SUMMARY REPORT OF

THE FACILITATED SCIENTIFIC REVIEW

OF THE CALFED BAY-DELTA PROGRAM'S

DRAFT ECOSYSTEM RESTORATION

PROGRAM PLAN (ERPP)

Convened October 6-9, 1997
Sacramento, CA

Facilitated by: CONCUR

Report Prepared: October 31, 1997

PART I: OVERVIEW OF THE FACILITATED SCIENTIFIC REVIEW AND STRUCTURE OF THIS REPORT

The Ecosystem Restoration Program Plan. The CALFED Bay-Delta Program developed an Ecosystem Restoration Program Plan (ERPP) whose objective is to improve and increase aquatic and terrestrial habitats and improve ecological functions in the Bay-Delta to support sustainable populations of diverse and valuable plant and animal species. The foundation of the ERPP is that restoration of ecological processes (associated with streamflow, stream channels, watersheds and floodplains) will create and maintain habitats essential to species dependent on the Delta. Three volumes comprise the ERPP describing the visions for the ecosystem elements (*Volume I*), the visions for the Ecological Zones (*Volume II*) and the working draft vision for adaptive management (*Volume III*).

Impetus and Planning Support for the Scientific Review. The impetus for review stems from the widespread recognition in the stakeholder community that the ERPP represents an unusually ambitious program, and would benefit an independent scientific evaluation. Planning for the scientific review began in the spring of 1997 and included extensive stakeholder involvement. In fact, the concept of the independent review was first put forward in Phase I of the CALFED process and was formally taken up by the CALFED Program staff and the BDAC Ecosystem Work Group at its March meeting. The format, panel selection criteria, and questions used to structure the scientific review were discussed in detail at the Ecosystem Work Group through the summer and early autumn. In addition, a CALFED agency steering committee worked closely with the CALFED and CONCUR team to address these preparatory items.

Purpose of the Scientific Review Panel. The Scientific Review Panel was designed to assess and evaluate the scientific validity and rationale of the scientific concepts contained in the ERPP. Some of the specific results contemplated for the review process were:

- Identification of primary areas of scientific agreement and areas of disagreement;
- Assessment and evaluation of the scientific validity and rationale of the underlying hypotheses and implementation objectives embodied in the ERPP;
- Advice on the presentation and structure of the ERPP; and
- Recommendations for structuring the adaptive management strategy.

Composition of the Scientific Review Panel. The Scientific Review Panel was composed of eight nationally-recognized scientists with broad expertise in landscape ecology, fisheries and aquatic biology, physical processes and terrestrial and wetlands ecology. In order to ensure an independent and objective review, panelists were recruited who do not have extensive experience in the Bay-Delta system.

Panelists are listed along with areas of expertise and affiliation in Table 1 below.

TABLE 1: SCIENTIFIC REVIEW PANELISTS

Panelist	Areas of Expertise	Affiliation
Dr. Ken Cummins, Panel Chair	Stream and river ecology and riparian ecosystems	Distinguished Scientist, South Florida Water Management District
Dr. Paul Angermeier	Geographical ecology of freshwater fishes and the use of biotic communities to assess environmental quality.	Unit Scientist at the Virginia Cooperative Fish and Wildlife Research Unit and Associate Professor in Fisheries and Wildlife Sciences at Virginia Tech
Dr. Michael Barbour	Plant ecology, California vegetation, and the measurement of plant communities	Professor of Environmental Horticulture, U.C. Davis
Dr. Christopher D'Elia	Estuarine ecology and nutrient dynamics	Professor, Center of Environmental and Estuarine Studies, Chesapeake Biological Laboratory, and Director of the Maryland Sea Grant College Program
Dr. Thomas Dunne	Fluvial geomorphology and the application of hydrology and geomorphology to landscape management and hazard analysis.	Professor in the School of Environmental Science and Management, U.C. Santa Barbara
Dr. Jack McIntyre	Population biology of salmonid fishes	Independent fisheries biologist
Dr. Dennis Murphy	Terrestrial ecology and natural community conservation planning.	Research Professor, Biology Department, University of Nevada, Reno
Dr. Joy Zedler	Saltmarsh ecology, structure and functioning of coastal wetlands.	Professor of Biology and Director of the Pacific Estuarine Research Laboratory at San Diego State University

Technical Advisors to the Panel. Technical advisors with specific expertise in the Bay-Delta system were assembled to assist the Scientific Review Panel in its review if additional technical expertise or clarification of specific issues was needed. The technical advisors included experts affiliated with governmental agencies, stakeholders, and local universities who have played a significant role in the development of the scientific issues in the Bay-Delta system.

Public Participation. Members of the public were invited to attend all phases of the deliberations. There were public comment periods on each day of the workshop and opportunities to submit written comments to the panel throughout the course of the workshop. In all, about 80 people attended all or part of the scientific review, in addition to CALFED staff, consultants, panelists, and technical advisors.

Scope of the Panel Review. The review focused on landscape-level issues of basic scientific theories and the planning approach of the ERPP. The panel was not asked to review action-specific issues or analyze technical data due to the short period of review and because the panelists may not be familiar with the Bay-Delta system. Questions were developed to facilitate and promote the panel discussions by highlighting the important issues of the ERPP; they were not intended to limit the scope of the panel's review. Short briefings for the panel provided background information to facilitate discussions and deliberations.

Process and Structure of the Scientific Review Panel Workshop. Over the four day period from October 6 through 9, 1997, the panel convened the facilitated scientific review of the draft ERPP. The first morning was devoted to an overview of the CALFED Bay-Delta Program. During the remainder of the first day, the second day, and the morning of the third day, the panel deliberated on the series of twelve questions developed to structure the agenda. The panel deliberated on each question and at the end of each item the facilitator and panel chair summed up the results. The panel continued its deliberations in caucus on the morning of the third day and developed an additional series of findings and recommendations.

Structure of This Document. CONCUR has worked with the panelists to prepare this written summary of the panel deliberations. The panelists have reviewed and revised a complete working draft to ensure that it accurately represents the panel discussion and recommendations. Thus, this summary report reflects the comments and revisions of the panel.

