Quantitative Procedure to Estimate Fish Population Increases from Ecosystem Restoration Projects and Other Activities

Project Information

1. **Proposal Title:**

   Quantitative Procedure to Estimate Fish Population Increases from Ecosystem Restoration Projects and Other Activities

2. **Proposal applicants:**

   William J. Miller, San Luis & Delta-Mendota Water Authority

3. **Corresponding Contact Person:**

   William J. Miller
   San Luis & Delta-Mendota Water Authority
   P.O. Box 5995 Berkeley, Ca. 94705
   510 644-1811
   bjmill@aol.com

4. **Project Keywords:**

   At-risk species, fish
   Environmental Risk Assessment
   Fish Management

5. **Type of project:**

   Research

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

   No

7. **Topic Area**:

   At-Risk Species Assessments

8. **Type of applicant:**

   Local Agency

9. **Location - GIS coordinates:**

   Latitude: Not Applicable

   Longitude:

   Datum:

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

The project location covers all management zones.

10. **Location - Ecozone:**

    3.1 Keswick Dam to Red Bluff Diversion Dam, 3.2 Red Bluff Diversion Dam to Chico Landing, 3.3 Chico Landing to Colusa, 3.4 Colusa to Verona, 3.5 Verona to Sacramento, 4.1 Clear Creek, 4.2 Cow Creek, 4.3 Bear Creek, 4.4 Battle Creek, 5.1 Upper Cottonwood Creek, 5.2 Lower Cottonwood Creek, 6.1 Stony Creek, 6.2 Elder Creek, 6.3 Thomas Creek, 6.4 Colusa Basin, 7.1 Paynes Creek, 7.2 Antelope Creek, 7.3 Mill Creek, 7.4 Deer Creek, 7.5 Big Chico Creek, 7.6 Butte Creek, 7.7 Butte Sink, 8.1 Feather River, 8.2 Yuba River, 8.3 Bear River and Honcut Creek, 8.4 Sutter Bypass, 9.1 American Basin, 9.2 Lower American River, 10.1 Cache Creek, 10.2 Putah Creek, 10.3 Solano, 10.4 Willow Slough, 12.1 Vernalis to Merced River, 12.2 Merced River to Mendota Pool, 12.3 Mendota Pool to Gravelly Ford, 12.4 Gravelly Ford to Friant Dam, 13.1 Stanislaus River, 13.2 Tuolumne River, 13.3 Merced River, West San Joaquin Basin, 1.1 North Delta, 1.2 East Delta, 1.3 South Delta, 1.4 Central and West Delta, 11.1 Cosumnes River, 11.2 Mokelumne River, 11.3 Calaveras River, 2.1 Suisun Bay & Marsh, 2.2 Napa River, 2.3 Sonoma Creek, 2.4 Petaluma River, 2.5 San Pablo Bay, Code 15: Landscape, Code 16: Inside ERP Geographic Scope, but outside ERP Ecozones

11. **Location - County:**

    Alpine, Amador, Butte, Calaveras, Colusa, Contra Costa, El Dorado, Glenn, Madera, Merced, Napa, Nevada, Placer, Plumas, Sacramento, San Joaquin, Santa Clara, Shasta, Sierra, Siskiyou, Solano, Stanislaus, Sutter, Trinity, Tulare, Tuolumne, Yolo, Yuba

12. **Location - City:**

    Does your project fall within a city jurisdiction?

    No

13. **Location - Tribal Lands:**

    Does your project fall on or adjacent to tribal lands?

    No

14. **Location - Congressional District:**

    Not Applicable

15. **Location:**

    California State Senate District Number: Not Applicable

    California Assembly District Number: Not Applicable

16. **How many years of funding are you requesting?**

    2 yrs.

17. **Requested Funds:**

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

No

If no, list single overhead rate and total requested funds:

Single Overhead Rate: 0%

Total Requested Funds: 416,800

b) Do you have cost share partners already identified?

No

c) Do you have potential cost share partners?

No

d) Are you specifically seeking non-federal cost share funds through this solicitation?

No

If the total non-federal cost share funds requested above does not match the total state funds requested in 17a, please explain the difference:

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

No

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

Yes

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

Letter Agreement Dated Autgust 8, 2001	**Interim Water Supply Grant Contract**	**Prop 13,Chapt 9, Art. 4**

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

No

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

No

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

    No

    Please list suggested reviewers for your proposal. (optional)

    Sam Luoma CALFED 916 653 6628

    Wim Kimmerer CALFED 415 338 3515

    Randy Brown CALFED 916 296 0192

21. **Comments:**

Environmental Compliance Checklist

Quantitative Procedure to Estimate Fish Population Increases from Ecosystem Restoration Projects and Other Activities

1. **CEQA or NEPA Compliance**
   a) Will this project require compliance with CEQA?

      No
   b) Will this project require compliance with NEPA?

      No
   c) If neither CEQA or NEPA compliance is required, please explain why compliance is not required for the actions in this proposal.

      This product will be a set of calculation procedures. Neither CEQA nor NEPA is applicable.

