## Preparer Information

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>PrepName_1A</td>
<td>Susan Lang</td>
</tr>
<tr>
<td>PrepEmail_1B</td>
<td><a href="mailto:sqlang@ucsd.edu">sqlang@ucsd.edu</a></td>
</tr>
<tr>
<td>PrepPhone_1C</td>
<td>206.920.6607</td>
</tr>
</tbody>
</table>

## Project Information

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ProjectNo_2C</td>
<td>R/SF-26</td>
</tr>
<tr>
<td>ProjectTitle_4</td>
<td>Investigating the Lower Trophic Levels of Suisun Bay Food Web: A Biomarker-Specific Isotope Approach</td>
</tr>
<tr>
<td>StartDate_3a</td>
<td>9/1/2007</td>
</tr>
<tr>
<td>EndDate_3b</td>
<td>8/31/2010</td>
</tr>
</tbody>
</table>

## CALFed Fellow contact information

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>FelTitle_5A</td>
<td>Dr</td>
</tr>
<tr>
<td>FelLast_5B</td>
<td>Lang</td>
</tr>
<tr>
<td>FelFirst_5C</td>
<td>Susan</td>
</tr>
<tr>
<td>FellInit_5D</td>
<td></td>
</tr>
<tr>
<td>FellInstitution_5E</td>
<td>University of California, San Diego</td>
</tr>
<tr>
<td>FellStreetAddr_5G</td>
<td>9500 Gilman Dr.</td>
</tr>
<tr>
<td>FelCity_5H</td>
<td>La Jolla</td>
</tr>
<tr>
<td>FelState_5I</td>
<td>CA</td>
</tr>
<tr>
<td>FelZip_5J</td>
<td>92093</td>
</tr>
<tr>
<td>FelPhone_5K</td>
<td>206.920.6607</td>
</tr>
<tr>
<td>FelFax_5L</td>
<td></td>
</tr>
<tr>
<td>FelEmail_5M</td>
<td><a href="mailto:sqlang@ucsd.edu">sqlang@ucsd.edu</a></td>
</tr>
<tr>
<td>FelPositionTitle_5N</td>
<td>Post-doctoral Researcher</td>
</tr>
</tbody>
</table>

## Research Mentor (for additional please see #8)

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>RMTitle_6A</td>
<td>Dr</td>
</tr>
<tr>
<td>RMLastName_6B</td>
<td>Aluwihare</td>
</tr>
<tr>
<td>RMFirstName_6C</td>
<td>Lihini</td>
</tr>
<tr>
<td>RMInit_6D</td>
<td></td>
</tr>
<tr>
<td>RMIInit_6D</td>
<td></td>
</tr>
<tr>
<td>RMInstitution_6E</td>
<td>University of California, San Diego</td>
</tr>
<tr>
<td>RMDepartment_6F</td>
<td>Scripps Institution of Oceanography</td>
</tr>
<tr>
<td>RMStreetAddr_6G</td>
<td>9500 Gilman Dr.</td>
</tr>
<tr>
<td>RMCity_6H</td>
<td>La Jolla</td>
</tr>
<tr>
<td>RMState_6I</td>
<td>CA</td>
</tr>
<tr>
<td>RMZip_6J</td>
<td>92093</td>
</tr>
<tr>
<td>RPMPhone_6K</td>
<td>(858) 822-4886</td>
</tr>
<tr>
<td>RMFax_6L</td>
<td></td>
</tr>
<tr>
<td>RMEmail_6M</td>
<td><a href="mailto:laluwihare@ucsd.edu">laluwihare@ucsd.edu</a></td>
</tr>
<tr>
<td>RMPositionTitle_6N</td>
<td>Associate Professor</td>
</tr>
</tbody>
</table>

## Community Mentor (for additional please see #9)

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMTitl_7A</td>
<td>Dr</td>
</tr>
<tr>
<td>CMLastName_7B</td>
<td>Mueller-Solger</td>
</tr>
<tr>
<td>CMFirstName_7C</td>
<td>Anke</td>
</tr>
<tr>
<td>CMInit_7D</td>
<td></td>
</tr>
<tr>
<td>CMInstitution_7E</td>
<td>CALFED Bay-Delta Program</td>
</tr>
</tbody>
</table>
Simultaneous declines of multiple pelagic organisms in the upper San Francisco Bay suggests a possible trophic linkage and that a decline in food resources is an important factor in the decline of juvenile fish. Juvenile fish and the Delta Smelt rely predominantly on zooplankton as their food source, but the species of zooplankton that is most abundant changes temporally for multiple reasons. Because zooplankton species have different feeding strategies and because river flow directly and/or indirectly controls the magnitude and quality of organic matter available, there is a need to directly relate water management strategies to shifts in food sources available to the zooplankton community.

