II (Computational Assessments of Scenarios of Change for the Delta Ecosystem II), a broad-scope assessment of scenarios of change in the SFB-Delta watershed that does not include impacts to avian species and does not model sediment dynamics and geomorphic change for the South SFB. Our primary objectives are to: 1) use downscaled global climate change models to translate sea-level rise and climate scenarios into habitat quantity predictions through Delft3D and D-Flow-FM (unstructured grid) geomorphic modeling in South SFB; 2) model the response of avian prey (i.e. benthic invertebrates) to intertidal flat changes in area and geomorphology; 3) model shorebird and waterfowl response to geomorphic and invertebrate change; and 4) integrate predictive changes in habitat quantity and prey abundance to generate spatially-explicit assessments of avian response to changes expected from climate change and sea-level rise.

Specific products that will result from our work include: 1) a Digital Elevation Model (DEM) of current South SFB shoals posted online; 2) Delft 3D/D-Flow FM model for the South SFB developed, calibrated and linked with CASCaDE grid; 3) an assessment of South SFB wave energy, tidal currents, and sediment flux; 4) waterbird habitat and carrying capacity models for South SFB intertidal zone that relates mudflat geomorphology, invertebrate prey, and birds; 5) a preliminary assessment of habitat change due to three scenarios of sea-level rise and climate change.

Our study would provide the first data addressing the effects of climate change and sea-level rise on intertidal shoal habitats critical for the health of migratory birds in coastal estuaries. The approach to assessing sea-level rise and climate effects on waterbirds developed in this project is transferable to other areas within California and the Pacific coast. Additionally, our project integrates with efforts to project sea-level rise and sediment dynamics in tidal wetlands, which form a continuum with intertidal mudflats and shallow subtidal habitats. Understanding the dynamic interactions among these habitats will improve our ability to model and manage critical areas for migratory birds.

CA LCC Priorities Addressed:

Decision Support for Managers (Synthesis, Translation, Integration, Tools and Modeling): Future scenarios involve assessing the influences of sea-level rise and climate change at the landscape scale that may threaten the resiliency of shoal and marsh habitats. Our proposed project informs decision-support systems by developing indicators at each modeling step. This project predicts climate effects according to ecological baselines in order to guide long-term monitoring and restoration programs in intertidal, subtidal and marsh ecosystems.

By incorporating effects on migratory birds (see Fig. 1) our project will add value to the collaborative, ongoing CASCaDE I and II efforts to model the cascading effects of climate change in SFB. Our work would extend the application of these models, and provide critical information to the multiple agencies and non-profits involved in migratory bird conservation and management in SFB.

Our project builds on down-scaled outputs from current Global Climate Change modeling (CASCaDE I and II) to provide resource managers with vital information on waterbird population responses to sea-level rise, altered freshwater flow (including increased storm surge events) and sediment supply that will help them plan management actions accordingly. This information will be directly applicable to managers working on the South Bay Salt Pond Restoration Project (see letter from J. Bourgeois). Other managers and public entities that would specifically benefit from our research include: the U.S. Fish and Wildlife Service (Div. of Migratory Birds Management, SFB National Wildlife Refuges among others), CA Depart Fish & Game (Marine Life Protection Act (MPA) planning for SFB), Bay Conservation and Development Commission

(Subtidal Habitat Goals), U.S. Army Corps of Engineers (South Bay Shoreline Study), CA State Coastal Commission (Living Shorelines Nearshore Linkages project), Department of Water Resources, Delta Science Program (a funder of the CASCaDE project), as well as non-governmental organizations concerned with waterbird populations along the Pacific Flyway.

Ecosystem Impact and Response, and Tracking Change Specific to Manager Needs:

The impacts of sea-level rise, climate change, and current and planned management on intertidal and shallow subtidal habitats and their associated bird and prey populations in South San Francisco Bay will be assessed at regional and local-site scales. Scenarios that vary the amount of sea-level rise and frequency of severe storm events will be modeled to determine potential geomorphic response and resulting biological effects. The outcomes of these various spatially-explicit scenarios can be used in conjunction with land-use change projections to evaluate habitat loss and determine critical areas to consider for restoration or protection to benefit migratory birds.

Our carrying capacity models will be used to predict and monitor changes in habitat quality over time. These models will establish the current baseline resource value of the estuary and can be used in the future to monitor how indicator shorebird and waterfowl populations are affected by changing conditions. The sensitivities of vertebrate populations to different scenarios and outputs from physical models will be essential metrics for guiding management. Additionally, our spatially explicit sediment, hydrologic, and carrying capacity models provide methods for mapping habitat change at a regional scale that can also be applied to intertidal habitats statewide.

CA LCC Criteria Addressed:

- 1) *Addresses Natural Resource Management Need:* San Francisco Bay is one of the most important wintering and stopover areas for migratory birds on the Pacific Coast. Understanding how habitat quality may change is vital to managing the SFB areas for avian species. Our efforts to model predicted changes in avian foraging habitats and associated carrying capacity will provide metrics to guide management and restoration, particularly for projects such as the South Bay Salt Pond Restoration Project.
- 2) *Ecosystem Response to Projected Change:* Our habitat change modeling will incorporate a range of potential sea-level rise and management scenarios in order to model sensitivities of the biological community.
- 3) *Integrative in Nature:* Our project integrates the assessment of sea-level rise, extreme storms, and geomorphic change effects across multiple taxa and trophic levels (phytoplankton, invertebrates, vertebrate predators).
- 4) *Accessibility:* Model findings will be released to a broad group of scientists and resource managers, and products will be available online for public access. Implicit to all our products will be clear explanations of model limitations, uncertainties, assumptions and applicable scales.
- 5) *Partnerships/Leveraging:* Models will use expertise and model output developed in the CASCaDE project. Partnerships (including matching funds) are numerous and listed throughout this proposal.
- 6) *Transferability:* The geomorphic models of shoals that we produce can be integrated with wetland sediment models (i.e. WARMER and other USGS hydrodynamic studies). Avian ecology of shoals can be linked with modeling of climate change effects in associated nesting and roosting habitats. Additionally, our avian models can apply to other soft-bottom intertidal and subtidal habitats across CA.
- 7) *Capacity:* We have assembled a highly experienced team to accomplish this proposal. Three of the scientists involved with this study (Jaffe, van der Wegen, and Roelvink) have expertise in geomorphic and hydrodynamic modeling and are PIs or investigators in the CASCaDE project. This allows seamless transfer of data and results between projects. Takekawa, De La Cruz, and Woo together have over 60 years of experience studying avian foraging ecology, habitat use and benthic invertebrate communities in SFB.