2. **If the project will require CEQA and/or NEPA compliance, identify the lead agency(ies).** *If not applicable, put "None".*

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

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

   CEQA
   -Categorical Exemption
   -Negative Declaration or Mitigated Negative Declaration
   -EIR
   Xnone

   NEPA
   -Categorical Exclusion
   -Environmental Assessment/FONSI
   -EIS
   Xnone

   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.

   N/A

4. **CEQA/NEPA Process**
   a) Is the CEQA/NEPA process complete?

      Not Applicable

   b) If the CEQA/NEPA document has been completed, please list document name(s):

5. **Environmental Permitting and Approvals** (*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

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:

6. **Comments.**

Land Use Checklist

Quantitative Procedure to Estimate Fish Population Increases from Ecosystem Restoration Projects and Other Activities

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

   No

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

   No

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

   No

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

   Research only.

4. **Comments.**

Conflict of Interest Checklist

Quantitative Procedure to Estimate Fish Population Increases from Ecosystem Restoration Projects and Other Activities

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):

William J. Miller, San Luis & Delta-Mendota Water Authority

Subcontractor(s):

Are specific subcontractors identified in this proposal? Yes

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

William J. Miller	Consulting Engineer
Thomas R, Mongan	Consulting Engineer
Jim Buell	Consulting Biologist
Carl Mesick	Consulting Fisheries Biologist
J. Phyllis Fox	Environmental Engineer

Helped with proposal development:

Are there persons who helped with proposal development?

No

Comments:

Budget Summary

Quantitative Procedure to Estimate Fish Population Increases from Ecosystem Restoration Projects and Other Activities

Please provide a detailed budget for each year of requested funds, indicating on the form whether the indirect costs are based on the Federal overhead rate, State overhead rate, or are independent of fund source.

Independent of Fund Source

Year 1												
Task No.	**Task Description**	**Direct Labor Hours**	**Salary *(per year)***	**Benefits *(per year)***	**Travel**	**Supplies & Expendables**	**Services or Consultants**	**Equipment**	**Other Direct Costs**	**Total Direct Costs**	**Indirect Costs**	**Total Cost**
1.	Project Management					43,200				43200.0		43200.00
2.	Indentify/Actions					12,000				12000.0		12000.00
3.	Experts and Data					114,400				114400.0		114400.00
4.	Preliminary Algorithms					105,600				105600.0		105600.00
5.	Algorithm Review					14,400				14400.0		14400.00
		0	0.00	0.00	0.00	289600.00	0.00	0.00	0.00	289600.00	0.00	289600.00

Year 2												
Task No.	**Task Description**	**Direct Labor Hours**	**Salary *(per year)***	**Benefits *(per year)***	**Travel**	**Supplies & Expendables**	**Services or Consultants**	**Equipment**	**Other Direct Costs**	**Total Direct Costs**	**Indirect Costs**	**Total Cost**
1.	Project Management						21,600			21600.0		21600.00
5.	Algorithm Review						7,200			7200.0		7200.00
6.	Algorithm Revision						38,400			38400.0		38400.00
7.	Final Report						60,000			60000.0		60000.00
		0	0.00	0.00	0.00	0.00	127200.00	0.00	0.00	127200.00	0.00	127200.00

Year 3												
Task No.	**Task Description**	**Direct Labor Hours**	**Salary *(per year)***	**Benefits *(per year)***	**Travel**	**Supplies & Expendables**	**Services or Consultants**	**Equipment**	**Other Direct Costs**	**Total Direct Costs**	**Indirect Costs**	**Total Cost**
		0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Grand Total=416800.00

Comments.

Budget Justification

Quantitative Procedure to Estimate Fish Population Increases from Ecosystem Restoration Projects and Other Activities

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

All work done by consultants to San Luis and Delta-Mendota Water Authority. Total hours shown below under "Services or Consultants".

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

The compensation rate for each consultant is $150/hour.

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

None.

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

None, incorporated in compensation rate.

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

None.

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.

CONSULTANT CHARGES DAYS REQUIRED FOR CONSULTANTS CONSULTANT TEAM TASK 1 2 3 4 5 6 7 MILLER 27 2 12 8 0 4 10 MONGAN 27 2 12 8 0 4 10 BUELL 0 2 21 24 6 8 10 MESICK 0 2 21 24 6 8 10 FOX 0 2 21 24 6 8 10 DAYS/ 54 10 87 88 18 32 50 TASK $/ $64,800 $12,000 $104,400 $105,600 $21,600 $38,400 $60,000 TASK EXPERTS $10,000 TOT$64,800 $12,000 $114,400 $105,600 $21,600 $38,400 $60,000 /$TASK TOTALS CONSULTANT DAYS HOURS HOURLY RATE TOTAL CHGS. TEAM MILLER 63 504 150 $75,600 MONGAN 63 504 150 $75,600 BUELL 71 568 150 $75,600 MESICK 71 568 150 $85,200 FOX 71 568 150 $85,200 $/TASK $406,800 EXPERTS $10,000 TOTAL$/ $416,800 TASK

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 presentatons, reponse to project specific questions and necessary costs directly associated with specific project oversight.

Included in consultant services as Task 1, $64,800

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.

Included in consultant charges.