The balance of the panel's final report contains three parts:

- Part II presents key themes developed by the panel and presented on October 9th by panel facilitator Scott McCreary.
- Part III presents 27 additional findings, based on the panel's reflections across the twelve questions; and
- Part IV presents a synthesis of panel responses to each of the twelve questions framed to structure the review.

Next Steps. This report will be forwarded to the Bay-Delta Advisory Council Ecosystem Restoration Work Group to provide an opportunity for public review and input. Then, the report together with a summary of public comments will be forwarded to the full Bay Delta Advisory Committee and the CALFED agencies. The recommendations will be utilized to refine the ERPP.

PART II: KEY POINTS AND RECOMMENDATIONS

Preamble by the Panel Chair and Reflections from the Panelists.

Dr. Ken Cummins, Panel Chair

The ERPP is a planning document that reviews scientific information in the CALFED program. Thus, the scientific nature of the review lies in the fact that it was conducted by a panel of scientists who brought to the process:

- their understanding of the science used in the planning document;
- their analysis of the technical implications of the proposed activities; and
- their experience with the applications of scientific analysis in ecosystem management elsewhere.

In our responses to the broad questions and in our additional findings and recommendations we have attempted to rely on scientific principles and our collective personal experience in restoration and/or watershed-scale projects.

Dr. Christopher D'Elia, Professor at the University of Maryland, Center for Environmental Science

It is absolutely clear that the CALFED ERPP is an enormously important and ambitious activity on the national level. The difficulty is in its complexity and ensuring that there is a focused attempt to integrate necessary research with management needs. Our review should help those charged with the implementation of the CALFED ERPP accomplish their task more effectively.

Dr. Paul Angermeier, Department of Fisheries and Wildlife, Virginia Tech

The breadth and complexity of this project make it more demanding than anything that has been done or is being done elsewhere in the United States. CALFED deserves to be commended from that standpoint. Bear in mind that scientists respond in critical ways; that's the nature of their work in reviewing manuscripts and research projects.

Dr. Joy Zedler, Professor of Biology, San Diego State University

I felt that it was a very positive experience. Not only was the committee thoughtful, but CALFED staff and agency experts were very receptive to input.

A) **In revising the ERPP, CALFED should clearly state whether the goal of the project is restoration or rehabilitation and name the document accurately.** The term ecosystem restoration, as commonly used by ecologists, involves reverting to the extent possible to historic conditions. Another option, and perhaps a more realistic one, is to rehabilitate the ecosystem. This could involve improving habitat for native and exotic species. The ecosystem enhancement activities that encourage exotic fish species constitute rehabilitation (Figure 1) and not restoration. The decision to restore or rehabilitate need not be made on a system-wide level -- it could be made for individual watersheds or ecological zones. One example of this choice would be to restore diked wetlands to tidal marsh downstream (restoration) as opposed to creating many impoundments upstream (such as rice fields) for upstream waterfowl habitat (rehabilitation) as detailed in Figure 2.

This distinction between "rehabilitation" and "restoration" is one among several examples of the need for refining the use of phrases and terms in the ERPP, as indicated at other points in this summary report.

B) **Simplify and focus the presentation of the program and its goals on the basis of conceptual models.** The goals should be explicit, quantifiable, and attainable. The panel agrees with CALFED's tiering approach. The use of conceptual models will be essential to determine the allocation of effort to each tier. However, a coherent defense of the tiering decision, based on ecological and other policy arguments still needs to be articulated to explain the approach to stakeholders.

C) **From the outset, the Program should embed outside scientific expertise in the adaptive management process.** This requires continuous involvement of independent science in the formulation and implementation of the ERPP. Involvement should include: 1) reviewing the rationale, methods, results, and analyses; 2) developing and reviewing recommendations and funding proposals; and 3) pointing out new opportunities. Later portions of this report provide additional guidance on how to accomplish this involvement.

D) **In order to utilize science as a basis for the adaptive management system, there is a need for the development and use of models of physical and biotic ecosystem processes with links to key biotic components.** There are several kinds of models that may be useful in the ERPP. Some are large scale, qualitative, conceptual and concerned with expressing ecosystem operation. An example of such a model is found in the U.S. Forest Service's Northwest Forest Plan. A second type is a more focused model, which may or may not be quantitative, that addresses selected aspects of ecosystem operation. It should present hypotheses that can be tested through measurements and experiments. A third type of model is a quantitative simulation which can be useful for making predictions. As an example of the second type of model, the panel developed a sample qualitative input-output model which can be quantified as data are obtained (Figure 2).

FIGURE 1: COMPARISON OF ALTERNATIVE PATHWAYS TO RESTORATION OR REHABILITATON.

