

DRAFT
ADAPTIVE ECOSYSTEM MANAGEMENT IN THE
CALFED BAY-DELTA RESTORATION PROGRAM

WHAT IS ADAPTIVE ECOSYSTEM MANAGEMENT

Ecosystem management is the process of taking actions to preserve, sustain, enhance, and restore ecological resources and human needs of an ecosystem such as the Bay-Delta. "Adaptive" ecosystem management is learning and adjusting while performing specific activities. Adaptive management is a process involving stakeholders and resource managers in redirecting program actions in response to changing social, economic, and ecological information (Holling 1978; Walters 1986; Walters and Holling 1990). Because of the difficulties and uncertainties involved in ecosystem management, adaptive management has been suggested and widely adopted as the standard approach to ecosystem management (Everett et al. 1994). Adaptive management is a key component of ecosystem management because it provides a decision support system for stakeholders and resource managers (Wondolleck 1988). It deals with uncertainties of implementing ecosystem management through conducting focused experiments with rapid feedback of information (Everett et al. 1994).

"Adaptive management promotes the integration of social, economic, and ecological issues in land management planning and their expression in landscape patterns of resource values. Adaptive management addresses risks and uncertainties by increasing opportunities to redirect management with new information." (Everett et al. 1994.)

Perhaps most important is what adaptive management is not. Adaptive management will not be used to change the program vision, goals, and objectives; it will be used to adjust actions as needed to reach goals and objectives. It will not be used to delay treatment of known problems and solutions.

NEED FOR ADAPTIVE MANAGEMENT

The primary need for adaptive management is due to the uncertainty in dealing with complex ecosystems. Secondary needs include minimizing risks, providing flexibility, facilitating funding, providing equity, allowing stakeholder involvement, and incorporating social and political realities.

UNCERTAINTY

Uncertainty about the future is a primary reason for adaptive management. Change is likely with increases in development, greater water diversions, changing land use, demographics, economy, and values. Weather and rainfall are uncertain. Because we cannot be sure how such change will occur, we must adapt to the changes as they occur. Whether the future is chaotic or potentially predictable, adaptive management provides a mechanism to adjust actions in order to maintain the program vision, goals, and objectives.

Lack of sufficient knowledge on complex ecosystems, such as the Bay-Delta, can bring uncertainty to a restoration program that can be alleviated through adaptive management. Specific hypotheses can be tested experimentally to further understanding of the underlying cause-and-effect mechanisms that control the target ecosystem. There may be many hypotheses to test before the program can proceed toward success. Probing into uncertainty using experiments may provide information needed. With unknown ailments, combinations of diagnosis and treatments may be prescribed and responses monitored through key vital signs or indicators. More serious ailments may require more aggressive or even experimental treatments.

There is also uncertainty related to the potential benefits and costs or indirect effects of specific actions. Technical feasibility may be in question for specific actions and it may not be known how to implement an action. The potential effectiveness of specific actions may also be in question. A phased or experimental approach would allow some action to be directed toward problems before there is complete agreement on the overall solution. Diverse positions may require multiple approaches toward solving specific problems.

In addition, an adaptive approach helps to overcome uncertainties related to State, federal, and local restrictions and regulatory requirements by implementing programs in small digestible doses.

RISKS

The potential for risk or failure increases with uncertainty. Adaptive management is an effective tool to minimize risks in a ecosystem restoration program. Risks, such as indirect effects of actions, can be identified from test programs. For example, increasing flows in one season usually means decreasing flows in another. Test programs can identify risks so that we can minimize negative effects. Adaptive management can help us identify and adjust potential actions that might preclude future options. With stakes high and funding limited, adaptive management provides a cautious and potentially reversible approach.

VERIFICATION OF GOALS

Testing and monitoring under adaptive management provide for the essential verification of meeting goals and targets.

FLEXIBILITY

Adaptive management provides for flexibility in the restoration program. It allows a step-by-step approach where solutions can be implemented in phases for cost or technical reasons. Flexibility comes from the ability to adjust the program as needed.

FUNDING

Adaptive management provides opportunities to fund the program in stages. Commitments are often easier to obtain after each stage is proven successful and optimism builds for the next. Opportunities for cooperative funding or combining programs also come up that may improve the overall funding and potential success of the program. Unprofitable expenditures are limited and costly long-term commitments that provide little or no benefit are avoided.

EQUITY

Adaptive management allows for the periodic adjustment in an ecosystem management program of equity within and among resource categories that could otherwise become unbalanced. Staging decisions and direction, as well as funding and implementation levels, allows for consideration of equity toward resource uses.

STAKEHOLDER INVOLVEMENT

Adaptive management allows stakeholder involvement and resolution of potential disagreements. It allows for consensus and collective strategy and opportunities to contribute knowledge and resources to problems. It also provides an ability for those involved to weigh risks and benefits of actions. Such balancing usually benefits from cooperative stakeholder involvement.

SOCIAL AND POLITICAL REALITIES

Adaptive management allows for social and political realities to be incorporated into the restoration program. Social and political changes could affect the ability of program actions to meet targets and goals, thus potentially requiring adjustments to actions to keep the program on track.

POTENTIAL DRAWBACKS OF ADAPTIVE MANAGEMENT

There are a number of potential drawbacks of adaptive management.

- Small test efforts may not provide sufficient testing for an action that needs to be applied over a large time-and-space scale. The scale of an action, especially in a testing or pilot-study stage must be carefully considered.
- Delays in implementation in a phased approach could allow declines in the health of important ecosystem components. Testing programs take time to get results and further time to implement solutions. Some system resources may be in such a poor state of health that time is the critical resource. The program will be designed to take such considerations into account.
- Benefits of some aspects of the program may be a long time in coming or may not even be detectable, which may lead to dropping valuable program elements. It is imperative that actions requiring long-term commitments receive the necessary funding and support for the full term.
- Information and analytical needs of adaptive management are extensive and may require valuable time, people, and funding resources. The program should be designed to effectively provide these needs.