Executive Summary

Quantitative Procedure to Estimate Fish Population Increases from Ecosystem Restoration Projects and Other Activities

Executive Summary This is a $416,800, 18-month restoration planning proposal to develop a "Quantitative Procedure to Estimate Fish Population Increases from Ecosystem Restoration Projects and Other Actions" useful in all ERP regions. Project objective: CALFED must decide about actions to increase fish populations, including decisions about allocation of funds, use of the Environmental Water Account, and regulation of water projects. Such decisions should be based on benefit/cost ratios, that is, the ratio of a quantitative estimate in fish improvement to the cost of the action. However, no system exists for making such benefit/cost estimates. Work done under this proposal will develop the fish benefit aspect of such a system in the form of algorithms for estimating the percent increase in fish population for actions or categories of actions. Approach to implementation: We will first identify actions or categories of actions whose fish benefits would be estimated. Then, our team would contact experts on each action. We would discuss with these experts how such algorithms might be developed. We would review relevant data. Based on this information we would prepare a preliminary version of each algorithm. We would submit these preliminary algorithms to the experts and to others with valuable insights. Based on their comments, we would make revisions and produce the initial set of algorithms. These algorithms would incorporate estimates of uncertainty. They would include instructions on how the algorithms could be improved over time in accordance with CALFED's adaptive management approach. Hypotheses and uncertainties: This work tests the hypothesis that a quantitative estimates of fish benefits can be developed for CALFED resource allocation decisions. In some cases, uncertainties can be expressed in a statistical sense. In other cases, uncertainty will be subjective, based on the opinions of experts. In either case, attempts will be made to quantify uncertainty. An explanation of how quantified estimates were derived will be included. Expected outcome: The final report will be a series of algorithms, one for each action or category of actions. Each algorithm will be accompanied by estimates of uncertainty and a description of how the algorithm and uncertainty estimates were developed, including backup data. In addition, instructions for updating each algorithm, based on adaptive management principles, will be included. Algorithms will be produced on Excel spreadsheets that will be uploaded to the CALFED website for widespread use. Relationship to CALFED ERP and/or CVPIA goals: This proposal responds to a number of CALFED goals, including MR-6, SR-2, SR-6, SR-7, and DR-7.

Proposal

San Luis & Delta-Mendota Water Authority

Quantitative Procedure to Estimate Fish Population Increases from Ecosystem Restoration Projects and Other Activities

William J. Miller, San Luis & Delta-Mendota Water Authority

PROPOSAL

By

SAN LUIS AND DELTA-MENDOTA WATER AUTHORITY

To

CALFED ECOSYSTEM RESTORATION PROGRAM

For Development of

QUANTITATIVE PROCEDURE TO ESTIMATE FISH POPULATION INCREASES FROM ECOSYSTEM RESTORATION PROJECTS AND OTHER ACTIONS

Project Description: Project Goals and Scope of Work

1. PROBLEM

CALFED must make a variety of decisions intended to increase fish populations, including decisions about allocation of funds, use of resources of the Environmental Water Account, and regulation of water project operations. Ideally, such decisions would be based, at least in part, on the benefit/cost ratio of each decision, that is, the ratio of a quantitative estimate in fish improvement to the cost of the action. However, no system exists for making such benefit/cost estimates, although the CALFED Science Program has expressed interest in having such estimates. While costs are relatively straightforward to estimate, no method now exists for estimation of fish benefits for the variety of actions that might be and are being taken.

Lack of such a system means that scarce resources may be miss-allocated. Is it better to fund fish screening programs of a particular type or to increase spawning gravels? Should Environmental Water Account water be used to curtail exports during a wet period, or should the water be saved for drier times? During any year, should Environmental Water Account water be used now or later? How much is a more sophisticated hatchery and harvest management system worth? More than is spent on fish passage improvements or shallow water habitat improvements? These questions cannot be answered now.

The proposed methods for estimating fish benefits will provide at least some quantified information directed at such questions. The initial estimates will undoubtedly be uncertain, but it is also possible that comparisons among estimates may indicate that the differences are much larger than the uncertainties.

In addition, attempts at quantifying uncertainty will be revealing as well. If benefits of one action or category of actions are highly uncertain, the value of the action or actions may be less and the need for more adaptive management may be more acute.

The method will be useful in all ERP regions. This proposal responds directly to several section in the Draft Stage 1 Implementation Plan" in the 2002 Proposal Solicitation Package, as described in more detail later in this proposal.

To summarize as requested in the 2002 Proposal Solicitation Package, the goal, objective and hypothesis of this proposed study are:

Goal: Assist CALFED in making resource allocation decisions related to increasing fish populations.

Objective: Develop a set of algorithms with which to estimate the increases in fish population (as a percent) and uncertainties in that estimate for each action or category of actions intended to increase fish populations.

Hypothesis: An initial set of quantitative estimates can be developed for fish benefits, including the uncertainty in each estimate, and this initial set can provide a framework for future, more refined estimates.