Scope of Work – Approach and Integration with Related Projects:

The study will quantify and map changes in availability of migratory waterbird habitats in estuaries caused by sea-level rise and the likely response of the birds to these changes. We will accomplish this through information derived from downscaled global climate models, geomorphologic models that generate intertidal extent and elevations, and foraging models informed by data collected in the South San Francisco Bay. A brief summary of each component follows.

Downscaled Global Climate Modeling

The CASCaDE project has developed data on the cascading effects of changes under different climate scenarios as they propagate from the climate system to watersheds to river networks to the Delta and San Francisco Bay (Cayan et al. 2008a, 2008b, 2008c, Ganju et al. 2008, Ganju and Schoellhamer 2010). The CASCaDE I model output is available now and is the input for the geomorphic model. CASCaDE II additionally involves the Delft-D-Flow FM model, incorporates hydrodynamic effects from ocean to river. This LCC Project will build on the on-going work with CASCaDE II in order to also evaluate climate change and sea-level rise effects on shoal ecosystems and vertebrates of the South San Francisco Bay.

Geomorphic Modeling

Changes in depth, due to sediment redistribution, and sea-level rise, alter the distribution of available habitat. Freshwater inflows and sediment supply needed for modeling are simulated from GCM output and combined with sea-level rise and estuarine hydrodynamics to estimate likely future geomorphic change (Ganju et al., 2009; Van der Wegen et al. 2008, Van der Wegen et al., 2011). These models are informed by research on historical intertidal changes in the northern San Francisco Estuary (Jaffe et al. 2007, Jaffe et al. 1998, Capiella et al. 1999). The same type of data will also allow calibration and validation of the geomorphic models in the South San Francisco Bay. GIS tools will be developed that integrate with the avian foraging model.

The influence of sediment size, tidal range, and wave exposure will be assessed at locations with characteristic profile shapes (Bearman et al., 2010) from around South San Francisco Bay. This work will be performed by a Masters student at UNESCO-IHE, The Netherlands, under the guidance of Dr. Mick van der Wegen and Prof. Dano Roelvink. Running simplified models of profile behavior will be helpful in identifying key driving processes of habitat change. 1D and 2DV models that explore cross-shore behavior and marsh response will be used to identify key sensitivities to parameterize in the larger model. An initial assessment of scenarios of shoals geomorphic change will be made by van der Wegen and Roelvink using both the 1-D results and the Delft3D modeling system (http://delftsoftware.wldelft.nl/index.php?option=com_content&task=view&id=109 and <http://www.wldelft.nl.soft/d3d/intro/>). The Delft3D modeling system will investigate sediment transport, hydrodynamics, and morphologic change by using a combination of the Delft 2DH (Roelvink et al. 2001) and 3D (Lesser et al. 2004, Winterwerp 2001). The coupled hydrodynamic, sand and mud transport models and morphology models within the Delft3D system will assess likely changes to habitats.

Foraging Modeling

The USGS Western Ecological Research Center (WERC) has investigated the foraging ecology of migratory birds in San Francisco Bay for over 20 years. We will apply our extensive existing datasets on foraging behavior, as well as the results of detailed shorebird and invertebrate prey surveys from the USGS Shoals Project and our knowledge of current and past baywide distribution of migratory waterbirds (Takekawa et al.

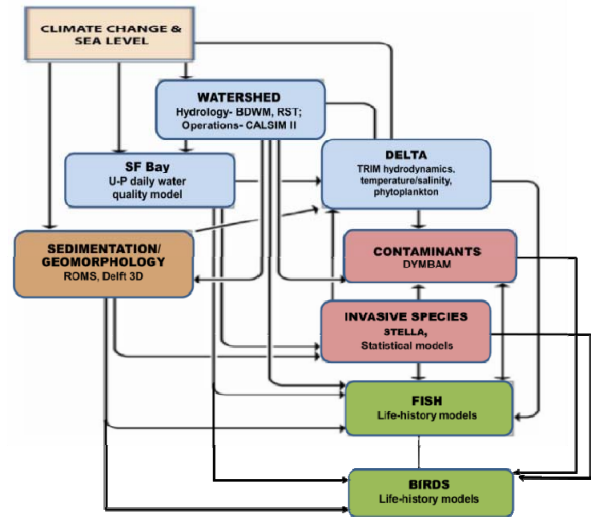


Figure 1. A modification of the CASCaDE conceptual model to incorporate additional effects on birds

2001, Takekawa et al. 2002, Warnock et al. 2002, Takekawa et al. 2006, Hickey et al. 2007, Takekawa et al. 2009, De La Cruz 2010) and model simulations to determine how sediment and morphological changes may affect community composition and availability of their macroinvertebrate food resources. We will use CANOCO 4 (ter Braak and Smilauer 1998) to perform canonical correspondence analyses (CCA; ter Braak 1986, ter Braak 1988) to reveal gradients in species composition and relate log-transformed macroinvertebrate abundance values to environmental variables (salinity, bed elevation, sediment grain size).

Models of South San Francisco Bay shoal carrying capacity will be parameterized with information from both prey-based and habitat-based models. Carrying capacity models determine the current baseline resource value of the estuary and can be used to estimate how vertebrate populations will be affected by changing conditions. The sensitivities of vertebrate populations to different scenarios and outputs from physical models will be essential metrics for guiding management. Habitat metrics include physical influences on avian foraging and prey accessibility (water depth, slope, movement of tide line, and sediment permeability), as well as factors determining the suitability of food sources. Density, distribution, biomass, and size classes of invertebrates are dependent on tidal inundation-exposure regime, predation pressure, water quality, benthic conditions, phytoplankton, and seasonally-variable external forcing factors.

We will use spatially-explicit geographic information system-based analyses (ArcGIS, ESRI Systems, Redlands, CA) to map expected macroinvertebrate densities in response to changing physical conditions and to compare the current and projected extent of shoal habitats through the next half of a century with our knowledge of foraging ecology of migratory birds to estimate likely functional and numerical responses to alteration of their foraging resources. Our goal is a spatially explicit evaluation of: a) quantitative change in habitat availability for key waterbird species, incorporating both climate change-driven changes in sediment distribution and increased sea-level rise; and b) change in distribution and relative abundance of waterbird species, incorporating changes in habitat quantity and quality (i.e., invertebrate food resource changes due to changes in salinity or sediment grain size).

Integration with related projects

Results from first year objectives of this LCC Project have shown that modeling sea-level rise effects on shoals and vertebrate predators is feasible by adapting current models and would be very valuable in understanding the effects of future sea-level rise in San Francisco Bay. A comprehensive data summary report incorporating all project deliverables was released to the LCC and other interested parties (Jaffe et al. 2011, see report at www.werc.usgs.gov). Current project funds are depleted and additional funds will allow for model construction and project expansion.

