



**CALFed Progress Questionnaire**  
**California Sea Grant College Program**

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 TypeQuestionnaire\_2B Interim Questionnaire

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**Project Information**

ProjectNo\_2C R/SF-3      StartDate\_3a Sept. 1, 2003      EndDate\_3b August 31, 2004  
 ProjectTitle\_4 Sediment Supply and Marsh Development in the San Francisco Estuary

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**Additional Research Mentors and Community Mentors**

**Additional Research Mentors\_8**


**Additional Community Mentors\_9**

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**Project Objectives: Please type your responses, and answer the questions in a style appropriate for laymen.**

**ProjectObjectives\_10**

Evaluate the relative contributions of different sources of detrital sediments to the S.F. Bay tidal marshes over time and space and the relative contribution of organic versus inorganic sediments Evaluate the impacts on sediment supply to San Francisco Estuary tidal marshes of altered fresh water inflow from the Delta.

Evaluate potential impacts on sediment supply to tidal marshes due to wetland restoration projects within the Bay ñ Delta system.

Evaluate the role of climate variability over time in sediment supply for local tidal marshes, on timescales of decades to centuries.

**SPECIFIC OBJECTIVES TO MEET GOALS**

Characterize geochemical signatures of suspended sediments (primarily clays) transported by local streams and creeks in the North Bay, a sub-basin of the Estuary.

Characterize geochemical signatures of suspended sediments passing through the Sacramento ñ San Joaquin Delta, i.e., that are derived from the Sacramento river and San Joaquin river watersheds.

Characterize the surface sediments (modern) of tidal marshes in the North Bay.

Determine the current relative inputs of detrital sediments supplied to the tidal marshes of the S. F. Bay from local stream watersheds versus inputs supplied from tributaries to the Delta.

Determine the relative contributions of organic sediments (autochthonous inputs) versus mineral sediments (allochthonous inputs) to selected marsh sites over time, on timescales of decades to centuries.

**Summary of progress in meeting each of these goals and objectives**

**ProgressSummary\_11**

**SAMPLES**

During high flow periods in the winter months of 2003-2004 water year, we collected 30 samples of suspended sediments from the Sacramento river, the San Joaquin river and their tributaries, sites within the Delta, and from local tributaries to San Pablo bay. The samples will characterize the geochemical signatures of these various source regions.

Surface material was collected from the mouths of four marshes adjacent to San Pablo bay and analyzed to evaluate the sources of recent sediments supplied to these marshes.

We collected four meter-long cores along a transect across Novato Creek marsh in San Pablo bay, using the San Francisco Estuary Institute's EcoAtlas to assist in finding old marsh sites for sample collection. The transect extends from the Bay shore across the marsh surface inland along Novato creek. The cores contain the following information: changes in organic versus inorganic sediments accreting on the marsh surface over the last 100 to 200 years, changes in sources of mineral sediments over time and changes in the vegetation occupying the marsh surface over time.

**ANALYSES**

Each marsh sediment core has been x-radiographed, described and subsampled for the trace elemental and isotopic (Sr and C) analyses as well as carbon content. Trace element analyses, using ICP-MS (Inductively Coupled Plasma Mass Spectrometry), have been done on all the river sediment samples, the marsh surface samples and on a total of 110 samples from the four Novato Creek marsh cores (sampling interval every 2 cm).

We analyzed 50 samples from the first two cores collected from Novato Creek marsh for organic content using Loss on Ignition (burning samples at 550 degrees F. for one hour) to evaluate the organic input to the sediments.

**DATA MINING**

We have collected precipitation data available on the Web for stations adjacent to San Pablo Bay as well as stations from the watershed regions to assess the changes in local climate over time. We have also collected local reports describe landuse practices within the watershed of Novato Creek and Napa River (we will be collecting sediment cores from Napa marsh in Y2).

**PROJECT MODIFICATIONS: Please explain any substantial modifications in research plans, including new directions pursued. Describe major problems encountered, especially problems with experimental protocols and**

how they were resolved. Describe any ancillary research topics developed.

**Modifications\_12**

We decided to change our experimental protocol for preparing samples for ICP-MS analysis. A standard methodology involves the use of Hydrofluoric acid, Nitric acid and Hydrochloric acid to dissolve sediments completely. This method generally results in complete dissolution of the silicates, but not of all the organic material. In addition, it is both a time-consuming and very dangerous methodology. Instead we have experimented with adapting a fusion method for fusing our sediment samples using a lithium borate flux. The samples are combined with the flux and heated to 900 - 1000 degrees C for 10 minutes, then the molten material is quickly dissolved in weak nitric acid. This method is safer, relatively fast and the ignition burns off all the organic material.