2. JUSTIFICATION (including conceptual model, hypotheses and selection of project type)

Conceptual model:

The conceptual model for this proposal is as follows:

- CALFED actions or categories of actions affecting fish populations can be identified. These actions fall into two general categories:
  - Those for which statistical correlations have been developed relating actions to species abundance or survival. This category consists primarily of actions to manage water project operations in the Delta.
  - Those for which such correlations have not been developed but for which estimates can be derived. An example of would be gravel enhancement actions or harvest management actions.
- For each of these two general categories of actions, preliminary algorithms can be developed relating the magnitude of the action to the percent change in fish population produced by the action. In addition estimates of the uncertainty associated with each estimate can be developed. For those in the category for which statistical correlations are available (see, e.g., Kimmerer, 1998; Newman, 2000), a preliminary set of algorithms has already been developed along with uncertainty estimates and can be viewed on the web site of the San Luis and Delta-Mendota Water Authority at http://www.sldmwa.org. This set of preliminary algorithms must be updated based on data from year 2001. For all other actions, the preliminary set of algorithms will be developed based on data from this and other systems and especially from the knowledge and opinions of experts with experience in each of the actions.
- These preliminary algorithms and uncertainty estimates will be reviewed by the experts who contributed to their development and by others with insights and

expertise. Relevant CALFED committees and consultants would be expected to review these algorithms and uncertainty estimates.
- Based on this review, the preliminary algorithms and uncertainty estimates will be modified to produce the final set of algorithms and uncertainty estimates.
- Methods for updating these algorithms and uncertainty estimates will be developed.
- All of this information would be uploaded to the CALFED website along with documentation of its development and instructions for its use so that anyone would be able to use the algorithms and uncertainty estimates and update them as new information becomes available.

Hypothesis tested:

This work would test the hypothesis that a quantitative basis can be developed for CALFED resource allocation decisions while adhering to CALFED solution principles. An inability to develop a specific procedure for quantitatively estimating environmental restoration program benefits would call this hypothesis into question.

Uncertainties addressed:

For those algorithms based on statistical correlations, uncertainty can be estimated by from the data used for the correlations. For algorithms for other actions, uncertainties can be estimated from the subjective opinions of experts. See the "Approach" section below for examples.

Adaptive management

Methods developed by this proposal will be consistent with CALFED's principle of adaptive management in three ways.
- First, estimation of the fish benefits (coupled with cost) of a variety of actions will enable adaptive management to proceed on a more rational basis. For example, resources can more confidently be assigned to actions that are most likely to produce a benefit that can be measured, which, of course, is one of the necessities of adaptive management.
- Second, estimates of uncertainty are a good indication of actions for which adaptive management is necessary in order to produce the data that will reduce uncertainty.
- Third, adaptive management will produce data that can be used to improve the estimates of fish benefits as well as estimates of uncertainty.

A key step in adaptive management, as outlined in Figure 1 "Adaptive Management Process" in the Draft Stage 1 Implementation Plan, is "Explore Policy Alternatives Using Simple Simulations." This proposal provides the means to accomplish this critical step, by providing a reliable way to estimate fish benefits for a variety of actions.

In summary, the methods developed pursuant to this proposal will be an integral part of the adaptive management program.

Project type

This is clearly a restoration planning project [see Project Information form on the Proposal Submittal Website]. However, it should be noted that the project would have additional benefits because the methods can be used as an educational tool to help students understand trade-offs involved in allocating water and money to increase fish abundance in the Bay/Delta system.

3. APPROACH

The proposed effort will develop a draft procedure to quantitatively estimate changes in fish populations expected from any given ecosystem restoration project or program. The procedure will explicitly account for uncertainties. Resource agencies will be contacted for advice throughout the development process. Completion of this work will involve eight tasks:

Task 1. Project management (18 months).

Project management is identified as a separate task in accordance with the instructions on page 62 0f the 2002 Proposal Solicitation Package.

Task 2. Specify actions or categories of actions to be evaluated (2 months)

Generally speaking, actions to increase fish populations in the Bay/Delta system are in three categories:

1. Flow modifications, including
    - X2 or Delta outflow requirements
    - Sacramento River inflow requirements
    - San Joaquin River inflow requirements
    - Total Delta inflow requirements
    - Constraints on water exports
    - Requirements on Delta Cross Channel operation
2. Hatchery reprogramming (basin-wide), including
    - Implement conservation genetics protocols, local stocks only
    - Complete marking (100%), constant fractional CWT program
    - "Progressive" release strategies
3. Harvest management reprogramming (with PCFFA, CDFG, PFMC)
    - Hatchery-only selective fishery
    - Zone time/area management to minimize/optimize non-target encounter rate
    - Gear/method restrictions to decrease non-target encounter and latent hooking mortality
    - IFQ with restrictions preventing permit "stacking" and other abuses
4. Habitat modifications, including

- Spawning gravel enhancement
- Fish passage improvement
- Intake screening
- Predator/competitor management
- Pollution control
- Temperature control
- Riparian vegetation enhancement

This task will specify the actions for which effects on fish populations will be evaluated, and the way in which those actions should be characterized to facilitate evaluation.

Task 3. Contact experts and review relevant literature and data for each actions or category of actions (4 months)

This task would consist of identification of individuals with relevant information necessary for developing population effect algorithms and uncertainty estimates for each action or category of actions. Initial meetings would be held with each of these individuals and other contacts would be established for their convenience and ongoing input.

We would seek information useful in developing methods for estimating population level effects of actions and estimates of uncertainty. It may be necessary to merge the opinions of several experts, as for example with the issue of downstream density dependence for salmon.

