Ecosystem Restoration Program - 2002 Proposal Solicitation Package (PSP): Signature Page

Each applicant submitting a proposal to the CALFED Bay-Delta Program Ecosystem Restoration Program must submit a signed Signature Page.

Failure to sign and submit this form will result in the application not being considered for funding.

The individual signing below declares the following:

- the truthfulness of all representations in this proposal;
- the individual signing the form is authorized to submit the application on behalf of the applicant (if applicant is an entity or organization; and
- the applicant has read and understood the conflict of interest and confidentiality discussion in the PSP Section 2.4 and waives any and all rights to privacy and confidentiality of the proposal on behalf of the applicant, to the extent as provided in this PSP.

Proposal Title:

A PILOT REGIONAL MONITORING PROGRAM FOR MERCURY IN FISH IN THE BAY-DELTA WATERSHED

_____
Authorized Signature

Jay Davis

_____
Printed Name

San Francisco Estuary Institute

_____
Organization

Ecosystem Restoration Program - 2002 Proposal Solicitation Package (PSP): Form I - Project Information

All applicants must complete this form for their proposals. *Failure to answer these questions will result in the application not being considered for funding.*

1. Proposal Title:
A PILOT REGIONAL MONITORING PROGRAM FOR MERCURY IN FISH IN THE BAY-DELTA WATERSHED

2. Proposal Applicants:

Jay Davis, San Francisco Estuary Institute
Mark Stephenson, San Jose State University Foundation
Maura Mack, California Department of Health Services
Darell Slotton, University of California Davis

3. Corresponding Contact Person:

Jay Davis
San Francisco Estuary Institute
7770 Pardee Lane
Oakland, CA 94621
510 746 7368
jay@sfei.org

4. Project Keywords:

Bioaccumulation
Contaminants
Water Quality Assessment & Monitoring

5. Type of project:

Monitoring

6. Does the project involve land acquisition, either in fee or through a conservation easement?

No
7. If yes, is there an existing specific restoration plan for this site?

8. Topic Area

Ecosystem Water and Sediment Quality

9. Type of applicant

Private non-profit

10. Location – GIS coordinates

Latitude:
Longitude:
Datum: (leave blank)

Describe project location using information such as water bodies, river miles, road intersections, landmarks, and size in acres.

Samples could be collected from throughout the entire ERP geographic scope.

11. Location – Ecozone

Code 15: Landscape

12. Location – County

Alameda, Amador, Butte, Calaveras, Colusa, Contra Costa, El Dorado, Glenn, Lake, Lassen, Madera, Mariposa, Merced, Napa, Nevada, Placer, Plumas, Sacramento, San Benito, San Joaquin, Shasta, Sierra, Solano, Stanislaus, Sutter, Tehama, Tuolumne, Yolo, Yuba

13. Location – City. Does your project fall within a city jurisdiction?

No

14. If yes, please list the city:

15. Location – Tribal Lands. Does your project fall on or adjacent to tribal lands?

No

16. Location – Congressional District.

California 13th

17. Location – California State Senate District & California Assembly District

California State Senate District Number: 9
California Assembly District Number: 16

18. How many years of funding are you requesting?

3

19. Requested Funds:

a. Are your overhead rates different depending on whether funds are state or federal?

No

b. If yes, list the different overhead rates and total requested funds.

c. If no, list single overhead rate and total requested funds.

0% (see Comments on Budget Form)

$4,923,235

d. Do you have cost share partners already identified?

Yes

If yes, list partners and amount contributed by each.

California Department of Health Services $159,580

e. Do you have potential cost share partners?

No

If yes, list partners and amount contributed by each.

f. Are you specifically seeking non-federal cost share funds through this solicitation?

No

If yes, list total non-federal funds requested.

g. If the total non-federal cost share funds requested above does not match the total state funds requested in 19a, please explain the difference.

20. Is this proposal for next-phase funding of an ongoing project funded by CALFED?

No

If yes, identify project number(s), title(s) and CALFED program.

21. Have you previously received funding from CALFED for other projects not listed above?

If yes, identify project number(s), title, and CALFED program.

ERP-99-B06	**Assessment of the Ecological and Human Health Impacts of Mercury in the Bay-Delta Watershed**	**ERP**
ERP-99-N07	**Chronic Toxicity of Environmental Contaminants in Sacramento Splittail: A Biomarker Approach**	**ERP**

22. Is this proposal for next-phase funding of an ongoing project funded by CVPIA?

No

If yes, identify project number(s), title, and CVPIA program.

23. Have you previously received funding from CVPIA for other projects not listed above?

No

24. Is this proposal for next-phase of an ongoing project funded by an entity other than CALFED or CVPIA?

No

If yes, identify project number(s), title, and funding source.

25. Please list suggested reviewers for your proposal. (optional)

Name	Organization	Phone	Email
Jim Wiener	University of Wisconsin Lacrosse	608 785 6454	wiener.jame@uwlax.edu

26. Comments.

Ecosystem Restoration Program - 2002 Proposal Solicitation Package (PSP): Form II - Executive Summary

All applicants must complete this form for their proposals. *Failure to answer these questions will result in the application not being considered for funding.*

Proposal Title: A PILOT REGIONAL MONITORING PROGRAM FOR MERCURY IN FISH IN THE BAY-DELTA WATERSHED

Please provide a brief but complete (about 300 words) summary description of the proposed project; its geographic location, project type, project objective, approach to implement the proposal, hypotheses and uncertainties, expected outcome and relationship to CALFED ERP and/or CVPIA goals.

CALFED restoration and water management activities are predicted to lead to local and possibly regional increases in concentrations of mercury in aquatic food webs and may exacerbate the existing mercury problem. On the other hand, remediation efforts by CALFED and other organizations will aim to reduce mercury accumulation in food webs.

The mercury problem is going to persist in the watershed for decades, perhaps centuries. Long term, multi-disciplinary, process-oriented studies are needed in order to develop a capability to predict the impact of management actions on mercury bioaccumulation and to evaluate the impact of management actions, both on a project and regional level, in support of an adaptive management approach. A monitoring program for mercury in fish is a core component of the science program recommended in the Mercury Strategy. Currently, very little monitoring is being performed in the watershed, and large portions of the watershed that are likely to have significant mercury contamination have not been sampled in an appropriate manner. Public outreach based on a clear definition of the problem will be the most rapid means of reducing the impacts of mercury on human health.

The goals of this proposed 3-year project are: 1) Protect human health by assessing and reducing exposure to methylmercury-contaminated fish; 2) Provide "performance measures" to gauge methylmercury contamination of the watershed during restoration and remediation; and 3) Establish an organizational and technical foundation for adaptive, state-of-the-science regional monitoring of mercury in the watershed.

The objectives of the project are: 1) Monitor long term trends and spatial variation of total mercury (present largely as methylmercury) in sport fish eaten by humans; 2) Provide information needed to assess human health risks of fish consumption; 3) Conduct outreach, education, and training to increase public awareness of methylmercury contamination of fish, the health risks of methylmercury exposure, and ways to reduce methylmercury exposure; 4) Perform focused investigations needed to support risk communication; 5) Monitor total mercury and, as necessary, methylmercury, in biosentinel species to assess methylmercury contamination of aquatic food webs; 6) Identify spatial and temporal patterns in methylmercury concentrations in bioindicator organisms; 7) Establish a committee structure for stakeholder guidance of the monitoring program; 8) Establish sampling and analytical procedures that ensure the comparability of data across the watershed; 9) Link to process studies in order to develop mechanistic understanding of mercury accumulation in key indicator species; 10) Identify landscape attributes associated with mercury accumulation in the food web; and 11) Develop and test protocols for evaluating the impacts of restoration, remediation, and landscape manipulation.

Hypotheses to be evaluated are: 1) Management actions will lead to localized and regional changes in long term trends in fish mercury; 2) Fish mercury concentrations in the watershed will vary spatially, ranging from safe to hazardous; 3) Elevated mercury in fish will be found downstream of historic mercury and gold mining activity; 4) Elevated mercury in fish will be found downstream of drainages with high percentages of wetland or floodplain acreage.

Sampling of mercury in sport fish and lower trophic level biosentinel fish species will be performed. The pilot monitoring program will include index sites for monitoring of temporal regional trends, spatial characterization of sport fish contamination in the watershed, and development of protocols and monitoring of selected restoration and remediation sites. An organizational structure, including managers, scientists, and extensive local involvement, will be established to provide a lasting forum for communication between managers and scientists, and a means of continual adjustment of the program to meet management needs and continually become more cost-effective. Inclusion of local involvement will provide a channel for public outreach and education.

Expected outcomes of the project include peer reviewed reports on results; accessible data, maps, and reports; presentations at review meetings, symposia, and stakeholder meetings; an organized network of local stakeholders; educational materials for targeted fish-consuming populations; and training workshops and educational materials for local health departments.

This project will address many CALFED priorities relating to water quality, local involvement, and environmental justice. Water quality issues relate to remediating the existing beneficial use impairment and ensuring CALFED does not exacerbate the problem through habitat restoration and water management.

Significant changes from the original proposals are: 1) three proposals have been combined into one integrated proposal for a fish monitoring program; 2) recommendations of the Mercury Strategy have been fully incorporated; 3) reviewer comments have been addressed.

Ecosystem Restoration Program - 2002 Proposal Solicitation Package (PSP): Form III - Environmental Compliance Checklist

All applicants must complete this form for their proposals. *Failure to answer these questions will result in the application not being considered for funding.*

Successful applicants are responsible for complying with all applicable laws and regulations for their projects, including the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA).

Any necessary NEPA or CEQA documents for an approved project must tier from the CALFED Programmatic Record of Decision and Programmatic EIS/EIR to avoid or minimize the projects adverse environmental impacts. Applicants are encouraged to review the Programmatic EIS/EIR and incorporate the applicable mitigation strategies from Appendix A of the Programmatic Record of Decision in developing their projects and the NEPA/CEQA documents for their projects.

1. **CEQA or NEPA Compliance**
   a. Will this project require compliance with CEQA? NO
   b. Will this project require compliance with NEPA? NO

   If neither CEQA or NEPA compliance is required, please explain why compliance is not required for the actions in this proposal.

   This is an environmental monitoring project.

2. **If the project will require CEQA and/or NEPA compliance, identify the lead agency(ies). Please write out all words in the agency title other than United States (use the abbreviation US) or California (use the abbreviation CA). If not applicable, put None.**

   CEQA Lead Agency:
   NEPA Lead Agency (or co-lead:)
   NEPA Co-Lead Agency (if applicable):

   None

3. **Please check which type of CEQA/NEPA documentation is anticipated.**

   CEQA

   ☐ Categorical Exemption
   ☐ Negative Declaration or Mitigated Negative Declaration
   ☐ EIR
   X ☒ none

NEPA

☐ Categorical Exclusion

☐ Environmental Assessment/FONSI

☐ EIS

X☒ none

If you anticipate relying on either the Categorical Exemption or Categorical Exclusion for this project, please specifically identify the exemption and/or exclusion that you believe covers this project.

CEQA/NEPA Process

a. Is the CEQA/NEPA process complete?

NOT APPLICABLE

b. If the CEQA/NEPA process is not complete, please describe the dates for completing draft and/or final CEQA/NEPA documents.
c. If the CEQA/NEPA document has been completed, please list document name(s):

4. **Environmental Permitting and Approvals**

Successful applicants must tier their project's permitting from the CALFED Record of Decision and attachments providing programmatic guidance on complying with the state and federal endangered species acts, the Coastal Zone Management Act, and sections 404 and 401 of the Clean Water Act. The CALFED Program will provide assistance with project permitting through its newly established permit clearing house.

Please indicate what permits or other approvals may be required for the activities contained in your proposal and also which have already been obtained. Please check all that apply. If a permit is *not* required, leave both Required? and Obtained? check boxes blank.

LOCAL PERMITS AND APPROVALS

Conditional use permit

Variance

Subdivision Map Act

Grading Permit

General Plan Amendment

Specific Plan Approval

Rezone

Williamson Act Contract Cancellation

Other

STATE PERMITS AND APPROVALS

Scientific Collecting Permit REQUIRED AND OBTAINED

CESA Compliance: 2081

CESA Compliance: NCCP

1601/03

CWA 401 certification

Coastal Development Permit

Reclamation Board Approval

Notification of DPC or BCDC

Other

FEDERAL PERMITS AND APPROVALS

ESA Compliance Section 7 Consultation

ESA Compliance Section 10 Permit

Rivers and Harbors Act

CWA 404

Other

PERMISSION TO ACCESS PROPERTY

Permission to access city, county or other local agency land.
Agency Name:

Permission to access state land.
Agency Name:

Permission to access federal land.
Agency Name:

Permission to access private land.
Landowner Name:

Comments. If you have comments on any of the above questions, please enter the question number followed by a specific comment.

Ecosystem Restoration Program - 2002 Proposal Solicitation Package (PSP): Form IV - Land Use Checklist

All applicants must complete this form for their proposals. Failure to answer these questions will result in the application not being considered for funding.

1. Does the project involve land acquisition, either in fee or through a conservation easement?

NO

2. If you answered yes to #1, please answer the following questions:

a. How many acres will be acquired?

b. Will existing water rights be acquired?

c. Are any changes to water rights or delivery of water proposed?

d. If yes, please describe proposed changes.

e. **Will the applicant require access across public or private property that the applicant does not own to accomplish the activities in the proposal?**

YES: PUBLIC PROPERTY (BOAT LAUNCHES)

3. Do the actions in the proposal involve physical changes in the land use?

NO

4. If you answered no to #3, explain what type of actions are involved in the proposal (i.e., research only, planning only).

MONITORING ONLY

5. If you answered yes to #3, please answer the following questions:

a. How many acres of land will be subject to a land use change under the proposal?

b. Describe what changes will occur on the land involved in the proposal.

c. List current and proposed land use, zoning and general plan designations of the area subject to a land use change under the proposal.

d. **Is the land currently under a Williamson Act contract?** *(For multiple sites, answer Yes if true for any parcel, and provide an explanation in the Comments box below)*

e. **Is the land mapped as Prime Farmland, Farmland of Statewide Importance, Unique Farmland or Farmland of Local Importance under the California Department of Conservation's Farmland Mapping and Monitoring Program?** For more information, contact the California Department of Conservation, Division of Land Resource Protection, Farmland Mapping and Monitoring Program (http://www.consrv.ca.gov/dlrp/FMMP/index.htm). (For multiple sites, answer Yes if true for any parcel, and provide an explanation in the Comments box below)

f. If yes, please list classification:

g. Describe what entity or organization will manage the property and provide operations and maintenance services.

6. Comments.

Ecosystem Restoration Program - 2002 Proposal Solicitation Package (PSP): Form V - Conflict of Interest Checklist

All applicants must complete this form for their proposals. *Failure to answer these questions will result in the application not being considered for funding.*

You may update your information at any time. The [update proposal] button is located at the bottom of this form.

Please list below the full names and organizations of all individuals in the following categories:

- Applicants listed in the proposal who wrote the proposal, will be performing the tasks listed in the proposal or who will benefit financially if the proposal is funded.
- Subcontractors listed in the proposal who will perform some tasks listed in the proposal and will benefit financially if the proposal is funded.
- Individuals not listed in the proposal who helped with proposal development, for example by reviewing drafts, or by providing critical suggestions or ideas contained within the proposal.

The information provided on this form will be used to select appropriate and unbiased reviewers for your proposal.