CASCaDE: Three of the scientists involved with this study (Jaffe, van der Wegen, and Roelvink) are PIs or investigators in the CASCaDE project (USGS 2007). This allows seamless transfer of data and results between projects. The CASCaDE II project involves the Delft-D-FLOW FM model to simulate hydrodynamics, sediment, geomorphology, salinity, and temperature along a continuum from ocean to river. This LCC project will further expand the scope to the South SFB shoals and associated avian communities.

USGS Shoals Project: The ongoing shoals project supported by the USGS WERC is the first to address intertidal habitats in a comprehensive, interdisciplinary project. A key uncertainty in the South Bay Salt Pond Restoration Project is the effect of restoration on the estuarine shoals that support most of the region's migratory birds and fishes. As the lead science support agency for the South Bay Salt Pond restoration project, USGS has taken a leadership role to ensure that the proper scientific foundation is developed to guide future restoration.

In advance of restoring the first salt pond (SF2) on the SFB National Wildlife Refuge, our USGS science team completed the first phase of sampling and instrumentation in the shoals adjacent to SF2 from late FY08 to mid FY09. Pond SF2 construction began in February 2009 and restoration to the Bay occurred in August 2010. USGS Menlo Park Science Center scientists applied advanced terrestrial light detection and ranging (LiDAR) surveys to map the shallows and part of SF2 in advance of the restoration. In FY2010, WERC conducted bird surveys of the Dumbarton shoals to determine mudflat use; monthly benthic invertebrate prey sampling and delineation; shorebird capture, sampling to examine diet (isotopes, emetics), and radio tracking; and remote instrumentation development (cooperative with Sun Labs). Bird surveys also were conducted at

Eden Landing and Alviso shoals to provide comparison data. During summer and fall 2010, South Bay Salt Ponds program funding was used to conduct pre-restoration invertebrate studies on the Alviso. USGS California Water Science Center scientists installed instruments on the Dumbarton Bridge and in the shallows to examine sediment movement and wind waves, and established a sediment station on a major tributary (Coyote Creek). USGS Coastal and Marine Science Center scientists used interferometric side-scan sonar to map the intertidal mudflats, the channel, and deeper shoal habitats. This effort also collected bottom sediment samples to provide grain size input needed for geomorphic models.

Carrying Capacity Modeling in San Francisco Bay: Models of carrying capacity have recently been developed for diving ducks of San Pablo Bay Shoals (Lovvorn et al. *submitted*, Lovvorn et al. 2010) and small sandpipers on the Dumbarton Shoals (Rowan et al. *in prep.*, Rowan 2010). Both of these projects involve LCC team members from USGS-WERC, allowing data and methods to be effectively linked to upcoming modeling efforts.

Products/Data Sharing:

Our primary products include: 1) Digital Elevation Model of current South San Francisco Bay shoals posted online; 2) Delft 3D/D-Flow FM model for the South San Francisco Bay developed, calibrated and linked with CASCaDE grid; 3) assessment of South San Francisco Bay wave energy, tidal currents, and sediment flux from San Bruno Shoals to Alviso; 4) waterbird habitat and carrying capacity models for South San Francisco Bay intertidal zone that relates mudflat geomorphology, invertebrate prey, and birds; 5) Preliminary assessment of habitat change due to three scenarios of sea level and climate change. All reports, modeling results and publications associated with our project will be posted on USGS websites.

Timetable:

	FY12 Q4	FY13 Q1	FY13 Q2	FY13 Q3	FY13 Q4
Create DEM for South SF Bay Shoals	X	X			
Develop, Calibrate, Link Delft3D/D-Flow FM to CASCaDE	X	X	X		
Model Wave Energy, Tidal Currents, and Sediment Flux		X	X	X	X
Model Shorebirds and Invertebrates with Habitat Parameters	X	X	X		
Develop Shorebird Carrying Capacity Model for South SF Bay			X	X	X
Conduct Preliminary Assessment of Habitat Change Effects					X
Meetings between Project Partners	X		X		X

Measuring Results:

Our performance metrics for FY13 will include successful completion of the following products: 1) DEM of South San Francisco Bay shoals, 2) Delft3D/D-Flow FM model linked to CASCaDE grid, 3) report of wave energy, tidal currents, and sediment flux South of San Bruno Shoals, 4) habitat relationship models of bird and invertebrate distributions in South San Francisco Bay, and 5) shorebird carrying capacity model for South San Francisco Bay shoals. Model progress and results will be posted online as each stage is complete. To assist habitat managers in planning and decision making, digital elevation models and maps displaying invertebrate densities and regional carrying capacity will be available on-line via USGS websites.

Literature Cited:

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13 May 2012

MANAGEMENT BOARD:

*Bay Area Audubon Council
Bay Area Open Space Council
Bay Planning Coalition
Citizens Committee to
Complete the Refuge
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Board, SF Bay Region
San Francisco Estuary Project
U.S. Army Corps of Engineers
U.S. Environmental
Protection Agency
U.S. Fish & Wildlife Service
U.S. Geological Survey
Wildlife Conservation Board*

Dear Ms. Fris:

I am pleased to send this letter of support by the San Francisco Bay Joint Venture (SFBJV) for the project entitled: "Climate-Driven Geomorphic Alteration of Intertidal Foraging Habitats for Migratory Birds in the San Francisco Bay Estuary," submitted by **Dr. Bruce Jaffe** (USGS PCMSC) for consideration of funding through the California Landscape Conservation Cooperative.

The SFBJV is one of 17 wetland habitat Joint Ventures operating under the certification of the North American Waterfowl Management Plan, a Congressional agreement between the United States, Canada, and Mexico. It is a partnership of non-governmental organizations, utilities, landowners, and non-voting agencies. The goal of the SFBJV is to protect, restore, increase and enhance all types of wetlands, riparian habitat and associated uplands throughout the San Francisco Bay region to benefit birds, fish and other wildlife. The Management Board consists of 27 agencies and private organizations whose members agree to support and promote the goal of the Joint Venture and who represent the diversity of wetlands interests found in the San Francisco Bay region.