In addition, we would review relevant reports and collect and analyze data useful in developing estimates of population level effects and estimates of uncertainty.

Task 4. Develop algorithms to quantify effects on fish populations along with estimates of uncertainty (4 months)

Based on the information obtained from experts and other sources we would develop a trial set of algorithms and methods of estimating uncertainty in those estimates. We would document the steps in developing these algorithms. We would also include preliminary instructions on how these algorithms might be updated and improved over time.

Some general examples of the algorithm development are as follows:

Example 1: Effects of changes in X2 requirements (Delta outflow) on fish abundance:

Kimmerer (1998) showed that the fish abundance/X2 relationships can be expressed as regression equations relating the logarithm of the abundance indices and X2 for the appropriate months. Kimmerer (1993) also showed that X2 can be expressed as a function of the logarithm of Delta outflow. Using the latest available data, regression

equations relating the fish abundance indices (actually, the logarithm of fish abundance indices) and Delta outflow (actually, the logarithm of average Delta outflow) during the biologically relevant periods specified by Kimmerer (1998) were developed.

These equations can be used to estimate abundance that would be associated with any particular average Delta outflow during the critical period for a species. The action in this case is an increase in Delta outflow. Therefore, the percent change in abundance is simply the difference in predicted abundance with and without the action divided by the predicted abundance without the action, expressed as a percent.

Uncertainties can be estimated from the confidence limits for the correlation.

Example 2: Effects of exports, Sacramento River flow, and Cross Channel operation on salmon smolt survival.

Newman (2000) analyzed USFWS salmon smolt release/recapture experiments from 1979 through 1994 to relate water exports, Delta Cross Channel closure, and Sacramento River flow to survival of salmon smolts emigrating down the Sacramento River. Newman's equation for smolt survival *S* from Sacramento to Chipps Island is $S = \frac{e^{\beta}}{1+e^{\beta}}$. β is a function of Sacramento River flow, exports, and Cross Channel gate position.

The action in this case could consist of a Cross Channel gate closure, an export curtailment, an increase in river flow, or some combination of the three. Assume that the population of adult salmon is proportional to the number surviving migration through the Delta (i.e., no density dependence downstream of the Delta). Therefore, the percent change in adult population is the difference in survival with and without the action(s) divided by the survival without the action(s), expressed as a percent. If there is reason to believe that density dependence or other factors will make the proportionality assumption invalid, a factor or factors would be added to account for this.

Example 3. Effects of export constraints on Delta smelt population

Effects of export constraints on Delta smelt abundance is one of the most difficult issues to address. Delta exports are typically curtailed when Delta smelt counts at the export pumps exceed a certain threshold. However, the Recovery Plan for the Sacramento/San Joaquin Delta Native Fishes (USFWS Recovery Plan, 1996, page 21) says there is no relation between Delta smelt salvage at the export pumps and subsequent abundance of Delta smelt. We will reinvestigate historical data to look for correlations between Delta smelt mortality at the export pumps and subsequent Delta smelt abundance.

Example 4. Spawning gravel replenishment

Estimation of percent increase in population would begin with estimates of the amount of spawning gravel already in place and the amount to be added, in acres. If spawning gravel were limiting adult production, the percent increase in spawning gravel area would be a rough estimate of the percent increase in population. If there were confounding factors, such as other limiting conditions or density dependence after spawning, a adjustment term (a fraction) or terms would be necessary to express the effect of these factors. These terms might vary based on conditions in any year.

It is also possible that spawning gravel habitat would degrade due, say, to sediment deposits. In that case, a term expressing this degradation over time might be necessary.

Example 5. Mark select fishery and gear restrictions

One potential action is to mark all hatchery fish and only allow harvest of marked fish. Under such a program, harvest mortality to wild fish would be limited to catch and release mortality plus violations of the rules prohibiting harvest of marked fish. This approach would also have to account for the latent hooking mortality rate and encounter rate, both related to gear. Estimates of these factors would be necessary for comparison with harvest mortality without this action. It is possible that catch and release and non-compliance mortality would decrease over time. This trend would also have to be reflected in the adjustment applied for these factors.

Task 5. Expert review of algorithms (3 months)

This task would consist of subjecting the algorithms and estimates of uncertainty to experts, including relevant CALFED committees for critical review. The algorithms for Delta water project operation actions have already been developed in preliminary form. These algorithms could be submitted for review early. The other algorithms would be submitted for review as developed. Comments from reviewers would be actively solicited.

These reviewers would certainly include Dr. S. Luoma, Dr. W. Kimmerer, Dr. R. Brown, and Dr. C. Hanson. Funds are requested in this proposal to reimburse reviewers where necessary.

Task 6. Revision of algorithms for population level estimates and methods for estimating uncertainty (3 months)

Based on comments from reviewers, the algorithms and methods for estimating uncertainty would be revised to produce a final set. Any other comments, such as those on the documentation or methods for updating and improving the algorithms would also be addressed.

The result of this task would be the initial set of algorithms, their documentation, methods of estimating uncertainty, and methods for updating and improving the algorithms.