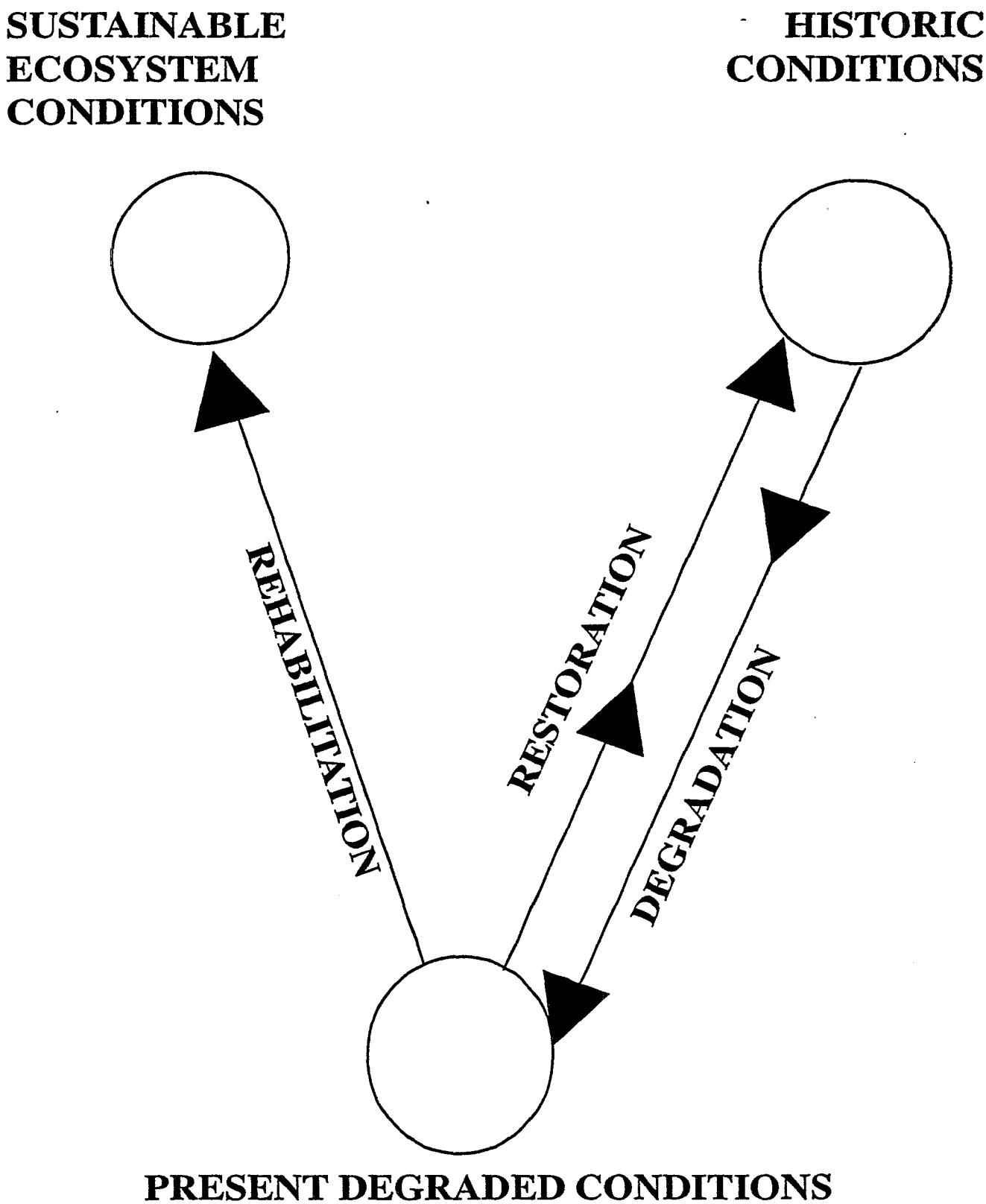
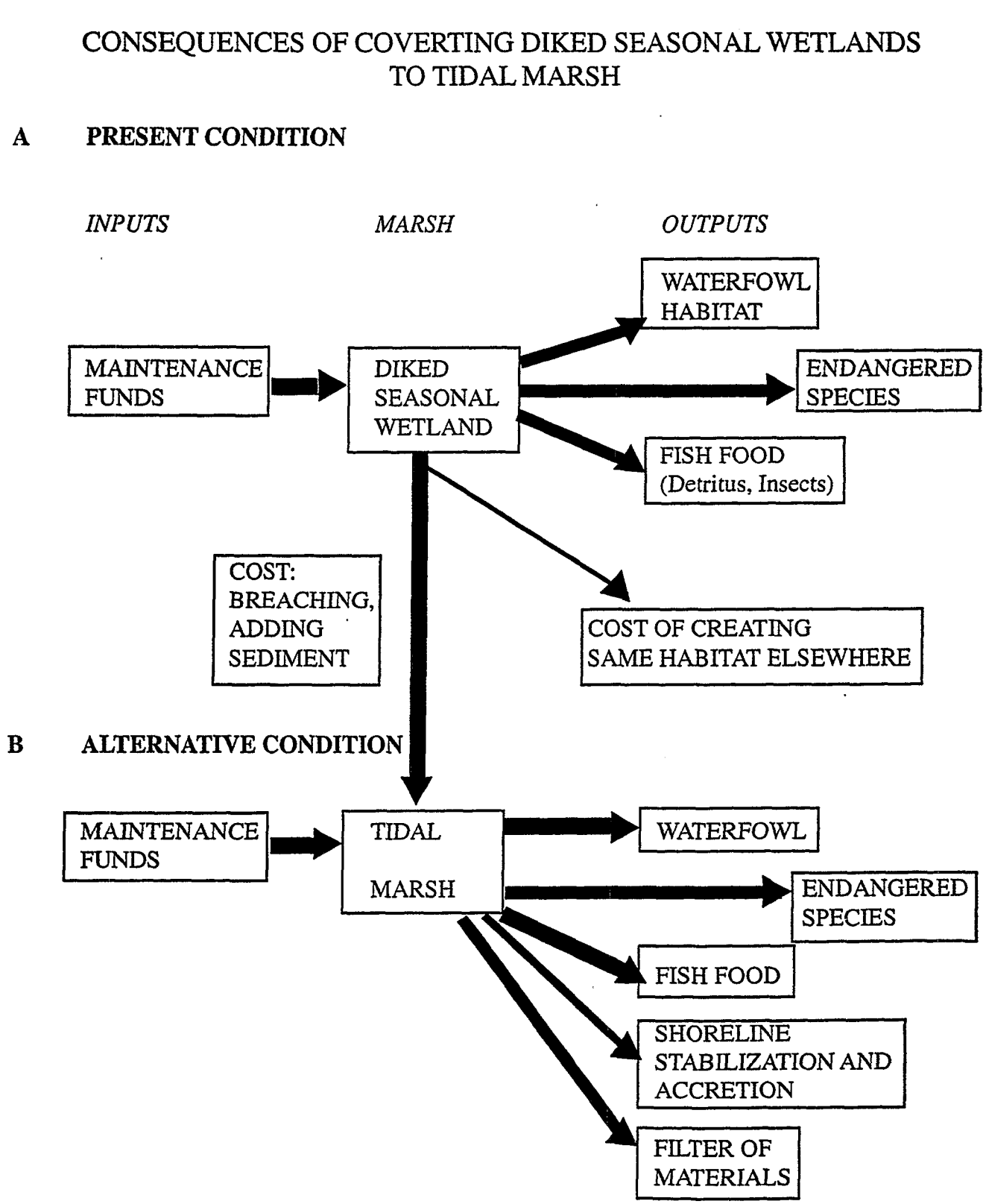


FIGURE 2: DRAFT FOCUSED CONCEPT MODEL



E) **The ERPP report wisely promises that the program will involve an adaptive management framework incorporating decisions that are based incrementally in scientific analysis, hypothesis testing, and monitoring. Therefore the monitoring component of the adaptive management framework should be developed from testable hypotheses.** Information from monitoring should guide management of resources in the following manner: 1) The program would propose a management action to improve the ecosystem; 2) Managers would formulate alternative hypotheses that describe the outcomes of the management action; 3) The action would be conducted as an experiment, and 4) Results would be monitored by gathering data to determine which alternatives are most plausible. The panel acknowledges that not all management actions can be structured as experiments, but recommends that this method be applied wherever practicable.