ECOSYSTEM MANAGEMENT AND THE NEED FOR ADAPTIVE MANAGEMENT IN CALFED BAY/DELTA PROGRAM

CALFED staff have chosen to approach restoration of the Bay-Delta from an ecosystem perspective because of the system's large size and complexity. The traditional piecemeal approach of addressing multiple local area restorations will not work in a large complex and integrated ecosystem such as the Bay-Delta and its upstream watersheds. The ecosystem approach incorporates external sources of influence including the cumulative effects of all the watersheds that feed into the

Bay-Delta. The ecosystem approach considers the relationships of the parts and the unity of the whole.

The goal of CALFED is to restore the health of the ecosystem through an unprecedented and comprehensive commitment on the part of federal and State agencies and stakeholders. For the program to be a success will require a considerable amount of information that can be provided through adaptive management.

Adaptive management is necessary because of uncertainties as to the causes of the ills of the Bay-Delta ecosystem. Identified declines in many fish populations have been related to a combination of diverse factors, with the cause-and-effect mechanisms and roles of each factor being relatively unknown. Fish declines coincide with changes in flow and habitat conditions; the specific role of each is unknown.

CALFED staff will proceed based on available information and experience. Adaptive management will allow us to test alternative approaches before we make major commitments. Testing will take the form of pilot studies and carefully monitored research.

With limited resources (e.g., dollars, land, water, time) a careful approach is necessary for success. Priorities and breadth of research in CALFED will depend on the extent to which each resource is limited. With many possible directions toward restoration, the routes with the most promise and equity must be found. The challenge will be to find a solution that is equitable, balanced, and least costly. Finding such a solution will require knowledge of factors and interactions that presently may not exist. Strong, focused first steps, with course corrections along the way, will be the key to success.

Testing is unnecessary to guide all actions. Early actions will pursue readily known solutions to serious problems that have already been identified (core actions). Even core actions, such as screening diversions, may require some degree of experimentation to work out cost and engineering feasibility, as well as ecological considerations.

Adaptive management will allow more focus on ecosystem functions: those factors that are key in supporting populations of important fish and wildlife. This is essential for successful ecosystem restoration.

Adaptive management will also provide more focus on geographic differences and watershed units. The experimental approach focuses on specific watersheds or watershed units. Focusing intensively on a watershed provides a comprehensive view of the status and behavior of program actions without the need to extend efforts to the entire system. Upon testing, the program can be expanded within a watershed and to other watersheds.

REQUIREMENTS OF THE ADAPTIVE ECOSYSTEM MANAGEMENT PROGRAM

VISION/TARGETS/GOALS

Adaptive management cannot succeed without a strong resolve to achieve a tangible vision. Such a vision for the future, in terms of targets and goals, is needed to guide the adaptive management program. Each target or goal becomes the basis to test alternative mechanisms for achieving the goal. The vision does not change, only the actions applied are fine-tuned and course corrections made, as needed, to achieve the vision.

TIME FRAMES

Targets and goals need timeframes based on critical needs of important resources. An array of timeframes helps set the terms of the adaptive management experiments.

MONITORING

Monitoring is an essential part of adaptive management. It provides information on the relative success toward reaching goals and provides key information on the process (e.g., costs, risks, schedule).

MODELS

Because of the lack of available information and understanding on complex ecosystems, ecological modeling tools are especially valuable in an adaptive ecosystem management program. Models are used to predict system responses through manipulation of controlling or limiting factors based on available information or theory. Models help guide the program toward areas of uncertainty and are helpful to document what is learned. Uncertainties can be built into a model and then tested through direct manipulation of the ecosystem. Models also need verification through experiments and are used to test the accuracy of information being used in the program. Models can also simulate various possible outcomes to provide a measure of uncertainty.

GEOGRAPHIC INFORMATION SYSTEMS

Geographical Information Systems (GIS) provide a means for storing, analyzing, and presenting spatial information from the program for use in the decision support system portion of the adaptive management program.

INFORMATION MANAGEMENT

Given the expected vast amount of information to be transferred and reviewed under the proposed adaptive management program, tools such as the Internet through the World Wide Web offer excellent means of communicating the results and decisions of the program. Such tools also help to keep the public informed and educated.

APPLICATION OF ADAPTIVE MANAGEMENT TO THE CALFED BAY-DELTA PROGRAM

CALFED staff will adopt adaptive management in the areas of technical feasibility, scientific uncertainty, enhancing performance of actions, and in impact reductions.

TECHNICAL FEASIBILITY

Many of the proposed program actions have concerns and questions relating to technical feasibility. Adaptive management provides for testing or pilot programs wherein technical details and problems can be resolved before large-scale actions are implemented. For example, one action involves screening of Delta diversions. The engineering and operational details of screening diversions can be worked out during pilot or test programs.

SCIENTIFIC RESEARCH

Where the benefits or responses of actions have been predicted based on limited knowledge, experiments or pilot studies can be employed to verify that benefits will be accrued. In the screening example, studies can be conducted to determine whether the response of fish to a specific screen design are as predicted.

ENHANCEMENT OF PERFORMANCE

Enhancing the performance of CALFED actions is another reason for employing adaptive management. Information gained from experiments and pilot studies may provide insights into improving the performance of specific actions. In the screening example, subtle changes in design or operation tested in pilot studies may indicate ways to improve the cost efficiency of the design.

IMPACT REDUCTION

Ultimately, adaptive management will be used to modify program actions to reduce existing effects and any new program-related impacts.

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