Task 7. Prepare final report (2 months)

This task would consist of preparation of a final report documenting all of the results. In addition, all of the algorithms would be in the form of Excel Spreadsheets with simple plug-in instructions for generating population effect estimates and estimates of uncertainty. These spreadsheet would be uploaded to the CALFED website for widespread use.

As required by the 2002 Proposal Solicitation Package, data will be submitted in hard copy, as PDF files and in an electronic format compatible with Microsoft Access.

4. Feasibility

We are confident the proposed effort is feasible. A draft Excel spreadsheet for quantitatively estimating fish population increases and water costs of alternative flow modifications and export restrictions has already been completed and is available for review at http://www.sldmwa.org. All personnel involved in the proposal are experts in this type of work, and have completed many similar assignments in similar time frames in the past. The proposed effort involves no physical actions on public or private lands, and no permits are required.

Assumptions will be necessary to complete some of the work, and uncertainties will be produced by those assumptions. We intend to keep those uncertainties in the forefront of our work so that users of these methods will have a clear understanding of this uncertainty.

In addition, we will be judicious in our use of assumptions. For example, suppose that an action is expected of having considerable benefit, relative to its cost. In that case we might consistently make assumptions that would tend to produce a low estimate of that action's benefits. If, in spite of such assumptions, the estimate of benefits is still high, then we would have good reason to believe that the benefits would be high. Of course, the opposite approach could be used for actions suspected of having low benefits.

5. Performance measures

Because this proposal is for a straightforward restoration planning project, performance measurement is less complicated than for more complex field ecosystem restoration projects. Performance measurement will involve tracking project completion against the schedule and product delivery milestones specified in the Work Schedule.

Project performance evaluation/monitoring plan

As required on page 58 of the 2002 Proposal Solicitation Package, the proposed effort includes a project performance evaluation/monitoring plan. The project performance evaluation/monitoring plan is task-based, reflecting the work breakdown outlined above. Reports on each task will be submitted as follows:

Task 1. Project management (18 months).

Task 2. Specify actions or categories of actions to be evaluated (months 0 through 2)
Milestone: 2 months after project initiation, a list of actions and categories of actions with the rationale for the list.

Task 3. Contact experts and review relevant literature and data for each actions or category of actions (months 1 through 6)
Milestone: 6 months after project initiation, a report on contacts made and information and data obtained and analyzed

Task 4. Develop algorithms to quantify effects on fish populations along with estimates of uncertainty (months 6 through 10)
Milestone: 10 months after project initiation, a preliminary set of algorithms, documentation of their development, methods for estimating uncertainty, and methods for updating and improving the algorithms.

Task 5. Expert review of algorithms (months 10 through 13)
Milestone: 13 months after project initiation, a set of comments provided by reviewers.

Task 6. Revision of algorithms for population level estimates and methods for estimating uncertainty (months 14 through 16)
Milestone: 16 months after project initiation, a revised set of the product of Task 4.

Task 7. Prepare final report (months 16 through 18)
Milestone: 18 months after project initiation, the final report in the forms specified by CALFED.

6. Data handling and storage

The final report on the proposed effort will reference and document assumptions, data sources and input data. This will be the basis for future reviews and updates of the estimation procedure. As required by the 2002 Proposal Solicitation Package, data will be submitted in hard copy, as PDF files and in an electronic format compatible with Microsoft Access.

7. Expected products/Outcomes

Please see the Project performance evaluation/monitoring plan above.

8. Work schedule

Please see the Project performance evaluation/monitoring plan above.

9. Inseparable tasks if only a portion of the project is funded

If only a portion of the project is funded, we would propose to funding in the following order of priority:

Development of algorithms for those actions or categories of actions expected to have the highest ratios of fish benefit to cost, because these algorithms would provide the most relevant information

Development of algorithms for those actions expected to have lower ratios of fish benefits to cost.

Review and revision of already developed algorithms for water project operations in the Delta, because these algorithms have already been developed and could be used on a preliminary basis immediately.

10. Potential to incrementally fund and implement the scope of work

The project could be broken down into three logical increments:

Tasks 2 and 3, to produce an initial assessment of the actions most amenable to estimation of fish benefits and a plan for additional work

Tasks 4 and 5, to produce a draft set of algorithms and a review of those by experts, as a basis for deciding for which algorithms development should proceed immediately

Tasks 6 and 7, to produce a final product, suitable for widespread use.

11. **How payments would relate to milestones**

We would prefer payments on a monthly basis. Payments could be tied to the percent completion of each task. A second less desirable option would be to have payments made based on completion of products from each task.

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

1. ERP, Science Program and CVPIA priorities

This proposal responds directly to several section in the Draft Stage 1 Implementation Plan" in the 2002 Proposal Solicitation Package, including the following:

- MR-6: "Salmonids integrated across the system," "Knowledge for conceptual models illustrate linkages within the systems," and "Develop performance measures that can be used to compare restoration progress across tributary streams."
- SR-2: "Restore fish habitat and fish passage particularly for spring-run chinook salmon and steelhead trout and conduct passage studies."
- SR-6: "Continue major fish screen projects and conduct studies to improve knowledge of implications of fish screens for fish populations," which includes comprehensive studies addressing cost benefits, cumulative benefits, selection criteria, and alternatives to screening.
- SR-7: "Develop conceptual models to support restoration of river, stream and riparian habitat," including "Compare conceptual models and develop restoration performance measures for tributary streams and rivers" and "Understand and compare salmon/steelhead life histories, needs and responses to restoration."
- DR-7 "Protect at-risk species in the Delta using water management and regulatory approaches" aims to "Minimize effect of diversion on fish" and asks:
    - What are the full, economic or non-economic, cost-benefit implications of current water use, water management and fish protection strategies?
    - Can models or statistical relationships be used to improve knowledge of the relationships between management actions and their influences on fish populations?
    - What are the implications and environmental tradeoffs associated with the Environmental Water Account?