Applicant(s):

Jay Davis, San Francisco Estuary Institute
Mark Stephenson, San Jose State University Foundation
Maura Mack, California Department of Health Services
Darell Slotton, University of California Davis

Subcontractor(s):

Are specific subcontractors identified in this proposal? YES

If yes, please list the name(s) and organization(s):

Gary Ichikawa	California Department of Fish and Game
Chuck Armor	California Department of Fish and Game
Robert Smith	Independent Consultant

Helped with proposal development

Are there persons who helped with proposal development? YES

If yes, please list the name(s) and organization(s):

Chris Foe Central Valley Regional Water Quality Control Board

Ecosystem Restoration Program - 2002 Proposal Solicitation Package (PSP):
Form VI: Budget Summary

YEAR 1

Task No.	Task Description	Direct Labor Hours	Labor Cost	Travel	Supplies and Expendables	Services or Consultants	Equipment	Other Direct Costs	Total Cost
1	Project Management	2280	$ 191,472	$ 3,000	$ -	$ 63,000	$ -	$ -	$ 257,472
2	Temporal Trend Monitoring	0	$ -	$ -	$ -	$ 340,342	$ -	$ -	$ 340,342
3	Spatial Characterization of Watershed	0	$ -	$ -	$ -	$ 325,902	$ -	$ -	$ 325,902
4	Restoration and Remediation Project Monitoring	0	$ -	$ -	$ -	$ 299,196	$ -	$ -	$ 299,196
5	Data Interpretation and Reporting	2840	$ 229,453	$ 3,000	$ 2,000	$ 69,117	$ -	$ -	$ 303,570
6	Stakeholder Involvement	160	$ 16,026	$ 1,000	$ -	$ 320,625	$ -	$ -	$ 337,651
	TOTALS	5280	$ 436,950	$ 7,000	$ 2,000	$1,418,181	$ -	$ -	$ 1,864,132

Form VI: Budget Summary
YEAR 2

Task No.	Task Description	Direct Labor Hours	Labor Cost	Travel	Supplies and Expendables	Services or Consultants	Equipment	Other Direct Costs	Total Cost
1	Project Management	2280	$ 199,130	$ 3,000	$ -	$ 63,000	$ -	$ -	$ 265,130
2	Temporal Trend Monitoring	0	$ -	$ -	$ -	$ 223,976	$ -	$ -	$ 223,976
3	Spatial Characterization of Watershed	0	$ -	$ -	$ -	$ 332,899	$ -	$ -	$ 332,899
4	Restoration and Remediation Project Monitoring	0	$ -	$ -	$ -	$ 213,445	$ -	$ -	$ 213,445
5	Data Interpretation and Reporting	2840	$ 238,631	$ 3,000	$ 2,000	$ 67,300	$ -	$ -	$ 310,931
6	Stakeholder Involvement	160	$ 16,667	$ 1,000	$ -	$ 325,488	$ -	$ -	$ 343,155
	TOTALS	5280	$ 454,428	$ 7,000	$ 2,000	$ 1,226,107	$ -	$ -	$ 1,689,535

Form VI: Budget Summary

YEAR 3

Task No.	Task Description	Direct Labor Hours	Labor Cost	Travel	Supplies and Expendables	Services or Consultants	Equipment	Other Direct Costs	Total Cost
1	Project Management	2280	$ 207,096	$ 3,000	$ -	$ 63,000	$ -	$ -	$ 273,096
2	Temporal Trend Monitoring	0	$ -	$ -	$ -	$ 237,157	$ -	$ -	$ 237,157
3	Spatial Characterization of Watershed	0	$ -	$ -	$ -	$ -	$ -	$ -	$ -
4	Restoration and Remediation Project Monitoring	0	$ -	$ -	$ -	$ 206,439	$ -	$ -	$ 206,439
5	Data Interpretation and Reporting	2840	$ 248,176	$ 3,000	$ 2,000	$ 69,536	$ -	$ -	$ 322,712
6	Stakeholder Involvement	160	$ 17,333	$ 1,000	$ -	$ 311,831	$ -	$ -	$ 330,164
	TOTALS	5280	$ 472,605	$ 7,000	$ 2,000	$ 887,962	$ -	$ -	$ 1,369,568

GRAND TOTAL = $4,923,235

COMMENTS

This form is a slight variation from the format for the original PSP. This format was developed in consultation with the State Water Resources Control Board for a Central Valley monitoring project of similar scope: the Aquatic Pesticide Monitoring Program. This format is consistent with the way invoices will be submitted on the project. SFEI billing rates are generally lower than other private companies because SFEI is a non-profit institution.

Ecosystem Restoration Program - 2002 Proposal Solicitation Package (PSP): Form VII - Budget Justification

All applicants must complete this form for their proposals. ***Failure to answer these questions will result in the application not being considered for funding.***

Direct Labor Hours. Provide estimated hours proposed for each individual.

	YEAR 1	YEAR 2	YEAR 3
Environ. Scientist II	800	800	800
Asst Environ Scientist	1760	1760	1760
Accountant	240	240	240
Contract Manager	240	240	240
Office Manager	240	240	240
System Analyst	120	120	120
GIS Analyst	280	280	280
Environ Analyst	840	840	840
Environ. Scientist I	640	640	640
Graphics Designer	120	120	120

Salary. Provide estimated rate of compensation proposed for each individual.

	YEAR 1	YEAR 2	YEAR 3
Environ. Scientist II	43.27	45.00	46.80
Asst Environ Scientist	23.50	24.44	25.42
Accountant	24.40	25.37	26.39
Contract Manager	26.30	27.35	28.45
Office Manager	20.70	21.52	22.38
System Analyst	23.75	24.70	25.69
GIS Analyst	35.00	36.40	37.85
Environ Analyst	21.00	21.84	22.71
Environ. Scientist I	29.97	31.17	32.42
Graphics Designer	25.50	26.52	27.58

Benefits. Provide the overall benefit rate applicable to each category of employee proposed in the project.

18% of salary

Travel. Provide purpose and estimate costs for all non-local travel.

All travel will be local.

Supplies & Expendables. Indicate separately the amounts proposed for office, laboratory, computing, and field supplies.

Purchase of computers and statistical software: $6000

Services or Consultants. Identify the specific tasks for which these services would be used. Estimate amount of time required and the hourly or daily rate.

Task 1: PROGRAM MANAGEMENT

Peer Review: $50,000 per year in years 1, 2, and 3 ($10,000 for travel and labor for each of 5 reviewers)

Statistical consultation: $13,000 per year in years 1, 2, and 3 for design and analysis (labor and travel)

Task 2: TEMPORAL TREND MONITORING

Sport fish sampling and chemistry SJSUF

	HOUR	SALARY	BENEFIT	TRAVEL	SUPPLIE	SERVICE	EQUIPMI	DIRECT	TOTAL DI	INDIRECT	TOTAL CO
YEAR 1	3546	$ 48,285	$ 12,216	$ 2,300	$ 10,900	$ 24,588	$55,000	$ 6,500	$ 153,289	$ 34,876	$ 194,665
YEAR 2	2726	$ 36,598	$ 9,259	$ 2,300	$ 10,900	$ 25,546	$ -	$ -	$ 84,603	$ 16,768	$ 101,371
YEAR 3	2906	$ 38,673	$ 9,784	$ 3,000	$ 10,900	$ 30,544	$ -	$ -	$ 92,901	$ 17,626	$ 110,527
TOTAL	9178	$ 123,556	$ 31,260	$ 7,600	$ 32,700	$ 80,678	$55,000	$ 6,500	$ 330,793	$ 69,270	$ 406,563

Labor includes Project assistants at 132%. Overhead for DFG equals 19%, benefit rate equals 28%, other direct charge = overhead (26%) of first $25,000). Services include a total of $64,369 contracted to Gary Ichikawa for sampling fish (this contract contains funds for about 30% of his salary at a base salary of $50,689/year, plus $3000 in travel); consultant services for QA splits of 5% of samples. Travel expenses are for collection of samples. Supplies include fishing supplies (fishing gear, bait, nets, gloves and misc pertaining to fishing, maintenance and replacement parts for boats), laboratory supplies, instrument maintenance. Equipment includes an infatable boat, trailer, and 15 hp motor, 2- backpack shockers, $35,000 for purchase of Mercury Analyzer (Milestone DMA-80).

Biosentinel sampling and chemistry UC Davis

Year	Labor Hours	Salary	Benefits	Travel	Supplies	Service Contracts	Equipment	Other Direct	Total Direct	Indirect	TOTAL
1	2,912	$58,180	$18,908	$1,600	$4,000	$10,000	$27,000	$1,500	$121,188	$24,489	$145,677
2	2,912	$60,145	$19,547	$1,648	$4,120	$10,300		$1,545	$97,305	$25,299	$122,604
3	2,912	$62,157	$20,201	$1,697	$4,244	$10,609		$1,591	$100,500	$26,130	$126,630
TOTAL	8,736	$180,482	$58,657	$4,945	$12,364	$30,909	$27,000	$4,636	$318,993	$75,918	$394,911

Labor costs = 1.4 FTE each year. Positions are 1) Principal Investigator (0.15 FTE); 2) Lab/Field/Data Manager (0.25 FTE); 3) Head Chemist (0.5 FTE); Student assistants (0.5 FTE). Benefits are included at 32.5% of salaries. Travel costs include mileage reimbursements for use of personal vehicles in sampling, launch fees, and boat fuel costs.

Supplies includes supplies for field collections, sample handling and preparation, and laboratory analytical work. Services primarily charges to accomplish 5% QA/QC split sample analyses by outside laboratory. App. 12% for annual maintenance contract for laboratory analytical equipment. Equipment budget to outfit a boat specialized for electroshocking small fish. On-campus charges for nitrogen and carbon stable isotope analyses of selected samples. No indirect costs for equipment. UC Davis standard off-campus indirect rate for all other direct costs = 26%; potential 10% rate available for direct CBDA-UC Davis contracting.

Task 3 SPATIAL CHARACTERIZATION

Sport Fish Sampling and Chemistry SJSUF

	HOURS	SALARY	BENEFITS	TRAVEL	SUPPLIES	SERVICES	EQUIPMEI	DIRECT	TOTAL DI	INDIRECT	TOTAL CC
YEAR 1	8,869	$ 111,299	$ 28,159	$ 12,250	$ 17,000	$ 104,230	$ -	$ 6,500	$ 272,938	$ 46,464	$ 325,902
YEAR 2	8,869	$ 116,864	$ 29,567	$ 12,250	$ 17,000	$ 108,942	$ -	$ -	$ 284,622	$ 48,277	$ 332,899
Total	17,738	$ 228,163	$ 57,725	$ 24,500	$ 34,000	$ 213,172	$ -	$ 6,500	$ 557,560	$ 94,741	$ 658,801

Labor includes Project assistants at 391%. Overhead for DFG equals 19%, benefit rate equals 28%, other direct charge = overhead (26%) of first $25,000). Services include $193,172 Contracted to Gary Ichikawa, for sampling fish for Sampling (this contract contains funds for about 50% of his salary at a base salary of $50,689/year, plus $24,500 in travel); consultant services for QA splits of 5% of samples. Travel expenses are for collection of samples. Supplies include fishing supplies (fishing gear, bait, nets, gloves and misc pertaining to fishing, maintenance and replacement parts for boats), laboratory supplies, instrument maintenance.

Task 4 RESTORATION AND REMEDIATION PROJECT MONITORING

UC Davis Project Monitoring

Year	Hours	Salary	Benefits	Travel	Supplies	Contracts	Equipment	Direct	Direct	Indirect	TOTAL
1	2,496	$50,907	$16,545	$1,400	$3,500	$10,000	$15,000	$1,500	$98,852	$21,802	$120,653
2	2,496	$52,627	$17,104	$1,442	$3,605	$10,300		$1,545	$86,622	$22,522	$109,144
3	2,496	$54,388	$17,676	$1,485	$3,713	$10,609		$1,591	$89,462	$23,260	$112,722
TOTAL	7,488	$157,921	$51,324	$4,327	$10,818	$30,909	$15,000	$4,636	$274,937	$67,584	$342,520

Labor costs = 1.2 FTE each year. Positions are 1) Principal Investigator (0.15 FTE); 2) lab/Field/Data Manager (0.25 FTE); 3) Head Chemist (0.3 FTE); Student assistants (0.5 FTE). Benefits are included at 32.5% of salaries. Travel costs include mileage reimbursements for use of personal vehicles in sampling, launch fees, and boat fuel costs.

Supplies include supplies for field collections, sample handling and preparation, and laboratory analytical work. Services primarily charges to accomplish 5% QA/QC split sample analyses by outside laboratory. App. 12% for annual maintenance contract for laboratory analytical equipment. Equipment includes atomic fluorescence analyzer for analysis of very low concentration samples such as Delta region amphipods. Other Direct Costs include on-campus charges for nitrogen and carbon stable isotope analyses of selected samples. No indirect costs for equipment. UC Davis standard off-campus indirect rate for all other direct costs = 26%; potential 10% rate available for direct CBDA-UC Davis contracting.

SJSUF Project Monitoring Water

	HOUR	SALARY	BENEFIT	TRAVEL	SUPPLIE	SERVICE	EQUIPM	DIREC	TOTAL DIF	INDIREC	TOTAL CC
YEAR 1	2,240	$ 36,000	$ 9,529	$ 5,000	$ 7,000	$ 4,000	$53,000	$ -	$ 114,529	$29,778	$ 144,307
YEAR 2	2,240	$ 36,000	$ 9,529	$ 5,000	$ 7,000	$ 4,000	$ -	$ -	$ 61,529	$15,998	$ 77,527
YEAR 3	2,240	$ 36,000	$ 9,529	$ 5,000	$ 7,000	$ 4,000	$ -	$ -	$ 61,529	$15,998	$ 77,527
TOTAL	6,720	$ 108,000	$28,588	$ 15,000	$ 21,000	$12,000	$53,000	$ -	$ 237,588	$61,773	$ 299,360

Labor includes Project assistants at 108%. Overhead for DFG equals 19%, benefit rate equals 28%, other direct charge = overhead (26%) of first $25,000). for travel expenses for collection of samples. Travel for collecting and analytical supplies. Services for 5% QA splits. Equipment for hydrology equipment--4 Sontek Acoustic Dopplers—and for analytical equipment--Tekran Atomic Flourescence Detector for Hg analysis.

SJSUF Project Monitoring Sport Fish

	HOUR	SALARY	BENEFI	TRAVEL	SUPPLI	SERVICE	EQUI	DIRECT	TOTAL D	INDIREC	TOTAL CC
YEAR 1	731	$ 9,147	$ 2,314	$ 2,000	$ 1,700	$ 8,628	$ -	$ 6,500	$ 23,599	$ 4,137	$ 34,236
YEAR 2	542	$ 6,778	$ 1,715	$ 4,000	$ 2,300	$ 8,072	$ -	$ -	$ 22,915	$ 3,859	$ 26,774
YEAR 3	260	$ 2,492	$ 630	$ 2,000	$ 1,000	$ 8,476	$ -	$ -	$ 14,598	$ 1,592	$ 16,190
TOTAL	1,533	$18,416	$ 4,659	$ 8,000	$ 5,000	$ 25,176	$ -	$ 6,500	$ 61,112	$ 9,588	$ 77,200

Labor includes Project Assistant at 25%. Overhead for DFG equals 19%, benefit rate equals 28%, other direct charge = overhead (26%) of first $25,000). for travel expenses for collection of samples. Travel for collecting and analytical supplies. Services for 5% QA splits and for subcontract to DFG for Gary Ichikawa ($24,236). Supplies for fishing supplies (Fishing gear, bait, nets, gloves and misc pertaining to fishing). Maintenance and replacement parts for boats, supplies for dissecting and homogenizing supplies, laboratory supplies.

Task 5 INTERPRETATION AND REPORTING

UC Davis Interpretation and Reporting

Year	Labor Hours	Salary	Benefits	Travel	Service Supplies	Service Contra	Service Equipme	Other Direct	Total Direct	Indirect	TOTAL
1	1,456	$36,362	$11,818	$1,000	$2,500		$4,000		$55,680	$13,437	$69,117
2	1,456	$37,591	$12,217	$1,030	$2,575				$53,412	$13,887	$67,300
3	1,456	$38,848	$12,626	$1,061	$2,652				$55,187	$14,349	$69,536
TOTAL	4,368	$112,801	$36,660	$3,091	$7,727	$0	$4,000	$0	$164,279	$41,673	$205,952

Labor costs = 0.7 FTE each year. Positions are 1) Principal Investigator (0.4 FTE); 2) Lab/Field/Data Manager (0.3 FTE). Benefits are included at 32.5% of salaries. Travel primarily related to project and scientific meetings, including lodging, fees, and mileage reimbursements for use of personal vehicles. Supplies includes office and reporting supplies such as computer software and hardware, photocopying, toner, etc. Equipment includes one computer and peripherals purchase to improve data manipulation and graphics capability. No indirect costs for equipment. UC Davis standard off-campus indirect rate for all other direct costs = 26%; potential 10% rate available for direct CBDA-UC Davis contracting.