F) **The recommendations the panel has made above will require continual interaction of agency managers, agency scientists, and independent scientists. Part of this interaction should entail the creation of a standing science body, a scientific and technical advisory board, composed of agency scientists, stakeholder scientists, and scientists independent of the program.** The body would facilitate the introduction of science into long-term management. The panel notes that other efforts of this kind and scale have failed due to the lack of independent scientific review. Activities to be carried out by the science body would include generating and reviewing hypotheses, formulating monitoring schemes, and reviewing and interpreting data. Another function of this body could be to resolve technical conflicts over data, analyses, interpretations, and conclusions. Designing the terms of reference and modes of operation for such a body could involve another round of review and discussions between this panel and CALFED staff.

PART III: PANEL CONCERNS AND RECOMMENDATIONS

Following their deliberations on the twelve questions, the panel met for several hours to review their responses. In preparation for this discussion, the panel caucused and individual panelists put forward findings and recommendations. Each tentative finding was presented and then discussed by the full panel, which led to the revision of some of the tentative conclusions. Below is a cumulative list of suggestions, presented with the revised wording that emerged from the panel. This list of 27 points was in turn used to generate the recommendations A-F presented in Part I of the report.

The Need for Conceptual Models

1. Conceptual models should be incorporated early and prominently into the ERPP. Clear priority setting, ordering of objectives, and resolution of conflicts are essential and should be part and parcel of these conceptual models.

2. Conceptual models should be constructed to include alternate hypotheses and alternate management actions. Use science to make decisions. Establish a management procedure that tests the models and one's understanding of them.

3. Develop and employ quantitative and mathematical models to determine which factors are most important to the persistence of threatened and endangered species. Assess how much change must occur. Develop hypotheses about how much change can be produced. Monitor success over appropriate time frames.

Guidance on Developing Conceptual Models

1. The models should emphasize the importance of maintaining native biotic diversity. Set and articulate explicit and quantifiable program goals that focus on native biotic diversity.

2. Although fish and fisheries are appropriate primary concerns of the ERPP, the focus of the ERPP should target ecosystem level processes, and more emphasis should be given to issues relating to upland wetlands, riparian communities, etc., and their responses to flow regime. The ERPP should

give greater emphasis to such habitat types as inland tule marsh, slough edges, levee banks, tidal saltmarsh, brackish marsh, and riparian forest.

3. With regard to the geographic scope, further discussion of project goals, expected ecological costs and benefits, and anticipated success is needed to resolve whether the ERPP focuses on the Delta proper or encompasses the entire watershed.

Adaptive Management

1. Adaptive management has two interdependent goals: 1) to achieve management objectives, and 2) to enhance our understanding of how ecosystems work.

2. The ERPP should embed outside scientific expertise in the adaptive management framework. This entails providing guidance in the process of adaptive management, identifying the ecological costs and benefits of actions, predicting or measuring consequences, characterizing current and past conditions, identifying problems and mid-course corrections, and providing feedback to the monitoring program.

3. The appropriate role of science in the development and implementation of the ERPP is regular, repeated use of independent science to review methods, results, and analyses, and to develop and review recommendations (including funding proposals).

4. Incorporate science in the management process. That is, conceive of management as a series of steps, where each step is designed and evaluated as an experiment that yields an increment of information to help design the next management action.

5. Inasmuch as adaptive management requires testable hypotheses that are essential to the formulation of indices and indicators, the ERPP needs to include explicit hypotheses to test and propose experimental techniques to employ.

6. Initiate studies to validate and enhance ecological elements that models indicate are especially important to ecosystem structure and function.

7. The panel suggest the ERPP give more attention to air- and water-borne pollutants. It should clearly show linkages between the ERPP and existing water quality programs (including CALFED's water quality program). The program should also integrate into the ERPP the hypothesis that toxic materials have negative impacts on the Bay-Delta ecosystem.

8. The potential role of toxics in contaminating fish and shellfish, and in structuring aquatic communities and altering their function needs further evaluation. This should include recognition of a set of "key" toxics to be followed specifically and that could serve as surrogates for broader suites of toxics.

9. Research and monitoring need to be better integrated. Data collected in monitoring programs need constant analysis and validation, and resources must be continually allocated for that purpose.

10. CALFED should take advantage of opportunities to conduct landscape level experiments where feasible.

11. CALFED should develop a capacity for joint fact-finding among all the concerned parties guided by strong leadership to build consensus on methodology, data analysis, and interpretation of results.

Public Involvement

1. The long-term viability of the CALFED program will necessitate better public outreach and communications as well as an increased role for public participation in setting and agreeing to targets, goals and objectives.

2. Simplicity and clarity are the keys to developing widespread understanding and support for the ERPP.

Strengthening the Document

1. The word "restoration" does not readily apply to an extensively human-modified system like the Bay-Delta. A better word would be "rehabilitation."

2. The word "vision" is overused and a substitute should be found. An example of this is the ambiguous phrase "visions for ecological processes and functions..."

3. The ERPP should define terms, use them in a consistent manner, and where applicable, be consistent with the published literature.

4. The ERPP should simplify and clarify goals and priorities.

5. The ERPP should clearly identify conflicting targets, as well as ecological costs and benefits associated with targets.

6. There is an ample and pertinent scientific literature that is not recognized or cited in the ERPP. Key papers in the literature, such as the Jassby et al. "X2" indicator definition, should be cited and fully explained.