Our research goal is to obtain a coarse time-series of food sources being utilized by the dominant zooplankton inhabiting the upper SFB estuary (Suisun Bay). Based on this series of snapshots, we hope to further assess the impact of particular water management strategies on zooplankton community dynamics. We focus on Suisun Bay as it is a critical habitat and likely to be strongly affected by proposed changes to the San Joaquin River.

Our specific objectives are: (1) To determine what sources of organic matter support the dominant zooplankton population within Suisun Bay at different time points of the year and (2) To determine if changes in water management practices modify the type and magnitude of food sources available to support zooplankton production.
Our approach is to use biomarker-specific isotopes to obtain a snapshot of the primary food sources of zooplankton. While the traditional approach of using stable carbon (13C) and nitrogen (15N) isotopes to distinguish organic matter inputs is difficult in the San Francisco Bay estuary due to the number of potential sources and their overlapping isotopic signatures (Canuel et al., 1995; Cloern et al., 2002), the use of biomarkers and multiple isotope tracers can help overcome some of these limitations. Specifically, our goal is to analyze the carbon isotopes of lipid biomarkers to determine carbon inputs of specific sources; the nitrogen isotopes of amino acids to determine sources of nitrogen and trophic-level interactions; and both radiocarbon and sulfur isotopes of bulk biomass to trace estuarine-marine vs. terrestrial organic inputs.

Our goal in the first year was to complete two sampling cruises (Spring, Summer) during which the entire suite of measurements would be analyzed. Once the baseline isotopic composition of all potential organic matter inputs to zooplankton was determined, we would then focus on those analyses that provided the most information.

In April and July of this past year, a full suite of samples was collected from Suisun Bay and its inputs/outputs: Benicia, Suisun Slough, San Joaquin River and Sacramento River. The bulk stable carbon and nitrogen isotope signatures of all fractions of these samples have been measured. In addition, a method for quantitative extraction of lipids from these samples has been tested; a current focus is to test if both lipids and amino acids can be isolated from the same zooplankton sample quantitatively and without isotopic fractionation.

The amino acid composition for this suite of samples has also been determined as a first-step to measuring the nitrogen isotopes of individual amino acids. This analysis also provides information on the concentration of D/L amino acids (a tracer of bacterial input) and of non-protein amino acids (a tracer of organic matter freshness). We are also currently culturing zooplankton isolated from Suisun Bay to directly test the trophic relationship in amino acid isotope signatures (between food source and zooplankton) within the species found in the relevant estuarine environment.

Initially, we proposed to identify the isotopic signature of primary producers in Suisun Bay through size fractionation. This approach had the potential pitfall of co-isolating detritus or bacteria. Instead, a method to determine the carbon and nitrogen isotopes of chlorophyll a has been developed which will allow the stable isotopes of primary producers in Suisun Bay to be determined directly.

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.
Since the first year of this project is focused on method-development and identifying the most promising tracers, we do not yet have actionable findings.
**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**

<table>
<thead>
<tr>
<th>Authors</th>
<th>Title</th>
<th>Conference</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lang, S.Q. and Aluwihare, L.I.</td>
<td>Investigating the carbon and nitrogen sources supplying the base of the Suisun Bay food web: a compound-specific isotope approach</td>
<td>CALFED Science Conference</td>
<td>2008</td>
</tr>
</tbody>
</table>
The USGS and Dr. James Cloern have generously provided berth space on the R/V Polaris during monthly cruises through the San Francisco Bay and immediate access to critical data such as chlorophyll concentrations and water salinity. We hope to pursue further collaborations with USGS scientists. For instance, USGS scientist Dr. Carol Kendall is monitoring the sulfur isotopes of sulfate, which will directly complement our own measurements of sulfur isotopes in zooplankton.

The Department of Water Resources has generously provided access to several of their water monitoring stations on the Sacramento and San Joaquin River.

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.

KEYWORDS: List keywords that will be useful in indexing your project.
**PATENTS:** List any patents associated with your project.

<table>
<thead>
<tr>
<th>Patents_18</th>
</tr>
</thead>
<tbody>
<tr>
<td>does not apply</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Additions_19</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>ProjectYear_2A</td>
</tr>
<tr>
<td>---------------</td>
</tr>
<tr>
<td>1st Year</td>
</tr>
</tbody>
</table>