Task 6 STAKEHOLDER INVOLVEMENT…

Year	Labor hours	Salary	Benefits	Travel	Supplies	Services	Other Direct	Equipm	Indirect	TOTAL
1	4,657	$ 147,433	$ 45,321	$ 7,628	$ 5,000	$ 32,000	$ 30,699		$ 52,544	$ 320,625
2	4,712	$ 155,280	$ 47,733	$ 7,781	$ 5,000	$ 32,000	$ 24,353		$ 53,341	$ 325,488
3	4,712	$ 161,352	$ 49,600	$ 7,936	$ 5,000	$ 12,000	$ 24,840		$ 51,103	$ 311,831
TOTAL	14,081	$ 464,065	$ 142,654	$ 23,345	$ 15,000	$ 76,000	$ 79,892	$ -	$ 156,988	$ 957,944

Labor costs = 2.57 FTE in Year 1 and 2.60 FTE in Years 2 and 3. Positions are 1) Two Health Educators (1.5 FTE). 2) Environmental Scientist (1.0 FTE); 3) Contract Manager (0.05 FTE); Graphic Artist (0.02 FTE in Year 1 and 0.05 in Years 2 and 3). Benefits are included at 30.74% of salaries. Salaries and benefits are subject to annual merit and COLA increases of up to 4%. Staff will travel by car to the Delta counties involved in the study. Lodging, per diem, and mileage expenses are included. Supplies: This category includes funding for educational material development and reproduction (flyers, posters, cards). Services: This category includes translation and interpretation support, advisory group expenses, and GIS consultant. It also includes expenses associated with development and implementation of the needs assessments and trainings. Other Direct Costs: Costs for contract staff who are housed in a State office building, i.e. rent, communications, and office automation. Impact Assessment's Indirect Costs cover the general administrative activities required to execute the awarded contract including financial management, project monitoring and reporting, personnel administration, secondary subcontract administration, consultant purchasing and lease agreement negotiation. The Indirect Cost rate is 19.6% of Direct Costs less any costs associated with

subcontracts and equipment. EHIB staff make a significant contribution to this project. Five staff contribute a total of 0.37 FTE time to the project each year. All their associated costs are contributed as well. The total value of all contributed costs is approximately $160,000 over 3 years.

Equipment. Identify non-expendable personal property having a useful life of more than one (1) year and an acquisition cost of more than $5,000 per unit. If fabrication of equipment is proposed, list parts and materials required for each, and show costs separately from the other items.

NONE

Project Management. Describe the specific costs associated with insuring accomplishment of a specific project, such as inspection of work in progress, validation of costs, report preparation, giving presentations, response to project specific questions and necessary costs directly associated with specific project oversight.

	YEAR 1	YEAR 2	YEAR 3
Contract and Financial Management	$ 61,790	$ 64,262	$ 66,832
Coordination	$ 90,092	$ 91,575	$ 93,118
Program Design	$ 45,052	$ 46,334	$ 47,667
QA Oversight	$ 18,027	$ 18,748	$ 19,498
Data Mgmt/GIS/Web	$ 42,512	$ 44,212	$ 45,981
TOTAL	$ 257,472	$ 265,130	$ 273,096

Other Direct Costs. Provide any other direct costs not already covered.

NONE

Indirect Costs. Explain what is encompassed in the overhead rate (indirect costs). Overhead should include costs associated with general office requirements such as rent, phones, furniture, general office staff, etc., generally distributed by a predetermined percentage (or surcharge) of specific costs. *[CORRECTION: If overhead costs are different for State and Federal funds, note the different overhead rates and corresponding total requested funds on Form I - Project Information, Question 17a. On Form VI - Budget Summary, fill out one detailed budget for each year of requested funds, indicating on the form whether you are presenting the indirect costs based on the Federal overhead rate or State overhead rate. Our assumption is that line items other than indirect costs will remain the same whether funds come from State or Federal sources. If this assumption is not true for your budget, provide an explanation on the Budget Justification form.]* Agencies should include any internal costs associated with the management of project funds.

Total labor costs are provided, which include costs of salary, benefits, rent, communications, office equipment, office supplies, administrative staff, administrative time, holiday, vacation, and sick time.

A PILOT REGIONAL MONITORING PROGRAM FOR MERCURY IN FISH IN THE BAY-DELTA WATERSHED

A. PROJECT DESCRIPTION: PROJECT GOALS AND SCOPE OF WORK

1. PROBLEM

Present concentrations of mercury in aquatic food webs in the Bay-Delta watershed are high enough to warrant concern for the health of humans and wildlife. Recent sampling has found that several sport fish species (including largemouth bass, striped bass, Sacramento pikeminnow, channel catfish, and white catfish) had mercury concentrations of high human health concern, exceeding the screening value (0.3 ppm) in a majority of samples and frequently exceeding 1 ppm (Figures 1 and 2) (Davis et al. 2002). These concentrations pose a serious problem because fishing for food and recreation remains a popular activity throughout the watershed. Nearly 10% of the California population engages in fishing activities (USDI 2001). Creel surveys by the California Department of Fish and Game (CDFG) have shown that anglers spend over 2 million hours per year fishing on the Sacramento River alone (CDFG 2001). Wildlife exposure is another facet of the problem. Recent studies indicate that mercury concentrations in eggs of several bird species are high enough to reduce hatching success.

CALFED restoration and water management activities are predicted to lead to local and possibly regional increases in concentrations of mercury in aquatic food webs. On the other hand, remediation efforts by CALFED and other organizations will aim to reduce mercury accumulation in food webs.

Mercury science is a rapidly developing field, and the Bay-Delta watershed represents a unique, challenging, and so far perplexing setting for mercury investigations. Mercury has a complex biogeochemical cycle that is only beginning to be understood in this system. Recent studies in the region (Davis et al. 2002, Slotton et al 2002a,b, and others) have found striking regional variation in mercury bioaccumulation that currently defies explanation. Our present understanding of mercury is not sufficient to predict which restoration or remediation projects will affect mercury accumulation in food webs on a local or regional scale. One thing that seems clear is that the rate of reduction in mercury exposure at a regional scale will be slow. The mercury problem in northern California was created in the 1800s by gold and mercury mining throughout the watershed (Figure 3), has persisted to the present, and is likely to persist for decades more.

With uncertainty surrounding the potential impacts of restoration and remediation actions on mercury exposure in the ecosystem, it is imperative that a thorough monitoring program is in place as a performance measure to evaluate progress. Monitoring of mercury in fish is the most relevant measure of mercury exposure in aquatic ecosystems. Monitoring will be an essential component of adaptive management of the mercury problem, allowing managers to identify and advance actions that reduce mercury exposure rather than increase it. For these reasons, a monitoring program for mercury in fish is a core component of the science program recommended in the Mercury Strategy (Wiener et al. 2003). Currently, very little monitoring is being performed in the watershed, and large portions of the watershed that are likely to have

significant mercury contamination have not been sampled in an appropriate manner. The first step in adaptive management is clear definition of the problem, and the spatial extent of the mercury problem in the watershed has not yet been characterized.

Given the recalcitrance of mercury contamination, the best way to reduce exposure in the short term is to provide the public with information that will allow them to reduce exposure through selection of fishing locations or species that are less contaminated, or simply through reducing consumption. Consumption advisories are an important tool in this regard. Although some health advisories recommending consumption limits have been issued, these advisories address only a very small fraction of the overall watershed, mainly in the Coast Range (Figure 4). Advice has been issued for only one area in the Sierra foothills, and only the Delta on the Central Valley floor. Given the presence of widespread mercury contamination, current advisories are most likely inadequate to protect public health.

The recent needs assessment conducted by the California Department of Health Services, Environmental Health Investigation Branch (EHIB) in five counties in the watershed (Attachments 1 and 2) found very low awareness of fish contamination issues, in particular among Southeast Asian, Russian, Latino, and African American groups in the Delta region. In addition, while the health and environmental health departments in these counties believe that local fish contamination issues are a threat to public health, they are not undertaking public outreach and education activities, in large part because they lack the resources to address them.

This project will establish a foundation for adaptive, state-of-the-science regional monitoring of mercury in the watershed, coupled with public outreach and education on how to reduce exposure to mercury in fish. Monitoring and education will be essential tools for achieving short term and long term reductions in mercury exposure in the watershed.

Project Goals

1. *Protect human health by assessing and reducing exposure to methylmercury-contaminated fish*
2. *Provide "performance measures" to gauge methylmercury contamination of the watershed during restoration and remediation*
3. *Establish an organizational and technical foundation for adaptive, state-of-the-science regional monitoring of mercury in the watershed*

Objectives

1. *Monitor long term trends and spatial variation of total mercury (present largely as methylmercury) in sport fish eaten by humans*
2. *Provide information needed to assess human health risks of fish consumption*
3. *Conduct outreach, education, and training to increase public awareness of methylmercury contamination of fish, the health risks of methylmercury exposure, and ways to reduce methylmercury exposure*
4. *Perform focused investigations needed to support risk communication*
5. *Monitor total mercury and, as necessary, methylmercury, in biosentinel species (lower trophic level fish and invertebrates) and sport fish to assess methylmercury contamination of aquatic food webs and wildlife health risks*

6. *Identify spatial and temporal patterns in methylmercury concentrations in biosentinel species and sport fish.*
7. *Establish a committee structure for stakeholder guidance of the monitoring program and outreach, education, and training activities*
8. *Establish sampling and analytical procedures that ensure the comparability of data across the watershed*
9. *Link to process studies in order to develop mechanistic understanding of mercury accumulation in key indicator species*
10. *Identify landscape attributes associated with mercury accumulation in the food web*
11. *Develop and test protocols for evaluating the impacts of restoration, remediation, and landscape manipulation*

Goals 1 and 2 and Objectives 1 – 6 are taken directly from the Mercury Strategy discussion of goals and objectives for a fish monitoring program. Goal 3 and Objectives 7 – 11 are also based on the Strategy recommendations.

2. JUSTIFICATION

Conceptual Models Relating to Mercury Accumulation in the Watershed

The Mercury Strategy (Wiener et al. 2003) contains a strong recommendation for a mercury monitoring program, and includes a thorough discussion of the present understanding of mercury in the ecosystem and the conceptual rationale for this recommendation. Conceptual models relating to mercury in the watershed were also described in some detail in the original submittals of the three proposals that have been combined into this one. The page limitation on this proposal allows only a summary of the important points derived from conceptual models for mercury that pertain to the necessity and design of a pilot mercury monitoring program.

Summary of Conceptual Models

- Mercury has a complex biogeochemical cycle that makes it difficult to predict spatial and temporal patterns in food web contamination.
- Through biomagnification, predatory fish attain mercury concentrations that are approximately a million times higher than concentrations in water.
- High trophic level sport fish species are essential indicators of mercury contamination, useful in characterizing human exposure, contaminated food webs, and spatial and temporal variability in the watershed.
- Striped bass are probably the most important indicator of mercury contamination in the region from a human health perspective, due to high mercury concentrations, their abundance, their great popularity for consumption, and the existence of historic data.
- Largemouth bass are a valuable indicator because they accumulate high concentrations, and are abundant, broadly distributed, popular with anglers, and generally nonmigratory.
- Low trophic level species (i.e., small fish and invertebrates) can provide the best statistical differentiation of spatial and temporal variability in methylmercury exposure. They also provide representative data for prey items of piscivorous wildlife.

- Management actions of CALFED and the Regional Water Quality Control Board will lead to fluctuations in long term trends on a local scale, and could lead to long term increases or decreases on a regional scale.
- The complex interplay of processes involved in the mercury cycle can be expected to lead to interannual variation in food web mercury. The key to detecting real change in fish mercury will be filtering out extraneous interannual variation to reveal actual long term trends.
- Elevated food web mercury in the watershed has been observed downstream of both mercury and gold mining regions, indicating that both elemental mercury and cinnabar are reactive enough in this watershed to lead to food web accumulation.
- Many areas in the watershed have not yet been sampled in a manner that would allow comparison with the growing body of high quality data in the Delta region (Figures 1 and 2), most notably many streams and reservoirs on the east side of the Valley draining Gold Country, including the watersheds of the American, Mokelumne, Stanislaus, Tuolumne, and Merced rivers. These drainages alone contain hundreds of reservoirs.
- The most effective way to reduce human exposure in the short term is to document patterns in concentrations of mercury in fish species in the Bay-Delta watershed, conduct activities to increase public awareness of the problem, and provide guidance on ways to reduce exposure.

Hypotheses and Means of Evaluation

1. *Management actions will lead to localized and regional changes in long term trends in fish mercury.* Establish a network of long term sampling sites to begin characterizing interannual variability and provide a solid basis for evaluation of long term trends.
2. *Fish mercury concentrations in the watershed will vary spatially, ranging from safe to hazardous.* Conduct sport fish sampling broadly in the watershed, tracing contamination upstream from areas with demonstrated contamination, and including areas not influenced by historic mining or known mercury sources except for atmospheric deposition.
3. *Elevated mercury in fish will be found downstream of historic mercury and gold mining activity.* Sample reservoirs, streams, and rivers downstream of historic mining regions.
4. *Elevated mercury in fish will be found downstream of drainages with high percentages of wetland or floodplain acreage.* Sample drainages in the watershed with varying degrees of wetland and floodplain acreage.

Project Type This proposal will initiate a pilot monitoring program for mercury in fish. A committee structure will be formed as part of this effort with representation from appropriate stakeholders to provide a forum for ongoing communication between managers and scientists, and a means of continual adjustment of the program to meet management needs and become more cost-effective. This monitoring will provide an essential performance measure for evaluating the impact of restoration and remediation on mercury accumulation in aquatic food webs; a critical ingredient for adaptive management of the ecosystem.

3. APPROACH

The proposed approach represents a compromise between the elements of the proposals as originally submitted, the urgent need to begin monitoring, and the deliberate, stepwise approach recommended in the Mercury Strategy for establishing a monitoring program. In this proposal we outline a plan for the Pilot Monitoring Program that will serve as a starting point for

discussion. We will follow the steps outlined in the Strategy, and will immediately begin establishing the organizational framework, goals, and objectives for the monitoring program. However, it is possible that some of the organizational framework will not be fully established prior to the arrival of the 2004 sampling season. Given the three year limit to the grant and the urgency of obtaining pre-project information and developing the information needed to allow people to reduce their mercury exposure, we need to begin sampling in 2004. This is consistent with the Strategy recommendation that the "development and implementation of a monitoring program should be expedited to the greatest extent possible." We will work with the Steering Committee to decide how to proceed in this situation.

This is a large and complex project that can only be briefly summarized within the page limitations of this proposal. Short descriptions of the primary tasks are provided below.

Developing an Organizational Framework for Stakeholder Guidance of the Program

The first step in implementing this proposal, as recommended in the Strategy, will be to establish a multidisciplinary, multi-institutional Steering Committee to lead and facilitate the development process. Establishing this institutional structure will provide the most important element of a lasting framework for adaptive management of the mercury problem over the long-term. The proposed membership of the Committee is listed in Table 1. The Committee will also provide a forum for local input and include representation from county health agencies, the public, and other local groups from throughout the CALFED solution area (described further under Task 6 below). Having the right mix of representation on the Committee is essential to establishing appropriate goals and objectives for the monitoring program, and keeping the program sharply focused on management needs on a continuing basis. As described in the Strategy, this Committee will *refine* the goals and objectives developed in the Strategy and incorporated into this proposal. The goals and objectives listed in this proposal are derived from those in the Strategy, the SRWP fish monitoring program, and the RMP fish monitoring program, and should be close to what is needed.