7. The ERPP should highlight and clarify rather than bury conflicts. Conflict is natural and expected when the scientific basis of decisionmaking is not well established. The ERPP should clearly articulate which objectives and elements are likely to contradict each other. Create a mechanism to define clearly and analyze and reduce technical conflict; such a mechanism my involve outside scientists.

8. More information should be presented in the "vision" summaries. The ERPP should explain how acreages proposed for rehabilitation are related to habitat already lost. For example, in the recommendations for habitat restoration, develop and present three ratios:
    - acreage proposed: current conditions;
    - acreage proposed: acreage lost; and
    - acreage proposed: acreage potentially recoverable.

PART IV - SUMMARY OF RESPONSES TO THE TWELVE QUESTIONS PUT BEFORE THE PANEL

Introduction. This portion of the report presents a summary of the panel's responses to twelve broad questions. The panel chose to take questions 1 through 3 in order, then rearranged the sequence as shown in Table 2 below. For each question, CALFED staff presented a short briefing. Then panelists weighed in with their commentary. At the end of each question, the panel facilitator summed up the advice and recommendations of the panel.

TABLE 2: Sequence of Questions Addressed by the Panel

Day One October 6, 1997	Day Two October 7, 1997	Day Three October 8, 1997	Day Four October 9, 1997
Introductory Session. Question 1 Question 2 Question 3	Question 7 Question 4 Question 5 Question 6	Question 9 Question 10 Questions 8, 11 and 12 Workshop Adjourned Additional Panel Deliberations	Presentation of Key Points and Recommen-dations

Summary of Comments from Introductory Session

- Is this truly a restoration plan? Given the high degree of management, perhaps it would be more accurate to call it a rehabilitation program, or even a "reintegration plan" as one panelist suggested.

- The panel expressed concerns about the ability of an agency (or consortium of agencies) to commit to such a long-term effort, given the changing political climate. To succeed, this restoration/rehabilitation effort cannot change direction every few years. Clear 10- and 20-year plans should be articulated early on.

- The conflicting legal mandates that direct Bay-Delta operations still need to reconciled. CALFED staff recognize that this will be very challenging.

Question One: To what extent is the general planning approach described in the ERPP appropriate and adequate to meet the ecosystem quality objective of the CALFED Bay-Delta Program? How does this approach differ from other restoration efforts with which you are familiar? What lessons can be learned from other restoration programs? Are there elements of the ERPP planning approach that are unnecessary? Are there elements missing that can improve the project?

Summary of Responses to Question One:

Adequacy of the Planning Approach

- The panelists stated that the planning approach was generally adequate, but for the effort to succeed, the CALFED program needs to define ecological health and reach consensus on the long-term vision for the ecosystem.

Comments on Terminology and Definitions

- The panel discussed the merits of using the phrase "ecosystem health" in articulating the program goals. They agreed that a clear definition backed up with citations is needed.

- Although the phrase "ecosystem integrity" could be an alternative, that the public responds to the phrase "health" and that public support and understanding of this project are vital. In any case, both "health" and "integrity" are subjective terms.

- The panel suggested an operational definition of ecosystem health: a healthy ecosystem is one in which there is no loss of management options.

- The procedure by which objectives were or will be prioritized needs to be spelled out.

- The panel would like to see definitions of terms, particularly since some are incorrectly used.

- The panel also wanted a description of "trade-offs" inherent in the program design.

Comments on the Need for Models

- There is a need to develop a conceptual model describing what system attributes are desired. What should be achieve by the end of the rehabilitation process and how it will work?

- Both conceptual and mathematical models are needed.

- There is a need to develop a conceptual models of both the planning process and the reconstruction process.

- At the Kissimmee River conceptual models have been very successful. There has been full disclosure about what is known about the system and what information is needed.

Lessons Learned from Other Program

Panelists referenced three restoration programs of scales similar to the CALFED program and characterized their strengths and weaknesses.

International Biological Program

- This program had many independent researchers working in isolation.
- A lesson learned from this project is that "multi-disciplinary" is not equivalent to "interdisciplinary." Landscape level problems are solved by scientists from different fields working together.

Sierra Nevada Ecosystem Project

- This project was staffed primarily by independent researchers; few government scientists were involved.
- The projects was not open to the public and this is viewed as a shortcoming of the project.

Tahoe Research Group

- This project gathered new information and put an emphasis on conveying this information to the public.

Distinguishing Characteristics of the Draft ERPP

- It involves many agencies.
- It defines the ecosystem very narrowly - riverine, estuarine aquatic.
- The staff effort is primarily a synthesis of existing data.
- It contains no independent voices.
- It has a very high level of stakeholder involvement.
- It has a focus on long-term, practical solutions.
- It does not differentiate areas of scientific agreement from areas where there is disagreement.

Comments on Assumptions

- Many of the assertions in the document need to be stated as hypotheses, not as facts.
- The panel stated that the word "restoration" is used where it doesn't really apply.
- The panel suggested that the plan should state what human population densities are being assumed over the time span covered.

Comments on Adaptive Management

- The panel suggested that a clearer explanation of the process by which targets and actions are changed should be provided.
- The panel suggested that the report identify where scientific expertise will be brought in over the life of the program.

- The panel warned against invoking the term adaptive management to justify whatever changes are made to the ecosystem in pursuit of any narrow, short-term, or politically motivated goal.

- The panel urged CALFED to seize the opportunity to build in science and landscape-level experimentation in this process.

- The panel stated that there is the potential to improve the way science is built into the ERPP framework.

Question Two: To what extent do the implementation objectives adequately describe a vision of ecological health?

Summary of Responses to Question Two:

Comments on Vision of Ecological Health

- The lack of conceptual modeling weakens the program. Inter-relations between aspects of the system are not well explained. For example, how do components relate to each other and how will adjusting one affect another? The cascade of consequences is not identified -- neither in process nor in magnitude.

- Using a Christmas tree analogy, the panel characterized the plan as having "many ornaments but no branches." That is, the panel stressed the need to create strong conceptual underpinnings. The plan needs a clear description of structures and functions.

- The panel stated that the implementation objectives describe a vision of ecological health. However, without conceptual models, it cannot be determined whether the targets are sufficient.