The proposed interdisciplinary modeling study is a continuation of the 2010 LCC Project to evaluate the effects of global climate change and sea level rise on shoals in the San Francisco Estuary, and on migratory waterbirds that rely on this critically important resource in the Pacific Flyway. By incorporating available data on downscaled climate parameters, invertebrate prey, bird foraging dynamics and shoal geomorphology, models will project the effects of climate change and sea level rise on shoal habitats and highlight related effects on the health of migratory birds in coastal estuaries. This will be critical information for resource managers to assess how water bird populations will respond to sea level rise, altered freshwater flow and sediment supply, and help them plan management actions accordingly. Project results will also supply vital information to many stakeholders and Joint Venture partners involved in long-term planning and decision-making within the San Francisco Bay Estuary.

This effort represents an important step in achieving a baseline understanding of the significance of shoal habitats to Joint Venture target species, and the potential for permanent change to this vital habitat due to climate change related impacts, and as such addresses a priority research need outlined in the 2011 SFBJV Monitoring and Evaluation Plan. It ties in with a number of ongoing investigations on shorebirds and diving ducks supported by the Joint Venture, and the study will directly contribute significant information to implementing not only Joint Venture goals, but also those published in the 2010 San Francisco Bay Subtidal Habitat Goals report (<http://www.sfbaysubtidal.org/>). Beyond the critical application of the research in the San Francisco Bay, this integrated approach to assessing sea level rise and climate effects on shorebirds developed in this project is also transferable to other areas within California and the Pacific coast, and will be of great benefit to other wetland areas within the LCC.

The SFBJV Management Board would like to recommend this proposal as a funding priority for achieving Joint Venture goals, and urge you to strongly consider its potential to advance the management of high-value wetlands in an Estuary of hemispheric importance to shorebirds.

Sincerely,

Diane Ross-Leech
Chair, SFBJV Management Board



Making San Francisco Bay Better

May 15, 2012

Ms. Debra Schlafmann, Coordinator
California Landscape Conservation Cooperative
3020 State University Dr. East #2007
Sacramento, CA 95819

SUBJECT: Climate-Driven Alteration of Shoal Habitats for Migratory Birds in the
San Francisco Estuary

Dear Ms. Schlafmann:

I am pleased to lend my support for the interdisciplinary research project entitled "Climate-Driven Alteration of Shoal Habitats for Migratory Birds in the San Francisco Estuary." This continuing California Landscape Conservation Cooperative (CA LCC) project will examine the effects of sea level rise, climate change, and subsequent management actions on shoals, the benthic community and associated bird and prey populations in the San Francisco Bay Estuary. Results of modeling efforts will help us assess how estuarine bird populations would respond to sea level rise, altered freshwater flow and a decrease in sediment supply, and thereby directly assist us in developing appropriately responsive policies and management actions. The San Francisco Bay Conservation and Development Commission (Commission) has recently updated our San Francisco Bay Plan, to include climate change policies. In doing this work, we reviewed current and relevant scientific research on climate change and its potential impacts to the Bay Area, both in the built and natural environment. Much of the research we reviewed focused on land-based impact from rising seas, inundation of shorelines, and increases in storm surge events, little was found on impact to the subtidal habitats of the Bay and the implications for wildlife. The in-depth analysis of the potential impacts from this project will greatly increase the knowledge base for these habitats.

Last year our staff had the opportunity to meet with the principals on this project and their partners to discuss the study in a two-day workshop. Staff was extremely impressed by the collaborative nature of this interdisciplinary team, with expertise in modeling, benthic ecology, ornithology, and sediment transport. The importance of this work was clearly evident in both the nature of the discussion and the level of experts that were drawn to this topic. Changes to the subtidal and intertidal habitat are compounded in the Bay due to the decrease in suspended sediments entering the Bay from the Delta, potentially creating a clearer Bay with deeper waters, beyond the effects of climate change. Because the Bay is home to multiple species of birds and the most important stopover for migrating birds on the West coast, it is vital to understand how climate change will affect their food supply and habitat. The Bay provides vital foraging resources for birds and fishes, and knowledge of changes in the availability and quality of these habitats are critical for long-term habitat conservation planning. Further, reductions in access to foraging resources can lead to widespread reproductive failure in migratory species at the nesting areas far from the Bay. Understanding the impacts of climate change in the Bay Area on these resources can assist in explaining changes in breeding habitats

Ms. Debra Schlafmann
May 15, 2012
Page 2

on other continents. Therefore, sound management of the resources here is critical and must be built on scientific knowledge of a changing system. Research efforts to predict specific potential effects of sea level rise and climate change on estuarine habitats will be critical to addressing these uncertainties and directing project priorities.

Continuing this interdisciplinary modeling study will provide the first data to analyze the effects of climate change and sea level rise on shoal habitats critical for the health of migratory birds in coastal estuaries. There are many stakeholders in the Bay Area that will benefit from the results of the study, including multiple wetland restoration projects as they strive to create an ecologically sound transition to the subtidal habitat. The analysis will supply critical information for long-term planning within the San Francisco Bay Estuary and along the Pacific Flyway. I urge you to support this project for its immediate application and wide potential to advance the planning and management of tremendously high-value subtidal, intertidal and wetland habitat in the estuary. The approach to assessing sea level rise and climate effects on shorebirds developed in this project is also transferable to other areas within California and the Pacific coast.

Sincerely,



STEVE GOLDEBECK
Acting Executive Director
San Francisco Bay Conservation and
Development Commission

SG/BG/rca



South Bay Salt Pond Restoration Project

Restoring the Wild Heart of the South Bay

11 May 2012

Debra Schlafmann, Coordinator
California Landscape Conservation Cooperative
3020 State University Dr. East #2007
Sacramento, CA 95819

Subject: LCC proposal “Climate-Driven Alteration of Shoal Habitats for Migratory Birds in the San Francisco Estuary”

Ms. Schlafmann,

The South Bay Salt Pond Restoration Project (SBSP) is pleased to send this letter of support for the interdisciplinary research project entitled “Climate-Driven Alteration of Shoal Habitats for Migratory Birds in the San Francisco Estuary” by Bruce Jaffe and others. This continuing CA LCC project will address the effects of sea level rise, climate change, and management on shoals and associated bird and prey populations in the San Francisco Bay Estuary. The project hosted a regional workshop in October 2010 that brought together managers, biologists, and modelers to discuss how subtidal and intertidal habitats may be altered by sea level rise, changes in freshwater flows, and reduction in sediment supply, and how results from modeling scenarios would be useful to inform adaptation planning.

The SBSP is the largest tidal wetland restoration project on the West Coast. When complete, the project will restore 15,100 acres of industrial salt ponds to a rich mosaic of tidal wetlands and other habitats. Restoration of South Bay salt ponds provides an opportunity to begin to reverse the loss and degradation our wetlands have suffered by improving the health of San Francisco Bay for years to come. The SBSP will achieve its goals through an adaptive management framework wherein Project Managers measure and analyze changes on the ground and fold that new information back into the management process. This integrated approach will lead to an understanding of how the South Bay ecosystem responds to management changes. Key to this process is current information on how climate change and sea-level rise will affect the restoration trajectory.