Program Design

After the Steering Committee adopts goals and objectives, the next step will be to adopt a sampling design to meet them. For developing this proposal, we had to devise a preliminary sampling plan. This preliminary sampling design will be presented to the Committee for refinement. While the proposal process will not allow for complete flexibility in the design of the program, there will be room for Committee input. This Pilot Program is anticipated to lead to continued monitoring in later years that would be entirely at the discretion of the Committee.

Statistical aspects of the design will be developed in consultation with a statistician: Dr. Robert Smith. Robust strategies will be developed to meet the defined objectives. Statistical analysis of recent fish mercury data will be used in crafting an efficient sampling design, particularly with respect to power to detect temporal trends on a site-specific and regional basis.

An important consideration in site selection will be linking to process-oriented studies of mercury dynamics in water, sediment, and other portions of the food web. Linkage with these

studies will support one of the objectives of this proposal: developing a mechanistic understanding of mercury uptake by key indicator species. Linkage with other types of research and monitoring projects, such as wetland monitoring or food web studies, may also lead to a better understanding of mercury cycling. A list of the other efforts with which this pilot program will coordinate is provided in Table 2. Other criteria to be considered in site selection are described for each Program element below.

The next step, following Strategy recommendations, will be documentation of procedures for program tasks, including: fish sampling, handling and analysis of samples, quality assurance, archiving, data management, statistical analysis, synthesis and reporting, risk communication, outreach and education, and peer review. This documentation will facilitate the next step in the process, external peer review of the design of the program. A budget for peer review is included in this proposal. Peer review of this Pilot Program will be coordinated with any broader peer review of Strategy implementation. For review of the Pilot Program, a panel comprised of experts in fish mercury, monitoring, statistical sampling design, and outreach and education will be assembled, with the guidance of the Steering Committee. This panel will provide initial review of the Pilot Program prior to sampling in 2004, and will meet annually to provide guidance on Program design and review of products emanating from the Program.

Temporal Trend Monitoring (Task 2)

Temporal trend monitoring will consist of two major elements: monitoring of index sites and monitoring of striped bass. Striped bass monitoring is separated because this species is highly migratory and cannot reliably be collected at the same locations that are desirable for long term trend monitoring of other species.

Index Site Monitoring (Task 2a)

General Index Site Sampling Design. Index site monitoring will be conducted to provide information on long term regional trends, spatial variation, mechanisms of mercury uptake in indicator species, factors influencing mercury accumulation in food webs, and health risks associated with fish consumption. The index sites (approximately 15) will be selected by the Steering Committee. The following draft selection criteria will be presented to the Committee:

- Integrative representation of subwatersheds;
- Spatial coverage of study area, especially regions where restoration and remediation are occurring;
- Existence of historic data at the location;
- Popularity with local anglers; and
- Linkage with other process and monitoring studies.

A list of candidate sites is given in Table 3 and locations are shown in Figure 5.

Approximately three index sites will be sampled more intensely ("intensive sites"). At the intensive sites, a concerted effort will be made to sample the entire spectrum of sport fish and lower trophic level fish species. This will provide valuable information on mercury concentrations in less common species and on how concentrations in the primary indicator species can generally be extrapolated to other species.

Biosentinel Sampling at Index Sites. Biosentinel (a term used in this proposal to refer to relatively non-migratory, short-lived, generally lower trophic level small fish and invertebrates) sampling at index sites will be conducted with the objective of evaluating long term, interannual, and seasonal trends in methylmercury exposure and bioaccumulation. Sampling will resemble that done by UC Davis in recent CALFED projects, with an emphasis on adequate replication and the generation of consistent, tight statistical confidence intervals for each mean biotic mercury concentration. Index site sampling will occur once each year in late summer or fall when the primary target organisms, representative young-of-year fish, have attained sufficient size to be important prey items and have integrated methylmercury bioaccumulation across the bulk of the warm season. At approximately three "intensive" sites, all prevalent small fish species (and possibly some macroinvertebrates) will be sampled. At one or more representative sites, intensive within-year sampling will be conducted, tracking the seasonal patterns of methylmercury bioaccumulation in the dominant prey fishes as they move through their annual cycles. This work is also planned to include caged clam experiments and monthly collections of aqueous methylmercury. Finally, at a series of sampling locations spanning a range of mercury exposure conditions and where alternate important prey fish species overlap, collections of both of the overlap species will be made in order to develop models linking the mercury bioaccumulation levels in alternate prey fish with those in the primary sentinel species. The extended sampling programs will help guide the basic index monitoring and its interpretation.

The primary target biosentinel organism will be a small fish with the greatest convergence of key attributes, including: (1) wide and abundant presence throughout the study region, (2) importance or dominance as a prey item of co-occuring piscivorous sport fish and wildlife, (3) relatively consistent and predictable diet and trophic level across the target sizes, and
(4) significant accumulation of methylmercury, allowing the differentiation of temporal and spatial variability. A single primary sentinel species will be most useful in assessing spatial and temporal variability across the study region. However, at certain monitoring locations, different species assemblages will almost certainly require the use of alternate sentinel species. Sampling at each site and date will generally consist of a minimum of 15 individuals of the target species, to be analyzed individually. Sample handling and analysis will follow procedures developed in prior work. Samples will be cleaned and quick frozen in water directly in the field, providing optimal, essentially fresh condition for analysis following archiving of up to one year. Prior to analysis, individual samples will be weighed and measured and then dried to constant weight and ground to a consistent powder. Moisture percentage will be carefully determined, facilitating the conversion of dry weight analyses to wet/fresh weight concentrations. Dry powder samples have proven ideal for reproducibility, sample archiving, and availability for ancillary analyses such as carbon and nitrogen stable isotopes.

Samples will be analyzed for total mercury by UC Davis using a Perkin Elmer Flow Injection Mercury System (FIMS) with an AS-90 autosampler, following digestion under pressure at 90 °C in a mixture of concentrated nitric and sulfuric acids with potassium permanganate. Methylmercury in selected samples will be analyzed by UC Davis by complexation with bromide in a copper sulfate / sodium bromide solution, followed by organic extraction into methylene chloride / hexane, and then acid digestion and FIMS analysis as for

total mercury. Numerous blanks, aqueous standards, appropriate standard reference materials, field duplicates, method duplicates, continuing control standards, and matrix spikes will be digested and analyzed with each set of samples. The UCD analytical lab will participate in the QA program being established by the Bay-Delta Authority. As part of this program, splits of 5% of samples will be analyzed by an independent lab. Funds for this have been included in the budget. Sufficient tissue mass from each sample will be archived to allow for reanalysis.

As biosentinel individuals within a given sample will be collected as functional replicates in a similar size range, differentiation of results by size or age will not generally be necessary. Individual data will typically be pooled post-analysis to generate mean mercury concentrations together with 95% statistical confidence intervals. These measures will be used to assess relative spatial and temporal variation among samples. A consistent number of individual analyses per sample will allow the consistent determination of statistical confidence.

Sport Fish Sampling at Index Sites. Sport fish sampling at index sites will be performed with the primary objective of evaluating long term trends in regional mercury contamination. Sampling will occur once each year in late summer. The primary target sport fish species at a given index site will depend on the fish assemblages present in that region. At Valley floor locations, the primary target species will include largemouth bass and white catfish. In clearer, cooler streams and rivers, primary targets will include Sacramento pikeminnow and Sacramento sucker. Different primary targets may be needed in other areas. For primary target species we will attempt to catch a minimum of 9 fish at each site, spanning a broad range of sizes, with the goal of establishing a regression between mercury and length at each location. Muscle tissue from primary target species will be analyzed individually for mercury. Secondary target species will be collected at each index site as bycatch. For secondary target species, composite samples comprised of 5 fish in a target size range will be analyzed.

Gut contents of all largemouth bass and white catfish collected from index sites will be analyzed by CDFG staff. This project will be conducted in collaboration with the Delta Resident Shoreline Fish Monitoring Project (DRSFMP) implemented by CDFG. The DRSFMP is a long term study of trends in populations and trophic interactions of popular sport fish species in the Delta. In the DRSFMP, year-round monthly gut content analysis is being performed at randomly selected sites within five blocks in the Delta. This proposal includes funds for CDFG to allow collaboration on gut content evaluation. This detailed diet information will be of great value in modeling mercury accumulation in largemouth bass and white catfish in the Delta.

Sport fish samples will be collected by Moss Landing Marine Laboratory (MLML) by electroshocking (with an e-boat), fyke nets, gill nets, or other methods. Samples will be stored and processed using non-contaminating techniques, following protocols established for the CALFED Mercury Project, RMP, and SRWP. Total mercury concentrations in sport fish muscle will be analyzed by MLML. Samples will be analyzed using a Perkin Elmer Flow Injection Mercury System (FIMS) with an AS-90 autosampler. Methylmercury in selected species will be analyzed by MLML using a digestion in 25% KOH/methanol followed by an isothermal GC separation of ethyl analogs and cold vapor atomic fluorescence (CVAFS). Three blanks, a standard reference material (DORM-2 for total and methylmercury), as well as a method duplicate and a matrix spike pair will be run with each set of samples. The MLML and UCD

analytical labs will participate in the QA program being established by the Bay-Delta Authority. As part of this program, splits of 5% of samples will be analyzed by an independent lab. Funds for this have been included in the budget. Sufficient tissue mass from each sample will be archived to allow for reanalysis.

Data from sport fish monitoring at index sites will be analyzed in several ways. For sites with data from previous years, interannual variation and trends will be evaluated using the improved ANCOVA method described in Davis et al. (2002). The Mercury Strategy recommends that mercury studies in the Estuary should move from a predictive phase into a mechanistic phase. Data on mercury concentrations in the food web and diet will be used to develop a mechanistic model of mercury uptake by largemouth bass and perhaps other key indicator species. The model will combine bioenergetics and a mercury mass balance approach (Trudel et al. 2000). This modeling will help define the pathway of mercury transfer through the food web to largemouth bass, and the seasonal dynamics of uptake. Finally, correlations between sport fish mercury and other parameters will be examined using index site data, in an effort to identify factors controlling spatial variation in food web mercury.

Striped Bass Monitoring (Task 2b)

Striped bass are probably the most important indicator of mercury contamination in the region from a human health perspective. Recent sampling efforts, including the CALFED Mercury Project and the RMP, have not effectively sampled this species and yielded relatively small sample sizes. In this study, we will conduct targeted sampling of striped bass to obtain an adequate sample size. Striped bass are long-lived and can be migratory, and consequently are not suited for monitoring of shorter-term interannual variation or spatial characterization. Given their popularity with anglers, however, it is important track mercury concentrations in striped bass on an infrequent basis (every few years) as an indicator of long term trends in the Estuary. This study will conduct focused striped bass sampling in one year only (2005), establishing a solid benchmark for future reference.

The timing and location of striped bass sampling will be aligned with fishing activity for this species. Multiple locations will be sampled, as previous sampling has suggested some spatial variation, possibly due to the presence of some nonmigratory subpopulations. Striped bass will be sampled using gill nets or electroshock techniques. Sampling will be in collaboration with the DFG Bay Delta Striped Bass Group. A broad range of sizes will be collected at each location to provide suitable data for regression analysis. Striped bass will be analyzed as individuals using the same chemical methods described above for the other sport fish species.

Spatial Characterization of Watershed (Task 3)

The primary objective of this Task will be to obtain directly comparable data on food web mercury throughout the watershed. The study area is shown in Figure 3. Largemouth bass have been selected as the primary indicator species for this purpose because of their mercury accumulation, site fidelity, abundance, and broad distribution in rivers and reservoirs in the study area. Other species (e.g., Sacramento pikeminnow and trout) will be used in regions where

largemouth bass are not present. This Task would provide a preliminary screening of regions that have not yet been covered by past sampling efforts. The emphasis will be on spatial coverage of the watershed, rather than multi-species comparisons. However, other species caught as bycatch will be retained and analyzed in order to provide guidance to the public. By defining the boundaries of the mercury problem, we will be able to steer anglers away from contaminated areas and toward uncontaminated areas. It is anticipated that more detailed studies will follow from this screening effort at many locations, focused more on the species with high rates of consumption and possibly upstream source identification.

The first step in designing this element will be to thoroughly review existing data on mercury in sport fish in the watershed (e.g., Rasmussen and Blethrow 1990, May et al. 2000). The second step will be to identify sampling sites. This will be done by the Steering Committee. Criteria to be considered in sampling site selection will include:

- input from local agencies, community groups, anglers, and others;
- the presence of largemouth bass and other target species;
- location downstream or upstream of historic mining activity or contaminated sites;
- amount of fishing activity;
- lack of coverage under past or present sampling programs; and
- location downstream of landscape features expected to affect mercury bioaccumulation.

Approximately 50 sites will be sampled each year in years 1 and 2 of the three year project. The overall goal is to obtain a thorough spatial characterization of the watershed, so the primary emphasis each year will be on sampling areas that have not yet been sampled. With two years of sampling it will be possible to achieve a reasonably thorough spatial coverage of the watershed.

Much of the sampling effort will be focused on largemouth bass. A minimum of 9 largemouth spanning a wide size range will be collected from each site, following the same approach employed at the index sites. The fish will be analyzed individually for mercury. Other popular species collected as bycatch will be retained and analyzed in cases where a sufficient number of individuals is available. Sample collection and chemical analytical procedures will be as described above for sport fish at the index sites.

Within each site, the size:mercury relationship for each species will be evaluated by regression to allow among-site comparisons of standard sized fish. Using GIS, data from this project will be compiled along with comparable data from other studies in the watershed to create map-based graphics of mercury distribution throughout the watershed. The data analysis component of this project will include a quantitative comparison of fish mercury concentrations from this study and other studies to landscape features of the surrounding region (e.g., wetland acreage, prevalence of mines).

The compiled data on the distribution of mercury in sport fish in the watershed will provide managers with information that is essential to understanding the scope of the mercury problem in the watershed, informing anglers of contaminated and uncontaminated areas, identifying sources, and setting priorities for remediation. This project will provide an integrated evaluation of data from different studies, and will result in the development of a data management framework that can continue to be used in the future.

Restoration and Remediation Project Monitoring (Task 4)

This task will include two components. One will be the development of appropriate methodologies for pre-project and continuation performance monitoring of restoration and remediation projects ("Protocol Development"). The second will consist of actual performance monitoring of select representative manipulated sites ("Site Monitoring"). This work will primarily utilize UC Davis biosentinel monitoring as a performance measure, supplemented at select test sites by collaboration with MLML, including sport fish monitoring, on/off site aqueous methylmercury loading, and sediment methyl:total mercury ratios.

Protocol Development (Task 4a)

Building directly on previous research by the project team, we will continue to develop and refine methodologies for the mercury-related performance assessment of restoration and remediation projects. Remaining areas of uncertainty to be addressed include: (1) re-assessment of optimal biosentinel species across the system, (2) linkage to diet of co-occurring piscivorous fish and wildlife, (3) development of new (likely invertebrate) potential biosentinel species for use directly within wetland restoration sites, and (4) establishment of individual variability in all biosentinels, for determination of minimum replication numbers for accurate statistical tracking. A remaining area of uncertainty related to remediation monitoring in watershed tributaries is the fine scale temporal pattern of bioaccumulation in small fish biosentinels. It is critical that annual performance monitoring be conducted and interpreted in relation to any existing seasonal cycle in bioaccumulation. Complementing the restoration-based seasonal collections of Task 2a, intensive seasonal collections of small fish will be made at a representative tributary site using a species to be utilized in mercury remediation monitoring. These collections may also include sampling of water and the use of clam transplant experiments. Additional performance testing tools for wetland restoration sites that were utilized in earlier CALFED research and will be further tested and refined include the estimation of aqueous methylmercury tidal loading on and off tracts and sediment methyl:total mercury ratio sampling. This work will be conducted in collaboration with MLML. For protocol development of all performance measuring components, methodologies for sample collection, processing, and analysis will be as established in the earlier CALFED Mercury Project Quality Assurance Project Plan or as described above in Task 2.