Comments on Implementation Objectives

- A conceptual model of ecosystem function is needed to unify goals.

- The tone and level of detail of the objectives need work. In some cases, the objectives are too specific and in some cases too vague.

- Some of the objectives are in conflict with one another -- especially those objectives dealing with exotic species that may be in conflict with those dealing with native species. The panel acknowledged the legal mandates for protection of some of the Bay-Delta's non-native fishes.

- Goals either lack numerical targets and parameters or the numbers are not explained. Some goals are unqualified and others may be unrealistic.

- Numerous species-focused implementation objectives obscure the emphasis on ecological function implementation objective.

- The ERPP should express linkages between implementation objectives -- how altering one implementation objective affects another.

Creation of an ERPP Science Program

- The panel suggested including in the document a description of the science program that will accompany the overall CALFED program. The panel would like to see a vigorous research program that develops understanding of the system through experimentation and monitoring. This is central to adaptive management.

Question Three: To what extent will the indicators selected adequately measure the visions of ecological health? Which landscape level indicators would you suggest for the ERPP?

Summary of Responses to Question Three:

Comments on what Constitutes a Useful Indicator

- Indicators, indices, and metrics are different. They should not be used interchangeably, and all should be carefully defined, with citations.

- Indicators are employed in adaptive management to act as surrogates for species and processes in testable hypotheses. Without hypotheses, one can neither develop indicators nor use adaptive management.

- Good indicators tell one what things are happening and why -- not just that one is meeting a management goal. The panel drew the distinction between indicators of quality versus indicators that are diagnostic.

- The panel suggested the route to developing good indicators: conceptual model -- > identification of stressors --> hypothesis --> adaptive management program (including experimental design) --> indicators.

- Panelists expressed a strong preference for simple, broad, easy-to-measure indicators that the public can understand, and that can tell ecologists about particular aspects of the system.

- The panel expressed a preference for broad, spatial, low temporal indicators. New methods for measuring this type of indicator may need to be developed.

Comment on ERPP Indicators

- Panel advised staff to look for species (e.g. keystone species) that will tell more about other species.

- Some indicators are useful in prospective monitoring and some in retrospective monitoring, and these are not specified or differentiated.

- Because of the newness of this program, new things will need to be measured. The ERPP describes only what is already being measured.

- The CALFED program cannot assess its progress in restoration until it has defined what it wants -- again the call for conceptual models and a framework that links objectives with actions.

- The ERPP may have too many indicators.

- The ERPP should focus on riparian indicators - they are easily measurable, are on a landscape level, and a small riparian acreage change can represent large ecosystem function change.

- Additional comments on indicators appear in response to question seven.

Question Seven: To what extent is the general adaptive management approach described in the ERPP appropriate and adequate to achieve the implementation objectives? How does this approach differ from other adaptive management efforts, and what lessons can be learned? Are there

elements of the adaptive management process that are unnecessary? Are there elements missing that can improve the process?

Summary of Responses to Question Seven:

General Comments on Adaptive Management

- Adaptive management recognizes that well-intentioned environmental management does not always succeed. Panelists gave three examples from their experience with other ecosystems.

- Adaptive management is less effective if each decision is repeatedly subjected to the political process. It is important to get initial buy-in to the long-term process.

- Adaptive management should reflect goals, that may themselves change.

- Adaptive management should help identify the things we can do something about, and those that we can't. For example, we may have to accept some species or habitat losses.

- Appropriate monitoring is critical and more likely to be used when it is linked to research.

- A conceptual model is essentially an hypothesis - it is a way to present information in a way that shows linkages and it lends itself to modeling.

- A useful approach is to develop a primary hypothesis with a series of sub-statements.

- Enhance hypotheses with quantification (e.g. "We think that *x acres* of restored habitat will raise the population of organisms to *y*).

Assessing Complex Systems with Simple Indicators

- Indicators need to be connected to adaptive management

- One panelist suggested development of a system-wide IBI (Index of Biotic Integrity) based on simple indicators of ecosystem quality. Such an IBI

would include key biological aspects and be easily communicated to non-biologists.

- Creation of an IBI would be effective because it 1) directly incorporates biota and 2) is multidimensional: structure and function; addresses several layers of biological organization (communities, populations, individuals).

- A single indicator can not characterize the health of the system adequately, therefore an index (IBI) is needed.

- The panel suggested a group should be convened to identify metrics, especially at landscape level. An IBI would work at landscape level in California, but not necessarily on specific streams.

- In applying an IBI to the Bay-Delta, CALFED should identify aspects of the biota most changed in the system (i.e. stream miles of spawning habitat, abundance of wetland types, number of species extirpated or imperiled, etc.)

- Technical Advisors added that it has been unable to find key indicators for the whole the Bay Delta System. X-2 is not an IBI because it is physical/ chemical but not biotic.

Suggestions to Improve the ERPP Adaptive Management Program

- The theme of iterative planning has been well undertaken in the ERPP.

- The panel suggested the CALFED program convene an annual gathering of all parties involved in monitoring, research, and management.

- The panel advised that monitoring and long-term research must be better integrated for successful adaptive management.

- The plan should acknowledge the possibility of total surprises and provide mechanisms to determine courses of action.

- Specify when actions will be terminated and by what process. (How can the program say "this is not working" and change direction?)

- The panel advised CALFED to consider this a program of landscape-level experimentation.

- Since the goal of the ERPP is to "improve and increase aquatic and terrestrial habitats and improve ecological functions in the Bay-Delta," adaptive management should strive for the same goal.

- The ERPP should clearly specify whether scientists or managers will decide what research will be performed. A fully integrative management structure will involve both. If managers are to make this decision, the scientific integrity of the process must be clearly protected throughout.

- Public Outreach should be built into the program; citizen involvement is crucial for sustaining the continuity of the program.

- Independent scientific review (not just local peer review) should be written into this program.

Question Four: Based on your experience, is the hybrid approach developed by the CALFED Program a reasonable method for setting restoration targets? How can we improve the process?

Summary of Responses to Question Four:

- The panel agreed that the hybrid approach is a practical response to limitations in data. In fact, hybrid approaches have been used in several other ecosystem restoration programs in which panelists have been involved.