One of the key uncertainties for our project is how tidal salt marsh restoration will affect the extensive mudflat/shoals habitat utilized by millions of migratory shorebirds. This study will downscale climate change models to be specific to South San Francisco Bay. In addition, this study will link these downscaled models with integrated habitat change and avian response scenarios. This interdisciplinary modeling study will provide the first data to address the effects of climate change and sea level rise on shoal habitats in South San Francisco Bay critical for the health of migratory birds in coastal estuaries, and therefore is vital information for our adaptive management approach to large scale restoration.

Project results will also supply critical information to many stakeholders involved in long-term planning within the San Francisco Bay Estuary. We believe this study has the potential for wide and immediate application to advance the planning and management of tremendously high-value wetlands in the estuary. The approach to assessing sea level rise and climate effects on shorebirds developed in this project is also transferable to other areas within California and the Pacific Coast.

The SBSP will work closely with USGS and its partners, as well as other researchers, to use decision support tools such as will come from this study, to make informed restoration and management decisions within the context of accelerating climate change and sea level rise.

Please feel free to contact me if you have further questions at jbourgeois@scc.ca.gov or 408.314.8859.

Sincerely,

A handwritten signature in black ink, appearing to read 'John Bourgeois', with a long horizontal flourish extending to the right.

John Bourgeois
Executive Project Manager
South Bay Salt Pond Restoration Project

cc: Laura Valoppi, USGS
Cheryl Strong, USFWS
John Krause, CDFG
Bruce Jaffe, USGS

SUSAN E. W. DE LA CRUZ, Wildlife Biologist, USGS Western Ecological Research Center, San Francisco Bay Estuary Field Station, 505 Azuar Drive, Vallejo, CA 94592 USA, Tel: 1-707-562-2004; Email: sdelacruz@usgs.gov

(A) PROFESSIONAL PREPARATION

University of California, Davis, CA, USA	Biological Sciences B.Sc.	1988-1992
Texas A&M University, College Station, USA	Wildlife and Fisheries Sciences M.Sc.	1996-1998
University of California, Davis, CA, USA	Ecology Ph.D.	2002-2010

(B) APPOINTMENTS:

1999-present Wildlife Biologist, San Francisco Bay Estuary Field Station, USGS Western Ecological Research Center (WERC), Vallejo, CA
1996-1998 Research Associate, Brazos Field Station, USGS Midwest Science Center, College Station, TX

(C) RELEVANT EXPERIENCE: I have over 12 years of wildlife research experience in San Francisco Bay (SFB) and throughout North America focused mainly on foraging ecology, migration ecology, habitat use, survival, and contaminant effects in waterbirds. My Ph.D. research focused on how changes in benthic prey resources in the SFB estuary influence the distribution, winter body condition, spring migration and cross-seasonal reproduction in sea ducks (surf scoters). I have just finished a collaborative project to model the carrying capacity of San Pablo Bay for diving (benthic foraging) waterfowl, which makes use of our extensive datasets on diving duck foraging ecology and habitat use in subtidal and intertidal shoals. This bioenergetics model will provide a foundation for examining how changes to available habitat as a result of sea level rise can impact carrying capacity of the shoals for waterbirds. Additionally, I am currently working on a NFWF funded project to identify critical scoter wintering habitat for potential protection and to examine the value of eelgrass restoration for providing foraging habitat to waterbirds and shorebirds. Other current research involves studying the body condition and distribution of western and Clark's grebes, evaluating the effects of commuter and recreational water traffic on open waterbird habitat use and behavior, and measuring survival and behavior of surf scoters after the Cosco Busan oil spill.

(D) SELECTED PUBLICATIONS:

Lok, E.K., D. Esler, J.Y. Takekawa, S.W. De La Cruz, W.S. Boyd, D.R. Nysewander, J.R. Evenson, and D.H. Ward. 2011. Stopover habitats of spring migrating surf scoters in southeast Alaska. *Journal of Wildlife Management* 75:92-100.

Lovvorn, J.R., De La Cruz, S.E. Takekawa, J.Y., Shaskey, L.E., Poulton, V.K., and Richman, S.E. *In Review*. Niche partitioning, threshold food densities, and species abundance in diminishing habitats for diving ducks. *Ecological Monographs*.

De La Cruz, S.E. 2010. Habitat, diet, and contaminant relationships of surf scoters wintering in San Francisco Bay: Implications for conservation in urban estuaries. Dissertation, University of California, Davis. 215 pp.

De La Cruz, S. E., J. Y. Takekawa, M. T. Wilson, D. R. Nysewander, J. R. Evenson, D. Esler, W. S. Boyd, and D. H. Ward. 2009. Spring migration routes and chronology of surf scoters (*Melanitta perspicillata*): a synthesis of Pacific coast studies. *Canadian Journal of Zoology* 87: 1069-1086.

Eagles-Smith, C. A., J.T. Ackerman, S.E.W. De La Cruz, J. Y. Takekawa. 2009 Mercury Bioaccumulation and Risk to Three Waterbird Foraging Guilds is Influenced by Breeding Stage and Trophic Ecology. *Environmental Pollution* 157:1993-2002.

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(A) PROFESSIONAL PREPARATION

M.S. in Marine Science

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Virginia Institute of Marine Science, The College of William and Mary, Gloucester Point, VA

B.A. in Environmental Studies, concentration in GIS

June, 2000

University of California, Santa Barbara, CA

(B) APPOINTMENTS:

2010-present Geographer, U.S. Geological Survey Pacific Coastal and Marine Science Center,
Santa Cruz, CA

2000-2007 Geographer, U.S. Geological Survey Pacific Marine Science Center,
Santa Cruz, CA

(C) RELEVANT EXPERIENCE: I have performed extensive research on bathymetric change in San Francisco Bay over both long (100 + years) and short (seasonal) timescales. This research entails the collection, maintenance and analysis of numerous bathymetric, topographic, and sedimentary datasets throughout San Francisco Bay from which we can begin to distinguish natural versus anthropogenic variability in morphology of the bay floor. These data will serve as a foundation for modeling potential changes in intertidal habitats as a result of ongoing marsh restoration projects as well as future climate change scenarios to assess likely effects on migratory bird species that depend upon this critical habitat.

(D) SELECT PUBLICATIONS:

Bearman, J.A., C.T. Friedrichs, B.E. Jaffe, and A.C. Foxgrover, 2010. Spatial trends in tidal flat shape and associated environmental parameters in South San Francisco Bay. *Journal of Coastal Research*, v. 26, no. 2, p. 342-349.