Site Monitoring (Task 4b)

Performance monitoring will be conducted at a select group of representative, important restoration and remediation projects. As described above for Task 4a, methods will center on UC Davis biosentinel monitoring, supplemented at a subset of sites with sport fish, loading, and sediment work in collaboration with MLML. Sites will be chosen in close consultation with CBDA. While it will be beyond the scope of this program to exhaustively study every restoration and remediation site, we will endeavor to utilize basic but effective performance measures at the most important and representative projects as they commence. Primary candidate sites for intensive monitoring include the Napa Marsh complex, Dutch Slough, Yolo Bypass, and the North Delta Wetlands (restoration) and Cache and Marsh Creeks (remediation). Performance data will be comparable to ongoing results of the index site monitoring program

and its linkage to a variety of process studies. Sample collection, processing, analytical, and data generation and interpretation methodology will be as described above in previous tasks.

Stakeholder Involvement and Outreach, Education, and Training (Task 6)

Stakeholder Involvement

Input from local stakeholders will be an important part of the fish monitoring program and ensure that outreach, education, and training activities respond to local needs and concerns, and build local capacity. Activities to ensure stakeholder involvement will include:

Needs Assessments. A three-tiered needs assessment process will be conducted as follows:
Tier One. Community leaders (e.g., local elected officials, civic leaders, clergy) in 30 counties within the Sacramento, Delta, and San Joaquin Regions of the ERP Geographic Scope will be informed about the project via a letter and companion document describing the project and providing contact names for additional information.
Tier Two. Staff in local governmental agencies, anglers or angler groups, persons involved in fishing activities (e.g., managers of fishing areas, wardens, marina operators, etc.), and others to be identified within the 30 counties will be informed about the project via a letter and companion document describing the project. In addition, these individuals will be asked to complete a survey questionnaire that seeks information pertinent to fish monitoring. This information will include local fish contamination concerns, locations of fishing activity, fish species caught and consumed, and populations engaged in fishing activities. Key informant interviews may also be conducted with these agencies and individuals, as necessary, to obtain more in-depth information. These activities will be conducted in concert with Tasks 2 and 3, with half of the watershed covered in 2004 and half in 2005.
Tier Three. A more in-depth needs assessment will be conducted with local stakeholders in approximately six to eight counties in the watershed. The information obtained will be used to support the project's objective of increasing public awareness of mercury contamination of fish and reducing exposure. The counties will be selected based on criteria such as: (1) high levels of fishing activity; (2) high fish mercury levels in existing data; (3) presence of a health advisory; (4) environmental justice concerns; (5) local interest; and (6) areas where the need to reduce exposure to mercury is the greatest; among other criteria. These needs assessments will be similar to the needs assessment already conducted by EHIB in five counties (Sacramento, San Joaquin, Yolo, Placer, and Lake), and planned in four counties (Contra Costa, Solano, Nevada, Yuba) for August 2003 to May 2004. Stakeholders may include local governmental agency staff, health care providers, community-based organizations, environmental groups, Native American tribal agency staff, and others to be identified. Key informant interviews, focus groups, and surveys will be conducted to obtain the following types of information:

- Awareness, concerns, and information needs regarding fish contamination;
- Optimal methods for outreach, education and training; and
- Opportunities for collaboration.

Advisory Groups. Zonal advisory groups (ZAGs) will be comprised of local stakeholders from specific geographic areas of the watershed. The ZAGs will provide a forum for local stakeholders to be informed about project activities and provide input on these activities. A

Delta ZAG will be the first ZAG created and will represent the counties of Sacramento, San Joaquin, Yolo, Contra Costa, and Solano. Subsequent ZAGs may include a Sierra Lakes ZAG (Placer, Nevada, and Yuba counties) and a Lake County ZAG, among others. ZAG representatives will participate on the Steering Committee.

Outreach, Education and Training

Outreach, education and training activities will include the following:

1. Modify the outreach, education, and training strategy developed with funding from CBDA. In July 2003, EHIB received a grant from CBDA to develop an outreach, education, and training strategy based on the results of the five-county needs assessment. EHIB will modify the strategy, as necessary, to address the specific objectives of this project. The strategy will identify a variety of activities that may be directed to all 30 counties, or may be targeted to specific counties, communities, or populations.
2. Develop, field test, translate, and disseminate public outreach and education messages and materials in collaboration with the ZAGs based on priorities from the outreach, education, and training strategy.
3. Design and conduct training for county and other local agency staff, community-based groups, health care providers, and others on a variety of topics related to mercury in fish.
4. Evaluate the usefulness and effectiveness of education and training activities.

4. Feasibility SFEI and MLML have collaborated on sport fish sampling projects for many years, including the Sacramento River Watershed Program, the Delta Fish Study, the CALFED Mercury Project, and a CALFED-funded study evaluating contaminant effects on splittail. Based on experience from these projects it is considered feasible to conduct this sampling. If necessary, DFG staff from the Water Pollution Control Lab (WPCL), which performs TSMP sampling and has sampled widely across the State, is available to assist in sample collection. WPCL can also assist in mercury analysis if necessary. The DFG staff that would perform the sampling have the permits needed to collect fish in the region. UC Davis has conducted sampling of small fish and invertebrates in the region for many years, including extensive sampling in the ERP project "Effects of Wetland Restoration on the Production of Methylmercury in the San Francisco Bay-Delta System." SFEI, MLML, DFG, and UC Davis all collaborated successfully in the recent CALFED Mercury Project. An earlier review concern was the reliance on an outside contract laboratory for certain analyses. UC Davis has now established a reliable methylmercury capability for biotic samples. In addition, by working together with MLML, all mercury analyses will be conducted "in-house". EHIB staff have extensive experience coordinating local involvement on a variety of environmental health issues including fish contamination. The outreach, education, and training activities proposed in this project are modeled after successful programs conducted by EHIB staff in other areas of the state.

5. Performance Measures The best way to ensure that this project successfully meets its goals and objectives will be to include high quality peer review in design, implementation, and interpretation. The model established in the CALFED Mercury Project will be followed.

The success of this project will be evaluated by the following performance measures:

- *Complete subcontracts with MLML, DFG, UC Davis, and DHS/IAI*
- *Submit quarterly fiscal and programmatic reports on time*
- *Develop peer-reviewed annual sampling plans*
- *Obtain target numbers of fish in defined size ranges from each sampling location*
- *Prepare sampling report*
- *Meet data quality objectives for chemical analysis*
- *Complete chemical analysis and QA/data report in May of each year*
- *Complete peer-reviewed annual project reports presenting findings*
- *Present findings at annual review meetings, other symposia, and at meetings of stakeholder groups*
- *Create and convene quarterly stakeholder advisory group and committee meetings*
- *Conduct needs assessments and trainings*
- *Develop and translate educational messages and materials*
- *Develop education and training tools, protocols, and reference materials*
- *Effectively distribute results to local agencies, environmental groups, the media, and the public*
- *Conduct activities to evaluate the usefulness, effectiveness, and appropriateness of education and training activities*
- *Produce peer-reviewed final report*
- *Present findings and raw data on the web*
- *Publish results in peer-reviewed journal*

6. Data Handling and Storage SFEI will manage the data from this study using procedures developed for the Regional Monitoring Program for Trace Substances, whose data SFEI has been successfully managing for the past seven years. Analytical results will be transferred to SFEI in Microsoft Excel spreadsheets by the laboratories and compiled into an Oracle database, which will be maintained by SFEI. Laboratories will submit data in formats that are compatible with the conventions being established by Karl Jacobs for CALFED. Data will be reviewed to ensure that they are consistent with the format of the database and other data records. The database will be created in Access to allow for easy manipulation and retrieval of data, and transferred to Oracle for storage upon final validation of the data. Results will be compiled in a cross-tabular format (e.g. site, date, variable, result) for their QA review and reporting, and will be made accessible on SFEI's website.

7. Expected Products/Outcomes

- Peer-reviewed interpretive annual project reports
- Presentations at annual review meetings, symposia (e.g., CALFED Science Conference, NorCal SETAC, SETAC), and at meetings of stakeholder advisory groups and committees (e.g., the Sacramento River Watershed Program, the CBDA Justice Subcommittee, the Fish Consumption Planning Group, regional meetings of the California Conference of Directors of Environmental Health and the California Conference of Local Health Officers)
- Data, maps, and reports accessible through the SFEI website
- Peer-reviewed final report
- Peer-reviewed journal publication

- An organized network of stakeholders
- Public outreach and educational materials
- Training modules and workshops for local and tribal agencies, community-based organizations, and others
- Continuing medical education seminars for health care providers

8. Work Schedule The work schedule for the project is shown in Table 4. This schedule assumes that funds would be available and work could begin in 2004. Tasks 2, 3, 4, and 6, and subtasks identified therein, are separable. If particular tasks were deleted, Tasks 1 and 5 would be reduced proportionately.

B. Applicability to CALFED ERP and Science Program Goals and Implementation Plan and CVPIA Priorities

1. ERP, Science Program and CVPIA Priorities

This proposed project addresses one issue under one of the four objectives of the CALFED long-term, comprehensive plan (the Plan): to provide good water quality for all beneficial uses. The fish consumption advisories that have resulted from mercury contamination in sport fish represent a beneficial use impairment. Mercury accumulation in aquatic food webs is one of the most pressing water quality problems in the watershed.

As described in the Mercury Strategy (Wiener et al. 2003), success in achieving most of the goals of the Ecosystem Restoration Program (ERP) will depend in part on the behavior and mitigation of mercury in the ecosystem, which, in turn, will depend on effective monitoring of mercury in the food web.

- Goal 3 is to "maintain and/or enhance populations of selected species for sustainable commercial and recreational harvest, consistent with the other ERP Strategic Goals." Objective 2 under Goal 3 is to "maintain, to the extent consistent with ERP goals, fisheries for striped bass…. and nonnative warmwater gamefishes" . This project would characterize impairment of the recreational harvest of striped bass and warmwater gamefishes.
- The most applicable goal is Goal 6: "Improve and/or maintain water and sediment quality conditions that fully support healthy and diverse aquatic ecosystems in the Bay-Delta watershed and eliminate, to the extent possible, toxic impacts to aquatic organisms, wildlife, and people." Environmental justice is one of the CALFED Program's broad commitments, and a specific priority of the ERP. Mercury in fish raises concerns about environmental justice, as certain groups can be more heavily exposed via high rates of fish consumption (SFEI 2001), a situation considered probable in the Delta (Wiener et al. 2003). The local involvement activities included in this project would begin to identify and educate these adversely impacted groups.

This project would meet several of the stated priorities of the CALFED Science Program:

- *Develop performance measures*. Mercury concentrations in sport fish are arguably the most critical measure of success in remediating the mercury problem. Mercury concentrations in small fish and invertebrate biosentinels are valuable indicators of fine-scale spatial and

temporal trends, facilitating the statistical differentiation of both natural and human-based variation in methylmercury exposure and bioaccumulation.

- *Advance process understanding.* The information obtained in this project would advance understanding of the processes that drive mercury accumulation in fish and how they vary over time and space. Linkage of this study with long term, process-oriented studies of other components of the mercury cycle at a network of sites in the Delta will lead to a comprehensive understanding of mercury fate in the ecosystem.
- *Establish integrated science programs in complicated field settings.* Linkage of this study with the other studies proposed for the Delta with coordinated QA, interpretation, and peer review will create an integrated program of mercury study.
- *Advance the scientific basis of regulatory activities.* This project would provide a firm basis for evaluating whether management activities are successful in addressing the mercury problem in the Delta region.
- *Coordinate and extend existing monitoring.* The proposed project would be coordinated with other existing monitoring activities, and would be coordinated with other studies of mercury fate and long term trends in the Delta region.
- *Address environmental justice issues.* This project will address environmental justice issues by involving populations who may be adversely impacted by mercury contamination in fish.

The objectives of the CALFED Plan, the Strategic Goals and objectives of the ERP, and the priorities of the Science Program are reflected in the multi-regional and regional priorities listed in the Implementation Plan and PSP. This proposed project would address the following priorities, as excerpted from the PSP.

- **Multi-Regional Priority 5: Ensure that restoration is not threatened by degraded water quality.** "Stage 1 actions include assessment off mercury sources, loadings, factors affecting transformation and bioaccumulation across the watershed."
- **Sacramento Region Priority 7: Develop conceptual models to support restoration of river, stream and riparian habitat.** Under "Implications of mine wastes for remediation": "Mitigation of (the effects of mine wastes) can be possible, but prioritization (what to mitigate, where), relative to other needs, requires understanding and comparing the concentrations, distribution, fate and effects of contaminated sediments in and among the tributary rivers and streams of the Sacramento."
- **Delta and Eastside Tributaries Region Priority 6: Restore shallow water habitats in the Delta for the benefit of at-risk species while minimizing potential adverse effects of contaminants.** "Better understand processes that determine mercury methylation in the Delta and tributaries, particularly how it is affected by restoration in different settings."

2. Relationship to Other Ecosystem Restoration Projects This project would represent a continuation of two prior ERP projects: 1) the CALFED Mercury Project (sport fish sampling and remediation monitoring elements), and 2) Effects of Wetlands Restoration on Methyl Hg Levels by UC Davis, as discussed in Section B.3. (Requests for Next-Phase Funding). This project would also be coordinated with several other mercury studies, monitoring efforts, and restoration and remediation projects (Table 2).

3. Request for Next Phase Funding This project would be a continuation of the food web sampling elements of two previous ERP projects: *ERP-99-B06 Assessment of the Ecological and Human Health Impacts of Mercury in the Bay-Delta Watershed* and *ERP-97-C05 Effects of Wetlands Restoration on the Production of Methylmercury in the San Francisco Bay-Delta System.* This project would continue sampling at a subset of the sites sampled in the previous projects to begin building a long term time series, and would employ approaches that were developed and refined during the previous studies. The progress and accomplishments of the previous projects are described in Attachments 3 and 4.

4. Previous recipients of CALFED Program or CVPIA Funding

SFEI and MLML: *ERP-99-N07 Chronic Toxicity of Environmental Contaminants in Sacramento Splittail: A Biomarker Approach* – The project is in its final year. SFEI and MLML are performing field sampling and analytical chemistry. *ERP-99-B06 Assessment of the Ecological and Human Health Impacts of Mercury in the Bay-Delta Watershed* – SFEI and MLML are performing fish sampling and mercury analysis. The project is in its final year. A draft final report is in review.

SFEI: *CALFED Whitepaper on: Ecological Processes in Tidal Wetlands of the Sacramento-San Joaquin Estuary and Their Implications for Proposed Restoration Efforts of the Ecosystem Restoration Program.* Dr. Davis was lead author of article: Davis, J.A., J.N. Collins, D. Yee, S. Schwarzbach, and S.N. Luoma. Submitted. Issues in San Francisco Estuary tidal wetlands restoration: Potential for increased mercury accumulation in the Estuary food web. San Francisco Estuary and Watershed Science 1.

MLML: *ERP-99-B06 Assessment of the Ecological and Human Health Impacts of Mercury in the Bay-Delta Watershed* – A final report is in review. *Transport, Cycling and Fate of Mercury and Monomethyl Mercury in the San Francisco Delta and Tributaries* – The project is just beginning.

UC Davis: *ERP-97-C05 Effects of Wetlands Restoration on the Production of Methylmercury in the San Francisco Bay-Delta System* – Results from this project are summarized in Attachment 4. *ERP-99-B06 Assessment of the Ecological and Human Health Impacts of Mercury in the Bay-Delta Watershed* – The final reports for this project are in review. *Upper Yuba River Studies Program (spatial mercury bioaccumulation assessment portion)* – Work is in progress.

EHIB: *Research, Outreach, and Education on Fish Consumption in the Sacramento-San Joaquin Delta and its Tributaries* (Contract No. 4600002762). EHIB will create and convene advisory groups, conduct needs assessment activities, develop an outreach, education, and training strategy, develop an evaluation plan, and gather data and define goals and objectives for planning of a fish consumption study.

5. System-Wide Ecosystem Benefits Mercury is a system-wide problem in the watershed, and the ecosystem will benefit from system-wide regional monitoring of mercury in fish as a key component for the Strategy for avoiding increasing, and eventually decreasing, mercury exposure to humans and wildlife. Furthermore, this proposal will establish a lasting foundation

for an adaptive monitoring program that will last into the future. The synergism of this fish monitoring program with other monitoring, research, restoration, and remediation projects will lead to the most effective possible approach for minimizing mercury accumulation in aquatic food webs.