- It is essential to involve stakeholders in target-setting.

- However, the hybrid approach must be driven be a clear set of conceptual models. In addition, the panel strongly recommends that the ERPP must bring in scientific review of targets.

- The panel suggested that targets be set early on, but the program should be prepared to change them as additional information dictates.

- The panel stated that the program would be improved by communicating clear restoration themes to the public. Emerging themes that could be use to unify targets were:
    1. Expanded Flood Plain
    2. Pulse Flows (Return to a more natural flow regime)

Question Five: Is the relationship between targets and implementation objectives clearly defined? How could this relationship be improved?

Summary of Responses to Question Five:

- The panel generally found the that the relationship between targets and implementation objective was clearly defined.

- The panel expressed support for the program's use of a scoring system to identify the level of certainty with specific actions.

- The panel suggests the addition of timing and phasing when describing actions, and also clarification of whether action is short or long term.

- Research needs should be defined for each of the targets and actions.

- Creating a decision matrix may be helpful in setting and reinforcing priorities, although a matrix is only as good as the scoring procedures used to develop it.

Question Six: What are the conceptual strengths and weaknesses of pursuing this approach of tiering of actions? In your experience, under what circumstances would restoration of ecological processes and habitats, and reduction of stressors beyond CALFED's focused Ecological Zones (the uppermost areas of tributary watershed above major dams, the Central and South San Francisco Bay, and the nearshore ocean) result in measurable benefits to the Delta itself?

Summary of Responses to Question Six:

- The scope, if anything, is too inclusive and detailed, while lacking overarching principles and goals. The panel suggested focusing on two rather than five tiers, until a defensible case is made for the expanded set of tiers.

- The panel acknowledged the extreme limitations imposed by dams but advised that the ERPP should focus on floodplain and channel processes.

- The panel suggested that prioritized goals be used to determine scope and as guidance to concentrate on major rehabilitation goals.

- The phenomenon of habitat fragmentation needs to be given consideration and argues for a more expansive study area. For example,

wetlands in central and south San Francisco Bay function as refugia for native populations and as working models for ecosystem operation.

- Such relatively pristine areas should be protected from environmental degradation.

Question Nine: Multiple actions will be needed to achieve the implementation goals. Some of these actions may conflict to varying degrees, while other actions may interact to provide synergistic benefits. Based on your experience, are there any specific elements or types of actions in the ERPP which are likely to conflict with each other? Do you have any suggestions for actions which would optimize the probability of synergistic benefits?

Summary of Responses to Question Nine:

Description and Definition of Conflicts

- The document should identify and describe conflicts more clearly in the overall goals section and for each implementation objective. Currently, some goals are disparate (i.e. water quality, fisheries) and unrelated and can't be wedded together in a restoration/rehabilitation plan.

- The plan should elevate the visibility of conflicts and explain the basis of conflict: scientific, stakeholder-driven, legally mandated, or due to the limits of ecosystems.

- It appears that most conflicts are borne of the multiple excessive demands on ecosystem capacity. The document needs to state that not everyone can have all their demands met; ecosystems have limited capacity to provide goods and services. However, the panel advised against "averaging failure" -- complete compromise may mean that nothing works right.

Suggestions for Resolving Conflicts Between Actions

- Models of ecological structure and function need to be prepared before economic and social analysis can be factored in. A hierarchy of tradeoffs could be identified -- e.g. tradeoff between keystone and endangered species.

- The ERPP should examine which ecosystem uses can be moved elsewhere. Give top priority to those uses that can't be moved. For example, tidal wetlands can not be moved, but other types can be relocated. Look for

which uses have other solutions and which do not. As an example, see Figure 2.

- As the program progresses, threatened and endangered species recovery efforts will have synergistic effects on the system.

- The panel advised CALFED to maximize the area dedicated to ecosystem goals. The bigger the acreage set aside for conservation, the smaller the conflict between different species.

- Experimental designs should be appropriate for studying impacts of alternative actions.

Question Ten: Management of Hydrologic Processes -- One of the most debated issues involves the management of hydrologic processes necessary to support basic ecological processes and functions of riverine and estuarine ecosystems. What methods or approaches would you suggest to determine the hydrologic characteristics (including frequency of occurrence, length of duration, quantity of discharge, and other, if applicable) of the system that serve basic ecological processes and functions which sustain aquatic ecosystems? Would these be applicable to the Bay-Delta ecosystem?

Summary of Responses to Question Ten:

<u>The Role of the Hydrology in ERPP</u>

Hydrologic characteristics of the ecosystem determine the amount, depth, and speed of water flowing at any place in the ecosystem at any season, and therefore the hydrodynamic environment in which aquatic organisms live and biogeochemical cycles operate. They also determine the depth and duration of inundation of floodplains and other off-channel habitat. Thus, the most important hydrologic characteristics that directly influence the physical aquatic environment are the amount and timing of flows released into the delta and the disposition of these flows through the complex network of delta channels. Any management decisions about flow releases would interact with unpredictable aspects of the flow regime, such as the occurrence and magnitude of large floods or of intense droughts.

Thus, the methods for determining the hydrologic characteristics that serve ecological functions involve a combination of: models of streamflow modulated by reservoir storage management; hydrodynamic modeling of flow in channels, floodplains, and estuaries; and stochastic modeling of unpredictable extreme events. The techniques, developed mainly by various federal agencies (Corps of Engineers, Bureau of Reclamation, and U.S.

Geological Survey), are reliable and adequate for the purpose, although they will probably require an intensive computing effort; some augmentation of the network for gauging discharges (or at least water levels); and conflation of all discharge records from the U.S. Geological Survey and other agencies. In particular, the deterministic hydrodynamic models will have to be verified in the field through the use of chemical tracers, and flow sensors. This is almost certainly being done by the USGS in the lower delta.

A second set of hydrologic characteristics that influence ecosystem functions involve the transfer of solutes and solid materials by water. Flow sources and volumes influence the origin, recruitment, and chemical processing of soluble nutrients and of sediment with adsorbed nutrients. There are fewer studies and routine monitoring of these transfer processes, especially of sediments. Therefore, although the techniques for determining which hydrologic processes are important are fairly well understood, there is almost certainly a dearth of empirical field evidence for constraining such calculations.