Because all of our samples have been clays (and organic material), we have not done visual mineral identification. We do plan to analyze the major and minor elements using either ICP-MS or ICP-AES (which is less expensive and sufficiently sensitive for major and minor element analysis).

**BENEFITS AND APPLICATIONS:** Suggest the relevance of these new findings to management. Describe any accomplishment, that is significant effects your project has had on resource management or user group behavior. CALFED is looking for "management cue" (see <http://science.calwater.ca.gov/pdf/soemgmtcues.pdf>).

**BenefitsApplic\_13**

This research is relevant to the issue of sediment supply for Bay-Delta restoration, particularly tidal marsh restoration. Determining where the sediments accreting on the marsh surfaces came from can inform decisions on restoration sites most likely to succeed, particularly when it becomes clear how the sediment sources have changed over the last 100 - 200 years.

By analyzing core results against precipitation and land use records, we can assess not only the impacts of human activities on the Estuary marsh ecosystems, but also the impacts of climate variability on timescales of decades to centuries, which can be particularly useful to management as variability is expected to increase as a result of global warming (and also part of the natural cycle of climate variability).

**PUBLICATIONS:** List any publications, presentations, or posters that have resulted from this funded research. Give as many details as possible, including status of paper (e.g., in review; in press), journal name, conference location and date of presentation. Please note (as outlined in the conditions of the award) that each fellow is required to submit an abstract for an oral or poster presentation at each State of the Estuary conference and CALFED Science Conference during the duration of the fellowship.

**Publications 14**

- December 2004: F. Malamud-Roam, B. Lynn Ingram, and J. Collins. Trace elemental analyses of Suspended Sediments in the San Francisco Estuary and its tidal marshes. Poster presentation at Association of Geophysical Union 2004 Fall meeting, San Francisco.
- October 9, 2004: F. Malamud-Roam, B. Lynn Ingram and J. Collins. Sediment Sources for Local Tidal Marshes in the San Francisco Estuary. Poster presentation at the Chapman Conference on Salt Marsh Geomorphology: Physical and Ecological Effects on Landform, 2004, Halifax.
- October 5, 2004: F. Malamud-Roam, B. Lynn Ingram and J. Collins. Sediment Sources for Local Tidal Marshes in the San Francisco Estuary. Oral presentation at CALFED Science Conference, October 4 ñ 6, 2004, Sacramento.
- October 5, 2004: F. Malamud-Roam, B. Lynn Ingram M. Hughes and J. Florsheim. Paleoclimate Records from San Francisco Bay Estuary and corresponding research from its larger watershed region. Poster presentation at CALFED Science Conference, October 4 ñ 6, 2004.
- October 2004: F. Malamud-Roam, B. Lynn Ingram M. Hughes and J. Florsheim. Late Holocene Paleoclimate records from the San Francisco Bay Estuary and Watershed, CALIFORNIA. Review paper submitted to Journal of Quaternary Science Reviews.
- September, 2004: M. Goman, F. Malamud-Roam and B. L. Ingram. Holocene environmental history and evolution of a tidal salt marsh in San Francisco Bay, California. Submitted to Journal of Coastal Research.
- September, 2004: F. Malamud-Roam and B.L. Ingram. Late Holocene <sup>13</sup>C and pollen records of paleosalinity from tidal marshes in the San Francisco Bay estuary, California. Quaternary Research, V. 62 (2), 134-145.
- August, 2004: K. Malamud-Roam, F. Malamud-Roam, E. Watson, J. Collins and B. L. Ingram. The Quaternary Geography and Biogeography of North American Tidal Salt Marshes. In revision for Journal of Avian Biology.



**COOPERATING ORGANIZATIONS:** List those agencies and/or persons who provided financial, technical or other assistance to your project since inception. Describe the nature of their collaboration.

CoopOrganiz\_15

Interdisciplinary Center for Plasma Mass Spectrometry (UCD/ICPMS) at U.C. Davis. We have been using this lab for our trace element analyses.

Wenbo Yang, Earth and Planetary Studies Department, U.C. Berkeley. Dr. Yang has assisted with developing the methodology for sample fusion for ICP-MS.

**AWARDS:** List any special awards or honors that you, or mentor or members of the research team, have received during the duration of this project.

Awards\_16

NA

**KEYWORDS:** List keywords that will be useful in indexing your project.

Keywords\_17

suspended sediments; trace elements; tidal marsh geomorphology; ICP-MS

**PATENTS:** List any patents associated with your project.

Patents\_18

NA

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**Additions: Additional information can be added here. Please begin the text with the number of the question you are adding to.**

**Additions\_19**

10: We have archived halves of our cores, as well as surplus suspended sediments from river and marsh samples which we will make available for other research scientists for future collaborations.

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