C. Qualifications

Dr. Jay Davis of SFEI will be the principal investigator for the project (Figure 6), and will be assisted by SFEI staff in managing the project, and interpreting and reporting on the findings. Mark Stephenson will direct MLML efforts. Gary Ichikawa (bio in Attachment 5) will direct the sport fish sample collection and processing. Dr. Darell Slotton will direct all aspects of the biosentinel research and monitoring. Dr. Maura Mack and Alyce Ujihara (Attachment 5) will coordinate activities directed at local involvement and public outreach and education. Dr. Robert Smith (Attachment 5) will provide guidance on sampling design and power analysis. Dr. Chuck Armor (Attachment 5) and his staff will perform gut content analysis of sport fish.

Dr. Jay Davis, San Francisco Estuary Institute, Principal Investigator

Dr. Davis has performed research on contaminant issues in the Bay-Delta for 17 years. The accumulation and effects of persistent, bioaccumulative toxicants has been an area of particular emphasis. Dr. Davis is manager of the RMP, a $3 million/year program that monitors toxic chemicals in San Francisco Bay, and is an excellent model of an adaptive monitoring program. Dr. Davis has been principal investigator (PI) on several studies of contaminant accumulation in fish, including the following. 1) The CALFED Mercury Project, a directed action evaluating many aspects of mercury contamination in the Delta region. Sampling was performed in 1999 and 2000. 2) The Regional Monitoring Program (RMP) sport fish monitoring program for San Francisco Bay. Dr. Davis has been PI since this monitoring began in 1997. 3) The fish contamination monitoring element of the Sacramento River Watershed Program. Dr. Davis has been PI since the onset of this program in 1997. 4) The Delta fish contamination study. This was a one time study in 1998 evaluating mercury and organochlorine contamination in sport fish in the Delta region.

Mark Stephenson, San Jose State University Foundation

Mark Stephenson was the principal investigator for the first CALFED Mercury Project. This was an inter-disciplinary effort with 13 investigators with the goal to study mercury cycling in the Sacramento-San Joaquin Delta and Cache Creek and make recommendations to CALFED on how to lower the concentrations of mercury in sport fish. Mark is the current principal investigator for the recently funded project Transport, Cycling and Fate of Mercury and Monomethyl Mercury in the San Francisco Delta and Tributaries An Integrated Mass Balance Assessment Approach with Gary Gill, Chris Foe, and Kenneth Coale as co-principal investigators. Mark has been the director of the Department of Fish and Game s Marine Pollution Studies research group for the past 10 years. He has been the principal investigator of several multi-million dollar grants. Mark's laboratory has been analyzing water for total mercury for 5 years and tissue and sediment for 21 years. Recent State Water Resources Control Board projects he has been principal investigator on include: California State Mussel Watch, Coastal Fish Contaminants, State Water Assessment and Monitoring Program, Impact of Mercury on

Beneficial Uses in San Francisco Bay and the Central Valley Region, Mercury Monitoring in the Central Valley Region, and the Bay Protection Program. He has also been an investigator in the Sacramento River Watershed Program for the past 5 years.

Dr. Darell Slotton, University of California Davis
Dr. Slotton has directed applied research projects addressing heavy metal contamination and bioaccumulation issues in California aquatic ecosystems for over 15 years. Since 1985, he has run a mercury analytical laboratory and a mercury bioaccumulation research program at UC Davis. During the 1990s, he led a research program throughout the gold mining region of the Sierra Nevada, focusing on benthic invertebrates and fish as sentinels of relative bioavailable mercury exposure. Darell has directed numerous mercury investigations throughout the Cache, Putah, and Marsh Creek watersheds and has been a long-time participant in the Clear Lake Superfund Mercury Study. Other projects include ongoing investigations of mercury issues in the Truckee River and Pyramid Lake, Nevada, the Lake Titicaca watershed of Peru, and the Ayeyarwady River system of Myanmar. Since 1998, Dr. Slotton's primary focus has been directing several regional projects funded by the CALFED Bay-Delta Agency. One was a Delta study of mercury bioaccumulation, methylmercury, and implications for wetlands restoration projects. Another focused on the Cache Creek watershed, determining the trophic relationships in localized mercury bioaccumulation, and the relationship to aqueous mercury chemistry. Dr. Slotton's most recent CBDA-funded project investigates some of the mercury bioaccumulation implications of a potential large dam removal project on the Yuba River.

Dr. Maura Mack, California Department of Health Services /Impact Assessment, Inc.
Dr. Mack is chief of the Community Participation and Education Section in the Environmental Health Investigations Branch of the California Department of Health Services. She has 10 years of experience conducting stakeholder involvement activities and developing and implementing environmental health outreach, education, and training in diverse communities. Since 2001, Dr. Mack has supervised EHIB's fish contamination-related stakeholder involvement, outreach, and education projects in San Francisco Bay and the Los Angeles Palos Verdes Shelf area. More recently, she guided the planning and implementation of a needs assessment related to mercury contamination of fish in five counties located in the Sacramento-San Joaquin Delta Region. Dr. Mack will direct EHIB's future fish contamination-related stakeholder involvement, outreach, education, and training activities in the Delta Region.

D. Cost

1. Budget The detailed labor and materials budget for each year is included in the web forms. For subcontract work under Task 6 (Stakeholder Involvement and Outreach, Education, and Training) of this grant, Impact Assessment, Inc. (IAI) will serve as the fiscal agent responsible for grant management including financial management, monitoring and reporting, personnel and benefits administration, consultant agreements and subcontracts, and purchasing and lease agreements. IAI has served as the certified "bona fide" fiscal agent to the Environmental Health Investigations Branch of the California Department of Health Services since 1986. IAI is a state and federally recognized small business enterprise, and has assisted CDHS on the conduct of over 300 individual studies over the last eighteen years.

2. Cost-Sharing EHIB will contribute $159,580 of staff support over three years.

E. Local Involvement This project will include an extensive effort to involve the public and local agencies, as described in the Approach section, Task 6.

F. Compliance with Standard Terms and Conditions SFEI will be the primary contracting entity with CALFED. The standard terms and conditions are acceptable to SFEI.

G. Literature Cited

CDFG (California Department of Fish and Game). 2001. Central Valley Salmon and Steelhead Harvest Monitoring Project, 1999 Angler Survey.

Davis, J.A., B.K. Greenfield, G. Ichikawa, and M. Stephenson. 2002. Draft report: Mercury in Sport Fish from the Delta Region. San Francisco Estuary Institute, Oakland, CA.

Rasmussen, D. and H. Blethrow. 1990. Toxic Substances Monitoring Program Ten Year Summary Report: 1978 – 1987. Report 90 – 1WQ. State Water Resources Control Board, Sacramento, CA.

May, J.T. R.L. Hothem, C.N. Alpers, and M.A. Law. 2000. Mercury bioaccumulation in fish in a region affected by historic gold mining: the South Yuba River, Deer Creek, and Bear River watersheds, California, 1999. U.S. Geological Survey Open File Report 00-367, Sacramento, CA.

SFEI. 2001. San Francisco Bay Seafood Consumption Study. San Francisco Estuary Institute. Richmond, CA.

Slotton, D.G., S.M. Ayers, T. H. Suchanek, R.D. Weyand, and A.M. Liston. 2002a. Mercury bioaccumulation and trophic transfer in the Cache Creek watershed, California, in relation to diverse aqueous mercury exposure conditions. Draft Final Report for the CALFED Mercury Project.

Slotton, D.G., S.M. Ayers, T. H. Suchanek, et al. 2002b. Effects of wetland restoration on the production of methyl mercury in the San Francisco Bay-Delta system. Draft Final Report on CALFED Contract 97-C05.

Trudel, M., A. Tremblay, R. Schetagne, and J. B. Rasmussen. 2000. Estimating food consumption rates of fish using a mercury mass balance model. Canadian Journal of Fisheries and Aquatic Sciences. 57:414-428.

USDI (U. S. Department of the Interior), Fish and Wildlife Service and U.S. Department of Commerce, U.S. Census Bureau. 2001. 2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (California), FHW/01-CA-Rev., Revised March 2003.

Wiener, J.G., C.C. Gilmour, and D.P. Krabbenhoft. 2003. (External Review Draft) Mercury Strategy for the Bay-Delta Ecosystem: A Unifying Framework for Science, Adaptive Management, and Ecological Restoration. Report to the California Bay Delta Authority.

Table 1. Proposed membership of fish monitoring Steering Committee.

Representatives from:

- Bay-Delta Authority
- Central Valley Regional Water Quality Control Board
- San Francisco Bay Regional Water Quality Control Board
- State Water Resources Control Board (SWAMP)
- OEHHA
- DHS
- DFG
- SRWP
- SFEI
- UC Davis
- USGS
- Deltakeeper
- Zonal Advisory Groups: representing county health agencies and the public

Table 2. Other efforts that the Pilot Program will coordinate with.

Project	**Principal Investigator/Contact**
Monitoring and Research Programs	
Integrated Regional Wetlands Monitoring Pilot Project	Stuart Siegel
Evaluation of Mercury Transformations and Trophic Transfer in the San Francisco Bay/Delta	Mark Marvin-DiPasquale and Robin Stewart, USGS
Transport, Cycling and Fate of Mercury and Monomethyl Mercury in the San Francisco Delta and Tributaries An Integrated Mass Balance Assessment Approach	Mark Stephenson, MLML
Mercury in San Francisco Bay-Delta Birds: Trophic Pathways, Bioaccumulation and Ecotoxicological Risk to Avian Reproduction	Tom Suchanek, USFWS
Mercury and Methylmercury Processes in North San Francisco Bay Tidal Wetland Ecosystems	Don Yee, SFEI
San Francisco Bay Regional Monitoring Program	Jay Davis, SFEI
Sacramento River Watershed Program	Jay Davis, SFEI
Surface Water Ambient Monitoring Program	Val Connor, SWRCB
Delta Resident Shoreline Fish Monitoring Program	Chuck Armor, DFG
CALFED restoration projects	
Napa River	Dan Ray, CBDA
North Delta Improvement Project	Lauren Hastings, CBDA
Dutch Slough	Lauren Hastings, CBDA
Yolo Bypass	Lauren Hastings, CBDA
Possible remediation projects	
Sulphur Creek complex	
Abbott and Turkey Run Mine complex	
Mt Diablo Mercury Mine	
Programmatic initiatives	
Mercury Coordinator	
QA Program	Dave Crane, CDFG
Data management efforts	Karl Jacobs, DWR

Table 3. List of candidate index sites.

1. Sacramento River at River Mile 44
2. San Joaquin River at Vernalis
3. Frank's Tract
4. Prospect Slough
5. Cosumnes River
6. Napa River
7. Feather River near Nicolaus
8. American River near Discovery Park
9. Yuba River
10. Colusa
11. Stanislaus River
12. Tuolumne River
13. Merced River
14. Mud Slough
15. Dutch Slough

Table 4. Project timeline.

		YEAR 1				YEAR 2				YEAR 3			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
TASK 1	**PROJECT MANAGEMENT**												
1A	Contract and Financial Management	X	X	X	X	X	X	X	X	X	X	X	X
1B	Coordination	X	X	X	X	X	X	X	X	X	X	X	X
1C	Program Design	X	X	X	X	X	X	X	X	X	X	X	X
1D	QA Oversight	X	X	X	X	X	X	X	X	X	X	X	X
1E	Data Mgmt/GIS/Web	X	X	X	X	X	X	X	X	X	X	X	X
TASK 2	**TEMPORAL TREND MONITORING**												
2A	Index Sites	X	X	X	X	X	X	X	X	X	X	X	X
2B	Striped Bass							X					
TASK 3	**SPATIAL CHARACTERIZATION OF WATERSHED**												
3A	Sport fish collection and analysis		X	X			X	X					
TASK 4	**PROJECT MONITORING**												
4A	Protocol Development	X	X	X	X	X	X	X	X	X	X	X	X
4B	Monitoring of selected sites	X	X	X	X	X	X	X	X	X	X	X	X
TASK 5	**DATA INTERPRETATION AND REPORTING**												
5A	Literature Review, Data Compilation, and Interpretation	X	X	X	X	X	X	X	X	X	X	X	X
5B	Modeling mercury uptake by key indicator species	X	X	X	X	X	X	X	X	X	X	X	X
5C	Analysis of landscape attributes associated with mercury accumulation	X	X	X	X	X	X	X	X	X	X	X	X
5D	Annual report and publications					X				X			X
5E	Presentations at annual meeting, symposia	X	X	X	X	X	X	X	X	X	X	X	X
TASK 6	**STAKEHOLDER INVOLVEMENT…**												
6A	Stakeholder involvement…	X	X	X	X	X	X	X	X	X	X	X	X
6B	Outreach, education, and training	X	X	X	X	X	X	X	X	X	X	X	X
6C	Evaluation	X	X	X	X	X	X	X	X	X	X	X	X

Figure 1. Average mercury concentrations in largemouth bass at CALFED Mercury Project sites in 1999.

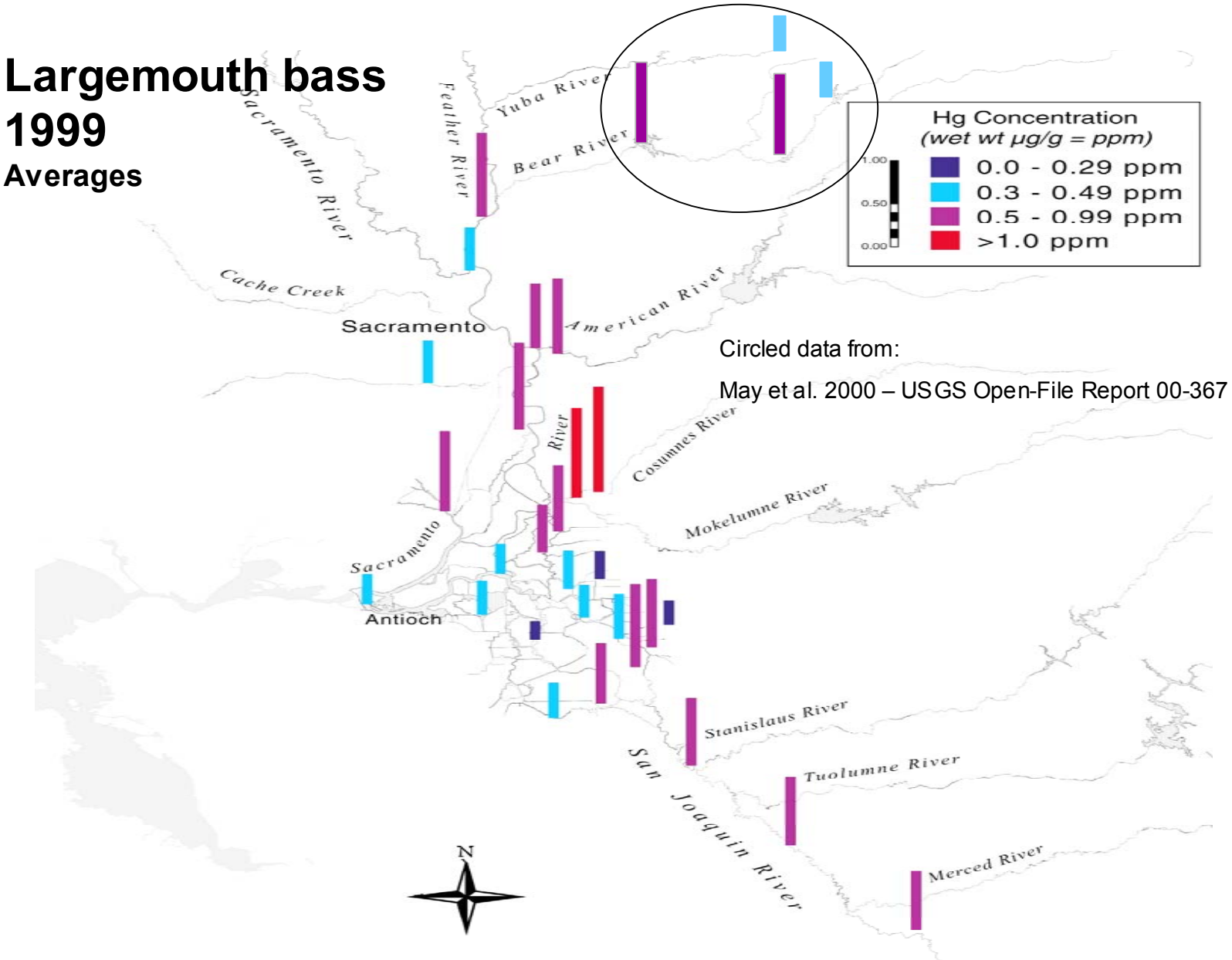


Figure 2. Average mercury concentrations in largemouth bass at CALFED Mercury Project sites in 2000.