Athearn, N.D., Takekawa, J.Y., Jaffe, B., Hattenbach, B. J., and Foxgrover, A.C., 2010, Mapping elevations of tidal wetland restoration sites in San Francisco Bay: comparing accuracy of aerial lidar with a singlebeam echosounder. *Journal of Coastal Research*, v. 26, no. 2, p. 312-319.

Foxgrover, A.C., Dartnell, P., Jaffe, B.E., Takekawa, J.Y., and Athearn, N.D., 2007, High-resolution bathymetry and topography of South San Francisco Bay, California, USGS Scientific Investigations Map, Report: SIM-2987, 1 sheet. [URL: <http://pubs.usgs.gov/sim/2007/2987>]

Foxgrover, A.C., Jaffe, B.E., Hovis, G.T., Martin, C.A., Hubbard, J.R., Samant, M.R., and Sullivan, S.M., 2007, 2005 Hydrographic survey of south San Francisco Bay, California: U.S. Geological Survey Open-File Report 2007-1169, 113 p. [URL: <http://pubs.usgs.gov/of/2007/1169>]

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BRUCE E. JAFFE, Research Oceanographer, USGS Coastal and Marine Science Center, Santa Cruz, 400 Natural Bridges Drive, Santa Cruz, CA 95060 USA, Tel: 1-831-427-4742; Email: bjaffe@usgs.gov

(A) PROFESSIONAL PREPARATION

University of California, Santa Cruz, CA, USA	Earth Science	B.Sc	1978-1981
University of Washington, Seattle, WA, USA	Oceanography	M.Sc.	1981-1983
University of California, Santa Cruz, CA, USA	Earth Science	Ph.D	1989-1993

(B) APPOINTMENTS:

1983-present Research Oceanographer, USGS, Coastal and Marine Science Center, Santa Cruz
1996-present Research Associate, Institute of Marine Sciences, University of California at Santa Cruz

(C) RELEVANT EXPERIENCE: For the past 16 years, I have studied sedimentation and habitat change in the San Francisco Estuary. From 2003 to 2007, my group documented the historical deposition and erosion in South San Francisco Bay. This research established the long-term trends and decadal-scale variability of the system. From 2006 to present, as a PI in the CASCaDE project (Computational Assessments of Scenarios of Change for the Delta Ecosystem) I have worked with Mick van der Wegen and Dano Roelvink (and students) to model the geomorphic response of northern San Francisco Bay to climate change. From 2009 to present, we collected interferometric side-scan swath bathymetry data to document seasonal variability of intertidal mudflats and subtidal shoals and channels in South San Francisco Bay. This data is invaluable as a baseline for salt pond restoration, geomorphic model development, and bird foraging model development (Takekawa's group collected benthic invertebrate and bird foraging data during the same period).

(D) PUBLICATIONS: (Out of 130+ peer-reviewed journal publications and reports)

Van der Wegen, M., Jaffe, B.E., and Roelvink, D., accepted, Process-based, morphodynamic hindcast of decadal deposition patterns in San Pablo Bay, California, 1856-1887, *Journal of Geophysical Research Earth Surface Processes*.

Ganju, N.K., Jaffe, B.E., and Schoellhamer, D.H., accepted, Discontinuous hindcast simulations of estuarine bathymetric change: a case study from Suisun Bay, California, *Estuarine, Coastal and Shelf Science*.

Van der Wegen, M., Jaffe, B.E., Dastgheib, A., and Roelvink, D., 2010, Bed composition generation for process-based morphodynamic modeling: case study San Pablo Bay, California, *Ocean Dynamics* doi:10.1007/s10236-010-0314-2 [URL:


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Athearn, N.D., Takekawa, J.Y., Jaffe, B., Hattenbach, B. J., and Foxgrover, A.C., 2010, Mapping elevations of tidal wetland restoration sites in San Francisco Bay: comparing accuracy of aerial lidar with a singlebeam echosounder. *Journal of Coastal Research*, v. 26, no. 2, p. 312-319.

Elias, E. and Jaffe, B., 2009, Modeling the effects of sea-level rise on the flow and waves in South Bay, San Francisco, California, 9th Biennial State of the Estuary Conference, Oakland, CA, p. 22

Jaffe, B.E., Smith, R.E., and Foxgrover, A.C., 2007, Anthropogenic influence on sedimentation and intertidal mudflat change in San Pablo Bay, California: 1856 to 1893. *Estuarine, Coastal and Shelf Science* 73 (1-2), 175-187, doi:10.1016/j.ecss.2007.02.017.

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NAME - DATE OF BIRTH - NATIONALITY:	J.A. (Dano) Roelvink – May 10, 1959 - Dutch
EDUCATION:	PhD Civil Engineering, Delft University of Technology MSc Civil Engineering, Delft University of Technology
PRESENT POSITION	Professor of Coastal Engineering and Port Development, UNESCO-IHE (0.8) and Senior Specialist Coastal Morphology, Deltares (0.2)
KEY QUALIFICATIONS:	 <p>Prof. Roelvink has 27 years of experience in coastal engineering and research. He has participated as team member and as project manager in a number of major consultancy projects related to coastal morphology. He has managed the development of the Delft3D model system for two- and three-dimensional simulation of waves, currents, water quality, ecology and morphodynamics, and has heavily contributed to development of the morphological part of this system. He has been actively involved in the EU-sponsored MaST-G6M and MaST-G8M, SASME, COAST3D and DELOS research projects on coastal morphodynamics. His field of expertise is in coastal hydrodynamics and morphodynamics modelling, in one, two or three dimensions. In 1993 he obtained a PhD-degree at Delft University of Technology, based on a thesis on the effect of surf beats on coastal profiles. He has published over 80 articles on coastal hydraulics and morphodynamics in international journals and conference proceedings, and he has been a part-time Associate Professor at Delft University of Technology from 1990-2005 and presently holds an honorary Professorship there. He has been Delft Hydraulics' principal investigator in the discipline of morphology and is a strong proponent of international scientific cooperation with various parties in order to further the state-of-the-art in morphodynamic modelling and has set up collaborative projects with the US Geological Survey, the US Office of Naval Research and the Army Corps of Engineers. He currently leads the development of XBeach, an open-source model for storm impacts</p>

PUBLICATIONS

Selection of recent journal publications

2011 Dano Roelvink and Ad Reniers. A Guide to Modeling Coastal Morphology. Advances in Ocean Engineering Volume 12, World Scientific, Singapore, 280 pp. ISBN-13.978-981-4304-25-2

2011 D. M. P. K. Dissanayake, R. Ranasinghe and J. A. Roelvink. The morphological response of large tidal inlet/basin systems to relative sea level rise, Climatic Change (in press: accepted 31st Oct 2011).