The work proposed will help CALFED effectively implement the CVPIA by providing a means for selecting projects with the greatest beneficial effect on (1) species of greatest concern, 2) factors most influencing fish populations, and (3) habitats critical to the populations.

2. Relationship to other Ecosystem Restoration Projects

- This project provides a key underpinning for all Ecosystem Restoration Projects (ERPs), allowing ERP proponents to estimate the fish benefits of all proposed actions and, using those estimate, to rank actions with respect to their cost effectiveness in producing fish benefits.

1. Requests for Next-Phase Funding - Not Applicable

4. Previous Recipients of CALFED or CVPIA funding

Carl Mesick Consultants (CMC) received funding from CALFED for the Knights Ferry Gravel Replenishment Project, #97-N21, which added 13,000 tons of clean gravel to 18 sites on the Stanislaus River from Two-Mile Bar to the city of Oakdale in August 1999.

CMC received funding to implement the "Spawning Habitat and Floodplain Restoration in the Stanislaus River, Phase 1, Two-Mile Bar" from the Anadromous Fish Restoration Program, agreement #11332-1J003. Work is expected to begin in fall 2001.

CMC's proposed project, "Spawning Habitat and Floodplain Restoration in the Stanislaus River, Phase 1, Lovers Leap, has been recommended for funding from the Four-Pumps Mitigation Agreement. The contract should be executed by March 2002.

5. System-Wide Ecosystem Benefits

This project will provide a key tool necessary to insure that proposed projects to benefit fish, considered from a system-wide standpoint, are cost-effective and beneficial to fishery resources and make efficient use of water in the Environmental Water Account.

6. Additional Information for Proposals Containing Land Acquisition - Not Applicable

C. Qualifications

Dr. William J. (B. J.) Miller, P.E., Consulting Engineer
PO Box 5995, Berkeley, CA 94705

Dr. Miller is an independent consulting engineer specializing in California water problems. He has been a consultant since 1980. Prior to that he served as Vice Chairman of the California State Water Resources Control Board.

As a consulting engineer, he was involved in the CalFed Bay-Delta Program. He was involved in negotiations leading to the December, 1994, federal-state agreement on the Sacramento-San Joaquin Delta. He has years of experience dealing with water supply and fish issues in the Sacramento-San Joaquin Delta. He was involved in the Three-Way Water Agreement Process among agricultural, environmental, and urban water leaders. He has also been involved in most of the major water issues of California.

His clients have included many of the largest water agencies in California as well as associations of those agencies.

He teaches a one-day course, "The Management of Water in California," annually at the University of California Engineering Extension and elsewhere.

He has a B.E. and M.S. in Civil Engineering from Vanderbilt University and a Ph.D. in Environmental Engineering from U.C. Berkeley. He is a registered civil engineer in California.

Dr. Thomas R. Mongan, P.E., Consulting Engineer/Environmental Scientist
84 Marin Avenue, Sausalito, CA 94965

Thirty years experience in engineering and environmental consulting for water, wastewater, irrigation and resource development projects. Twenty years experience with water quality, water management, and environmental protection projects in the Sacramento/San Joaquin watershed and San Francisco Bay/Delta system.

1987 - Present: Consulting Engineer/Environmental Scientist
1973 - 1986: Project Manager/Environmental Department Manager, Bechtel
1971 - 1973: Technical Director, Sydney Area Transportation Study, Sydney, Australia
1969 - 1971: Staff Scientist, Mitre Corporation, McLean, Virginia

B.S.	Civil Engineering	University of California, Berkeley
M.A.	Physics	University of California, Berkeley
Ph.D.	Physics	University of California, Berkeley

Civil Engineer - California Registration #36917
Environmental Assessor - California Registration #REA-00637

40 technical publications in peer-reviewed journals on water resources, environmental science, transportation planning and physics

Dr. J. Phyllis Fox, Environmental Engineer
2530 Etna St., Berkeley, CA 94704

Dr. Fox has over 30 years of experience in the field of environmental engineering, which includes extensive experience with Bay-Delta issues, including the analysis of water quality, water supply, hydrodynamic, and fishery issues. This work has included using complex statistical analysis program such as S Plus, Systat, MatLab, and other similar programs to evaluate trends and to determine cause-effect relationships in Bay-Delta and California resources including fishery, streamflow, precipitation, and temperature data.

B.S. Physics (with high honors), University of Florida, Gainesville, 1971.
M.S. Environmental Engineering, University of California, Berkeley, 1975.
Ph.D. Environmental Engineering, University of California, Berkeley, 1980.