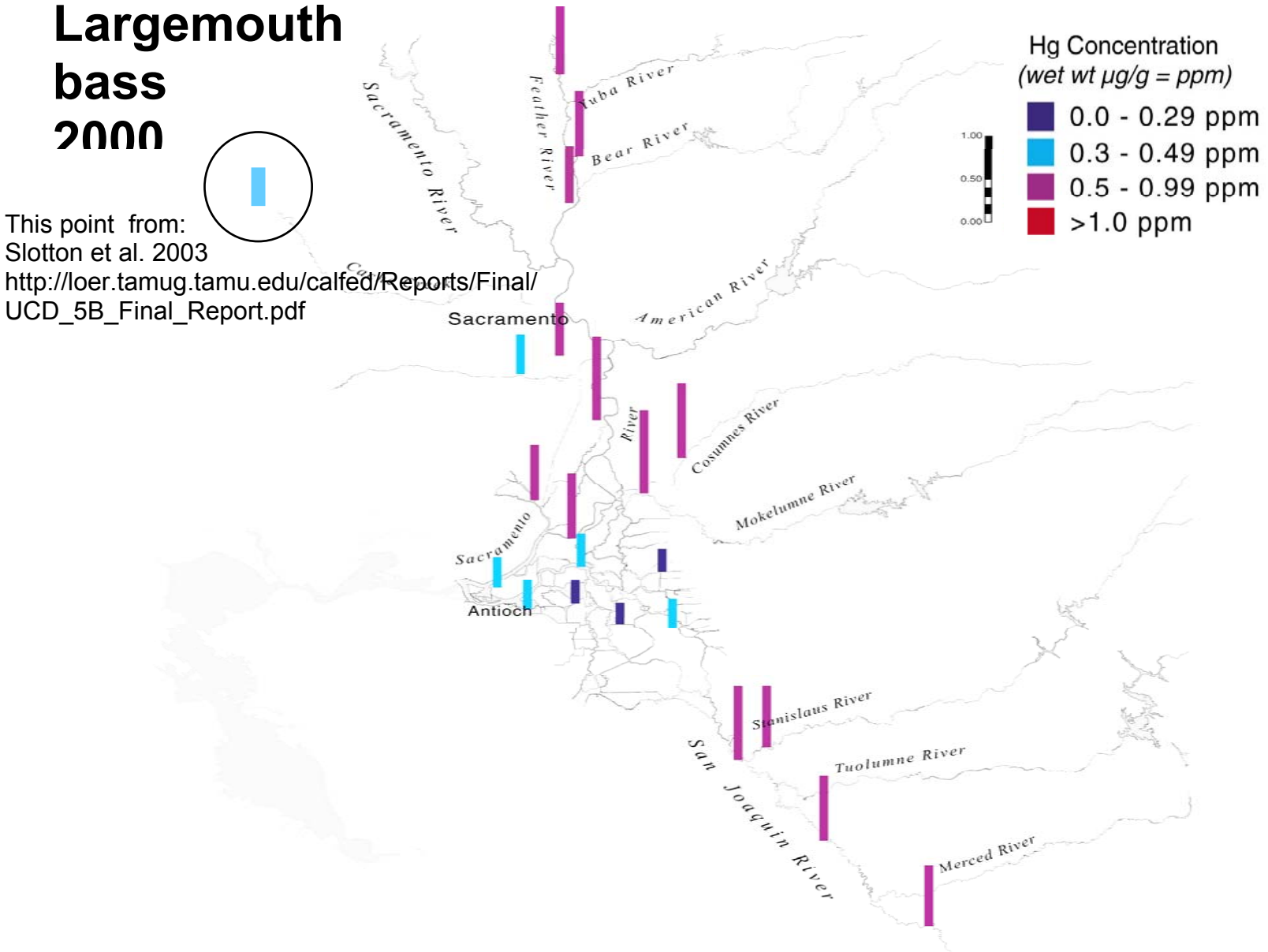
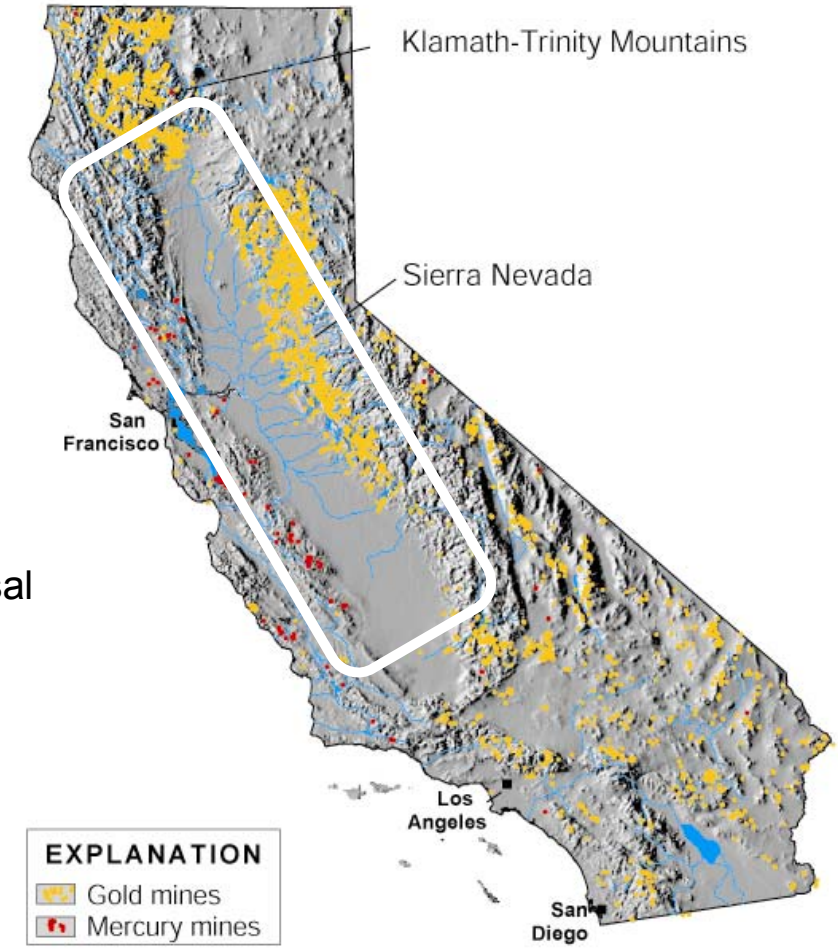


Figure 3. Distribution of historic gold and mercury mines in the watershed. Map from Alpers and Hunerlach (2000) – USGS Fact Sheet FS-061-00



White rectangle indicates proposal study area

Figure 4. Advisories issued by the California Office of Environmental Health Hazard Assessment (http://www.oehha.ca.gov/fish/nor_cal/index.html). Adapted from Alpers and Hunerlach (2000) – USGS Fact Sheet FS-061-00

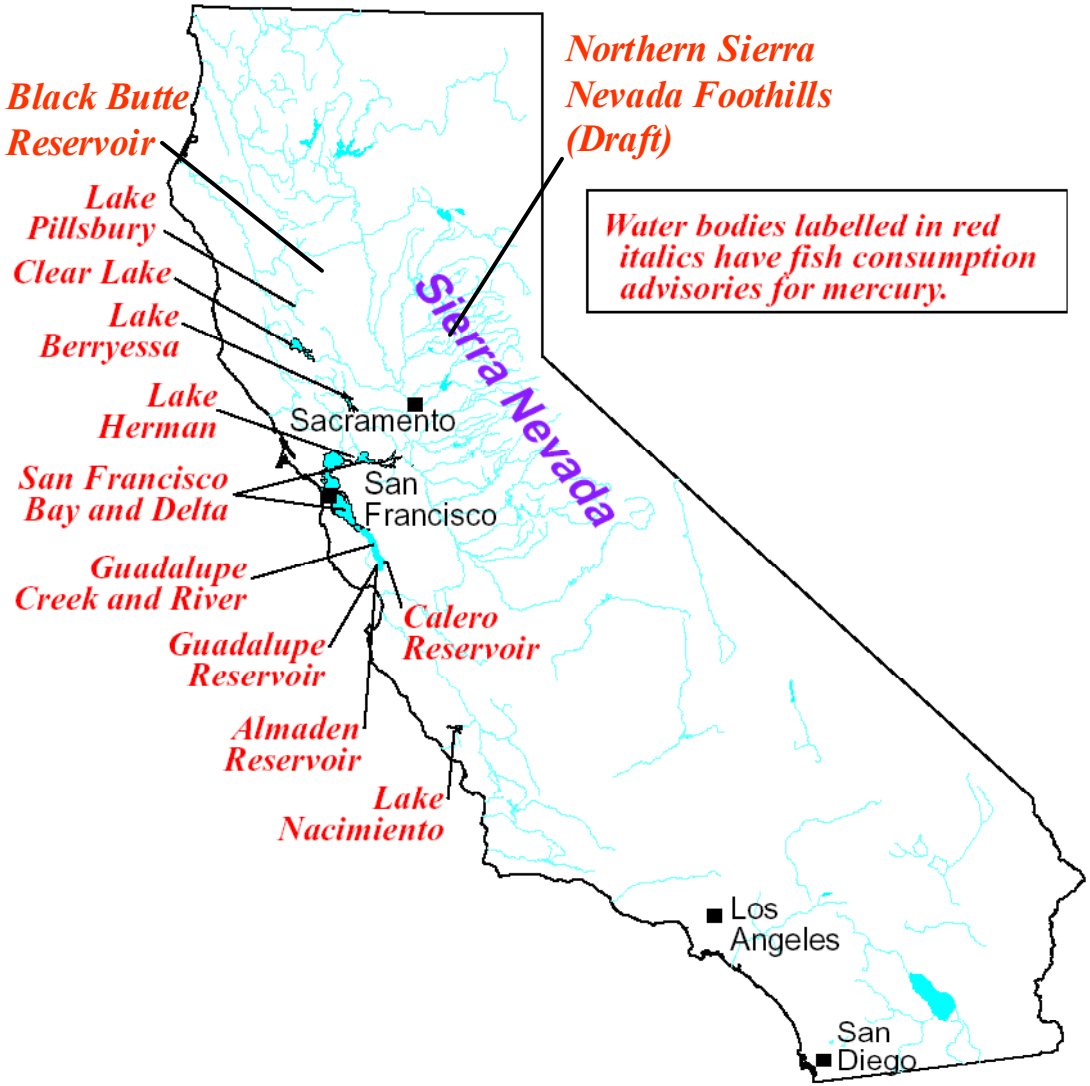


Figure 5. Location map of previous SFEI/MLML sport fish collection sites, including many potential candidate index sites for the proposed project. See Table 3 for actual list.

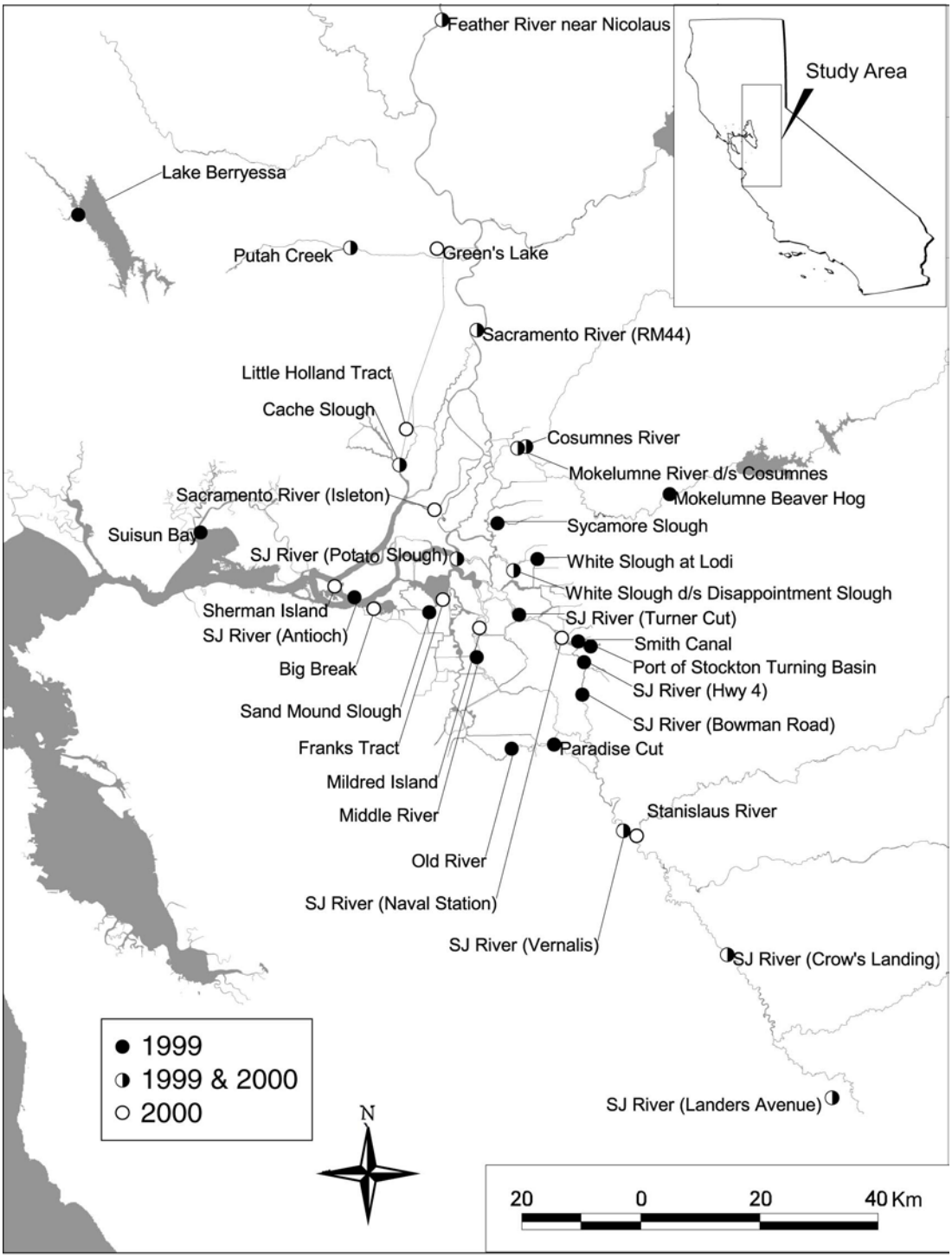
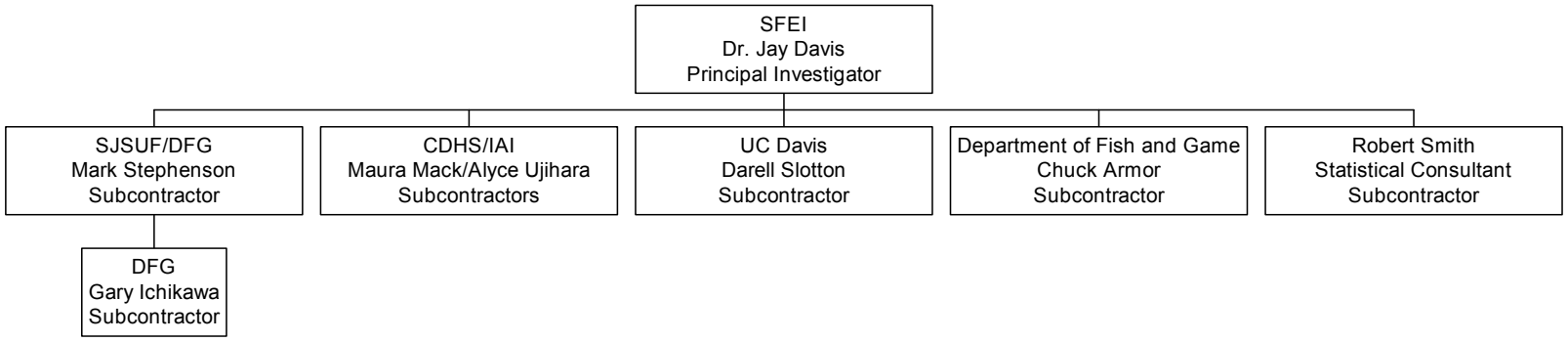


Figure 6. Organizational Chart.