The problem of data availability and methods of prediction will become particularly strong as CALFED addresses the role of water in molding the habitat through the erosion, selective transport, and deposition of sediments of various sizes from gravel to silt-clay. There appears to be much uncertainty about the role of hydrology in remolding the morphology of channels and their riparian zones, with only the most traditional of geomorphic concepts about river channel form and behavior being applied. The report should reflect morphologically important processes in the leveed channels and tidal channels of the delta, in rapidly migrating point-bar-dominated channels further upstream, at tributary junctions at the base of the uplands, and in channels along which levees will be breached. Field studies of deltas, such as the Danube delta, where levee breaching and wetland restoration is currently underway, would help CALFED personnel to anticipate river-channel changes that might result from engineering intervention in the Bay-Delta.

A hydrologic point of view can also help in the reconciliation of various ecological arguments concerned with upstream-downstream linkages, and the magnitude, frequency, and significance of large, rare flow events. Hydrologic analysis emphasizes the spatial and stochastic character of aquatic environments, and when combined with hydraulic analysis connects flow availability (including managed and natural influences) with such direct ecological influences as the character and distribution of habitat, and the availability of nutrients and toxins.

Although hydrologic techniques are available for making the model-based predictions necessary for ecosystem rehabilitation, it cannot be over-emphasized that CALFED needs to take advantage of and augment monitoring efforts, including existing gauging networks, new methods for

monitoring such processes as channel migration and morphological change, and the new generation of remote sensing techniques using satellites and airplanes. For example, it is not clear to the panel where CALFED intends to obtain data on the transport of sediment and absorbed nutrients now that the U.S. Geological Survey sediment sampling program in the river system have now been essentially halted. The large size of the Bay-Delta ecosystem requires that advantage be taken of modern, spatially extensive monitoring techniques that have been used to study functions and change in wetlands and large floodplains elsewhere.

In addition to analysis and modeling the current hydrologic and geomorphic processes, there is a need to reconstruct the evidence of hydrologic and geomorphic conditions in recent decades as a basis for rehabilitation and restoration of habitats. Fortunately, there is a rich record of detailed maps going back to the beginning of the 20th century, and an aerial photographic record approaching 60 years in duration. These records can be combined with ground-level evidence (from sediments, dendrochronology, isotopic traces, and other techniques for dating and environmental interpretation) to indicate physical and chemical conditions during times such as the 1960's which are thought to have been more desirable than the present.

Hydrology as it Relates to Other Ecosystem Processes

- The panel stated that hydrology has significance, but the question should really be -- "what is important about flow to ecosystem processes?". The program needs to define which processes are going to be vital to which species -- and not just for Chinook salmon. It then needs to create a good model for this system relating flow and ecological processes.

- The panel speculated that inter-annual variation can be very important to the persistence of many species. If the plan constrains inter-annual variation, some organisms will not experience the conditions they need. It will likely be politically difficult to allow for inter-annual differences. Seasonal differences are more palatable to the public.

- If stochasticity is removed from the system, important rehabilitation options may also be lost.

- Species can be found in situations they tolerate, but do not require or are not optimal. Do we know what the tolerance limits of fish are with regard to, for example, salinity?

- Panelists asked that the plan more specifically state that a goal of the program is to provide a self-sustaining channel and floodplain processes driven by a more natural hydrograph.

- The life histories of Bay-Delta species are adapted to stochastic flows. If the object here is maintaining diversity, then reducing a variable regime to a stable one may well reduce species and intra-species diversity.

- The panel advised that other drivers of the Bay-Delta system may fit into stochastic modeling, such as storms and fire frequency.

- The ecological model needs to link the targets for riparian habitat to the hydrology model. There is also a need to link sustainable ecosystems with different flow regimes.

Question Eight: Can you comment on our approach or recommend a method that addresses scientific uncertainty and biological urgency to achieve proper phasing of actions?

Summary of Responses to Question Eight:

Comments on Scientific Uncertainty as Addressed in the ERPP

- This question addresses the subject which is at the core of many of the panel's overall concerns about the ERPP. The ERPP tries to combine a strategic plan and an implementation plan into a single document.

- The panel suggested that a short document be produced that explains the conceptual model (what is expected in a 25-year period), overarching framework, and a few specific actions. A second document should be prepared that deals with how to go about achieve the desired conditions.

- The ERPP appears similar to the Columbia River program. To the extent that the ERPP is modeled after that, we need to look more closely at what has failed in the Columbia River system plan and learn lessons from its implementation.

- The ERPP is still vague about what is needed to restore/rehabilitate the ecosystem.

- The ERPP does not include a mechanism for conflict resolution.

Strategies to Increase Certainty in Habitat Restoration

- The most cost-effective way to protect systems is to prevent impacts. Preventing damage is much easier than repairing it. The ERPP should more explicitly embrace an anti-degradation philosophy. Ecosystem components that are in good shape should be kept intact. They provide working models of ecosystem operation and sources for reintroduction of native populations. They ERPP should emphasize preventing places that are fair from becoming poor. How is program related to other protective programs in state?

- The panel advised that the purchase of land and water rights is key to protecting and controlling Bay-Delta resources.

- One certainty in restoration is that more habitat is good. Questions arise through regarding which habitats can and should be maintained where. Uncertainties need to be explored through landscape level experiments.

- It is critical to retain refugia. The cost of fixing versus protecting ecosystems is dramatically different. The public should be advised of the cost-effectiveness of management options.

- The panelists agreed that once a species is listed under the Endangered Species Act, resource management options are severely limited.

- A successful program needs buy-in from the public. The panel also noted that a successful program needs to educate the public about consumption reduction. Not many people accept the notion that ecosystems have limits and education is needed to change that perception.

Suggestions for Successful Implementation

- The panel advised CALFED staff to include scientific review throughout the Program and encourage well-structured debates over technical issues.

- The panel suggested that CALFED convene an annual meeting that brings together scientists, policy makers, and stakeholders.

Attachments:

1. Full Biographies of Panelists
2. Questions to Structure the Review