2010 R.T. McCall, J.S.M. Van Thiel de Vries, N.G. Plant, A.R. Van Dongeren, J.A. Roelvink, D.M. Thompson, A.J.H.M. Reniers, 2010. Two-dimensional time dependent hurricane overwash and erosion modeling at Santa Rosa Island . Coastal Engineering, Volume 57, Issue 7, July 2010, Pages 668-683

2009 Dano Roelvink, Ad Reniers, Ap van Dongeren, Jaap van Thiel de Vries, Robert McCall, Jamie Lescinski. Modelling storm impacts on beaches, dunes and barrier islands. Coastal Engineering, Volume 56, Issues 11-12, November-December 2009, Pages 1133-1152

2008 van der Wegen, M., and J. A. Roelvink (2008), Long-term morphodynamic evolution of a tidal embayment using a two-dimensional, process-based model, J. Geophys. Res., 113, C03016, doi:10.1029/2006JC003983.

2007 Ruessink, B. G.; Kuriyama, Y.; Reniers, A. J. H. M.; Roelvink, J. A.; Walstra, D. J. R. Modeling cross-shore sandbar behavior on the timescale of weeks. J. Geophys. Res., Vol. 112, No. F3, F03010 DOI:10.1029/2006JF000730

2006 Elias, E.P.L., Cleveringa, J., Buisman, M.C., Stive, M.J.F. and Roelvink, J.A. (2006). Field and model data analysis of sand transport patterns in Texel Tidal Inlet (the Netherlands). Coastal Engineering, 53 (5-6), 505-529.

2006 Roelvink, J.A. Coastal morphodynamic evolution techniques. Coastal Engineering Volume 53, Issues 2-3 , February 2006, Pages 277-287

2005 Elias, J.P.L., M.J.F. Stive and J.A. Roelvink. Impact of back-barrier changes on ebb-tidal delta evolution. Journal of Coastal Research, Special Issue no. 42, pp. 460-476

2004 G.R. Lesser, J.A. Roelvink, J.A.T.M van Kester, G.S. Stelling, Development and Validation of a Three-dimensional Morphological Model
Coastal Engineering, Volume 51, Issues 8-9, October 2004, Pages 883-915

JOHN Y. TAKEKAWA, Research Wildlife Biologist, USGS Western Ecological Research Center, San Francisco Bay Estuary Field Station, 505 Azuar Drive, Vallejo, CA 94592 USA, Tel: 1-707-562-2000; Email: john_takekawa@usgs.gov

(A) PROFESSIONAL PREPARATION

University of Washington, Seattle, WA, USA	Wildlife Science	B.Sc.	1975-1979
University of Idaho, Moscow, ID, USA	Wildlife Ecology	M.Sc.	1979-1982
Iowa State University, Ames, IA, USA	Animal Ecology	Ph.D.	1982-1987

(B) APPOINTMENTS:

1995-present Research Biologist, San Francisco Bay Estuary Field Station, USGS Western Ecological Research Center (WERC), Vallejo, CA
1986-1995 Research Biologist, USGS WERC, Dixon Field Station, Dixon, CA

(C) RELEVANT EXPERIENCE: I established the SFBE field station in 1995 to conduct research on waterbirds and their habitats. Our studies have shown that tidal flats are critical habitats for many migratory bird species, yet there are few studies on the importance of tidal flats or on their ecological function supporting foraging resources for waterbirds. Restoration of bayland habitats may result in changes in sensitive adjacent tidal flat foraging habitats, and the effects of such change are largely unknown. Thus, we have been focusing our research on the relationship of migratory birds to their estuarine habitats and better understand how these resources provide support for wintering and migrating populations. Climate change is expected to have major effects on western estuaries as changes in snowpack and sea level rise alter current hydrology and sediment processes. Our project will use existing data to model changes in tidal flats, and we will extend those models to predict likely effects on migratory birds. We are working with scientists in the CASCaDE project (Computational Assessments of Scenarios of Change for the Delta Ecosystem) that will provide supporting climate change modeling on the estuary.

(D) PUBLICATIONS: (Out of 140+ peer-reviewed journal publications and book chapters)

Takekawa, J. Y., A. K. Miles, D. H. Schoellhamer, D. C. Tsao-Melcer, S. Fregien, and N. D. Athearn. 2009. Dietary flexibility in three representative waterbirds across salinity and depth gradients in salt ponds of San Francisco Bay. *Hydrobiologia* 626:155-168.

De La Cruz, S. E., J. Y. Takekawa, M. T. Wilson, D. R. Nysewander, J. R. Evenson, D. Esler, W. S. Boyd, and D. H. Ward. 2009. Spring migration routes and chronology of surf scoters (*Melanitta perspicillata*): a synthesis of Pacific coast studies. *Canadian Journal of Zoology* 87: 1069-1086.

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.

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.

NAME - DATE OF BIRTH - NATIONALITY:	Mick van der Wegen – December 31 , 1971 - Dutch
EDUCATION:	PhD Civil Engineering, Delft University of Technology MSc Civil Engineering, Delft University of Technology
PRESENT POSITION	Senior Lecturer Coastal Engineering and Port Development, UNESCO-IHE (0.8 FTE)
KEY QUALIFICATIONS:	<p>Mick van der Wegen's position at UNESCO-IHE has been related to research, lecturing and programme co-ordination in the field of coastal engineering. Regular advisory work is carried out in an international context on expert knowledge and capacity-building projects related to coastal engineering, coastal zone management and morphodynamics. Furthermore, internal projects carried out are related to programme accreditation and quality assurance programs. From 2005 to 2009 50% of the work was dedicated to PhD research on modeling long-term estuarine morphodynamic evolution. The defence of the PhD dissertation was in May 2010 at TU Delft. Last years' one of the major research projects has been on reproducing the morphodynamic development in San Francisco Estuary over the last 150 years in close collaboration with USGS within the CASCADE framework.</p> <p>Mick is characterized by his motivation and capacity to co-ordinate people from different backgrounds and cultures and to collaborate with them intensively. He combines this work with his expert knowledge of physical coastal processes. Specific fields of interest include salt intrusion, numerical hydrodynamic and morphodynamic modeling (Delft3D) and Integrated Coastal Zone Management.</p>



PUBLICATIONS

Selection of recent journal publications

Submitted

Van der Wegen, M. and J. A. Roelvink, *Reproduction of the Western Scheldt bathymetry by means of a process-based model*, submitted to *Geomorphology*