Class I Environmental Assessor, California (REA-00704)
Class II Environmental Assessor, California (REA-20040)
Qualified Environmental Professional (QEP #02-010007), Institute of Professional Environmental Practice

Professional Engineer (Environmental), Arizona (#36701)

Bechtel, Inc.: Engineer, 1971-1976
University of California, Berkeley: Program Manager, 1976-1977
Lawrence Berkeley Laboratory: Principal Investigator, 1977-1981
Environmental Management: Principal, 1981-present

80 technical publications in peer-reviewed journals and other professional publications on water resources, environmental science, and energy impacts.

James W. Buell, Ph.D. – Consulting Biologist (Fisheries)

Buell & Associates, Inc.; 2708 S.W. Bucharest Ct.; Portland OR 97225

Twenty-eight years experience in aquatic biology and estuarine ecology, specializing in salmonid fishes. Responsible for watershed management plans, environmental studies and assessments for major industrial developments (mines; ports/marinas; pipelines; hydroelectric; etc.), conservation programs, fish protection and passage facilities. Six years of direct experience with Bay-Delta issues and the CalFed program. Presently a member of several technical teams related to Central Valley fish protection and salvage facilities.

1976-Present President, Buell & Associates, Inc., Fisheries biology, aquatic resource management, estuarine ecology and fish protection facilities.

1974-1976 Beak Consultants, Inc.: Biologist specializing in fresh water, coastal marine and estuarine systems and in anadromous fishery problems.

1969-1970 Battelle Northwest Laboratories: Research Associate in Ecosystems Division, Aquatic Ecology Section.

1967-1969 University of Oregon: Graduate teaching assistant and lecturer in Honors Biology, Marine Parasitology, Comparative Physiology and Physiology of Marine Organisms.

B.S. Biology Occidental College
Ph.D. Biology University of Oregon

Dr. Carl Mesick, Consulting Fisheries Biologist
7981 Crystal Boulevard, El Dorado, CA 95623

Dr. Mesick received his Ph.D. in fisheries science from the University of Arizona in 1984. He has twenty years of experience as a fisheries scientist evaluating the effects of water diversions, hydroelectric operations, stream restoration projects, timber harvest, and

mine operations on trout, salmon, non-game species of fish, and invertebrates. Dr. Mesick's expertise includes stream habitat restoration and studies of instream flow, water temperature, riparian vegetation, sedimentation, entrainment at diversion intakes, food availability, fish passage, fish habitat preference, fish population monitoring, and stream habitat classification. He has studied the instream flow needs and spawning habitat of fall-run chinook salmon on the Stanislaus River since 1994 and he implemented a gravel restoration project on the Stanislaus River between 1998 and 2001. Dr. Mesick worked as a Habitat Restoration Coordinator for the U.S. Fish and Wildlife Service's Anadromous Fish Restoration Program in 1998 and 1999.

D. Cost

1. Budget

Task 1. Project management: Miller and Mongan each @ 1.5 days/month @ $1,200/day each for 18 months = $64,800.

Task 2. Specify actions or categories of actions to be evaluated: 5 members of project team each @ 1 day/month @ $1,200/day each for 2 months = $12,000

Task 3. Contact experts and review relevant literature and data for each actions or category of actions: 3 members of project team each @ 3.5 days/month and 2 members each @ 2 days/month @ $1,200/day each for 6 months + $10,000 for payment of private sector experts = $104,400 + $10,000 = $114,400

Task 4. Develop algorithms to quantify effects on fish populations along with estimates of uncertainty: 3 members of project team each @ 6 days/month and 2 members each @ 2 days/month @ $1,200/day each for 4 months = $105,600

Task 5. Expert review of algorithms: 3 members of project team each @ 3 days/month (coordinating review) @ $1,200/day each for 2 months = $21,600

Task 6. Revision of algorithms for population level estimates and methods for estimating uncertainty: 3 members of project team each @ 4 days/month and 2 members each @ 2 days/month @ $1,200/day each for 2 months = $38,400

Task 7. Prepare final report: 5 members of project team each @ 5 days/month @ $1,200/day each for 2 months = $60,000

TOTAL: $416,800

2. Cost-sharing - Not Applicable

E. Local Involvement - Not applicable

D. Compliance with Standard Terms and Conditions

We will comply with all standard State and Federal contract terms as described in Attachments D and E of the CALFED proposal submittal information.

G. Literature cited

W. Kimmerer, 1993, in “Managing Freshwater Discharge to the San Francisco Bay/Sacramento-San Joaquin Delta Estuary: The Scientific Basis for an Estuarine Standard – Conclusions and Recommendations of the Members of the Scientific, Policy and Management Communities of the Bay/Delta Estuary,” U.S. EPA San Francisco Estuary Project Report, 1993

W. Kimmerer, 1998, "A Summary of the Current State of the X2 Relationships," Interagency Ecological Program Newsletter, Fall 1998, page 14

K. Newman, 2000, Statistics Department, University of Idaho, "Estimating and modeling absolute survival rates for juvenile chinook salmon outmigrating through the lower Sacramento River using paired release data," Final Report to California Department of Water Resources, October 31, 2000

ACWA, 2000 (Association of California Water Agencies), "Science and the Bay-Delta," May, 2000, available at www.acwanet.com