Abstract

Mercury bioaccumulates in fish in the Sacramento-San Joaquin Delta watershed (hereafter referred to as the Delta watershed) at levels that may pose health risks to people who consume the fish. Mercury is prevalent due to naturally occurring deposits and human activities, such as historic mercury mining in the Coastal range and gold mining in the Sierra Nevada. Mercury concentrations in several species of fish at many locations in the Delta watershed exceed the health-based screening values set by the US Environmental Protection Agency. The Delta Fish Project is an interagency effort to reduce exposure to mercury in populations that consume fish caught in the Delta watershed. The Environmental Health Investigations Branch (EHIB) of the California Department of Health Services is the lead agency for project implementation. During October 2002-May 2003, EHIB conducted a needs assessment in five priority counties drained by the Delta watershed: Lake, Sacramento, San Joaquin, Placer, and Yolo. The counties were selected based primarily on the following criteria: (1) high levels of mercury in fish; and (2) high levels of fishing activity. The purpose of the assessment was to identify specific populations that consume fish caught in the Delta watershed, and to determine fish contamination awareness, concerns, and information needs of county health and environmental health departments, Native American tribes, community-based organizations (CBOs), community members, and health care providers that serve populations who consume fish from the watershed.

Needs assessment findings include the following: (1) while county health and environmental health departments believe that local fish contamination issues are a threat to public health, they are not undertaking public outreach and education activities, in large part due to a lack of resources; (2) Pomo Indian tribal members reported that consumption of fish caught locally has decreased significantly due, in large part, to concerns about pollution in local waterbodies; (3) members of Southeast Asian, Latino, African-American, and Russian communities regularly eat fish, especially striped bass and catfish, and shellfish from local waters, and have generally low awareness of fish consumption advisories and the health risks of exposure to mercury in fish; and (4) visual materials (e.g., pictures, posters, calendars, videos.) and mass media (e.g., television and radio) are more effective than print materials for communicating with the project's target populations. The following recommendations are based on the needs assessment results: (1) develop outreach and education messages in collaboration with local government agencies, Native American tribes, and CBOs to ensure their appropriateness with respect to the languages and literacy levels of communities; (2) coordinate outreach and education campaigns with local government agencies and CBOs; (3) participate in community events (e.g., Earth Day, county fair) to disseminate information; (4) collaborate with health care providers (i.e., family practice physicians, obstetricians, pediatricians, and nurse practitioners) to inform target populations, especially women of childbearing age; and (5) evaluate outreach and education activities on an ongoing basis to ensure the effectiveness and appropriateness of messages, materials, and communication methods.

Needs Assessment Participants

LAKE COUNTY

***County Agencies*:**
*Lake County Department of Health: Craig McMillan, MD, Public Health Officer
*Lake County Department of Health-Environmental Health Division: Raymond Ruminski, Director

Tribes:
*Elem Indian Colony: Mike Umbrello, Environmental Director
*Robinson Rancheria: Meyo Marrufo, NAGPRA Director & CRM Tribal Representative
*Habematol of Upper Lake Rancheria: John Hancock, Environmental Director
*Big Valley Rancheria: Mike Schaver, Environmental Director

Health Care Providers:
*Lake County Tribal Health Consortium, Inc.: Mike Icay, Executive Director
*Redbud Community Hospital-Adventist Health: Dave Crunk, Administrative Director of Clinical Services

SACRAMENTO COUNTY

County Agencies:
*Sacramento County Health and Human Services: Glenna Trochet, MD, Public Health Officer
*Sacramento County Environmental Management Department: Richard Sanchez, Chief, Environmental Health Division

***Community Organizations*:**
*Council for Asian Pacific Islanders Together for Advocacy and Leadership (CAPITAL): Sonny Chong, Executive Director
*Slavic Assistance Center: Roman Romaso, Director.
*Center for Community Development & Well-Being "The Birthing Project": Kathryn Hall, Director and Founder.
*Galt Community Concilio: Mary Lou, Director

***Health Care Providers*:**
*Health For All, Inc.: Dr. Richard Ikeda, Executive Director

SAN JOAQUIN COUNTY

County Agencies:
*San Joaquin County Public Health Services: Karen Furst, Public Health Officer
*San Joaquin County Environmental Health Department: Donna Heran, Director

Community-Based Organizations:
*Asian Pacific Self-Development and Residential Association (APSARA): Souvanna Kourt, Director
*Lao Khmu, Inc.: Robert Khoonsrivong
*Vietnamese Voluntary Foundation: Ky Hoang, Program Manager

***Environmental Advocacy Organizations*:**
*DeltaKeeper: Bill Jennings, Executive Director

PLACER COUNTY

***County Agencies*:**
*Placer County Department of Health and Human Services: Mike Mulligan, MD, Public Health Officer.
*Placer County Environmental Health Division: Brad Banner, Director

YOLO COUNTY

County Agencies:
*Yolo County Public Health Department: Bette Hinton, MD, Public Health Officer
*Yolo County Environmental Health Division: Thomas To, Director

Faith-Based Organizations:
* Holy Myrrhbearing Women Church: Ivan Kosuleki, Chief Executive Officer
*Russian Church of Evangelical Christian Baptists: Mikhail Avramenko, Assistant Pastor

ATTACHMENT 3

MERCURY IN SPORT FISH FROM THE DELTA REGION (TASK 2A)

J.A. Davis and B.K. Greenfield
San Francisco Estuary Institute
Gary Ichikawa and Mark Stephenson
Moss Landing Marine Laboratory

EXECUTIVE SUMMARY

In spite of the popularity of the Delta as a fishing location, human health concerns raised beginning in 1971, the existence of a consumption advisory for the Bay, and recent concern over fish tissue contamination in the Sacramento River watershed, very little systematic sampling has been conducted in the Delta to evaluate human health risks associated with chemical contamination of fish tissue. This report documents the most detailed study of mercury contamination in sport fish from the Delta region ever performed.

The objectives of this study were, in order of priority:

- Determine whether mercury occurs in sport fish at concentrations of potential human health concern and whether further consumption advice should be issued;
- Firmly establish present mercury concentrations in sport fish as a basis for assessing long term trends;
- Evaluate spatial patterns in mercury accumulation at high trophic levels in the Bay-Delta; and
- Evaluate important factors influencing mercury concentrations such as age/size and trophic position.

Key features of the sampling design aimed at meeting these objectives were 1) sampling of a wide variety of species and 2) analysis of mercury in individual fish for the primary target species.

Sampling was performed in late summer 1999 and 2000. Primary target species, including largemouth bass, white catfish, striped bass, and Sacramento pikeminnow, were analyzed as individuals. Secondary target species, including channel catfish, black crappie, Sacramento sucker, common carp, bluegill, and redear sunfish, were sampled as multi-individual composites. Measured concentrations were compared to a screening value for mercury, defined as a concentration in fish or shellfish tissue that is of potential public health concern. Exceedance of the screening value should be interpreted as an indication that more intensive site-specific monitoring and/or evaluation of human health risk should be conducted.

The principal conclusions of the study are:

- Several species (including largemouth bass, striped bass, Sacramento pikeminnow, channel catfish, and white catfish) had mercury concentrations of high human health concern, exceeding the screening value (0.3 ppm) in a majority of samples and frequently exceeding 1 ppm.
- Three species had mercury concentrations of moderate human health concern, including common carp, black crappie, and Sacramento sucker.
- Significant spatial variation exists in the watershed. Mercury concentrations in the Feather River, northern Delta, lower Cosumnes River, and San Joaquin River regions were

significantly elevated and in the 1 ppm range. Concentrations in the central Delta region were significantly lower than other locations, and usually below the screening value. These regional patterns were evident among several sport fish species. There was a precipitous drop in concentrations between nearby stations in the Central Delta.

- Mercury concentrations in striped bass, which are integrative indicators of mercury in the watershed, have not changed perceptibly in the past 30 years. Some striped bass samples collected for this study were high even relative to the concentrations measured 30 years ago.

THE FULL REPORT IS AVAILABLE AT:

http://loer.tamug.tamu.edu/calfed/Reports/Final/Task%202A%20-%20Text%20and%20Figures.pdf

ATTACHMENT 4

The Effects of Wetland Restoration on the Production and Bioaccumulation of Methylmercury in the Sacramento-San Joaquin Delta, California

By

Darell G. Slotton [1,C], Shaun M. Ayers [1], Thomas H. Suchanek [2,3], Ronald D. Weyand [1], Anne M. Liston [1], Chance Asher [4], Douglas C. Nelson [4], and Brenda Johnson [2]

[1] Dept. of Environmental Science and Policy, University of California, One Shields Avenue, Davis, CA 95616
[2] Dept. of Wildlife, Fish & Conservation Biology, University of California, One Shields Avenue, Davis, CA 95616
[3] U.S. Fish and Wildlife Service, Div. of Environmental Contaminants, 2800 Cottage Way, Sacramento, CA 95825
[4] Division of Microbiology, University of California, One Shields Avenue, Davis, CA 95616

[C] Corresponding Author: dgslotton@ucdavis.edu

A collaborative, foundational project funded separately by the CALFED Bay-Delta Agency in a grant to the University of California at Davis, under CALFED contract 97-C05, July 1998 – March 2003

Submitted in collaboration with the multi-institution Directed Action research project:

Assessment of Ecological and Human Health Impacts of Mercury in the San Francisco Bay-Delta Wateshed

A CALFED Bay-Delta Program Project
October 1999 – March 2003

DRAFT FINAL REPORT
SUBJECT TO REVISION

UNPUBLISHED DATA – DO NOT CITE WITHOUT PERMISSION

September 25, 2002

ATTACHMENT 4

Abstract

Methylmercury (MeHg) production, export, and bioaccumulation were investigated at representative sites throughout the Sacramento-San Joaquin Delta in California, in relation to wetlands restoration efforts in the region. Sediment MeHg and MeHg:total mercury (THg) ratios were examined at paired sites inside and outside various flooded wetland tracts. Relative mercury (Hg) methylation potential was estimated in Hg-amended sediment slurry experiments. Concentrations of aqueous MeHg were assessed at a range of representative wetland tracts in inflowing vs outflowing water during tidal cycles. Relative biological Hg exposure levels throughout the region and spatially among habitats were assessed with naturally occurring small fish and invertebrate indicator species, which were tested for THg, MeHg, individual variability in Hg bioaccumulation, and nitrogen and carbon stable isotopic ratios.

Sediment MeHg concentrations and MeHg:THg ratios were found to be significantly greater in flooded tracts characterized by dense submergent or emergent aquatic vegetation, as compared to adjacent Delta channel, mudflat, or sandflat environments. Wetland sediments from vegetated flooded tracts exhibited 2-30 times greater potential to produce MeHg than aquatic sediments of adjacent channels and flats. At these same locations, concentrations of aqueous MeHg and aqueous MeHg normalized to suspended solids were found to be substantially elevated in outflowing tidal water (off the tracts), relative to inflowing water. Consistent with the literature for other estuarine systems, all of these measures indicated that highly vegetated, flooded wetland sediments functioned as net producers and exporters of MeHg to the wider Delta.

However, biological findings indicated no discernible localized increase in biotic MeHg concentrations in flooded wetland tracts vs adjacent aquatic habitats. Vigorous tidal action may effectively mix MeHg from net methylating habitats into local areas, creating larger spatial patterns. Most surprising was the finding of notably lowest overall Hg bioaccumulation throughout a broad region of the south and central Delta that contained numerous wetland restoration sites identified as net methylating environments. This indicates that the linkages between sediment MeHg, aqueous MeHg, and ultimate bioaccumulation by aquatic organisms may be quite complex. The regions with most highly elevated biotic Hg identified in this work can all be characterized as being dominated by ongoing new inflows of Hg from upstream San Francisco Bay-Delta tributaries. Inputs of both elemental Hg from historic gold mining in the Sierra Nevada and abandoned mercury mine cinnabar in the Coast Ranges appear to be of importance. This suggests that upstream remediation efforts on either side of the watershed may be more regionally meaningful than previously anticipated. A secondary zone of relatively elevated Hg bioaccumulation occurred in the estuarine entrapment / salinity transition zone.

THE FULL REPORT IS AVAILABLE AT:
http://loer.tamug.tamu.edu/calfed/Reports/Final/UCD_Delta_Report.pdf

ATTACHMENT 5: ADDITIONAL BIO SKETCHES

Gary Ichikawa, California Department of Fish and Game

Teaming with Dr. Davis, Mr. Ichikawa has managed sample collection and chemical analysis for various projects researching contaminant issues in the Bay-Delta in recent years. These projects investigated the accumulation of contaminants in fish and clams, including projects 1, 3, 4, and 5 listed under Dr. Davis, and the following:

- The Toxic Substance Monitoring Program. From 1995-present, Mr. Ichikawa assisted in the collection of fish samples from the Bay-Delta region.

In addition to work in the Bay-Delta, Mr. Ichikawa has managed the State of California Coastal Fish Contamination Program from its inception in 1998 to the present. The Program collects over 800 fish per year for contamination evaluation. Mr. Ichikawa also manages the State of California Mussel Watch Program which utilizes mussels to evaluate contaminants in the bays and harbors of the State.

Alyce Ujihara, California Department of Health Services

Ms. Ujihara is a research scientist with the exposure assessment section at EHIB. For the past 10 years she has designed and conducted studies to characterize chemical exposures among fish consuming populations. She was Co-PI of the San Francisco Bay Seafood Consumption Study, and has conducted fish sampling studies on sport fish in Richmond Harbor and in commercial white croaker in San Francisco Bay. She has also provided technical assistance to the San Francisco Bay Seafood Consumption Task Force and the Palos Verdes Fish Contamination Task Force, and developed education and training materials on fish contamination issues. Currently she chairs an interagency planning group that is exploring options for conducting fish consumption studies in the Sacramento-San Joaquin Delta watershed.

Robert W. Smith, Independent Consultant

Dr. Smith is an ecologist and statistician with over 30 years experience consulting for environmental monitoring and field study programs. This work has involved participation in monitoring and statistical design, statistical analyses, database management, and computer programming. Clients have included regulators (U.S. EPA, California Regional and State Water Quality Control Boards), research organizations (San Francisco Estuary Institute, Southern California Coastal Water Research project), several private environmental consulting firms, and many regulated concerns including electric power generators, sanitation districts, and oil companies.

Some more recent projects relevant to fish and monitoring design are as follows:

- For Orange County and the Southern California Coastal Research Project, power analyses were applied in developing monitoring programs for southern California streams.

- For the cities of Los Angeles and San Diego, and the San Francisco Estuary Institute, power and optimization analyses were used to assist in the design of marine monitoring programs.
- For Pacific Gas and Electric, a computer program was developed for evaluation of model predictions of fish abundance in response to altered stream flows. Also, relationships between fish and limiting environmental parameters were evaluated using nonlinear regression techniques.
- For the San Francisco Estuary Institute, a computer program was developed for standardizing fish lengths with nonlinear analysis of covariance.
- For the U.S. EPA, fish and benthic infaunal response indices were developed to measure the effects of pollution. This work involved collaboration with the Southern California Coastal Water Research Project.