2010

Van der Wegen, M., A. Dastgheib, B.E. Jaffe and J. A. Roelvink, *Bed composition generation for morphodynamic modeling: case study of San Pablo Bay in California, USA*. *Ocean Dynamics*, InterCoh 2009 Special issue, doi: 10.1007/s10236-010-0314-2

Accepted

Van der Wegen M., B.E. Jaffe and J. A. Roelvink, *Process-based, morphodynamic hindcast of decadal deposition patterns in San Pablo Bay, California, 1856-1887*, accepted by *JGR-ESP*

2010

Van der Wegen, M., A. Dastgheib and J. A. Roelvink, *Morphodynamic modeling of tidal channel evolution in comparison to empirical PA relationship*, *Coastal Eng.* 57 (2010) 827–837, doi:10.1016/j.coastaleng.2010.04.003

2009

Dissanayake, M. van der Wegen and J.A. Roelvink (2009), *Modelled channel patterns in a schematized tidal inlet*, *Coastal Engineering*, doi: 10.1016/j.coastaleng.2009.08.008.

2008

Van der Wegen, M., Z. B. Wang, H. H. G. Savenije, and J. A. Roelvink (2008), *Long-term morphodynamic evolution and energy dissipation in a coastal plain, tidal embayment*, *J. Geophys. Res.*, 113, F03001, doi:10.1029/2007JF000898.

2008

Nguyen Anh Duc, Mick van der Wegen, Dano Roelvink and Huub Savenije, *New analytical equation determining the dispersion coefficient in estuaries with a distinct ebb-flood channel system*, *Estuarine and Coastal Shelf Science*, doi 10.1016/j.ecss.2008.03.002.

2008

Van der Wegen, M., and J. A. Roelvink (2008), *Long-term morphodynamic evolution of a tidal embayment using a two-dimensional, process-based model*, *J. Geophys. Res.*, 113, C03016, doi:10.1029/2006JC003983.

ISA WOO, Wetlands Biologist, USGS Western Ecological Research Center, San Francisco Bay Estuary Field Station, 505 Azuar Drive, Vallejo, CA 94592; Phone: (707) 562-2001; Email: iwoo@usgs.gov; URL: <http://www.werc.usgs.gov>

(A) PROFESSIONAL PREPARATION

University of Wisconsin, Madison. M. S. Botany, Wetland Restoration emphasis. 2000
University of California, Berkeley. B. A. Integrative Biology, minor in Forestry. 1997

(B) APPOINTMENTS

2003 – current. Wetland Restoration Lead. USGS. WERC, Vallejo CA
2001 – 2003. Wetland Restoration Coordinator. Humboldt State University Foundation and USGS. WERC, Vallejo CA

(C) EXPERIENCE-- Mrs. Woo has 10 years of professional wetland research and monitoring experience as the Wetland Restoration program lead for the San Francisco Bay Estuary Field Station. The wetland restoration program focuses on applied science and monitoring to inform land managers and topics are far-ranging such as: monitoring the effectiveness of large scale estuarine restorations, design experiments to test restoration hypotheses, integration of science in restoration monitoring plans, methods development to measure rapidly changing restoring wetlands, tidal marsh vegetation, inundation and salinity effects on tidal marsh vegetation, meHg in tidal marsh foodwebs, recovery of tidal marsh vegetation after varying levels of all-terrain vehicle impacts, long term datasets and monitoring for endangered tidal marsh species, and prey availability studies within San Francisco Bay estuary and Southern Puget Sound. Mrs. Woo also understands the complexities of collaborations and has built and maintained strong partnership with fellow research scientists as well as Tribal, federal, state, and local managers and stakeholders. Mrs. Woo has authored or co-authored over 75 reports and presentations.

(D) SELECT PUBLICATIONS

- Woo, I.** and J. Y. Takekawa. In revision. Effects of inundation period and salinity on growth of *Sarcocoria pacifica* (common pickleweed): implications for future sea level rise scenarios and tidal marsh restoration. Wetlands.
- Takekawa, J. Y., **I. Woo**, N. D. Athearn, S. Demers, R. J. Gardiner, W. M. Perry, N. K. Ganju, G. G. Shellenbarger, and D. H. Schoellhamer. 2010. Measuring sediment accretion in early tidal marsh restoration. Wetlands Ecology and Management 18: 297-305.
- Woo, I.**, R. Storesund, J. Y. Takekawa, R. J. Gardiner, and S. Ehret. 2009. Integrating Terrestrial LiDAR and Stereo Photogrammetry to Map the Tolay Lakebed in Northern San Francisco Bay [in] Webb and Semmens, eds., Planning for an uncertain future—Monitoring, integration, and adaptation. Proceedings of the Third Interagency Conference on Research in the Watersheds: U.S. Geological Survey Scientific Investigations Report 2009-5049, p. 279-284.
- Tsao, D., J. Y. Takekawa, **I. Woo**, J. Yee, and J. Evens. 2009. Home range, habitat selection and movements of California Black Rails at tidal marshes at San Francisco Bay, California. The Condor 111(4): 599-610
- Tsao, D., K. Miles, J. Y. Takekawa, and **I. Woo**. 2008. Potential effects of mercury on threatened California black rails. Archives of Environmental Contamination and Toxicology Online First 10.1007/s00244-008-9188-4
- Takekawa, J. Y., **I. Woo**, H. Spautz, N. Nur, J. L. Grenier, K. Malamud-Roam, J. C. Norby, A. Cohen, F. Malamud-Roam, S. E. Wainwright-DeLa Cruz. 2006. Environmental threats to tidal marsh vertebrates of the San Francisco Bay Estuary. Studies in Avian Biology.
- Takekawa, J. Y., B. Sacks, **I. Woo**, M. B. Johnson, and G. D. Wylie. 2006. Effects of Tidal Marsh Fragmentation on Survival of San Pablo Song Sparrows in the San Francisco Bay Estuary. Studies in Avian Biology.
- Woo, I.**, T. Drlik, L. Swaidon, and W. Quarles. 2002. Integrated management of Knapweed. The IPM Practitioner. 24(4).
- Woo, I.** and J. B. Zedler. 2002. Can nutrients alone shift a sedge meadow towards the invasive *Typha x glauca*? Wetlands. 22:509-521.
- Zedler, J. B., R. Lindig-Cisneros, C. Bonilla-Warford, and **I. Woo**. 2001. Restoration of biodiversity: An overview. Pp. 203-212 in S. Levin, editor. Encyclopedia of Biodiversity, Vol. 5. Academic Press, San Diego.